General Motors North America
Engineering Center

GMW3119 - STANDARD PLATFORM-POWERTRAIN ELECTRICAL INTERFACE

SPECIFICATION FOR

PASSENGER CARS AND TRUCKS

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STANDARD
PLATFORM-POWERTRAIN
ELECTRICAL INTERFACE
for GMNA/Opel/Saab/Holden Passenger Cars and Trucks

PPEI Work Group Approval:

The Global Electrical Center Chairpersons for the Global PPEI Core Team are Shawn Boozer & Vaundle Jones. Signatures on this document signify approval of technical content. ICR (Interface Change Request) 2121 is the electronic version of the PPEI Work Group Approval sheet for GMW3119 PPEI Version 2.5 Release.

General Motors Asia Pacific (GMAP)

Not Available to Signoff.

Holden Dean Searle Date

General Motors Europe (GME), Fiat GM Powertrain

Signature on File *August 23, 2004*

Opel-Platform Dirk Bolduan Date

Signature on File *September 13, 2004*

Fiat GM Powertrain Dr. Peter Ramminger Date

Signature on File *August 23, 2004*

Saab-Platform & Sylvester Vertetics Date
Fiat GM Powertrain – Sweden

General Motors North America (GMNA)

Signature on File *August 23, 2004*

GM Powertrain Jim McKouen Date

Signature on File *September 14, 2004*

GM North America Platform Ron Kwiatkowski Date

Signature on File *September 14, 2004*

GM North America Platform Don Eveleth Date

Signature on File *September 1, 2004*

Global Electrical Center Shawn Boozer Date

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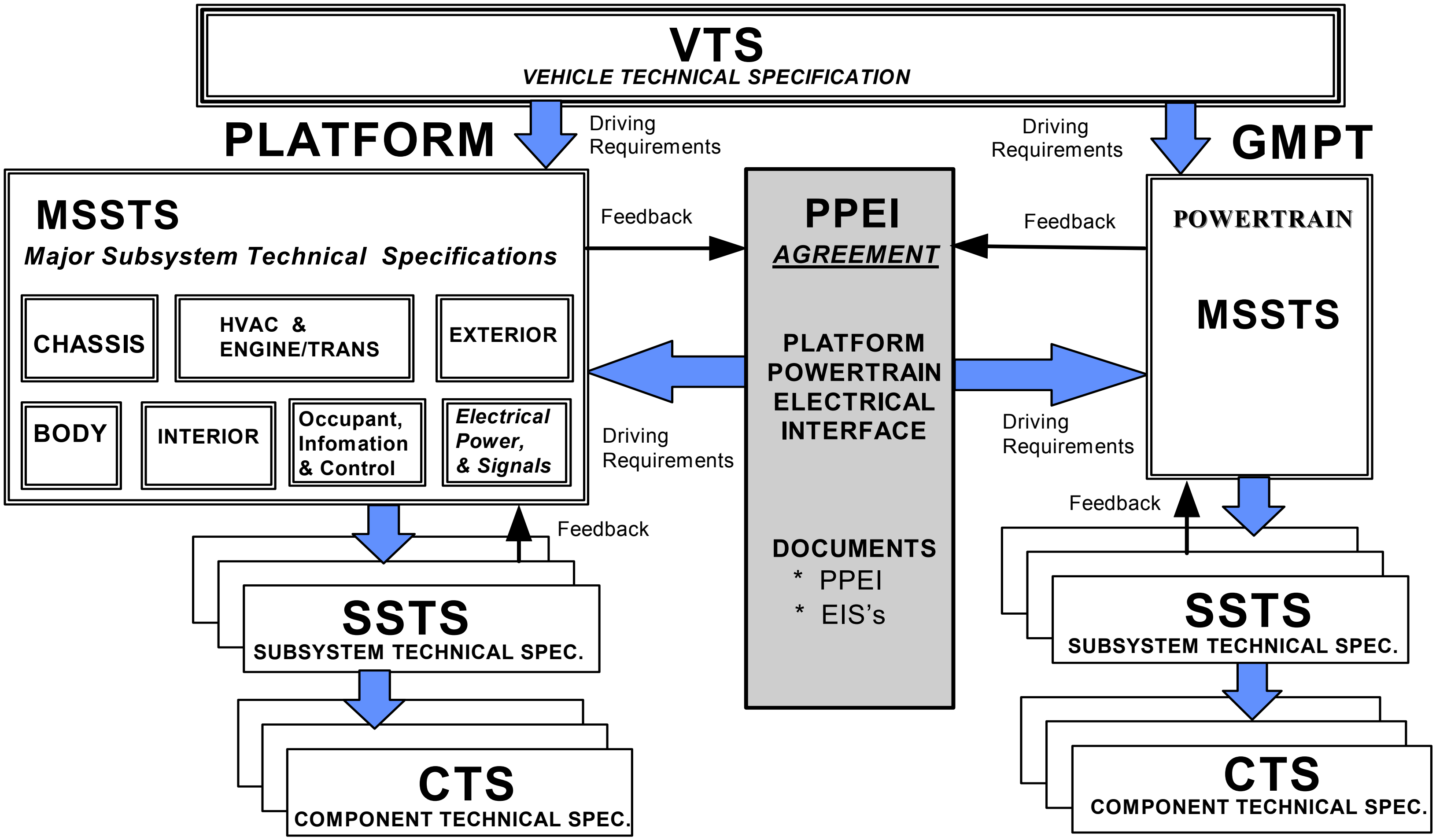
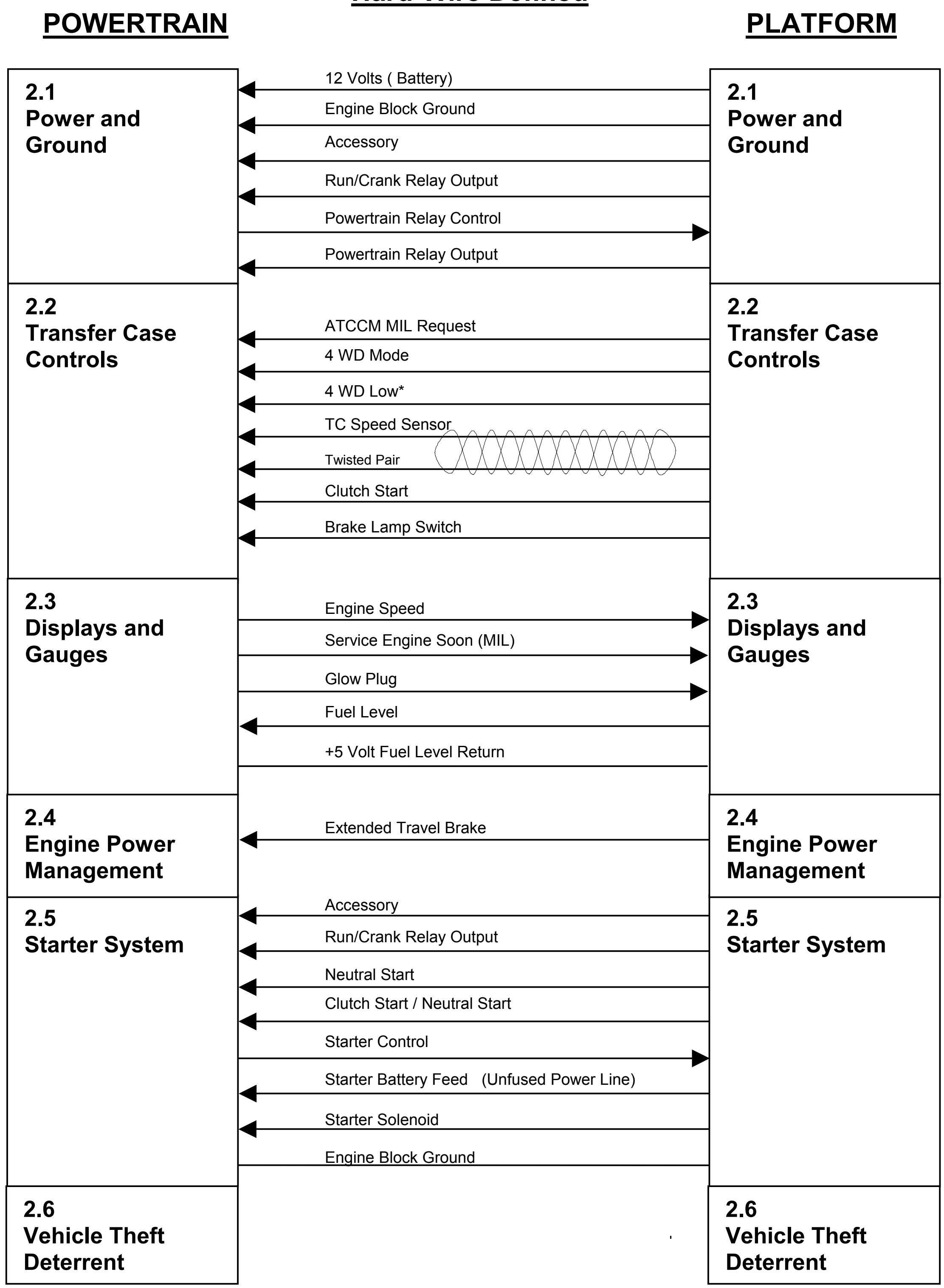
PLATFORM - POWERTRAIN ELECTRICAL INTERFACE DOCUMENTATION HIERARCHY



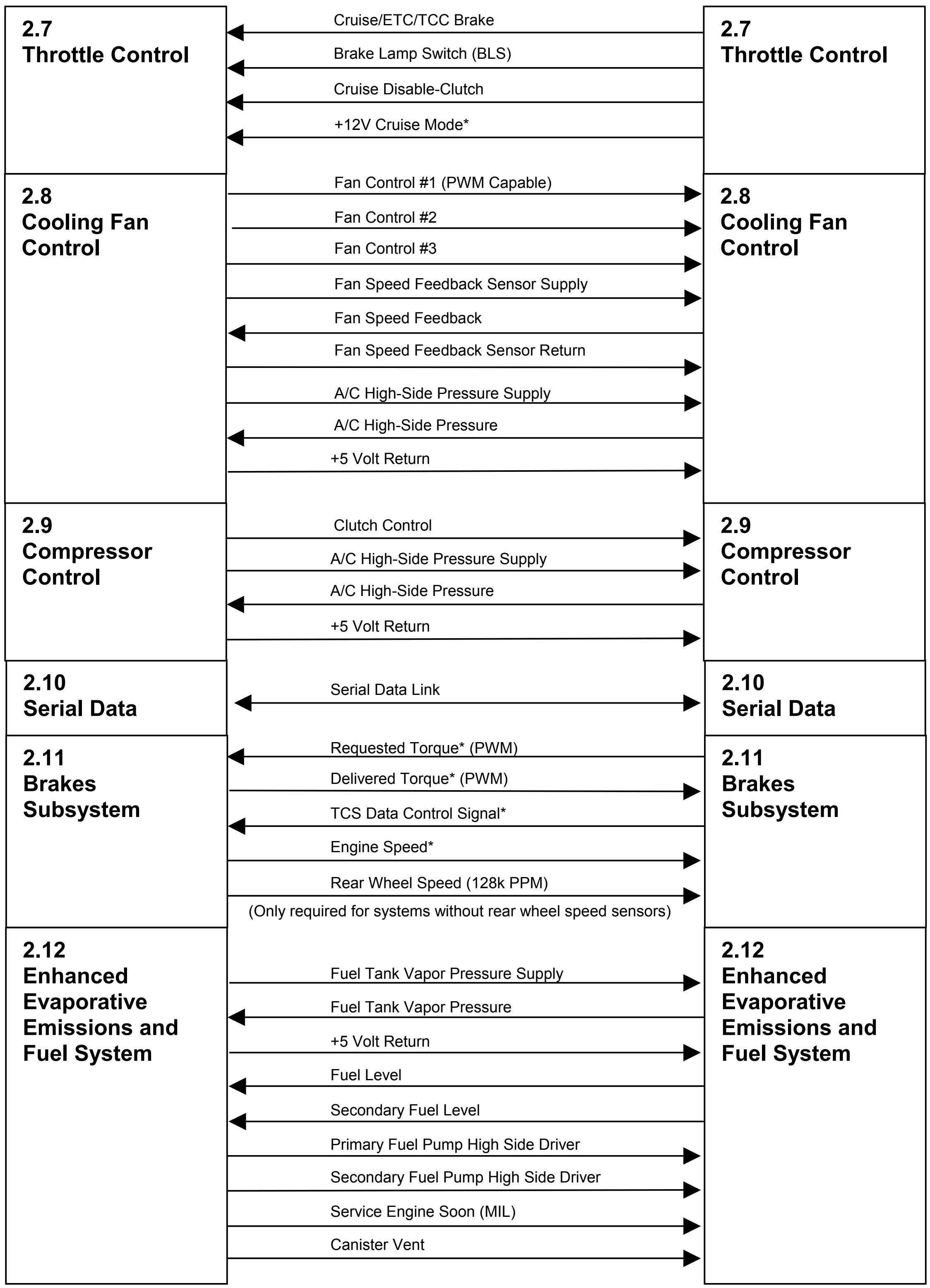
PPEI_HD.PPT

PPEI MACRO BLOCK DIAGRAM
Hard-Wire Defined



PPEI MACRO BLOCK DIAGRAM
Hard-Wire Defined

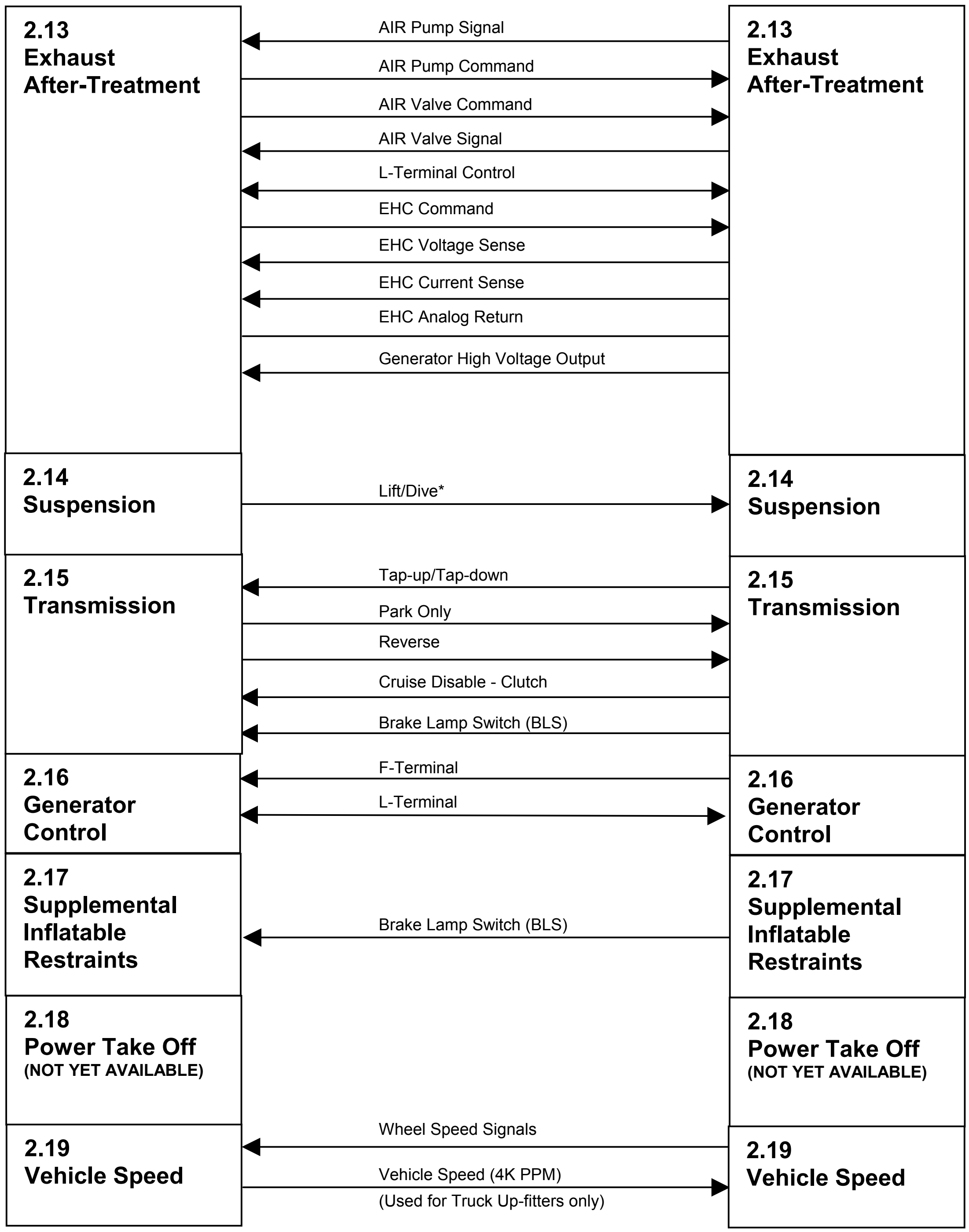
POWERTRAIN **PLATFORM**



* These signals are required for Class 2 based vehicles only

PPEI MACRO BLOCK DIAGRAM
Hard-Wire Defined

POWERTRAIN **PLATFORM**



* These signals are required for Class 2 based vehicles only

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1 GENERAL INFORMATION

1.1 Purpose

This document defines a standard electrical interface between Platform and Powertrain systems and components on all GMNA/Opel/Saab/Holden cars and trucks equipped with internal combustion engines. It shall be implemented according to the PPEI Implementation Plan (Page V). It may be implemented earlier on vehicles that are not having majors by mutual agreement between Platform and Powertrain.

The requirements in this document are intended to be satisfied over the useful life of the vehicle.

This document has been generated to implement, in part, the interface standardization strategy endorsed by the GM Electrical Council.

1.2 Scope

This document applies to all electrical interfaces between Powertrain and Platform systems and components. It does not apply to electrical interfaces within Powertrain or within Platform systems, even though these signals may be routed through a Platform wiring harness. Wiring harnesses, normally a Platform responsibility, are not considered interface components for this document. Connector definition and pin assignments are also outside the scope of this document.

GM Powertrain Group must meet the requirements in this document that apply to “Powertrain”. GMNA/Opel/Saab/Holden Platforms must meet the requirements in this document that apply to “Platform”.

Electromagnetic Compatibility requirements apply to systems and components and do not directly apply to the interface level. They are therefore beyond the scope of this document. Refer to GMW3097GS General Specification for Electrical/Electronic Components and Subsystems, Electromagnetic Compatibility (EMC), Requirements

1.3 Document Format

Section 2.0 uses the following format for consistent presentation of the information. Section 2.0 has the interface grouped by functional subsystem. The interface is the only standard defined by this document. Some of the functions are Platform optional, but if an interface signal or function is used, it shall be implemented according to this standard. The block diagrams show one possible mechanization and are not intended to specify a standard design on either side of the interface. Dotted items in block diagrams indicate optional functions. Implementation plans are based on best-known information at the time of publication and should be verified with the official program plans.

1.3.1 Format for Section 2.0

2.0	Description by Subsystem
2.X.1	Functional Overview
2.X.2	Hardware Overview
2.X.2.1	Block Diagram
2.X.2.2	Power and Ground Requirements
2.X.3	Interface Description
2.X.3.1	Serial Data Links
2.X.3.2	Signal A (Discrete)
2.X.3.N	Signal Z (Discrete)
2.X.4	Failure Modes and Diagnostics
2.X.5	Electrical Characteristics
2.X.6	Change Log

1.4 Document Control

The PPEI Work Group has approved the final version of this document for publication and distribution by the document librarian. The document librarian is the Electrical Center (8-226-5815) which is located at the GM Technical Center, Warren, Michigan. The PPEI Work Group is the corporate owner of this specification and shall be responsible for managing changes. Specification changes will be made as follows:

- Anyone proposing an interface specification change shall first consult his or her Engineering Center PPEI Representative. The PPEI Work Group Representatives include the following Engineering Centers: GMNA (Electrical Center, GMNA Platform – Pontiac, GMNA Platform – Warren, GM Powertrain), GME (Opel Platform, Opel Powertrain, Saab), and GMAP (Holden). The PPEI Representatives are responsible for generating an Interface Change Request (ICR) in the PPEI ICR Summary Database. Once the ICR is generated in the database, the PPEI Representative schedules the ICR for a PPEI Team Initial Review by contacting the PPEI Document Librarian. The PPEI Document Librarian will add the ICR on the PPEI Core Team Meeting Agenda for Initial Review. The PPEI Core Team will review the proposed change and either accept or reject the requested ICR as a valid request. If accepted, the ICR will move from the PENDING status to OPEN status; action items will be assigned until the ICR is resolved. If rejected, the ICR will move from the PENDING status to REJECTED status. Comments will be provided as to the reason for rejection for further clarification. This specification change process is depicted in the following flowchart.

The PPEI Document Librarian is *Vaundle Jones*.
Email: vaundle.jones@gm.com
Phone: (586) 986-5815 or 8-226-5815

The PPEI Website and the PPEI ICR Summary Database can be found at the Electrical Center Home Page Website.

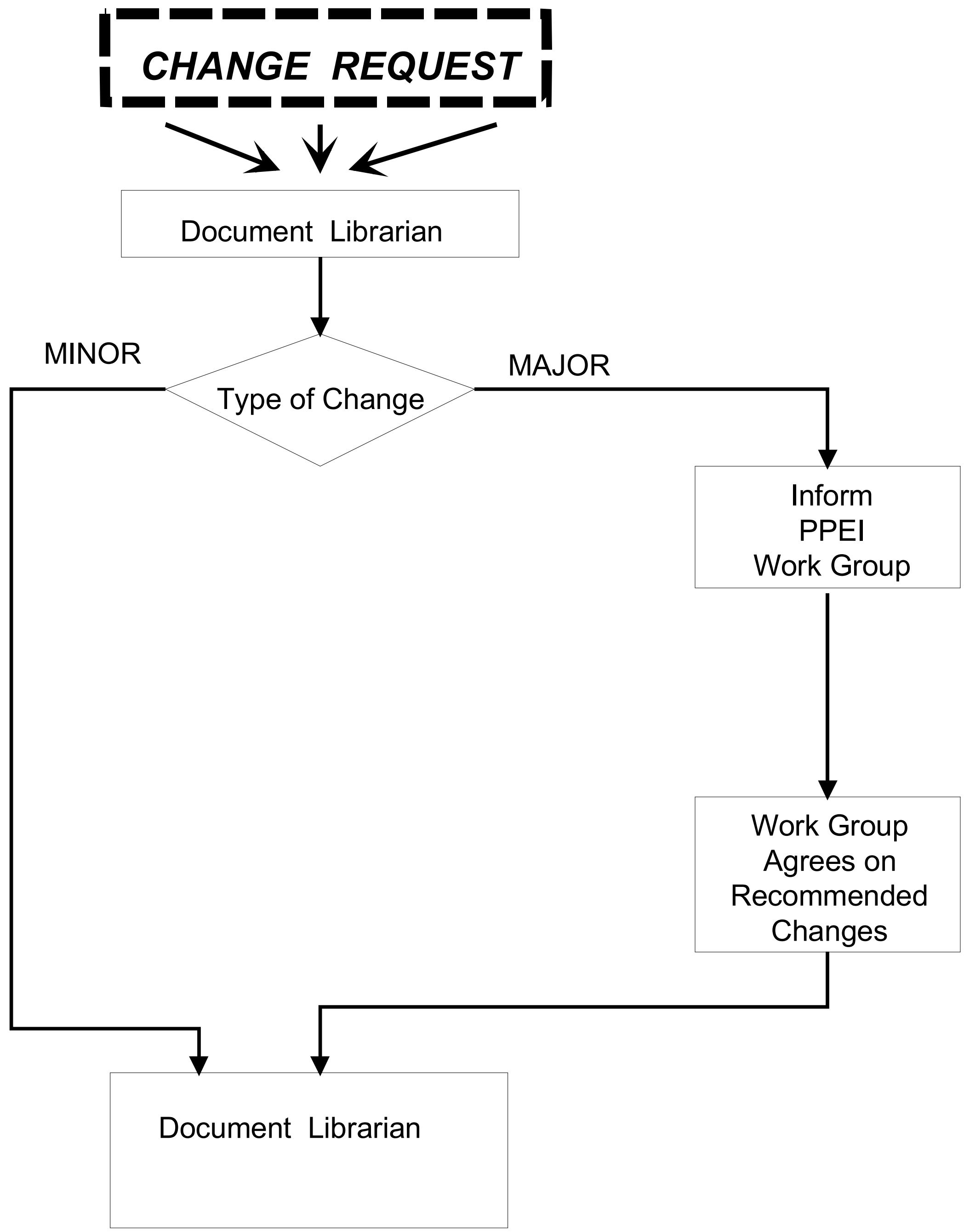
- For minor changes (i.e., a correction or clarification of existing mechanization detail), the librarian will revise the document text impacted by the ICR and present it to the PPEI Work Group for review and approval.

- For major changes (i.e., those which reflect a significant increase in cost and complexity or a change in system design philosophy), the librarian will inform the PPEI Work Group. The work group will develop a recommendation, which the librarian will reflect in the proposed document text.

- Changes that impact other Engineering Centers' areas of responsibility will be coordinated by the Electrical Center.

- Once the PPEI Work Group approves an ICR, the librarian will incorporate the approved document text into the specification and distribute it to the PPEI Work Group representatives.

PLATFORM - POWERTRAIN SPECIFICATION CHANGE PROCESS



Major = Significant increase in cost or complexity or change in philosophy
Minor = Corrections or additional detail

1.5 Related Documents

The PPEI specification shall take precedence in the event of any inconsistency between this specification and the documents listed below.

SAE J-1850	Class B Data Communication Network Interface
SAE J-1962	Diagnostic Connector
SAE J-1979	E/E Diagnostic Test Modes
SAE J-2178	Class B Data Communication Network Messages
SAE J-2190	Enhanced E/E Diagnostic Test Modes
SAE J-2284	Dual Wire, High Speed CAN
ISO 11898	Road Vehicles – Interchange of Digital Information – CAN for High Speed Communication
ISO 14230	Road Vehicles – Diagnostic Systems Part 1-4
GMI 12554, Part 1A	General Specification for Electrical/Electronic Subsystems and Components, General Specification for Electrical Signals and Interfaces
GMI 12554, Part 2A	General Specification for Electrical/Electronic Subsystems and Components, Specific Signal Specification for Vehicle Speed (DFA)
GMI 12554, Part 12A	General Specification for Electrical/Electronic Subsystems and Components, Specific Signal Specification for Brake Lamp Switch Input (BLS)
GMW3097GS	General Spec. for Electrical/Electronic Components and Subsystems, Electromagnetic Compatibility (EMC), Requirements
GMW3104	GMLAN Communication Strategy Specification
GMW3122	GMLAN Dual Wire CAN Physical Interface Specification
	Remote Vehicle Start System Level Specification
	Easy Key Subsystem Technical Specification
GMW3206	Brake Apply Sensing System-Level Specification
	Bosch Controller Area Network (CAN) Specification 2.0
	NAO Corporate Class 2 Functional Communication Specification Ver. 1.3
	NAO Class 2 Physical Message Diagnostic Strategy Specification Ver. 1.23
	GMNA Power Moding Specification
	GMLAN Ignition Switch Power Moding Specification
	Technical Specification for Flash Programming Components using Class 2 Communications Rev E
TL.07.0195.R03	Algorithm Description for Cruise Control
TL.15.2017	Cranking Subsystem Technical Specification
	Cruise Control Subsystem Requirements Document
99.95.2010.6	ETC Subsystem Requirements Document
TL.17.0015.R03	GM Powertrain Rough Road Detection Algorithm Description
TL.21.2038	Starter Control Requirements Document

1.6 Electrical Interface Standards (EIS)

Section	Electrical Interface Standard	
2.1 Power & Signal Distribution	SSTS EICC-80.201.01	Power and Signal Distribution Subsystem Technical Specification
2.6 Vehicle Theft Deterrent	EIS 70:4:10.1;2.03	Vehicle Theft Deterrent Subsystem Requirements for Powertrain –Electrical Interface Standard
2.6 Vehicle Theft Deterrent	Version 1.0	Powertrain Immobilizer Requirements Specification

1.7 General Information on On Board Diagnostics

1.7.1 Overview

The purpose of this section is to explain how PPEI manages platform-owned emissions-related components. Platform needs to take special care in design when dealing with such components, and a background with some guidelines is given below.

1.7.2 Identification of components

When new mechanizations are discussed, the PPEI work group also considers the OBD requirements. When potential emissions-related components are identified, the appropriate PPEI sections indicate that the interface may be emissions-related.

1.7.3 OBD Warranty and Defect Reporting

The following section provides a summary of the different warranty levels and required defect reporting associated with a component classified as emissions-related. Complete and official OBD regulations are found in the CARB, Federal, and European OBD Regulations documents.

1.7.3.1 US market, OBD II

1.7.3.1.1 Californian Emission Warranty

Depending on the customer cost of repair there are two levels of legislated warranty:

- 3 years / 50,000 miles, all emissions-related components, bumper-to-bumper.
- 7 years / 70,000 miles, for all high-cost components. The cost threshold is index-based and is subject to change. (For MY2000 the cost threshold is $410 including fault tracing and repair.)

1.7.3.1.2 US Federal Emission Warranty

There are two levels of legislated warranty:

- 2 years / 24,000 miles, all emissions-related components, bumper-to-bumper.

- 8 years / 80,000 miles, some specified components; Catalyst including cover, hoses, heat shield and possible heating devices, Control Module including cover, SW, HW and connectors.

1.7.3.1.3 Californian Defect Reporting

The Useful Life of an emissions-related component is defined to be 10 years / 100,000 miles. The Useful Life is increased to 120,000 miles with a phase-in starting at MY2004.

The table below shows the various levels of reporting to CARB associated with field claims. Ultimately CARB could decide a recall is necessary if the field situation is deemed unacceptable.

Action triggers	Content
1% or 25 unscreened claims. EWIR – Emission Warranty Information Report.	- Number of unscreened warranty claims per component within engine family in California. - Number of sold vehicles in engine family in California. - Description of component.
4% or 50 unscreened claims. FIR – Field Information Report	EWIR information plus: - Problem with the component, reason for claims. - Number of defects. - Estimated number of defects within Useful Life. - Estimated date when 4% or 50 defects will be reached.
45 days after FIR, or after CARB request. EIR – Emission Information Report	- Description of component, problem and likely cause of failure. - Effect on emissions, driveability, fuel economy and startability with defect present. - Based on the information in EIR, CARB may order a recall

1.7.3.2 European market, EOBD

1.7.3.2.1 Emission Warranty and Useful Life

EOBD has no legislation on emissions warranty but Useful Life is defined to 5 years / 80,000 km. There is currently no further legislation on manufacturer obligations related to the Useful Life of the EOBD system.

1.7.3.2.2 Defect Reporting

EOBD has no legislation on defect reporting.

1.7.4 Platform Guidelines

The following guidelines should be considered when designing the electrical system. The platform owner of the emissions-related component is advised to negotiate the electrical architecture with OBD experts to ensure that it will not cause GM added cost in terms of OBD emissions warranty or a risk for recall.

- Do not integrate emissions-related component in modules that fall under the high-cost component clause without supporting it with a business case study where the increased warranty cost is included.
- Do not control emissions-related components locally through Platform electronics. For example, emissions-related relays should be controlled directly by the Powertrain electronics.
- Emissions-related components should be designed so that a service replacement of the component could be filed under a unique labor code. This helps to isolate the component and keep the OBD warranty costs down.
- Minimize the amount of shared PCB traces with other components, e.g. supply lines or ground. A PCB trace is considered emissions-related if the trace is used for an emissions-related component.
- Use a fusing strategy that minimizes the OBD impact in case of an overcurrent situation in a non-emissons-related wire.

1.8 Symbol Conventions

A bi-polar transistor symbol is used only to represent low side and high side drivers and is not intended to be a restriction on the actual design.

1.9 Naming Conventions

Use of the term Powertrain Electronics within this specification may represent modules such as an ECM, PCM or TCM depending on the application.

1.10 Definitions

Working Document (on the cover) implies that this document has not been reviewed or approved.

Draft Document (on the cover) implies that this document has been submitted to the appropriate technical work groups for internal review and acceptance.

Released Specification (on the cover) implies that this document has been approved by the PPEI Work Group.

1.11 Acronyms and Abbreviations

ABS	Anti-Lock Brake System
AIR	Air Injection Reaction
BAS	Brake Apply Sensor
BASS	Brake Apply Sensing System
BLS	Brake Lamp Switch
BTSI	Brake Transmission Shift Interlock
CAN	Controller Area Network
CARB	California Air Resource Board
Class 2	GM Communication link which meets SAE J-1850
CVT	Continuous Variable Transmission
DIC	Driver Information Center

DoD	Displacement on Demand
ECM	Engine Control Module
EDC	Engine Drag Control
EGR	Exhaust Gas Recirculation
EHC	Electrically Heated Catalyst
EIR	Emission Information Report
EIS	Electrical Interface Standard
EMC	Electro-Magnetic Compatibility
EOBD	European On-Board Diagnostics
ETC	Electronic Throttle Control
ETS	Enhanced Traction System
EWIR	Emission Warranty Information Report
FIR	Field Information Report
GME	General Motors Europe
GMIO	General Motors International Operations
GMNA	General Motors North America
GMLAN	General Motors Local Area Network
ICD	Interface Control Document
ICR	Interface Change Request
KW2000	Protocol for ISO 14230 diagnostic link (K-line)
MRF	Magneto Rheological Fan
NAO	North American Operations (Being Replaced by GMNA)
NSBU	Neutral Start Back-Up
OBD	On-Board Diagnostics
OFVC	Off Vehicle Communications
PCM	Powertrain Control Module
PF	Platform
PPEI	Platform-Powertrain Electrical Interface
PT	Powertrain
PTSS	Powertrain System State
PWM	Pulse Width Modulation
RVC	Regulated Voltage Control
RVS	Remote Vehicle Start
SDL	Serial Data Link
SSTS	Subsystem Technical Specification
STG	Service Technology Group
TBD	To Be Determined
TCC	Torque Converter Clutch
TCM	Transmission Control Module
TCS	Traction Control System
TCSS	Transfer Case Speed Sensor
VSES	Vehicle Stability Enhancement System

1.12 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
1.11	Added EGR (Exhaust Gas Recirculation) to the Acronyms and Abbreviations section.	ICR 2092
1.5	Added Revision Level 3 to the GM Powertrain Rough Road Detection Algorithm Description document for version control purposes.	ICR 2196
1.11	Added DoD (Displacement on Demand) to the Acronyms and Abbreviations section.	ICR 2106
1	Revised the PPEI Workgroup Approval list to reflect the following: Added ICR 2121 for PPEI 2.5 release. Replaced Thomas Schlotthauer with Matthias Deegener for FGP-Germany. Replaced Janet Keane with Jackie Selig for GMPT-Powertrain.	ICR 2121

2. DESCRIPTION BY SUBSYSTEM

2.1 Power and Signal Distribution

The platform shall provide power and ground from the charging and energy storage subsystem to all powertrain components, as defined in this section.

2.1.1 Functional Overview

Powertrain components shall receive system voltage from the Platform using continuous and switched battery. Components connected directly to battery shall minimize standby current. If regulated voltage is required for a powertrain component, Powertrain will be responsible for providing it, either as part of the component design or from another powertrain component, such as the PCM.

The PCM (or ECM and TCM) requires battery voltage, switched battery voltage and ground from the vehicle electrical system. It utilizes these inputs to generate regulated power, as a source for certain internal circuits and as a source to power or control certain external loads. The switched battery input, typically in conjunction with a software turn-off delay, controls PCM (or ECM and TCM) use of unswitched battery power, except for a small amount of power needed for keep-alive memory functions.

2.1.2 Hardware Overview

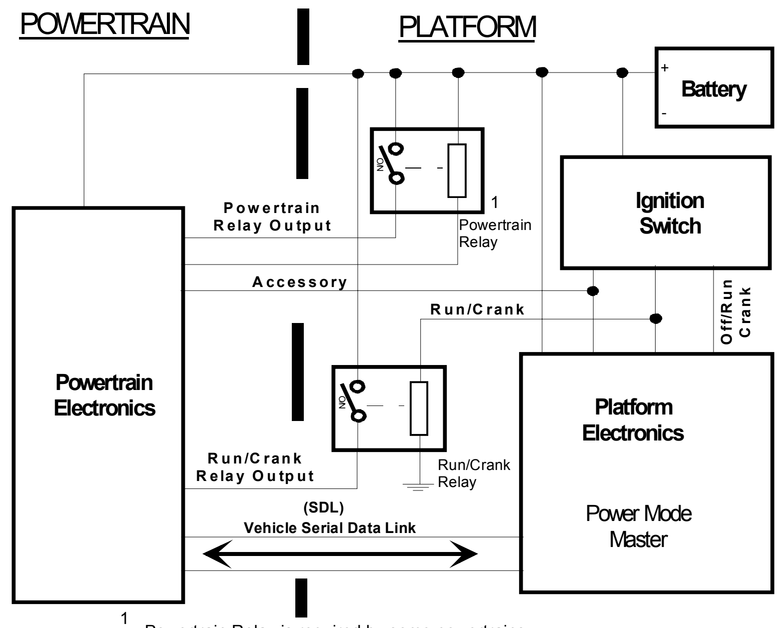
The hardware involved includes powertrain electrical components and the vehicle electrical system. The vehicle electrical system includes such items as generator, battery, vehicle wiring harnesses, relays, fuses and ignition switch.

All Platforms shall provide a Run/Crank relay. Platform also shall provide a powertrain relay when required by Powertrain. Some controllers (e.g., hybrid) require this relay for reverse battery protection. Diesel controllers may require this relay for engine shutdown management. When the powertrain relay is utilized, Powertrain shall provide circuit partitioning requirements to Platform.

2.1.2.1 Power Moding Block Diagram

North American applications shall follow the applicable version of the GMNA Power Moding Specification.

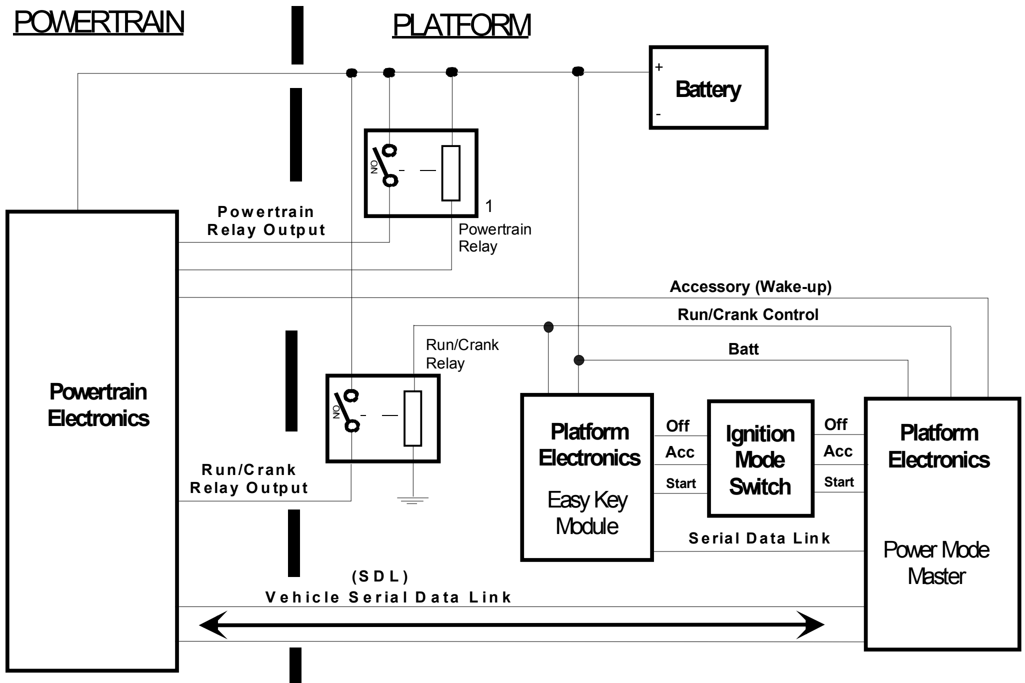
2.1.2.1.1 Ignition Key Switch



1 Powertrain Relay is required by some powertrains

2.1.2.1.2 Easy Key

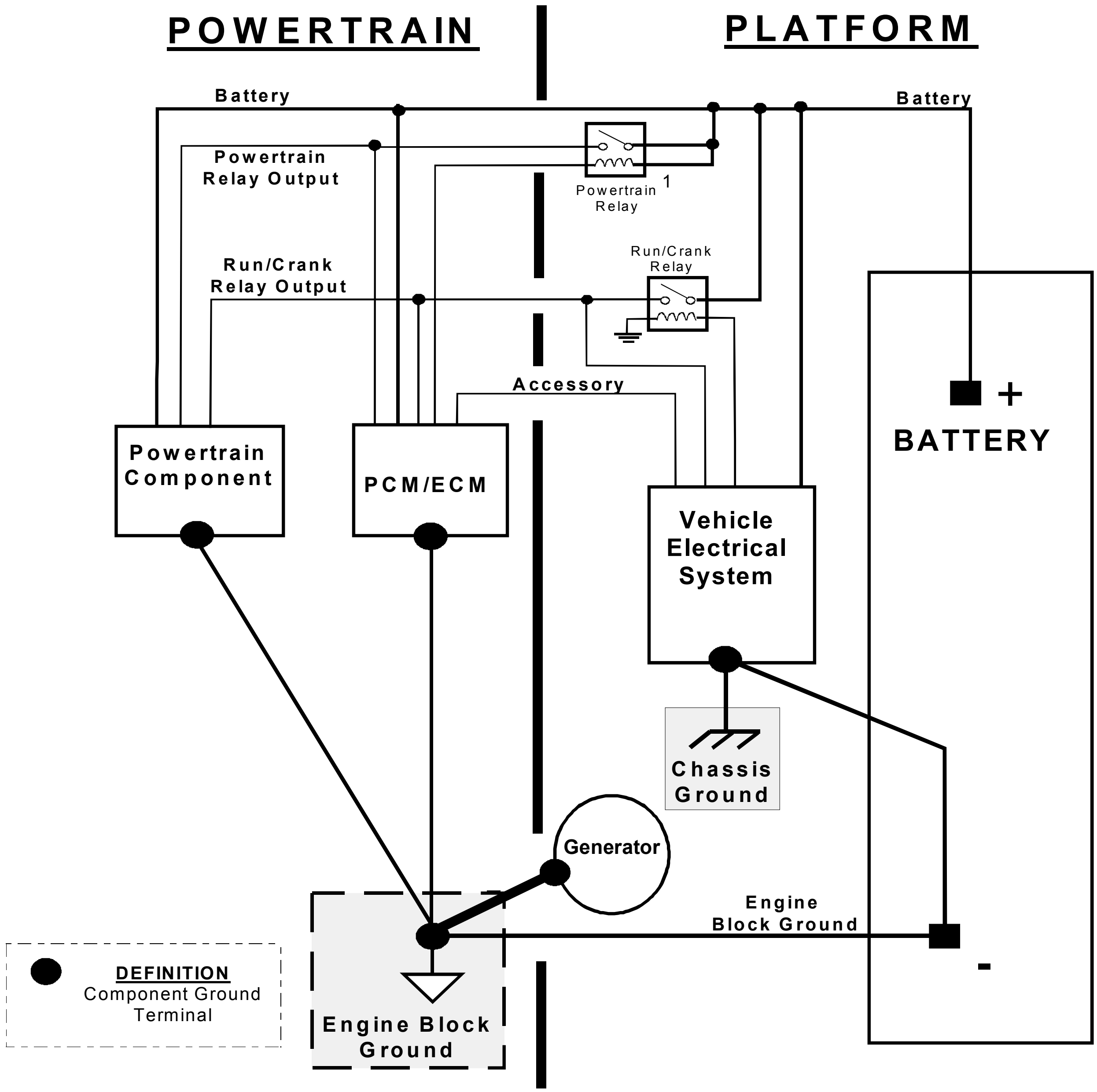
The following block diagram depicts the typical mechanization for Easy Key. The electrical interface between Powertrain and Platform is the only standard defined. Refer to the Easy Key Subsystem Technical Specification.



1 Powertrain Relay is required by some powertrains

2.1.2.2 Power and Signal Distribution Block Diagram

This block diagram is for illustrative purposes only.



DEFINITION
This symbol is the generic Vehicle System Ground that could be physically connected to either the Engine Block or Chassis Ground. This symbol is used throughout the document.

1 Powertrain Relay is required by some powertrains

2.1.2.3 Power and Signal Distribution Requirements

Powertrain current requirements will be negotiated for each application, along with the fusing and other distribution needs.

The "Engine Run Critical" fuse(s) shall include components that must be powered to operate the engine.

The "Emission Critical" fuse(s) shall include components required for emission control, but are not required for engine operation.

2.1.3 Interface Description

2.1.3.1 Serial Data Messages

Reference Section 5.0 for definitions of messages and signals.

2.1.3.1.1 Class 2 Serial Data Link

Serial Data Content	Transmitter	Primary ID	Secondary ID	Extended ID	Notes
Network Control - System Power Modes	Platform	FE	06	N/A	Required

2.1.3.1.2 GMLAN Serial Data Link

Signal Name	Transmitter	Notes
Backup Power Mode Master Virtual Device Availability	Platform	Required
Power Mode Master Accessory Terminal Status	Platform	Powertrain Optional
Power Mode Master Run Crank Terminal Status	Platform	Powertrain Optional
System Backup Power Mode	Platform	Required
System Backup Power Mode Enabled	Platform	Required on GMNA vehicles
System Power Mode	Platform	Required on GMNA vehicles

2.1.3.2 Accessory

The PCM (or ECM and TCM) shall have a logic input that connects to the Accessory ignition switch signal. This input shall be used for detecting wake-up.

For ignition key switch mechanizations, switched battery voltage shall be applied to the Accessory signal in the Accessory and Run ignition switch positions. For Easy Key mechanizations, a high side drive output from the Power Mode Master shall activate the Accessory signal in the ACCESSORY and RUN power modes.

The PCM (or ECM and TCM) shall use this signal to perform required Platform functions (i.e., communication of oil life reset and transmission mode information via the serial data link) in the ACCESSORY power mode.

2.1.3.3 Run/Crank Relay Output

The PCM (or ECM and TCM) shall have an input that connects to the Run/Crank relay output. This input shall be used for detecting wake-up.

For ignition key switch mechanizations, the Run/Crank relay shall be controlled by the ignition switch and shall be energized when the switch is in the Run and Start positions. This is the power source for the PCM (or ECM and TCM) and other powertrain components. On vehicles with Remote Vehicle Start (RVS) the Platform Electronics shall also control the Run/Crank relay. The Run/Crank relay may be energized for the RVS system when the switch is any key position.

For Easy Key switch mechanizations, the Platform Electronics (e.g., Power Mode Master and/or Easy Key module) shall energize the Run/Crank Relay in the RUN and CRANK power modes. A single point failure within the Platform Electronics shall not cause the Run/Crank relay to disengage in the RUN power mode. The Run/Crank relay may also be energized in other power modes for the RVS system.

When the Run/Crank relay output is not active, the Powertrain electronics shall ensure that the output control solenoids and systems indicator lamps are not energized. An exception to this can exist if the Run/Crank relay transitions from active to inactive. In this case, the PCM or ECM may remain energized under software control in order to perform some additional functions prior to the controller powering down.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.1.3.4 Powertrain Relay Control

This optional signal is a discrete low-side driver output of the powertrain electronics intended to drive the powertrain relay. The relay coil shall be powered from a fused battery power source. The powertrain electronics shall pull the output low for engagement of the relay.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.1.3.5 Powertrain Relay Output

This optional switched battery signal shall be an input to the PCM or ECM and other powertrain components.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.1.3.6 Battery

The Battery signal from the Platform to the Powertrain provides the electrical power for certain powertrain actuators (starter, etc.) and for powertrain internal power sources that provide regulated voltages.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.1.3.7 Engine Block Ground

The Platform shall provide a ground path from the battery negative terminal to the engine block. On some applications, EMC testing may dictate that a ground strap from the engine block to chassis (body) is also required.

The Powertrain electronics shall be grounded to the engine block (an internal Powertrain connection).

The PCM (or ECM and TCM) case may either be grounded or isolated from vehicle ground depending on the controller design. If there is a DC connection between the electronics and the case, the case shall be isolated from the vehicle chassis to avoid DC sneak circuits. If the controller is mounted on the engine block, then a DC connection may be allowed.

Powertrain shall provide these requirements for each individual application.

2.1.4 Failure Modes and Diagnostics

2.1.4.1 System Protection

Powertrain components must provide internal protection against all traditional battery, switched battery, and ground transients per GMW3097GS General Spec. for Electrical/Electronic Components and Subsystems, Electromagnetic Compatibility (EMC), Requirements.

Battery and switched battery circuits to the Powertrain shall be over-current protected by the platform to protect the wiring harness, so that disruption of vehicle operation is minimized. The number of protected circuits allocated shall minimize failure effects. To reduce walk-home type electrical failures, circuits essential to Powertrain operations shall be protected separately from circuits that are non-essential, except for functions addressed in legislated objectives (example - odometer security).

The Platform shall avoid undesired component operation due to loss of ground paths (i.e. sneak paths).

2.1.5 Electrical Characteristics

2.1.5.1 Operating Ranges

The powertrain electronics shall operate in the following steady state voltage ranges:

Low Voltage Range	$6.0 \leq Vdc \leq 11.0$
Normal Voltage Range	$11.0 < Vdc \leq 16.0$
High Voltage Range	$16.0 < Vdc \leq 26.5$

Voltages are referenced to component terminals.

In the low voltage range, the powertrain electronics and critical platform items (e.g., starter control relay, fuel pump, fuel pump relay) shall be able to provide sufficient control to start and run the engine. Refer to Section 2.1.5.2 for specific voltage requirements for starting.

In the normal voltage range, all vehicle functions shall perform as designed.

In the high voltage range, degraded operation may occur. The powertrain electronics shall be able to withstand voltages between 16 and 18 Vdc for 60 minutes and up to 26.5 Vdc for 1 minute without damage.

For specific high speed CAN system operating voltage ranges, refer to Section 2.10.2.2.

2.1.5.2 Voltage Requirements for Starting

The waveform depicted in GMW3097GS General Spec. for Electrical/Electronic Components and Subsystems, Electromagnetic Compatibility (EMC), Requirements (section 3.3.2 CI, Transients on Power Lines, Pulse No. 4, Pulse severity IV) represents the worst case cranking scenario. The Platform electrical system shall provide this waveform, at worst, to the powertrain electronics component terminals during the cold start event in order to satisfy VTS start time requirements. The cold start event, as defined in the VTS, is at -29 °C with the battery at 80% state of charge. The powertrain electronics shall be capable of providing sufficient control to start the vehicle under these conditions with this voltage waveform. The powertrain electronics microprocessor shall not reset during the cranking event. This waveform applies for both assisted and unassisted starting.

2.1.5.3 Voltage Drop Requirements

The vehicle wiring system shall meet and may exceed the requirements specified in this section. The requirements for the wiring system shall be dictated by the Power and Signal Distribution Subsystem Technical Specification (e.g., GMNA SSTS EICC-80.201.01).

To ensure proper system performance, the platform shall meet the following requirements during normal engine run. For transient performance requirements, refer to GMW3097GS General Spec. for Electrical/Electronic Components and Subsystems, Electromagnetic Compatibility (EMC), Requirements.

2.1.5.3.1 Positive Side

The platform shall provide a wiring system such that the maximum potential difference between the battery positive terminal and the powertrain shall be less than 1.0 volt. This voltage drop limitation shall also apply to the Accessory, Run, and Run/Crank signals during normal engine run.

The platform shall provide a wiring system such that in all cases the maximum potential difference between the battery input terminals on the following components shall be less than 1.0 Volt.

(a) Powertrain Electronics
(b) Platform components that interface with the Powertrain

2.1.5.3.2 Ground Path

The platform shall provide a wiring system such that the maximum potential difference between the PCM/ECM Ground Terminal and the following components shall not exceed 0.5 Volts at frequencies of less than 200 Hz during normal engine run.

Component	Maximum Potential Difference
Engine Block	-0.5V
Powertrain Component Ground Terminals	± 0.5V
Generator	± 0.5V
Platform Components that interface with the PCM/ECM	± 1.0V

2.1.5.4 Parasitic Load Current

Parasitic load current is defined as the average current through a component when in the OFF-ASLEEP power mode.

Over the temperature range -40 to +40°C, new Powertrain and Platform designs shall limit parasitic load for the powertrain to 1 mA maximum. The design goal shall be 300 µA for modules with wake-up, and 100 µA otherwise.

2.1.5.5 Accessory

Type:	Signal
Source:	Ignition Switch
Current:	250 mA maximum at 13.5 Vdc.

Reference Section 3.3.1.

2.1.5.6 Run/Crank Relay Output

Specific Run/Crank voltage, current, and recommended fusing requirements shall be provided by Powertrain.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.1.5.7 Powertrain Relay Control

The output of the powertrain electronics shall have the characteristics of a low-side driver, LSD3, as described in Section 3.1.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.1.5.8 Powertrain Relay Output

Specific battery voltage, current, and recommended fusing requirements shall be provided by Powertrain.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.1.5.9 Battery

Powertrain shall specify the total current required on the Battery interface and the circuit protection required shall be jointly negotiated.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.1.5.10 Ground

Powertrain components shall ground directly to the engine block. Specific voltage drop and current requirements will be provided by Powertrain for each application.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.1.5.11 Engine to Platform Ground Connection

The potential difference between the engine block ground and the negative battery terminal (post) shall be within -0.2 and + 0.5 volts, 0-200 Hz, during engine run with maximum electrical load with high generator output (at least 6000 generator RPM). The potential difference may exceed 0.5 Volts during engine crank.

2.1.6 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
	There were no changes made to this section for PPEI 2.5 Release.	

2.2 Transfer Case Controls

2.2.1 Functional Overview

2.2.1.1 Manual Transfer Cases

The transfer case (T-case) is an integral part of the powertrain system, which is responsible for vehicle propulsion. The primary function of the T-case is to engage four-wheel drive from two-wheel drive operation. It also provides two gearing ratios for four-wheel drive: high and low. Engagement and disengagement of the T-case can be performed manually by the operator using a shift lever. The Manual Transfer Case option will be implemented on Medium Duty Truck Platforms only.

2.2.1.2 Active Transfer Case

The interface defined in this section shall be applicable to all vehicles equipped with an active transfer case.

The active transfer case is a system which distributes powertrain torque between the rear wheels and the front wheels as needed thus maximizing vehicle traction. The transfer case control module controls the initiation and duration of the torque shift, and continually updates the percent torque to the front wheels.

The system determines that torque is needed at the front wheels when the rear wheels slip or when the system anticipates rear slip. This is accomplished by monitoring the front and rear output of the transfer case as well as the throttle position. The system also monitors braking activity and is deactivated during an anti-lock braking event thus ensuring the vehicle is in two-wheel drive during this event.

The system provides T-case output speed to the Powertrain electronics.

2.2.1.2.1 Active Push Button Control

Active Push Button Control is an active transfer case system that provides a push button selection for a traditional four-wheel drive low range. The active transfer case will tell the Powertrain Electronics when it is in four-wheel drive low via the 4WD Low signal.

2.2.1.2.2 Active All-Wheel Drive (AWD)

Active All-Wheel Drive is an active transfer case system that is always in all-wheel drive with no driver input.

2.2.1.3 Electronically Controlled Active Transfer Case

The interface defined in this section shall be applicable to all vehicles equipped with an electronically controlled active transfer case.

The electronically controlled active transfer case is a system, which distributes powertrain torque between the rear wheels and the front wheels as needed thus maximizing vehicle traction. The transfer case control module resides on the Powertrain side of the interface, and the Vehicle Stability Enhancement System (VSES) has an interface to control the distribution of torque.

The system contains basic functionality to maintain vehicle stability by evaluating the front and rear output of the transfer case as well as the throttle position and all four wheel speeds. The system also monitors braking activity and is deactivated during an anti-lock braking event thus ensuring the vehicle is in two-wheel drive during this event.

A hardwired BLS signal is required as a redundant signal to the serial data information.

2.2.2 Hardware Overview

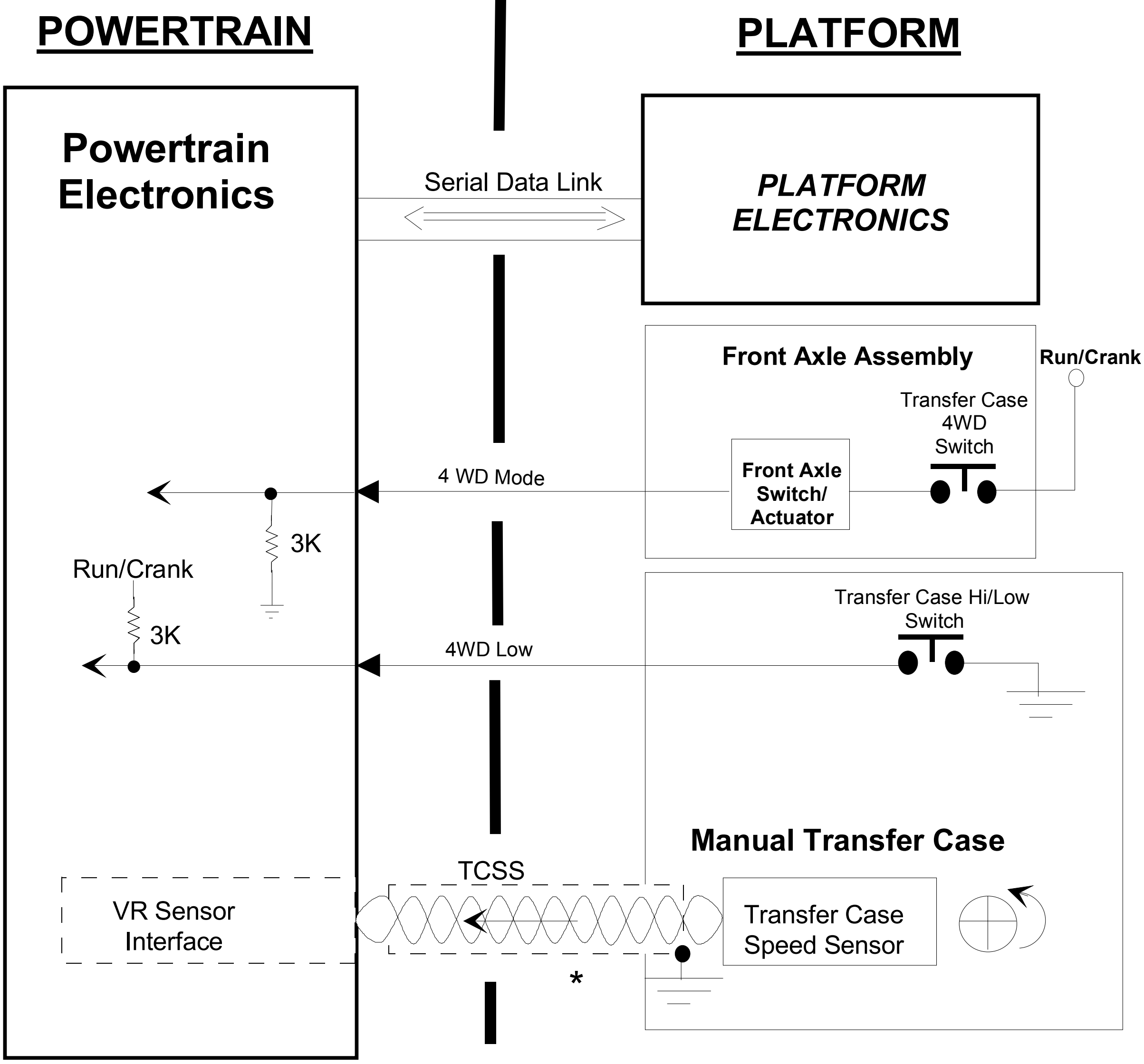
The description of this subsystem covers the serial data link (if utilized) and the discrete wiring between the front axle, Transfer Case switches, and the Transfer Case Control Module to the Powertrain Electronics.

2.2.2.1 Block Diagram

The following block diagrams depict a typical Platform-Powertrain electrical interface mechanization for the manual, active push button, active all-wheel drive transfer case control, and electronically controlled active transfer case systems. The interface is the only standard defined.

2.2.2.2 Manual (Medium Duty, Tandem Axle Systems)

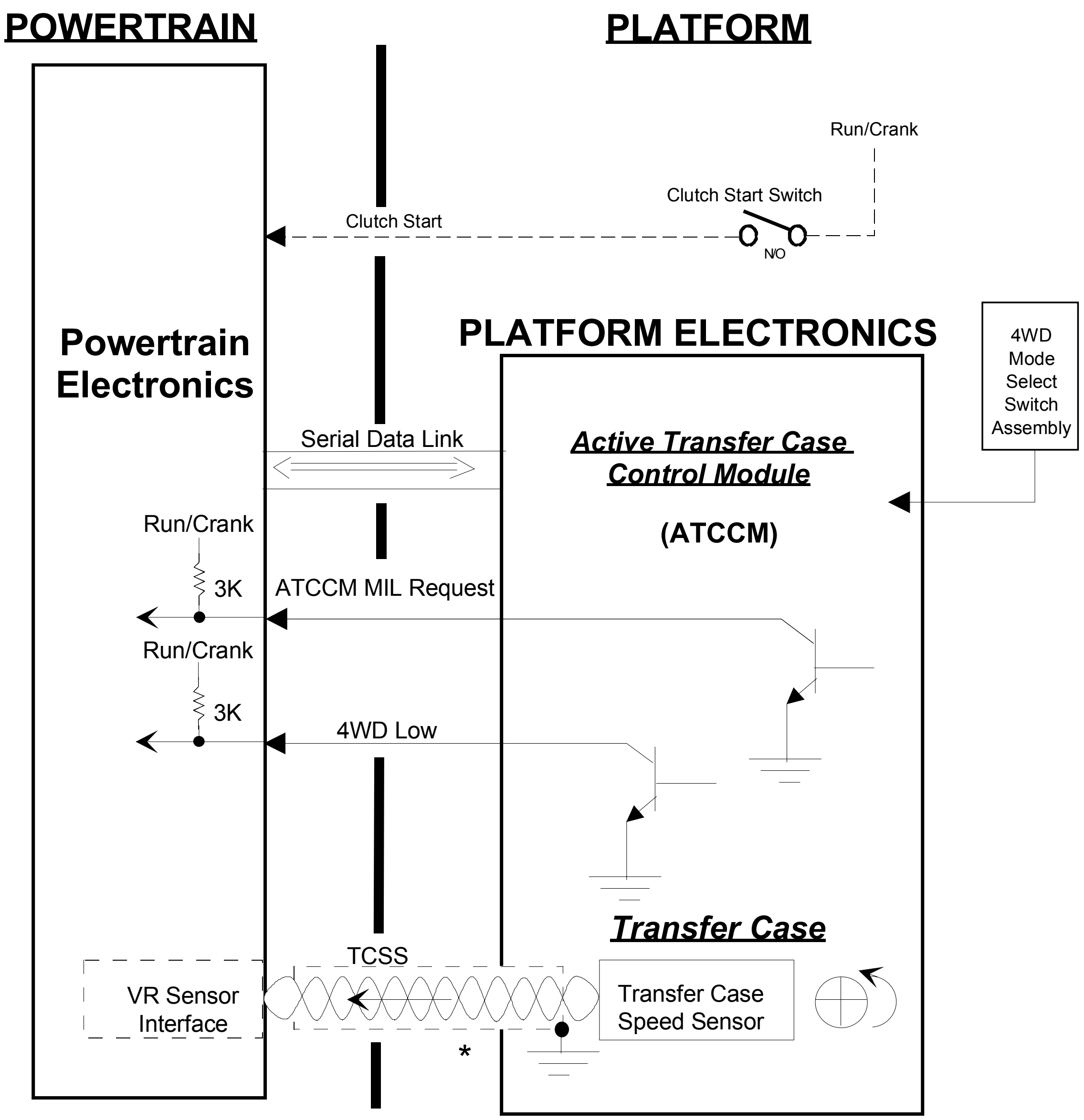
Page



0 * Twisting and shielding dependent upon proximity to high voltage ignition system

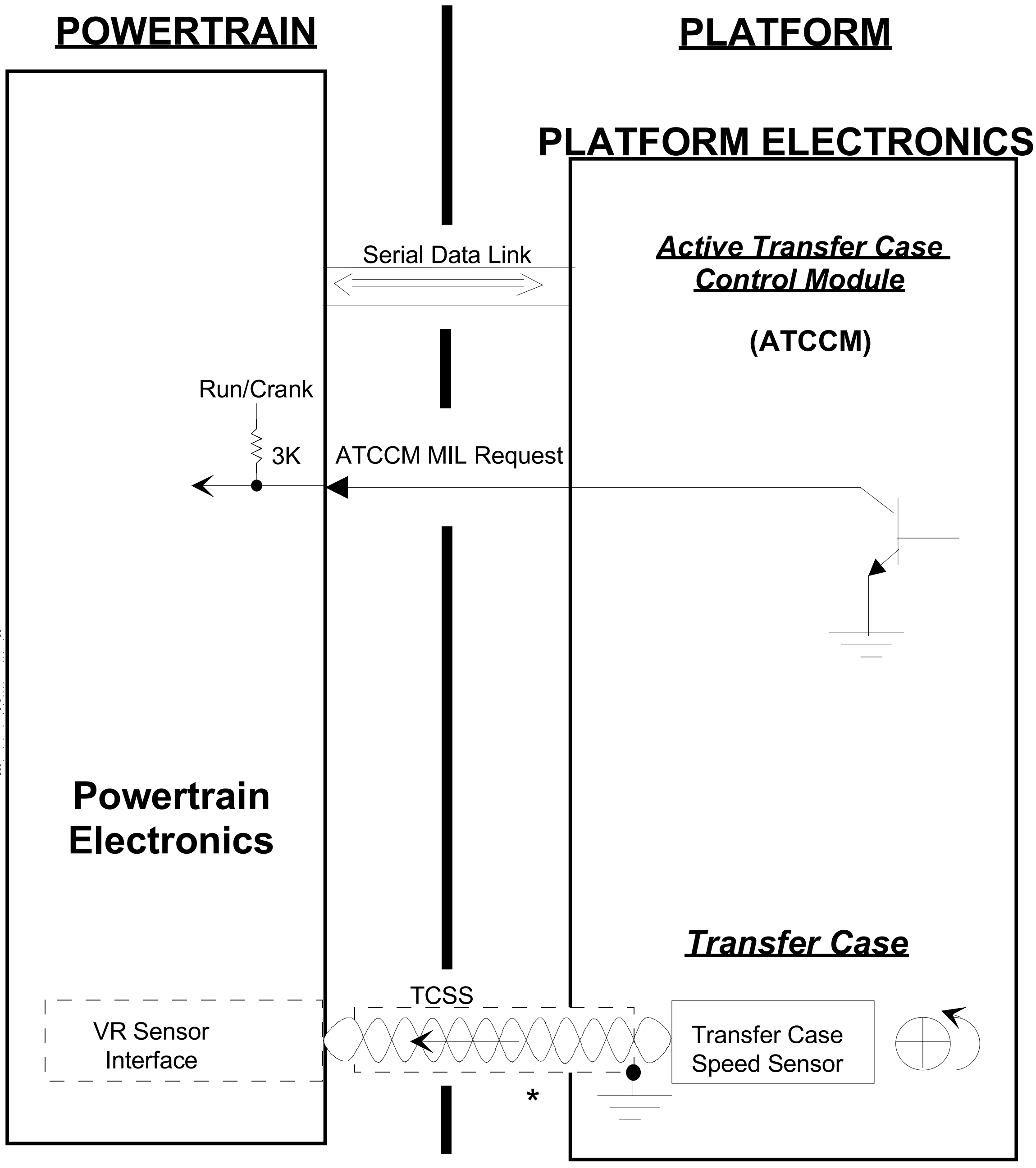
2.2.2.3 Active Transfer Case

2.2.2.3.1 Active Push Button Control



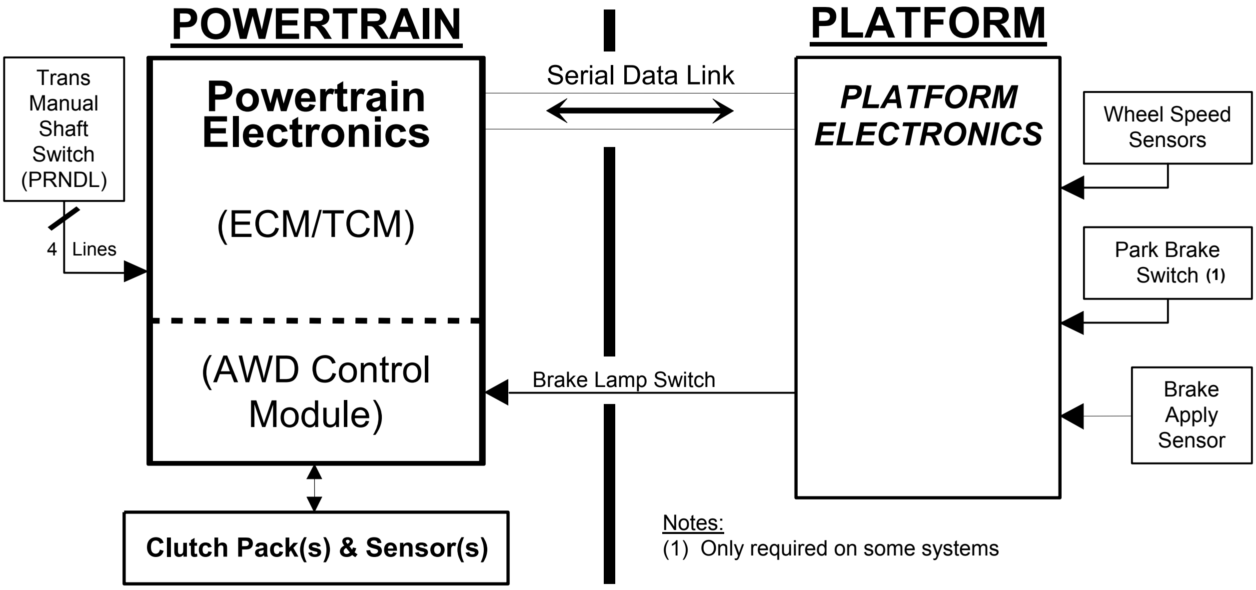
* Twisting and shielding dependent upon proximity to high voltage ignition system

2.2.2.3.2 Active All Wheel Drive (AWD)



* Twisting and shielding dependent upon proximity to high voltage ignition system

2.2.2.4 Electronically Controlled Active Transfer Case



2.2.3 Interface Description

2.2.3.1 Serial Data Links

Reference Section 5.0 for definitions of messages and signals.

2.2.3.1.1 Class 2 Serial Data Link

Serial Data Content	Transmitter	Primary ID	Secondary ID	Extended ID	Notes
Engine Torque - Delivered Torque	Powertrain	08	22	N/A	Required(1)
Engine Air Intake - Intake Air Temperature	Powertrain	0A	20	N/A	Required for active push button control
Throttle Position Sensor - Pedal Position	Powertrain	12	11	N/A	Required(1)
Wheels - Individual Wheel Speeds	Platform	24	09	N/A	Required for Non-Truck All Wheel Drive
Vehicle Speed - High Resolution - Metric	Powertrain	28	02	N/A	Required(1)
Brakes – System Fault	Platform	32	0A	N/A	Optional for Non-Truck All Wheel Drive
Transmission/Transaxle/PRNDL - Clutch Enable	Powertrain	3A	02	N/A	Required(1)
Transmission/Transaxle/PRNDL - Estimated Trans. Gear Engaged	Powertrain	3A	03	N/A	Required(1)
Transmission/Transaxle/PRNDL - Transfer Front Axle	Platform	3A	05	N/A	Required for active push button control
Transmission/Transaxle/PRNDL - Transfer Case TPS Thresholds	Platform	3A	22	N/A	Required(1)
Transmission/Transaxle/PRNDL - Driven Wheel Configuration	Powertrain	3A	35	N/A	Optional for Non-Truck All Wheel Drive
Transmission/Transaxle/PRNDL - Transmission Options	Powertrain	3A	3C	N/A	Required(1)
Transmission/Transaxle/PRNDL - Tire/Axle Correction Factor	Powertrain	3A	3D	N/A	Required(1)
Engine Run Flag	Powertrain	52	04	N/A	Required(1)
Engine System Other - Engine Type	Powertrain	52	22	N/A	Required(1)
Engine System Other – Calculated RDM Clutch Temperature	Powertrain	52	26	N/A	Required with VersaTrak applications
Tires - Spare Status	Platform	E4	18	N/A	Optional for Non-truck All Wheel Drive
Displays - Driver Notification - Four Wheel Drive	Powertrain	EA	20	E4	Required for Truck Four Wheel Drive with manual transfer case
Displays – Driver Notification – All Wheel Drive Disabled	Powertrain	EA	20	FE	Optional for Non-Truck All Wheel Drive
(1) Serial data messages marked "Required" indicate the serial data message is required for both Truck All-Wheel-Drive and Active-Push-Button (Two Speed ATC) applications					

2.2.3.1.2 GMLAN Serial Data Link

Signal Name	Transmitter	Notes
Accelerator Actual Position	Powertrain	Required(1)
Accelerator Actual Position Validity	Powertrain	Required(1)
All Wheel Drive Clutch Completely Open	Powertrain	Required(2)
All Wheel Drive Clutch Temperature	Powertrain	Required(2), (3)
All Wheel Drive Clutch Temperature Validity	Powertrain	Required(2), (3)
All Wheel Drive Mode Active	Powertrain	Required for Truck Four Wheel Drive with manual transfer case
All Wheel Drive Oil Temperature	Powertrain	Required(2)
All Wheel Drive Oil Temperature Validity	Powertrain	Required(2)
All Wheel Drive Overheated Indication On	Powertrain	Required(2)
All Wheel Drive System Failure Status	Powertrain	Required(2)
All Wheel Drive Torque Request Achievable	Powertrain	Required(2)
All Wheel Drive Transferred Torque	Powertrain	Required(2)
All Wheel Drive Transferred Torque Status	Powertrain	Required(2)
All Wheel Drive Transferred Torque Validity	Powertrain	Required(2)
Antilock Brake System Active	Platform	Required(2)
Body Virtual Device Availability	Platform	Required(2)
Brake Pedal Driver Applied Pressure	Platform	Required(2)
Brake Pedal Driver Applied Pressure Validity	Platform	Required(2)
Clutch Start Switch Active	Powertrain	Required(1)
Clutch Start Switch Active Validity	Powertrain	Required(1)
Engine Intake Air Temperature	Powertrain	Required for active push button control
Engine Intake Air Temperature Validity	Powertrain	Required for active push button control
Engine Off Time	Platform	Required(2)
Engine Off Time Validity	Platform	Required(2)
Engine Running Status	Powertrain	Required(1)
Engine Torque Actual	Powertrain	Required(1)
Engine Torque Actual Validity	Powertrain	Required(1)
Park Brake Switch Active	Platform	Required(2)
Spare Tire Status	Platform	Optional for Non-Truck All Wheel Drive
Steering Wheel Angle	Platform	Required(2)
Steering Wheel Angle Validity	Platform	Required(2)
Traction Control System Active	Platform	Required(2)
Transfer Case Non Emissions Related Malfunction Active	Powertrain	Required(2)
Transmission Actual Gear	Powertrain	Required(1)
Transmission Actual Gear Validity	Powertrain	Required(1)
Vehicle Dynamics Alive Rolling Count	Platform	Required(2)
Vehicle Dynamics Control Active	Platform	Required(2)
Vehicle Dynamics Control Enabled	Platform	Required(2)
Vehicle Dynamics Control Failed	Platform	Required(2)
Vehicle Dynamics Declutch Request	Platform	Required(2)
Vehicle Dynamics Declutch Request Validity	Platform	Required(2)
Vehicle Dynamics Over Under Steer	Platform	Required(2)
Vehicle Dynamics Over Under Steer Validity	Platform	Required(2)
Vehicle Dynamics Torque Transfer Request	Platform	Required(2)
Vehicle Dynamics Torque Transfer Request Protection	Platform	Required(2)
Vehicle Dynamics Torque Transfer Request Validity	Platform	Required(2)
Vehicle Dynamics Yaw Rate	Platform	Required(2)
Vehicle Dynamics Yaw Rate Validity	Platform	Required(2)
Vehicle Speed	Powertrain	Required(1)
Vehicle Speed Validity	Powertrain	Required(1)
Wheel Angular Velocity High Resolution Front Left	Platform	Required(2)

Wheel Angular Velocity High Resolution Front Left Validity	Platform	Required(2)
Wheel Angular Velocity High Resolution Front Right	Platform	Required(2)
Wheel Angular Velocity High Resolution Front Right Validity	Platform	Required(2)
Wheel Angular Velocity High Resolution Rear Left	Platform	Required(2)
Wheel Angular Velocity High Resolution Rear Left Validity	Platform	Required(2)
Wheel Angular Velocity High Resolution Rear Right	Platform	Required(2)
Wheel Angular Velocity High Resolution Rear Right Validity	Platform	Required(2)
(1) Serial data messages marked "Required" indicate the serial data message is required for both All-Wheel-Drive and Active-Push-Button (Two Speed ATC) applications (2) Required with electronically controlled active transfer case (3) Required with VersaTrak applications.		

2.2.3.2 4WD MODE

For manual transfer case systems, this active high discrete signal informs Powertrain that the transfer case has been engaged and the front axle is locked.

2.2.3.3 4WD LOW

This is an active low discrete signal which notifies powertrain that the transfer case is in low range.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.2.3.4 ATCCM MIL REQUEST

This is a low frequency modulated signal which notifies powertrain whether the transfer case control system is requesting MIL illumination or not. Note that this signal is not required for a manual transfer case system. Each time the run/crank signal becomes active, the ATCM is expected to create the signal as shown below and the powertrain controller will be expected to monitor the signal after the engine is running.

A. The ATCCM creates a 5 Hz periodic square wave (100 ms ON, 100 ms OFF) if and only if the MIL is required to be illuminated due to OBD regulations for emissions related transfer case control system malfunctions. When a 5 Hz signal is detected by the powertrain controller, it shall command the MIL ON immediately and store a DTC indicating an ATCM fault has occurred. The powertrain controller will be expected to monitor this signal at a frequency no less than 25 ms so that signal aliasing can be avoided. A 5 Hz signal will be detected by counting signal transitions during a calibrateable time interval (~ 1 second).

B. The ATCCM creates a 0.5 (1/2) Hz periodic square wave (1 sec ON, 1 sec OFF) if and only if the MIL is NOT required to be illuminated due to OBD regulations for emissions related transfer case control system malfunctions. When a 0.5 Hz signal is detected by the powertrain controller, it shall NOT command the MIL ON (it will go OFF immediately if no other diagnostics are requesting it to be ON).

C. Zero Frequency High and Low Signals detected by the powertrain controller shall be considered circuit malfunctions. In this case a DTC will be stored and the MIL will be illuminated if this condition is detected on two consecutive driving cycles.

This interface is emissions-related. Refer to Section 1.7 for platform design guidelines.

2.2.3.5 Transfer Case Speed Signal (TCSS)

This is a variable frequency signal from the transfer case speed sensor, which provides powertrain with final drivetrain speed information.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.2.3.6 Clutch Start

For manual transmission equipped vehicles, the Active Transfer Case uses this signal to determine when to allow a shift from high-to-low or low-to-high ranges to occur.

2.2.3.7 Brake Lamp Switch (BLS)

The electronically controlled active transfer case control module uses this signal as one of several indications of a brake apply. If the vehicle is braking the system changes its control strategy to not interfere with brake stability.

2.2.4 Failure Modes and Diagnostics

Reference Section 2.10.4 for serial data failure modes and diagnostic information. Platform and Powertrain, through coordination with STG, shall provide appropriate diagnostics and failsoft action for each of their inputs and outputs.

2.2.5 Electrical Characteristics

2.2.5.1 4WD Mode

This input to the Powertrain Electronics is determined by the front axle switch/actuator and the 4WD switch. It shall have the characteristics of the switched-high discrete input described in Section 3.3.1.

2.2.5.2 4WD Low

This input to the Powertrain Electronics is determined by the Transfer Case Hi/Low Switch for the manual transfer case or by the transfer case output for the active push button control system. It shall have the characteristics of the switched-low discrete input described in Section 3.4.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.2.5.3 ATCCM MIL Request

This input to the Powertrain Electronics is determined by the transfer case output for the active push button control system. It shall have the characteristics of the switched-low discrete input described in Section 3.4.

This interface is emissions-related. Refer to Section 1.7 for platform design guidelines.

2.2.5.4 Transfer Case Speed Signal (TCSS)

The Transfer Case Speed input to the PCM shall be design to interface with a variable reluctance sensor with the following characteristics:

TCSS Electrical Characteristics					
	Limits				
Parameter	Min.	Typ.	Max.	Units	Conditions
Resistance	1		10	KΩ	

Inductance	0.3		1.5	H	
Output Voltage			600	Vpp	Sensor Unloaded
Output Frequency	10		6000	Hz	
Output Waveform					Approximate Sinewave

The TCSS input to the Powertrain electronics shall be capable of interface to both a high-amplitude and low-amplitude sensors. The type of sensor interface shall be selectable via software in the Powertrain electronics.

TCSS Input Impedance Characteristics					
	Limits				
Parameter	Min*	Typ	Max**	Units	Conditions
C_{RFI}	650	820	1000	pF	
R_{IN}	46	51	56	KΩ	

The TCSS input interface for the high-amplitude sensor shall comply with the following characteristics:

High-Amplitude TCSS Input Voltage Characteristics					
	Limits				
Parameter	Min*	Typ	Max**	Units	Conditions
V_{SIGNAL} @ 10Hz	0.250		0.416	Vpp	
@ 50 Hz	0.256		0.447	Vpp	
@ 100 Hz	0.273		0.528	Vpp	
@ 150 Hz	0.298		0.634	Vpp	
@ 200 Hz	0.329		0.747	Vpp	
@ 250 Hz	0.364		0.858	Vpp	
@ 500 Hz	0.546		1.28	Vpp	
@ 750 Hz	0.696		1.51	Vpp	
@ 1000 Hz	0.804		1.62	Vpp	
@ 2000 Hz	0.993		1.77	Vpp	
@ 3000 Hz	1.03		1.79	Vpp	
@ 4000 Hz	1.07		1.81	Vpp	
@ 6000 Hz	1.09		1.82	Vpp	
*V_{SIGNAL} less than the Min. value shall be guaranteed not to trigger the input to the Powertrain electronics.					
**V_{SIGNAL} greater than the Max. value shall be guaranteed not to trigger the input to the Powertrain electronics					

The TCSS input interface for the low-amplitude sensor shall comply with the following characteristics:

Low-Amplitude TCSS Input Voltage Characteristics					
	Limits				
Parameter	Min*	Typ	Max**	Units	Conditions
V_{SIGNAL} @ 10Hz	0.250		0.416	Vpp	
@ 50 Hz	0.409		1.00	Vpp	
@ 100 Hz	0.641		1.52	Vpp	
@ 150 Hz	0.824		1.81	Vpp	
@ 200 Hz	0.956		2.00	Vpp	
@ 250 Hz	1.05		2.15	Vpp	
@ 500 Hz	1.33		2.62	Vpp	
@ 750 Hz	1.49		2.87	Vpp	
@ 1000 Hz	1.61		3.00	Vpp	
@ 2000 Hz	1.83		3.17	Vpp	
@ 3000 Hz	1.87		3.20	Vpp	
@ 4000 Hz	1.91		3.22	Vpp	
@ 6000 Hz	1.93		3.23	Vpp	
*V_{SIGNAL} less than the Min. value shall be guaranteed not to trigger the input to the Powertrain electronics					
**V_{SIGNAL} greater than the Max. value shall be guaranteed not to trigger the input to the Powertrain electronics					

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.2.5.5 Clutch Start

Refer to Section 2.5.5.1 for requirements.

2.2.5.6 Brake Lamp Switch

Refer to Section 2.7.5.2 for requirements.

2.2.6 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION

2.2.3.1.1 2.2.3.1.2	Added Class 2 message "Engine System Other – Calculated RDM Clutch Temperature" $52/26 to the Class 2 Serial Data Link Table. Added "Note (3)" which indicates that All Wheel Drive Clutch Temperature and Validity are required with VersaTrak applications.	ICR 2058

2.3 Displays and Gauges

2.3.1 Functional Overview

The data supplied and the display or gauge functions performed are vehicle application dependent and the responsibility of Platform. With the exception of the hard-wired signals noted in the Hardware Overview section below, all required data from Powertrain shall be transmitted to Platform via the serial data link. All Powertrain applications in a given Platform shall be capable of providing the same level of display or gauge data unless a change is mutually accepted by both Platform and Powertrain for that application.

The Service Engine Soon Display or Malfunction Indicator Lamp (MIL) is a telltale illuminated for critical, emissions-related faults and driven by the Powertrain electronics. The Service Engine Soon telltale shall be illuminated for a bulb check in accordance with legislated requirements.

Powertrain shall determine filtered fuel level information for display purposes. Refer to Section 4.6 for the algorithm description. Platform may do additional filtering of fuel level data received from Powertrain when used for display purposes.

When an oil pressure display is required, Powertrain and Platform shall mutually agree on whether oil pressure data will be provided from an oil pressure sensor or an algorithm in the Powertrain electronics. When an algorithm is used, an oil pressure switch is required.

2.3.2 Hardware Overview

The hardware for the display or gauge functions will vary with application as one of the means to provide a specific vehicle character. Not all vehicles will use the same display or gauge information.

Powertrain shall provide Platform the following hard-wired signals:

1. Engine Speed
2. Service Engine Soon (MIL)

The first signal is required by Platform for display; the last signal is mandated by legislated warranty requirements.

Powertrain may require an additional hard-wired signal to Platform for a glow plug telltale on some diesel powertrain applications.

Powertrain shall always provide input signal processing for the following components:

1. Crank position sensor (for determining engine speed)
2. Coolant temperature sensor
3. Engine oil pressure sensor/switch
4. Fuel level sensor

A single coolant temperature sensor shall be used for both displays and Powertrain controls.

Powertrain shall always provide vehicle speed information via the serial data link. Refer to Section 2.19 for details.

When required by Platform for electronic PRNDL display, Powertrain shall provide PRNDL information via the serial data link. Powertrain shall determine this information based on a PRNDL mode indication switch or the internal mode switches.

When required by Platform for display or gauge functions, Powertrain shall provide input signal processing for the Engine oil level sensor/switch.

All Platforms shall provide the following standard telltales or messages:

1. Service Engine Soon (MIL)
2. Low Engine Oil Pressure
3. Engine Coolant Hot
4. Generator Fault
5. Glow Plug (Diesel Powertrains Only)

Platform shall perform all required bulb checks for these standard indicators (except "Service Engine Soon" and "Glow Plug"). It is recommended that the MIL indicator be implemented in a way that minimizes or isolates the Platform electronics required for its operation.

On GMNA applications, Powertrains with Electronic Throttle Control (ETC) require an audible warning and driver notification using a telltale or DIC message due to the reduced engine power failure mode. The reduced engine power driver notification may also be required for other Powertrain system failures.

Some Powertrains require Platform to provide a "Stop Engine" indication when the engine temperature reaches a critical value.

Powertrain considers the "Low Oil Pressure" and "Stop Engine" indications to be high priority due to potential engine damage.

The "Service Vehicle Soon" indicator is required by some Powertrains for display of non-emissions-related faults. It also may be used for display of Platform faults.

Some Platforms may implement application-specific features that require additional information from Powertrain for display purpose via the serial data link. Some examples are:

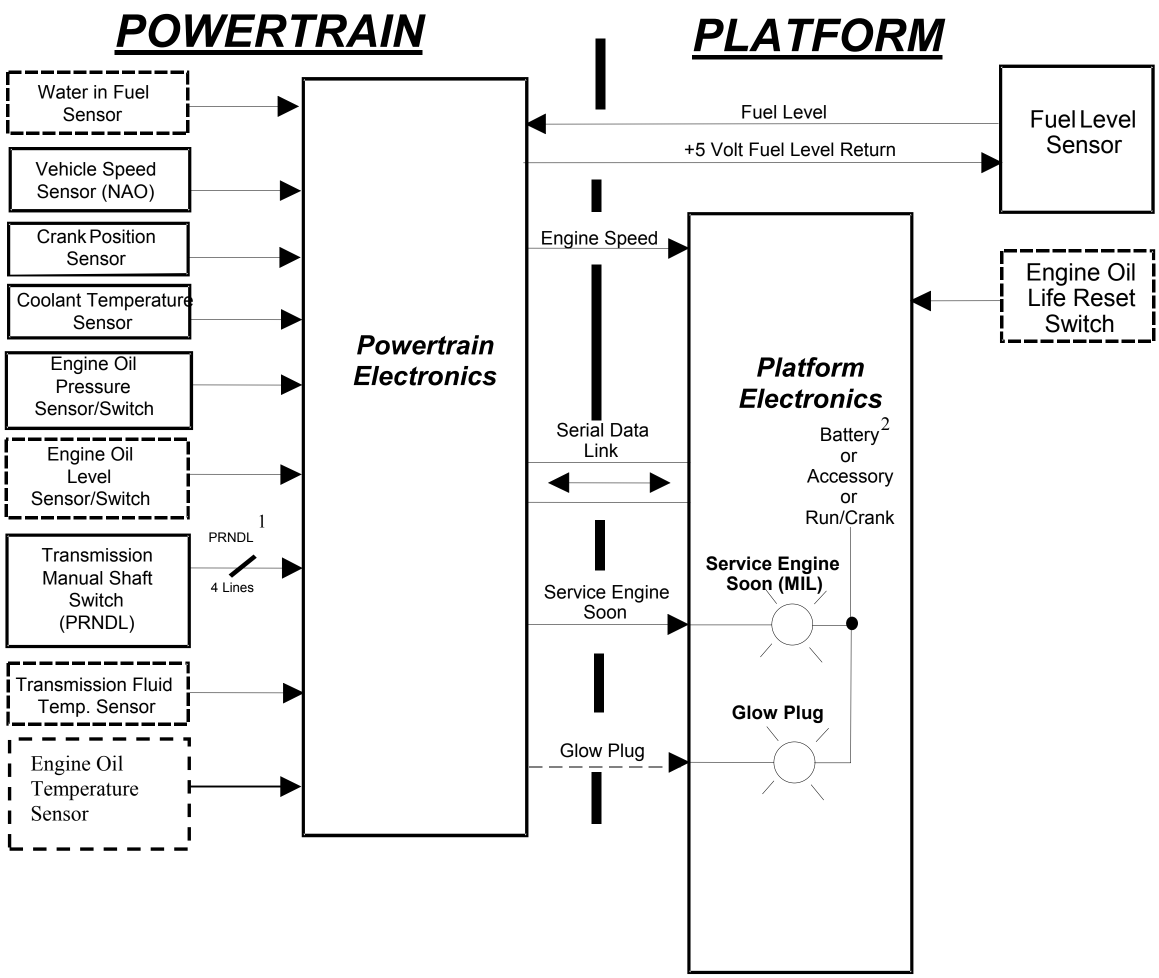
- Low Engine Oil Level
- Engine Oil Remaining Life
- Engine Oil Change
- A/C Disabled
- Transmission Skip Shift
- Cruise Set Speed
- Transmission Upshift
- Transmission Fluid Temperature
- Cruise Engaged
- PRNDL Range Selected
- Water in Fuel
- Turbo Boost Pressure

Other information is also provided as shown in the serial data message section.

All Powertrains shall feature an engine oil life monitor. The reset method shall be based on a throttle pedal stomp maneuver detected by the powertrain controller. Some Platforms also may utilize an engine oil life reset switch. Platform shall provide input signal processing for this switch and transmit the reset command to Powertrain via the serial data link. The standard engine oil life monitor algorithm shall accommodate both reset methods.

2.3.2.1 Block Diagram

The following block diagram depicts a typical mechanization for Platform display and gauge functions. The electrical interface between Powertrain and Platform is the only standard defined.



NOTES: 1. A P/N or PRNDL switch is not required on transmissions with internal mode switches.
2. Platform shall source additional 20 uA parasitic current to Powertrain Electronics for each output (i.e., MIL or Glow Plug) with pull-up to battery.

2.3.2.2 Power and Ground Requirements

Power and ground requirements for each vehicle display will be specified by the Platform in each application.

2.3.3 Interface Description

2.3.3.1 Serial Data Links

Reference Section 5.0 for definitions of messages and signals.

2.3.3.1.1 Class 2 Serial Data Link

Note: It is not intended that every message is used in every application.

Serial Data Content	*Transmitter*	*Primary ID*	*Secondary ID*	*Extended ID*	*Notes*
Engine Air Intake - Intake Boost Pressure - Gage	Powertrain	0A	10	N/A	Optional for super charger
Engine RPM - High Resolution	Powertrain	1A	10	N/A	Required
Vehicle Speed - High Resolution - Metric	Powertrain	28	02	N/A	Required
Transmission/Transaxle/PRNDL- Transmission Shift Solenoids State	Powertrain	3A	0E	N/A	Optional
Transmission/Transaxle/PRNDL- Tap Up/Tap Down Target Gear	Powertrain	3A	0F	N/A	Optional
Transmission/ Transaxle/ PRNDL - Fluid Temperature	Powertrain	3A	10	N/A	Optional
Transmission/Transaxle/PRNDL - Fluid Remaining Life	Powertrain	3A	14	N/A	Optional
Transmission/Transaxle/PRNDL - Performance Shift Mode	Powertrain	3A	31	N/A	Optional
Engine Coolant - Fluid Temperature	Powertrain	48	10	N/A	Required
Engine Oil-Fluid Temperature	Powertrain	4A	10	N/A	Optional
Engine Oil - Fluid Pressure	Powertrain	4A	11	N/A	Optional
Engine Oil - Fluid Remaining Life	Powertrain	4A	14	N/A	Optional
Engine System Other - Engine Run Flag	Powertrain	52	04	N/A	Required
Engine System Other - Engine Type	Powertrain	52	22	N/A	Optional
Vehicle Speed Control - Speed Limit Value	Powertrain	62	10	N/A	Optional with suspension control
Odometer - Vehicle Metric	Platform	7A	01	N/A	Powertrain Optional
Odometer - Rolling Count	Powertrain	7A	06	N/A	Required
Fuel System - Cumulative Fuel	Powertrain	82	0A	N/A	Optional
Fuel System - Fuel Level - Percent (Filtered)	Powertrain	82	12	N/A	Required
Fuel System - Fuel Capacity Metric	Powertrain	82	16	N/A	Required
Displays - PRNDL	Powertrain	EA	0A	N/A	Required with electronic PRNDL
Displays – Driver Notification – Transmission Shifts Delayed	Powertrain	EA	20	76	Platform-Optional
Displays – Driver Notification – Engine Overspeed Warning	Powertrain	EA	20	77	Platform-Optional
Displays - Driver Notification	Powertrain	EA	20	81	Optional

Serial Data Content	*Transmitter*	*Primary ID*	*Secondary ID*	*Extended ID*	*Notes*
- Engine Oil Change Soon					
Displays - Driver Notification - Engine Oil Change Now	Powertrain	EA	20	82	Optional
Displays - Driver Notification - Engine Oil Low Pressure	Powertrain	EA	20	83	Required
Displays - Driver Notification - Engine Oil Low Level	Powertrain	EA	20	84	Optional
Displays - Driver Notification - Engine Hot / Stop Engine	Powertrain	EA	20	85	Powertrain Optional
Displays - Driver Notification - Transmission Skip Shift	Powertrain	EA	20	88	Optional
Displays - Driver Notification - Transmission Upshift	Powertrain	EA	20	89	Optional
Displays - Driver Notification - Vehicle Speed Control Active	Powertrain	EA	20	8C	Optional with cruise control
Displays - Driver Notification - Charging System/Generator Fault	Powertrain	EA	20	8E	Required if EA 20 E2 not used
Displays - Driver Notification - Service Vehicle Soon	Powertrain	EA	20	8F	Optional
Displays - Driver Notification - Engine Coolant Hot	Powertrain	EA	20	9D	Required
Displays - Driver Notification - Change Transmission Oil Now	Powertrain	EA	20	AA	Optional
Displays - Driver Notification - A/C Off for Engine Protection	Powertrain	EA	20	B4	Optional
Displays - Driver Notification - Reduced Engine Power	Powertrain	EA	20	B7	Required with ETC
Displays - Driver Notification - Top Speed Fuel Cut Off	Powertrain	EA	20	C3	Optional
Displays - Driver Notification - Transmission Hot	Powertrain	EA	20	CB	Optional
Displays - Driver Notification - Check Gas Cap	Powertrain	EA	20	CC	Optional
Displays - Driver Notification - Reduce Top Speed	Powertrain	EA	20	D5	Optional
Displays - Driver Notification - Service Transmission	Powertrain	EA	20	D6	Optional
Displays - Driver Notification - Water-in Fuel	Powertrain	EA	20	D9	Optional with Diesel
Displays - Driver Notification - Generator Indicator	Powertrain	EA	20	E2	Required if EA 20 8E not used
Displays - Driver Notification - Four Wheel Drive	Powertrain	EA	20	E4	Required for Truck four wheel drive with manual xfer case
Displays - Driver Notification - Starting Disabled ETC	Powertrain	EA	20	E7	Platform Optional
Displays - Driver Notification - Tap Up/Tap Down Mode	Powertrain	EA	20	F7	Required with Tap Up/Tap Down
Displays – Driver Notification – All Wheel Drive Disabled	Powertrain	EA	20	FE	Opt. for Non-Truck All Wheel Drive
Displays-Driver Notification-Tap Up/ Tap Down Request Denied	Powertrain	EA	22	A4	Optional with Tap Up/Tap Down
Engine System Other	Powertrain	52	30	XX	Required with

Serial Data Content	*Transmitter*	*Primary ID*	*Secondary ID*	*Extended ID*	*Notes*
- Displacement on Demand Status					Displacement on Demand (DoD)

2.3.3.1.2 GMLAN Serial Data Link

Note: It is not intended that every signal is used in every application.

Signal Name	*Transmitter*	*Notes*
Air Conditioning Off Indication On	Powertrain	Platform Optional
All Wheel Drive Mode Active	Powertrain	Required with Truck four wheel drive with manual transfer case
All Wheel Drive Overheated Indication On	Powertrain	Required with Electronically Controlled Active Transfer Case
Apply Brake Pedal Indication On	Powertrain	Platform-Optional with Cruise Control
Check Fuel Filler Cap Indication On	Powertrain	Optional
Continuous Variable Transmission Present	Powertrain	GME use only - Required for CVT
Cruise Control Active	Powertrain	Required with cruise control
Cruise Control Driver Selected Speed	Powertrain	Required with cruise control
Cruise Control Driver Selected Speed Active	Powertrain	Required with cruise control
Cruise Control Enabled	Powertrain	Required with cruise control
Diesel Glow Plug Indication On	Powertrain	Optional
Distance Rolling Count Driven Wheel	Powertrain	Required - See Note
Distance Rolling Count Driven Wheel Reset Occurred	Powertrain	Required - See Note
Distance Rolling Count Driven Wheel Validity	Powertrain	Required - See Note
Distance Rolling Count Left Non Driven Wheel	Powertrain	Required - See Note
Distance Rolling Count Left Non Driven Wheel Reset Occurred	Powertrain	Required - See Note
Distance Rolling Count Left Non Driven Wheel Validity	Powertrain	Required - See Note
Distance Rolling Count Non Driven Wheel	Powertrain	Required - See Note
Distance Rolling Count Non Driven Wheel Reset Occurred	Powertrain	Required - See Note
Distance Rolling Count Non Driven Wheel Validity	Powertrain	Required - See Note
Distance Rolling Count Right Non Driven Wheel	Powertrain	Required - See Note
Distance Rolling Count Right Non Driven Wheel Reset Occurred	Powertrain	Required - See Note
Distance Rolling Count Right Non Driven Wheel Validity	Powertrain	Required - See Note
Driver Shift Control Request Denied Indication On	Powertrain	Optional for Tap Up/Tap Down
Engine Boost Pressure Indication	Powertrain	Optional on Turbo vehicles
Engine Boost Pressure Indication Validity	Powertrain	Optional on Turbo vehicles
Engine Coast Fuel Cutoff Active	Powertrain	Optional
Engine Coolant Hot Indication On	Powertrain	Required
Engine Coolant Temperature	Powertrain	Required
Engine Coolant Temperature Validity	Powertrain	Required
Engine Cylinder Deactivation Mode	Powertrain	Required with Displacement on Demand (DoD)
Engine Emissions Related Malfunction Indication Request	Powertrain	Required
Engine Hot / Stop Engine Indication On	Powertrain	Powertrain Optional
Engine Limp Home Mode Active	Powertrain	Required with ETC
Engine Oil Change Now Indication On	Powertrain	Optional
Engine Oil Change Soon Indication On	Powertrain	Optional
Engine Oil Level Low Indication On	Powertrain	Optional
Engine Oil Life Reset Performed	Powertrain	Optional
Engine Oil Life Reset Request	Platform	Optional
Engine Oil Pressure	Powertrain	Optional
Engine Oil Pressure Low Indication On	Powertrain	Required
Engine Oil Pressure Validity	Powertrain	Optional
Engine Oil Remaining Life	Powertrain	Optional

Signal Name	*Transmitter*	*Notes*
Engine Oil Remaining Mileage	Powertrain	GME use only
Engine Oil Starvation Indication On	Powertrain	Optional
Engine Oil Temperature	Powertrain	Optional
Engine Oil Temperature Validity	Powertrain	Optional
Engine Recommended Shift Indication	Powertrain	Optional
Engine Running Status	Powertrain	Required
Engine Speed	Powertrain	Required
Engine Speed Validity	Powertrain	Required
Engine Water In Fuel Indication On	Powertrain	Optional with diesel
Four Wheel Drive Mode Active	Powertrain	Required for Truck four wheel drive with manual transfer case
Fuel Capacity	Powertrain	Required
Fuel Injected Rolling Count	Powertrain	Optional
Fuel Injected Rolling Count Reset Occurred	Powertrain	Optional
Fuel Level Percent	Powertrain	Required
Fuel Level Percent Validity	Powertrain	Required
Generator Failed	Powertrain	Required
Instantaneous Fuel Consumption Rate	Powertrain	Required
Powertrain Exhaust Particle Filter Warning Indication On	Powertrain	Optional with Diesel
Powertrain High Electrical Load Requested	Powertrain	Optional with Diesel
Service Engine System Non Emission Related Indication Request	Powertrain	Platform-Optional
Service Transmission System Indication On	Powertrain	Optional
Starting Disabled Indication On	Powertrain	Platform Optional
Throttle Progression Request	Platform	Platform Optional
Throttle Progression Status	Powertrain	Required
Transmission Change Oil Now Indication On	Powertrain	Optional
Transmission Gear Indication	Powertrain	Optional
Transmission Gear Indication Validity	Powertrain	Optional
Transmission Gear Selector Position	Powertrain	Required
Transmission Gear Selector Position Validity	Powertrain	Required
Transmission Hot Indication On	Powertrain	Optional
Transmission Limp Home Mode Active	Powertrain	Optional
Transmission Load Management Shift Pattern Status	Powertrain	Optional
Transmission Oil Life Reset Request	Platform	Optional
Transmission Oil Remaining Life	Powertrain	Optional
Transmission Oil Temperature	Powertrain	Optional
Transmission Oil Temperature Validity	Powertrain	Optional
Transmission Performance Algorithm Shift Mode Active	Powertrain	Optional
Transmission Skip Shift Indication On	Powertrain	Optional
Transmission Sport Shift Pattern Status	Powertrain	Optional
Transmission Tap Up/Tap Down Mode Indication On	Powertrain	Optional
Transmission Trailering Shift Pattern Status	Powertrain	Optional
Transmission Winter Mode Status	Powertrain	Optional
Vehicle Odometer	Platform	Powertrain Optional
Vehicle Odometer Validity	Platform	Powertrain Optional
Vehicle Speed	Powertrain	Required
Vehicle Speed Validity	Powertrain	Required
Vehicle Top Speed Limit Value	Powertrain	Optional with suspension control
Vehicle Top Speed Limitation Indication On	Powertrain	Required with suspension control

Note: At most, two of the three Distance Rolling Count signals (Distance Rolling Count Driven Wheel, Distance Rolling Count Left Non Driven Wheel, and Distance Rolling Count Right Non

Driven Wheel) and their associated Reset Occurred and Validity signals are required for a given application.

2.3.3.2 Engine Speed

Engine Speed shall be provided by Powertrain for Platform use for the tachometer display. This signal shall have a frequency of two pulses per engine revolution for all Powertrains.

2.3.3.3 Service Engine Soon (MIL)

This output from the Powertrain electronics is a discrete low side driver. The output shall be pulled low when the bulb check mode is enabled and when a fault is detected. Powertrain shall perform the bulb check at power-up.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.3.3.4 Glow Plug

This output from the Powertrain electronics is a discrete low side driver used for glow plug telltale on diesel Powertrains.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.3.3.5 Fuel Level

Reference Section 2.12.3.5.

2.3.3.6 +5 Volt Fuel Level Return

Reference Section 2.12.3.9.

2.3.4 Failure Modes and Diagnostics

Reference Section 2.10.4 for serial data failure modes and diagnostic information.

Platform and Powertrain through coordination with STG shall provide appropriate diagnostics and failsoft action for each of their inputs and outputs.

For all display and gauge data, the interface shall be designed to avoid providing false warnings or gauge indications. A failed sensor shall result in a failsoft message. A loss of the engine speed sensor input to the PCM shall result in a 0% duty cycle Engine Speed (RPM) Signal output.

The “Service Engine Soon” faults can be broken down into shorts in wiring/circuits and controller failures. A short circuit to ground of the interconnecting wire causes the lamp to be continuously illuminated. A short circuit to battery is limited to 1.5 amps typical by the solid state driver. An open circuit results in no bulb check operation. A failure in the Powertrain electronics, through self-diagnosis, shall energize the output.

2.3.5 Electrical Characteristics

2.3.5.1 Engine Speed

The Engine Speed signal shall be an active low, open collector output of the Powertrain electronics, with a Platform-provided pull-up resistor to switched battery voltage. The signal shall have the following characteristics:

Parameter	Limits	Comments
V_{OL}: @ I_{load} = 1 mA @ I_{load} = 30 mA	0.45 V Maximum 1.00 V Maximum	
Load - Current	30 mA Maximum	Allows for one 10mA load with a pull-up resistor and additional loads of up to 20mA total.
Load - Capacitive	0.10 µF Maximum	Allows for 7 loads at 0.01µF each with a 50% tolerance on capacitors (0.03 µF).
Leakage Current @ 16 V	100 µA Maximum	
Output Frequency	2 Pulses/Rev	
Duty Cycle	25% to 75% Nominal	Over full operating speed range of engine (0 - 12,000 RPM). 25% duty cycle results from 6X or 7X sensor inputs. 75% duty cycle results from medium or high resolution sensor inputs.
Output Period Jitter	1% Maximum	Powertrain system.

2.3.5.2 Service Engine Soon (MIL)

The output of the Powertrain electronics shall be a low side driver, with at minimum the capability of an LSD4 driver, as described in Section 3.1.

For LED applications, a shunt resistor shall be used across the LED in the display to prevent LED turn-on in the “high” or “off” state due to PCM driver leakage.

Per OBD Regulations, Platform shall provide a MIL capable of sufficient illumination and location to be readily visible under all lighting conditions.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.3.5.3 Glow Plug

The output of the Powertrain electronics shall be a low side driver, with at minimum the capability of an LSD4 driver , as described in Section 3.1.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.3.5.4 Fuel Level

Reference Section 2.12.5.4.

2.3.5.5 +5 Volt Fuel Level Return

Reference Section 2.1.5.10.

2.3.6 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
2.7.3.1.2	Added GMLAN Signals: Cruise Control Driver Selected Speed and Cruise Control Driver Selected Speed Active	ICR 320
2.7.3.1.2	Comments on the following messages changed from Optional to Required with Cruise Control: 1. Cruise Control Active and 2. Cruise Control Enabled.	N/A – Comment revised to reflect PPEI rules for messaging and make consistent with Check Sheet and provide continuity with Mechanization.
2.3.3.1.2	Added GMLAN Signals: 1. Powertrain Exhaust Particle Filter Warning Indication On and 2. Powertrain High Electrical Load Requested	ICR 2023
2.3.3.1.2	Added GMLAN Signal Driver Shift Control Request Denied Indication On.	ICR 2040
2.3.3.1.1	Added Class-2 Message 'Displays-Driver Notification-Tap Up/ Tap Down Request Denied'	ICR 2052
2.3.3.1.2 2.3.1	Add to GMLAN Serial Data Link: Engine Oil Temperature and Engine Oil Temperature Validity. Revise block diagram by adding Engine Oil Temp. Sensor as optional input to the ECM.	ICR 2069
2.3.3.1.2	Revised the "Notes" column for GMLAN Signals "Powertrain Exhaust Particle Filter Warning Indication On" and "Powertrain High Electrical Load Requested" to read "Optional with Diesel."	ICR 2096
2.3.3.1.1,	Add new Class II message "Engine System Other - Displacement on Demand Status	ICR 2106

2.3.3.1.2	Add new GMLAN signal "Engine Cylinder Deactivation Mode"	
2.3.1 2.3.3.1.1	Revise block diagram by adding Engine Oil Temp. Sensor as optional input to the ECM. Add Class 2 message to class 2 serial data: Engine Oil-Fluid Temperature ($4A/$10).	ICR 2110
2.3.3.1.2	Corrected Notes for 'Air Conditioning Compressor Off Indication On' from Optional to 'Platform Optional'	ICR 2119

2.4 Engine Power Management

2.4.1 Functional Overview

This section defines the interface for various engine power management features. These features include the following.

1. Brake Torque Management (Platform optional)
2. Platform-Requested Idle Boost (Platform optional for meeting power steering functional requirements, electrical energy management, etc.)

The interface for Traction Control is not addressed here, but is included in Section 2.11.

2.4.2 Hardware Overview

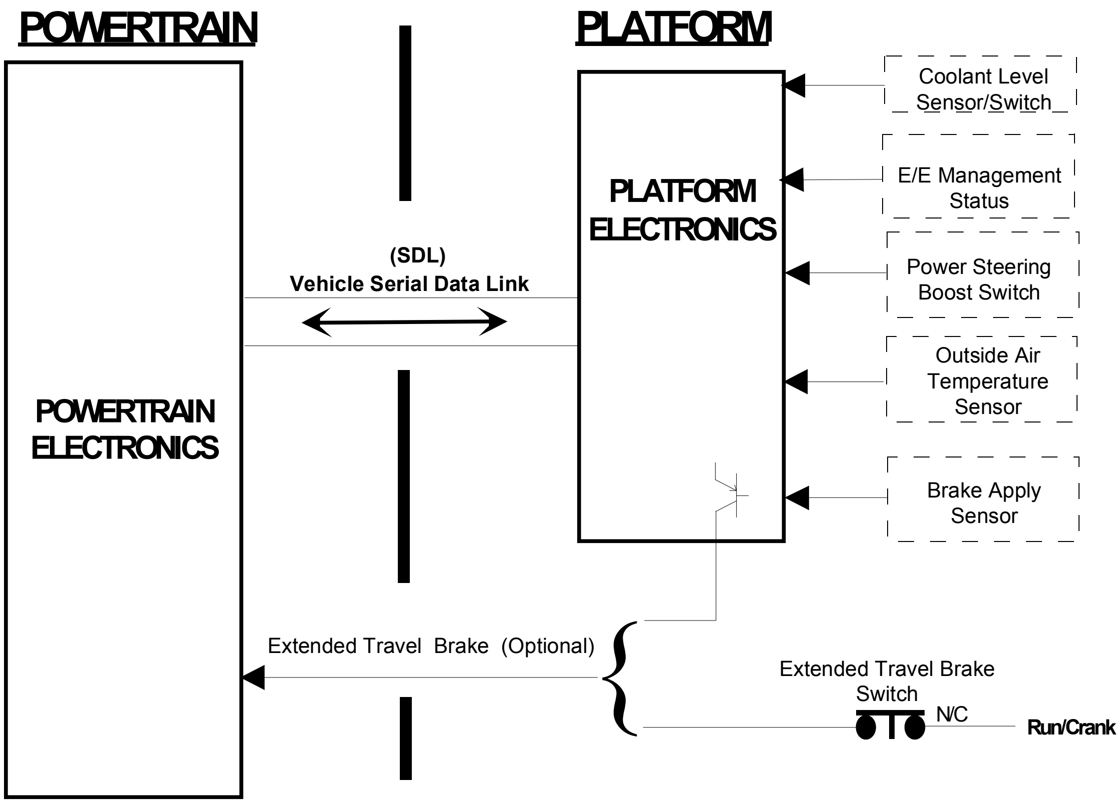
For Class 2 based vehicles requiring Brake Torque Management, with a Brake Apply Sensor, Platform shall provide a hard-wired Extended Travel Brake input to the Powertrain Electronics and shall transmit Extended Travel Brake information via the serial data link for redundancy. For vehicles with an Extended Travel Brake Switch, platform shall hardwire the switch directly to the Powertrain Electronics.

For GMLAN vehicles requiring Brake Torque Management with a Brake Apply Sensor, Platform shall transmit Extended Travel Brake information via the serial data link. For vehicles with a Extended Travel Brake Switch, Platform shall hardwire the switch directly to the Powertrain Electronics.

For Platform-Requested Idle Boost or for Brake Torque Management on vehicles with a BAS, Platform shall provide the appropriate information to Powertrain via the serial data link.

2.4.2.1 Block Diagram

The following block diagram depicts a typical mechanization for the various Engine Power Management features described in this section. The electrical interface between Platform and Powertrain is the only standard defined.



2.4.3 Interface Description

2.4.3.1 Serial Data Links

Reference Section 5.0 for definitions of messages and signals.

2.4.3.1.1 Class 2 Serial Data Link

Serial Data Content	Transmitter	Primary ID	Secondary ID	Extended ID	Notes
Brakes – Brake Pedal Status	Platform	32	2A	N/A	Required with Brake Torque Management with BASS
Engine Coolant - Coolant Level	Platform	48	32	N/A	Powertrain Optional
Electrical Energy Management - Requested Minimum Idle Boost Level	Platform	74	26	N/A	Optional
Displays - Traction Control System Off	Platform	EA	20	9B	Optional
Exterior Environment - Outside Air Temperature	Platform	F2	10	N/A	Optional

2.4.3.1.2 GMLAN Serial Data Link

Signal Name	Transmitter	Notes
Anticipated Electrical Load Estimation	Platform	Optional
Brake Pedal Moderate Travel Achieved	Platform	Required with Brake Torque Management
Brake Pedal Position Failure	Platform	Required with Brake Torque Management
Energy Management Minimum Idle Boost Level Request	Platform	Optional
Powertrain Exhaust Particle Filter Warning Indication On	Powertrain	Optional with Diesel
Powertrain High Electrical Load Requested	Powertrain	Optional with Diesel
Outside Air Temperature Corrected Value	Platform	Optional
Outside Air Temperature Corrected Value Validity	Platform	Optional
Traction Control System Enabled	Platform	Optional

2.4.3.2 Extended Travel Brake

This input to the Powertrain electronics is determined by the optional Extended Travel Brake Switch or BASS Module.

The Extended Travel Brake Switch is a momentary contact switch, normally closed to Run/Crank voltage. The switch opens when the operator depresses the brake pedal. The Extended Travel Brake Switch is the last brake switch in order of brake pedal travel.

On vehicles with a BAS, the Extended Travel Brake hardwire signal is generated by a high-side driver in the Platform BASS module. The output driver is active (high) when the brake pedal is not depressed. When the brake pedal is depressed past the Extended Travel Brake position, the output driver is deactivated.

2.4.4 Failure Modes and Diagnostics

N/A

2.4.5 Electrical Characteristics

2.4.5.1 Extended Travel Brake

Reference Section 3.3.1.

2.4.6 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
2.4.3.1.2	Added GMLAN Signals: Powertrain Exhaust Particle Filter Warning Indication On and Powertrain High Electrical Load Requested	ICR 2023
2.4.3.1.2	Revised “Notes” to read “Optional with Diesel” for the following GMLAN Signals: 1. Powertrain Exhaust Particle Filter Warning Indication On and 2. Powertrain High Electrical Load Requested	ICR 2096

2.5 Starter System

2.5.1 Functional Overview

The ECM/PCM Controlled Start mechanization defined in this section shall be applicable to vehicles equipped with an ignition key switch or push button start (Easy Key). The mechanization supports the Remote Vehicle Start (RVS) feature on automatic transmission vehicles only.

Starter Control requirements are captured in the Starter Control algorithm description in Section 4. For information about Easy Key, refer to the Easy Key Subsystem Technical Specification. For information about RVS, refer to the RVS Subsystem Technical Specification.

The ECM/PCM Controlled Start mechanization utilizes a serial data based power mode signal for a driver-initiated crank request. The ECM/PCM shall only initiate engine cranking when the value of this signal is CRANK after previously receiving an indication that the vehicle is in Park/Neutral or that the clutch is determined to be depressed. Clutch status is only used in vehicles with a calibration requiring clutch depression for crank initiation.

Upon loss of serial data from the Power Mode Master and the Backup Power Mode Master, the ECM/PCM shall use its discrete Run/Crank Relay Output (an input to the ECM/PCM) and Accessory Input signals for power moding. In this case, the ECM/PCM is unable to receive the CRANK power mode signal and shall not use its discrete inputs to initiate engine cranking.

The only exception to this criterion is as follows:

> **EXCEPTION:** The ECM/PCM can initiate engine cranking based on its discrete input signals **ONLY** when the ECM/PCM is in “Post Release Stall” mode operation. The “Post Release Stall” mode operation requires the following: the ECM/PCM has passed Vehicle Theft during the current ignition cycle, the engine has stopped rotating and there is a loss of System Power Mode signal over serial data.

The ECM/PCM shall disable engine cranking based on its discrete Run/Crank Relay Output and Accessory input signals, or when the value of the power mode signal is not equal to CRANK. The Power Mode Master will never issue the CRANK power mode signal when in the Off, Accessory, or Run ignition switch positions during any single point failure of the ignition key switch or Easy Key wires.

2.5.2 Hardware Overview

The Accessory and Run/Crank signals are required for starter control and shall be used for detecting wake-up. Clutch Start or Neutral Start information is communicated to the Powertrain electronics from the Platform with a discrete switch.

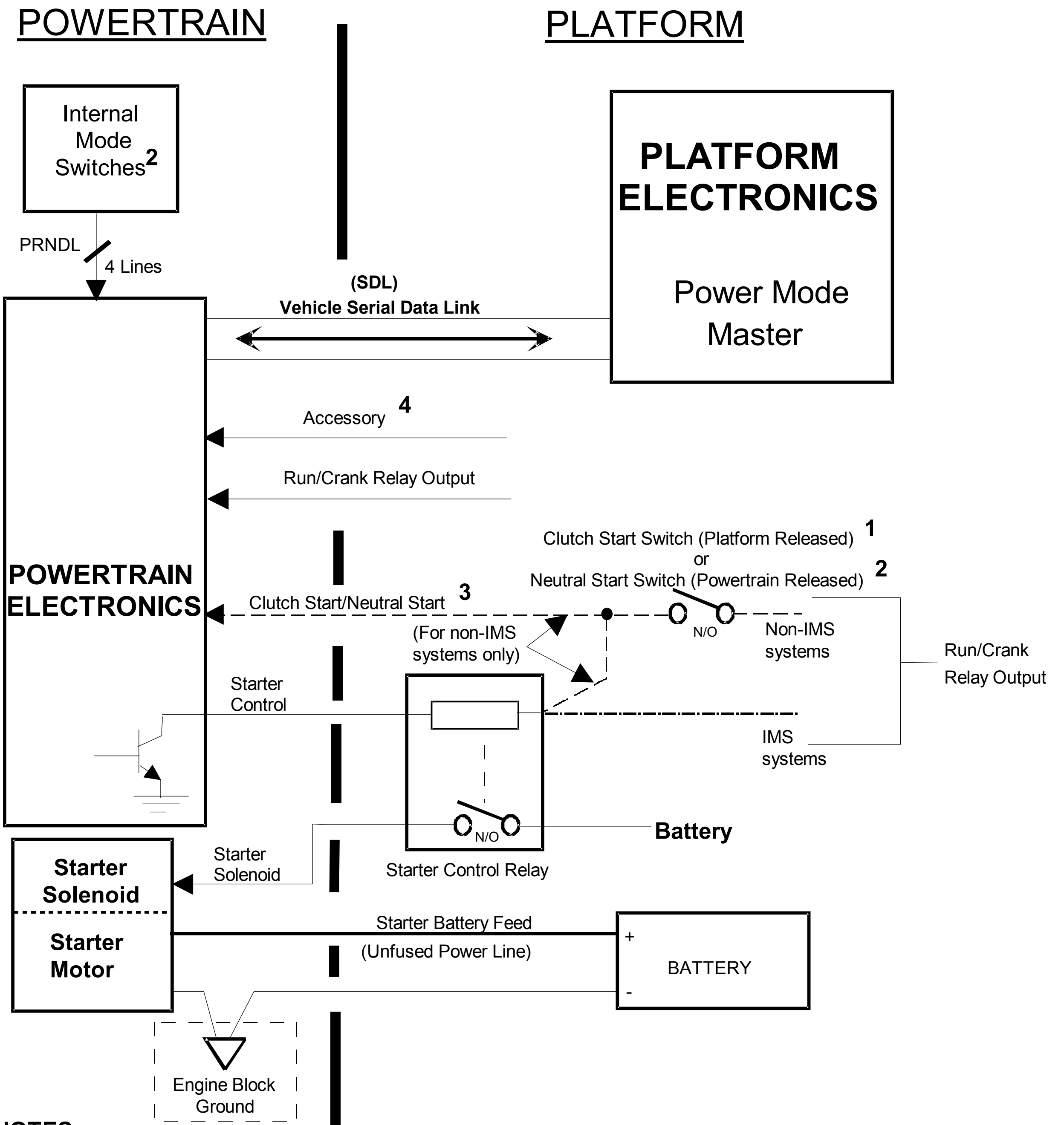
When internal mode switches are available, Powertrain shall determine park or neutral gear selection based on these switches. Otherwise, an external Neutral Start switch is required.

Vehicle theft password and status, and system power mode are communicated using the serial data link.

The starter solenoid is energized from the battery via the starter control relay. The starter control relay is controlled by the Starter Control output of the powertrain electronics.

Starter System Block Diagram

The following block diagram depicts the standard mechanization for ECM/PCM Controlled Start.



NOTES

1. Clutch Start Switch is required for NAO and optional for GMIO manual transmissions
2. Neutral Start Switch is only used with automatic transmissions that DO NOT have Internal Mode Switches (IMS).
3. This input is not utilized on Opel Powertrains
4. This input is from an Ignition Switch or Easy Key module, refer to paragraph 2.1.3.2.

2.5.2.1 Power and Ground Requirements

For GMNA applications, refer to the "Cranking Subsystem Technical Specification". The cranking circuit power and ground requirements shall be mutually resolved between Platform and Powertrain for each application.

2.5.3 Interface Description

2.5.3.1 Serial Data Links

Reference Section 5.0 for definitions of messages and signals.

2.5.3.1.1 Class 2 Serial Data Link

Serial Data Content	Transmitter	Primary ID	Secondary ID	Extended ID	Notes
Engine System Other-Remote Start Engine Run Flag	Powertrain	52	14	N/A	Required with RVS
Ignition Switch/Starter - Crank Aborted	Powertrain	86	15	N/A	Required with Easy Key and RVS
Ignition Switch/Starter-Remote Start Crank	Platform	86	16	N/A	Required with RVS
Ignition Switch/Starter-Remote Start Aborted	Powertrain	86	18	N/A	Required with RVS
Vehicle Security - Password	Platform	92	01	N/A	Required with GMNA VTD
Vehicle Security - Powertrain Status	Powertrain	92	02	N/A	Required with GMNA VTD
Displays - Driver Notification - Starting Disabled ETC	Powertrain	EA	20	E7	Optional
Network Control - System Power Modes	Platform	FE	06	N/A	Required

2.5.3.1.2 GMLAN Serial Data Link

Signal Name	Transmitter	Notes
Backup Power Mode Master Virtual Device Availability	Platform	Required
Powertrain Crank Aborted	Powertrain	Required with Easy Key and RVS
Powertrain Run Aborted	Powertrain	Required with RVS
Remote Vehicle Start Engine Running	Powertrain	Required with RVS
Remote Vehicle Start Request	Platform	Required with RVS
Starting Disabled Indication On	Powertrain	Platform optional
System Backup Power Mode	Platform	Required
System Backup Power Mode Enabled	Platform	Required
System Power Mode	Platform	Required
Vehicle Security Non Immobiliser Password	Platform	Required with Non-Immobiliser VTD
Vehicle Security Non Immobiliser Powertrain Status	Powertrain	Required with Non-Immobiliser VTD
Vehicle Security Non Immobilizer Password Status	Platform	Required with Non-Immobiliser VTD

2.5.3.2 Clutch Start/ Neutral Start

For automatic transmissions without internal mode switches, a normally open external Neutral Start switch is required. This input to the powertrain electronics is connected to Run/Crank voltage when the Neutral Start switch is closed.

For manual transmission equipped vehicles, the Clutch Start input to the Powertrain electronics is determined by a normally open clutch start switch. This input is connected to Run/Crank voltage when the clutch start switch is closed. The clutch start switch closes when the driver depresses the clutch pedal. The clutch start switch must not close until the clutch pedal is deep in the pedal travel to ensure disengagement of the clutch. The clutch start switch is not a required interface for European applications.

2.5.3.3 Starter Control

This signal is a discrete low-side driver output of the Powertrain electronics intended to drive a starter control relay. For IMS applications, the starter relay coil shall be powered from the Run/Crank relay. For non-IMS applications, the starter relay coil shall be powered from the Run/Crank relay in series with the Clutch Start or Neutral Start Switch. The Powertrain electronics shall pull the output low for engagement of the starter relay.

2.5.3.4 Starter Solenoid

This input to the starter motor is a power feed from the starter control relay that energizes the starter solenoid. The starter control relay is sourced by battery voltage and is driven by the starter control output of the Powertrain electronics.

2.5.3.5 Starter Battery Feed

The Platform shall provide an unfused Battery cable directly to the starter motor.

2.5.3.6 Engine Block Ground

Reference Section 2.1.3.7.

2.5.3.7 Accessory

Reference Section 2.1.3.2.

2.5.3.8 Run/Crank Relay Output

Reference Section 2.1.3.3.

2.5.4 Failure Modes and Diagnostics

Reference PPEI Section 2.10.4 for serial data failure modes and diagnostic information.

On vehicles equipped with Internal Mode Switches, the ECM/PCM shall perform a short to ground detection test on the starter control signal to not allow an engine start with the vehicle in gear. Fuel shall be disabled if all of the following conditions are true:

- A short to ground is detected.
- The transmission is in gear.

- The engine is not running or less than one second has elapsed since engine start.

2.5.5 Electrical Characteristics

2.5.5.1 Clutch Start/ Neutral Start

Reference Section 3.3.2 for the ECM/PCM input requirements. Transient protection for inductive loads is required for this input.

The clutch start and neutral start switches must be capable of sourcing up to 0.5A of current for the starter control relay.

2.5.5.2 Starter Control

The output of the Powertrain electronics shall have the characteristics of a low-side driver, LSD3, as described in Section 3.1.

2.5.5.3 Starter Solenoid

Voltage: Battery Voltage

Solenoid Current: Specific solenoid current is to be supplied by powertrain for each application.

Typical values of solenoid current are:
57 A (sum of pull-in and hold-in coils) for less than 32 msec
12 A hold-in coil

Series Resistance for the relay and wiring from battery to starter solenoid at 27 °C over the life of the vehicle shall be between 0.03 Ω and 0.06 Ω.

2.5.5.4 Starter Battery Feed

Reference Section 2.5.2.2.

2.5.5.5 Engine Block Ground

Reference Section 2.1.5.11 and 2.5.2.2.

2.5.5.6 Accessory

Reference Section 2.1.5.5.

2.5.5.7 Run/Crank Relay Output

Reference Section 2.1.5.6.

2.5.6 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE
2.5.1	Clarified Post Release Stall condition. Added conditions for Post Release Stall.	ICR 2178

2.6 Vehicle Theft Deterrent

2.6.1 Functional Overview

Vehicle Theft Deterrent (VTD) is a Platform owned system that interfaces with Powertrain. For GME vehicles this system is known as a Vehicle Immobilizer system due to European Legal and Insurance requirements.

2.6.1.1 GMNA VTD System

For GMNA vehicles the interface requirements are detailed in the Vehicle Theft Deterrent Subsystem Requirements for Powertrain (EIS 70.4:10.1;2.03) that is maintained by the Electrical Center.

2.6.1.2 GME Immobilizer System

For GME vehicles the interface requirements are detailed in the Powertrain Immobilizer Requirements Specification that is maintained by Opel at ITDC in Rüsselsheim.

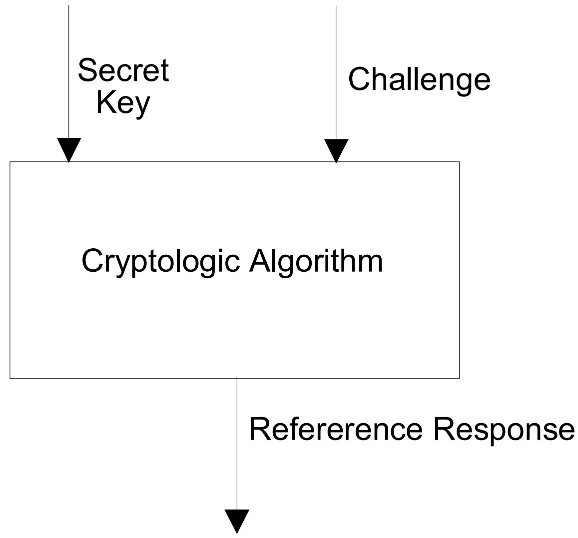
<u>Challenge/Response Algorithm</u>

The Powertrain Controller shall limit the engine running time after receiving the ignition on and start request signal. This time is called Pre-release timer. The complete user identification and therefore the engine enabling/disabling decision has to be made within that time. The engine will only be enabled if the user is identified as valid within that time. In all other cases the engine will be disabled when the timer expires at the latest.

In order to make the engine enable/disable decision the Powertrain Controller has to perform the following steps:

1. Calculate a randomly generated Challenge
2. Start calculation of the Reference Response
3. Send Challenge to Immobilizer device
4. Send Powertrain_Identifier to Immobilizer device
5. Receive Response from Immobilizer device
6. Compare Response with the Reference Response
7. If result is invalid and pre-release time is valid
   → - Return to step 3
8. If result is invalid and pre-release time is invalid
   → - DISABLE ENGINE,
   - Trigger optical indication
   - END
9. If result is valid
   → - ENABLE ENGINE
   - Store ENABLE ENGINE BIT in RAM memory
   - END

The Reference Response is calculated as follows:



The Immobilizer device shall be able to identify the Powertrain Controller. Therefore the Powertrain Controller shall send a Powertrain_Identifier to the Immobilizer device during identification process.

The ENGINE ENABLE BIT shall be used in order to avoid that after a valid authorization a running reset in the Powertrain Controller will disable the engine. Nevertheless it is important for security that this information is a stored in RAM memory. Therefore it shall not be able to manipulate this information in the Powertrain Controller.

In order to keep the system status transparent the Powertrain Controller and the Immobilizer device shall exchange controller status information. An optical indication shall be given to the customer in case the engine controller decides to disable the engine due to unauthorized use. Further definitions shall be given in the Immobilizer system specification.

2.6.2 Hardware Overview

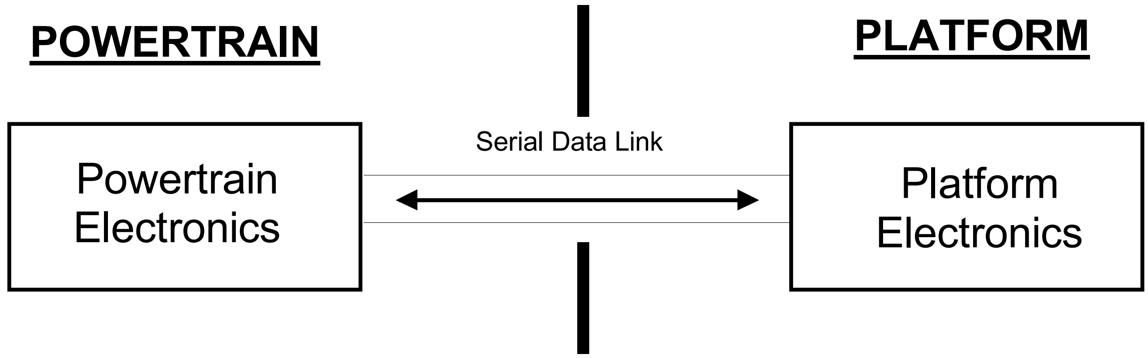
The Vehicle Theft Deterrent Interface consists of the serial data link only.

The Immobilizer system requires Platform and Powertrain Electronics to communicate during a crank condition.

It shall be ensured that the Immobilizer function in the Powertrain Controller cannot be either deactivated or manipulated (e.g., toggling the ignition and battery inputs, diagnostic services). It shall be ensured that a pin-compatible Powertrain Controller shall have at least the security level of the GMNA VTD system.

2.6.2.1 Block Diagram

The following block diagram depicts the typical mechanization for a Vehicle Theft Deterrent or Immobilizer system. The electrical interface between Powertrain and Platform is the only standard defined.



2.6.2.2 Power and Ground Requirements

Power and ground requirements for Theft Deterrent will be specified by Platform for each application.

2.6.3 Interface Description

2.6.3.1 Serial Data Links

Reference Section 5.0 for definitions of messages and signals.

2.6.3.1.1 Class 2 Serial Data Link

Serial Data Content	*Transmitter*	*Primary ID*	*Secondary ID*	*Extended ID*	*Notes*
Vehicle Security - Password	Platform	92	01	N/A	Required for GMNA VTD
Vehicle Security - Powertrain Status	Powertrain	92	02	N/A	Required for GMNA VTD

2.6.3.1.2 GMLAN Serial Data Link

Reference the Immobilizer specification for GMLAN Immobilizer signal and frame definitions.

Signal Name	*Transmitter*	*Notes*
Immobilizer Information (see specification)	Platform/Powertrain	Required for Immobilizer
Remote Vehicle Start Engine Running	Powertrain	Required with RVS
Vehicle Security Non Immobilizer Password	Platform	Required for Non-Immobilizer VTD
Vehicle Security Non Immobilizer Password Status	Platform	Required for Non-Immobilizer VTD
Vehicle Security Non Immobilizer Powertrain Status	Powertrain	Required for Non-Immobilizer VTD

2.6.4 Failure Modes and Diagnostics

Reference Section 2.10.4 for serial data failure modes and diagnostic information.

2.6.4.1 GMNA VTD Systems

Platform and Powertrain shall periodically transmit a state of health message for detection of serial data link failures during the appropriate power modes (i.e., as specified by the vehicle electrical technical specification). If a serial communication failure occurs between the Vehicle

Theft Deterrent module and the ECM/PCM after theft password authentication, the Powertrain VTD algorithm shall allow future engine starts using serial data requests, without requiring passing re-authentication of the theft password. This fail-enable mode will stay active until the serial communication failure between the VTD module and the ECM/PCM has been corrected.

Post release stall mode operation will allow the Starter Control algorithm to initiate starting with the ignition hardwires if serial data power mode is not available. The post release stall mode is active for a short duration after the engine stops rotating, when the theft algorithm has authenticated. Once the post release stall mode duration expires, the Starter Control algorithm is only allowed to initiate starting with serial data power mode information. Powertrain shall provide the following diagnostic trouble codes:

P1626 - Theft Deterrent System - Fuel Enable Circuit

P1630 - Theft Deterrent System - PCM in Learn Mode

P1631 - Theft Deterrent System - Password Incorrect

Reference the Vehicle Theft Deterrent Electrical Interface Standard Document for complete diagnostic and failure mode details.

2.6.4.2 GME Immobilizer Systems

In order to keep the system status transparent snapshot and trouble code information shall be stored in both the Immobilizer device and the Powertrain Controller.

System relevant data (e.g., Secret Key) has to be transferred within the system in order to allow initialization and serviceability. On the other side this data shall not be easily accessible. In order to be able to control the access to the system relevant data a password authorization of the external device (e.g., Service Tester) shall be used. The password is further referenced as the SECURITY CODE. Therefore the system relevant data will only be send from either the Immobilizer or the Powertrain Controller via the serial data link if the valid security code has been correctly entered.

Depending on the diagnostic strategy these programming functions will be performed through the same or a dedicated serial data link.

Reference the Immobilizer System Component Technical Specification for further details.

2.6.5 Electrical Characteristics

Reference the Vehicle Theft Deterrent Electrical Interface Standard and the Immobilizer System Component Technical Specification for further details.

2.6.6 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
2.6.3.1.2	Added Remote Vehicle Start Engine Running serial data signal.	ICR 2113
2.6.4.1	Added “stall” to post release mode references.	ICR 2178

2.7 Throttle Control

2.7.1 Functional Overview

The interface defined in this section shall be applicable to all vehicles equipped with Electronic Throttle Control (ETC) or Mechanical Throttle Control with Cruise Control.

Platform shall use one of the following two cruise switch interfaces to Powertrain:

- For all GMLAN based vehicles, High-Speed CAN interface is required.
- For all Class 2 based vehicles, the +12V Multiplexed Cruise Switch interface is required.

The cruise control mechanizations shall address the “brake before cruise” diagnostic requirements specified in the Algorithm Description for Cruise Control. For applications without a Brake Apply Sensor (BAS), both the Brake Lamp Switch (BLS) and the Cruise/ETC/TCC brake switches shall be seen as "depressed" on each ignition cycle before allowing cruise control to be engaged. For applications with a BAS both the BLS signal and a serial data signal shall be received and each shall indicate that the brakes are applied. This is to verify proper operation of the brake switches/sensor before cruise is allowed to be fully enabled.

Powertrain shall maintain an operator-desired vehicle speed by means of the ETC system or separate cruise actuator. The enabling of the system and engagement of the control is initiated through operator actuation of the cruise mode switches. The disabling of the system and disengagement of the control is effected via operator application of the brake and other defined operating conditions.

Platform may choose to communicate cruise cancel via the serial data link. Cruise cancel may be based on various reasons as defined in Section 5.

For vehicles equipped with ETC, only the ETC system controls the throttle actuator.

2.7.2 Hardware Overview

Platform shall provide required switch state information to Powertrain via hard-wired signals and serial data messages.

A hard-wired BLS signal is required on all vehicles.

A clutch switch is required on some manual transmission vehicles.

The Cruise/ETC/TCC brake signal is required on vehicles with an external cruise actuator, or on vehicles without BAS and with cruise control.

On Class 2 based vehicles the hard-wired switch state information also includes cruise on/off, set/coast, and resume/accel via the +12V cruise mode interface.

On GMLAN based vehicles, serial data is used to communicate cruise on, off, set, coast, resume, accel and optional cancel. The maximum latency to recognize a change of state for an input shall be 60 msec. The latency time is defined as the time from when the switch is initially activated by the driver until the information transmittal on the data link has been completed.

Platform shall provide appropriate debounce logic for cruise switch inputs. The software interfacing to the input switches shall allow for a minimum debounce time of 20 msec as measured from the initial contact opening or closing. Any change of state lasting less than this duration is to be ignored. The software shall require at least two successive reads of the input reflecting the new state before recognizing the change of state as valid. Depending on the sample time, more than two successive reads can be applied.

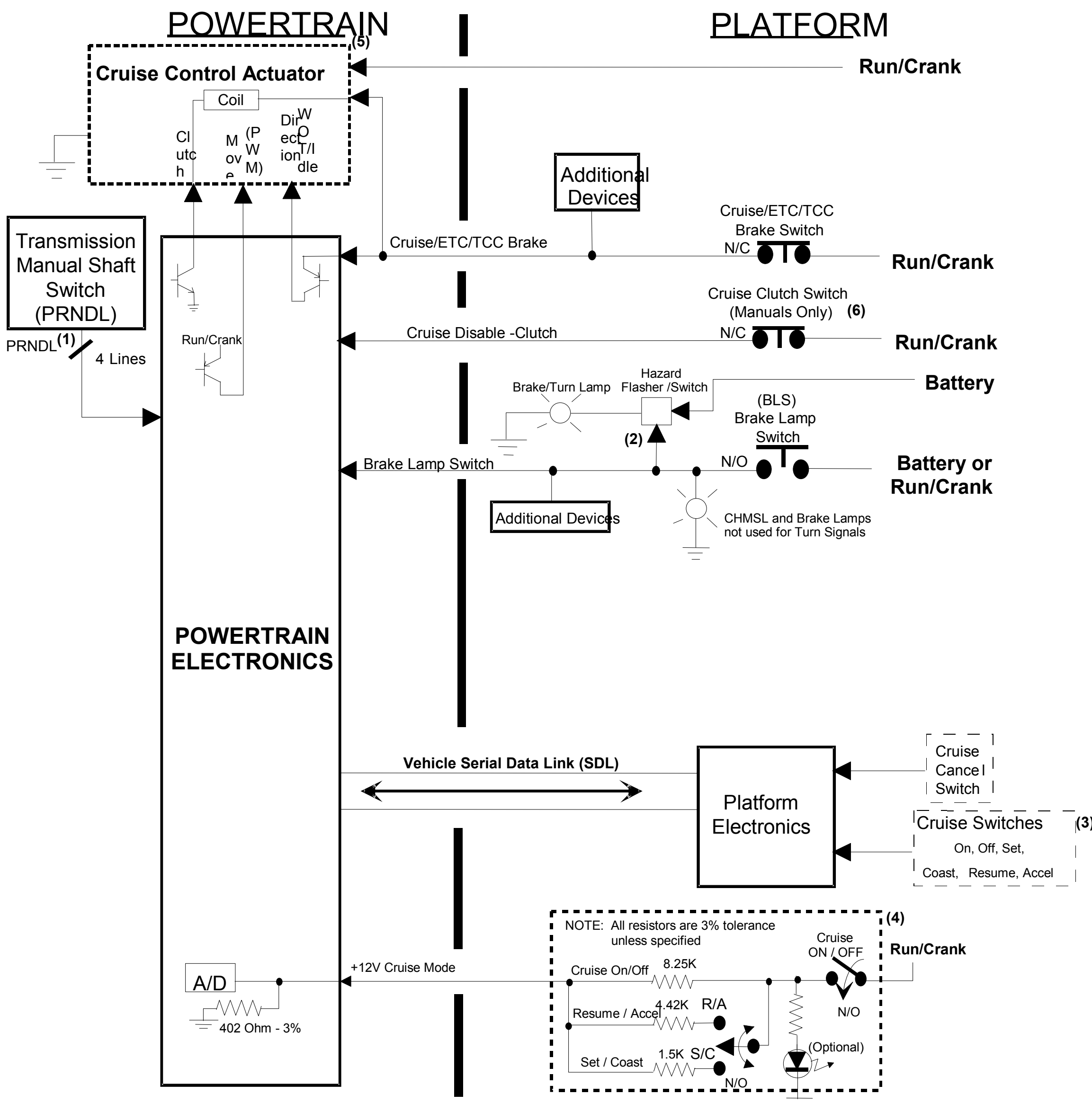
Additionally, each switch shall be debounced independently. I.e., an intermittent bounce on one signal should not preclude recognition of a valid change of state on another switch.

Powertrain shall determine park or neutral gear selection based on the PRNDL mode indication switch or internal mode switches.

2.7.2.1 Block Diagrams

The following block diagrams depict the typical mechanizations for ETC and Mechanical Throttle Control with Cruise Control. The ETC mechanization is not intended to specify the entire ETC system mechanization (i.e. Throttle Position Sensors, Throttle Actuator and Accelerator Pedal Position Sensor). The electrical interface between Powertrain and Platform is the only standard defined.

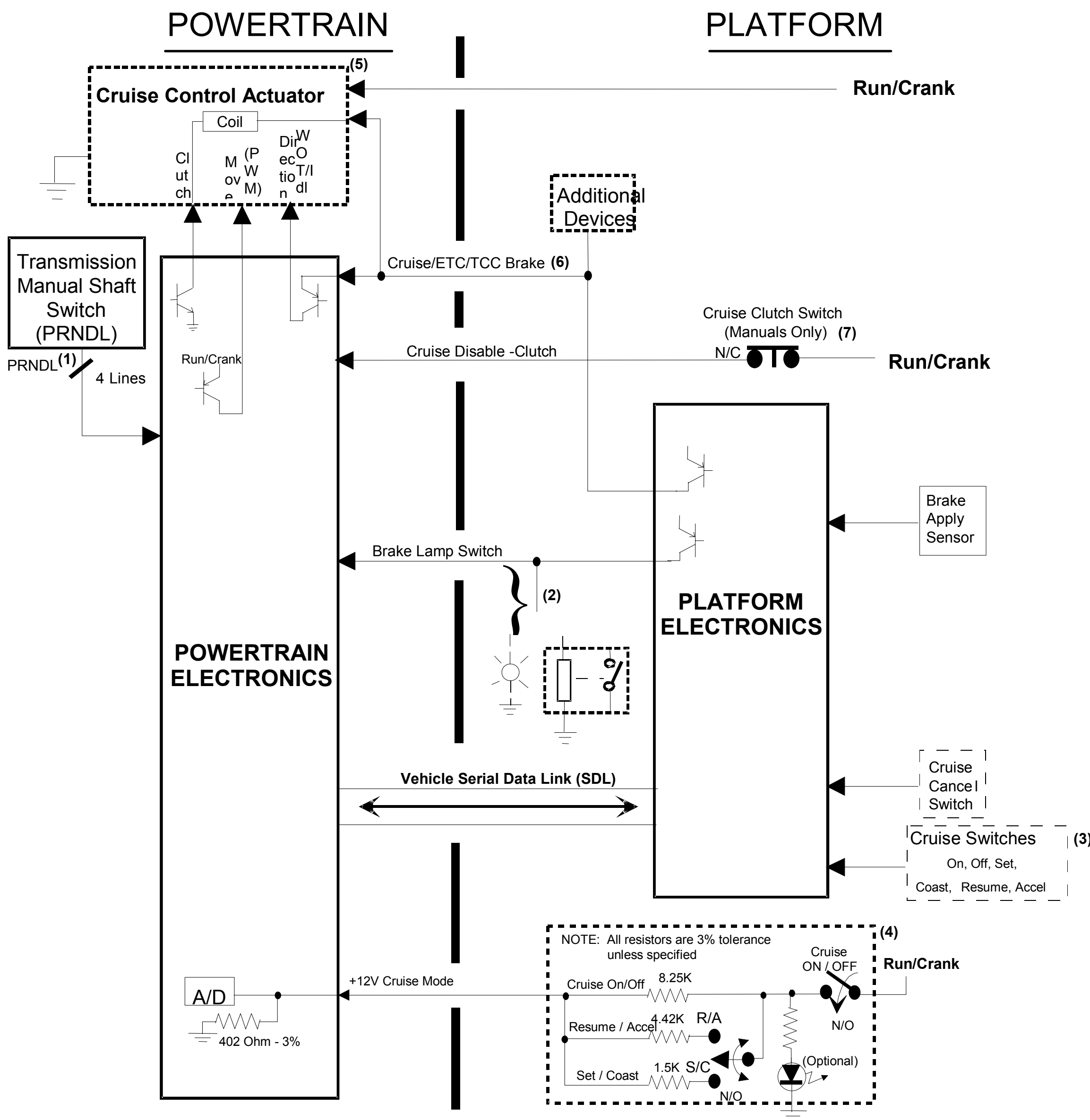
2.7.2.1.1 Vehicles Without a BAS



Note:

1. A P/N or PRNDL switch is not required on transmissions with internal mode switches.
2. Hazard Flasher/Switch Module must be mechanized as shown, if the same bulbs are used for both brake lamp and hazard flasher.
3. These switches are only used when Vehicle Serial Data Link is GMLAN.
4. These switches are only used when Vehicle Serial Data Link is Class 2.
5. The cruise control actuator is only used on vehicles with cruise control but without ETC.
6. The Cruise Clutch Switch is required for North American applications even if these applications are released in the non North American markets. However, this switch is optional for manual transmission systems that are released in Non North American markets that are not North American applications.

2.7.2.1.2 *Vehicles With a BAS*



Note:

1. A P/N or PRNDL switch is not required on transmissions with internal mode switches.
2. The BLS signal is used by Platform to control a Brake Lamp relay or the CHMSL/Stop Lamps.
3. These switches are only used when Vehicle Serial Data Link is GMLAN.
4. These switches are only used when Vehicle Serial Data Link is Class 2.
5. The cruise control actuator is only used on vehicles with cruise control but without ETC.
6. The Cruise/ETC/TCC Brake signal is not required for ETC GMLAN vehicles.
7. The Cruise Clutch Switch is required for North American applications even if these applications are released in the non North American markets. However, this switch is optional for manual transmission systems that are released in Non North American markets that are not North American applications.

2.7.2.2 Power and Ground Requirements

Power and ground requirements for the Electronic Throttle Control shall be specified by the Powertrain in each application.

For systems implementing the +12V cruise switch interface, the maximum voltage difference between the Run/Crank feed at the switch and the PCM Run/Crank pin shall be 0.7V.

2.7.3 Interface Description

2.7.3.1 Serial Data Links

Reference Section 5.0 for definitions of messages and signals.

2.7.3.1.1 Class 2 Serial Data Link

Serial Data Content	*Transmitter*	*Primary ID*	*Secondary ID*	*Extended ID*	*Notes*
Throttle Position Sensor - Pedal Position	Powertrain	12	11	N/A	Required for SDM & TCS (for TCS see Section 2.11)
Wheels - Wheel Reference Vehicle Speed Metric	Platform	24	03	N/A	Required when ABS and ETC are both present. This message enables additional ETC functionality
Brakes - System Fault	Platform	32	0A	N/A	Required with ABS and Cruise
Brakes – Parking Brake Active	Platform	32	20	N/A	Required with Auto Trailering Mode
Brakes – Brake Pedal Status	Platform	32	2A	N/A	Required with BASS
Vehicle Speed Control - Set Speed, Low Res Metric	Powertrain	62	02	N/A	Optional with Cruise
Vehicle Speed Control - Cruise Cancel	Platform	62	07	N/A	Optional with Cruise
Restraints – Airbags Deployed	Platform	D2	07	N/A	Powertrain-Optional with ETC
Displays - Driver Notification - Vehicle Speed Control Active	Powertrain	EA	20	8C	Optional with Cruise
Displays - Driver Notification - Reduced Engine Power	Powertrain	EA	20	B7	Required with ETC

2.7.3.1.2 GMLAN Serial Data Link

Signal Name	*Transmitter*	*Notes*
Accelerator Actual Position	Powertrain	Required with BASS and SDM
Accelerator Actual Position Validity	Powertrain	Required with BASS and SDM
Accelerator Effective Position	Powertrain	Required for Traction Control Required for ATC with active pushbutton control and Truck AWD
Accelerator Effective Position Validity	Powertrain	Required for Traction Control Required for ATC with active pushbutton control and Truck AWD
Airbag Deployed	Platform	Powertrain-Optional with ETC
Antilock Brake System Failed	Platform	Required with ABS and Cruise
Apply Brake Pedal Indication On	Powertrain	Platform-Optional with Cruise Control
Brake Pedal Initial Travel Achieved	Platform	Required with BASS
Brake Pedal Initial Travel Achieved Protection	Platform	Required with BASS
Brake Pedal Position Failure	Platform	Required with BASS
Brake Pedal Position Rolling Count	Platform	Required with BASS
Cruise Control Active	Powertrain	Required with Cruise
Cruise Control Alive Rolling Count	Platform	Required with Cruise
Cruise Control Cancel Request	Platform	Optional with Cruise
Cruise Control Driver Selected Speed	Powertrain	Required with Cruise
Cruise Control Driver Selected Speed Active	Powertrain	Required with Cruise
Cruise Control Enabled	Powertrain	Required with Cruise
Cruise Control On Switch Active	Platform	Optional with Cruise
Cruise Control Resume Switch Active	Platform	Optional with Cruise
Cruise Control Set Switch Active	Platform	Optional with Cruise
Cruise Control Switch Failed	Platform	Optional with Cruise
Cruise Control Switch Protection Value	Platform	Required with Cruise
Engine Limp Home Mode Active	Powertrain	Required with ETC
Powertrain Brake Pedal Discrete Input Status	Powertrain	Optional (GME Use Only)
Powertrain Brake Pedal Discrete Input Validity	Powertrain	Optional (GME Use Only)
Powertrain Brake Pedal Secondary Discrete Input Status	Powertrain	Optional (GME Use Only)
Powertrain Brake Pedal Secondary Discrete Input Validity	Powertrain	Optional (GME Use Only)
Wheel Angular Velocity Front Left	Platform	All Wheel Angular Velocity signals are required when ABS and ETC are both present. These signals enable additional ETC functionality.
Wheel Angular Velocity Front Left Validity	Platform	
Wheel Angular Velocity Front Right	Platform	
Wheel Angular Velocity Front Right Validity	Platform	
Wheel Angular Velocity Rear Left	Platform	
Wheel Angular Velocity Rear Left Validity	Platform	
Wheel Angular Velocity Rear Right	Platform	
Wheel Angular Velocity Rear Right Validity	Platform	

2.7.3.2 Cruise/ETC/TCC Brake

The Cruise/ETC/TCC brake signal is required on vehicles with an external cruise actuator, or on vehicles without BAS and with cruise control.

On vehicles without a BAS, this input to the Powertrain electronics is determined by the Cruise/ETC/TCC Brake switch. This switch is a momentary contact, normally closed to Run/Crank. This switch opens when the operator depresses the brake pedal. An additional device may be tied to this input. Since this device could be an inductive load, the Powertrain electronics shall provide transient protection.

On vehicles with a BAS and an external cruise actuator, the Cruise/ETC/TCC is generated by a high-side driver in the Platform BASS Module. The output driver is inactive (open) when the BASS Module determines that the brake is applied.

This input to the powertrain electronics is used by cruise control for disengaging cruise.

The purpose of the Cruise/ETC/TCC Brake Switch for ETC is:

1. Limit ETC authority during some failure modes.
2. Used as a redundant brake input for ETC with and without cruise control.

2.7.3.3 Brake Lamp Switch (BLS)

On vehicles without a BAS, the Brake Lamp Switch (BLS) is a momentary contact, normally open switch that closes to battery voltage when the operator depresses the brake pedal. This switch is defined as “open” when the operator’s foot is not applied to the brake pedal. The BLS input to the Powertrain electronics is asserted when the BLS is closed or when the input is open circuited. It is not asserted when grounded through the vehicle brake lamp bulbs.

This switch input shall not be asserted when the hazard flasher is engaged and the brakes are not applied.

On vehicles with a BAS, the BLS is generated by a high-side driver in the Platform BASS Module. The output driver is active (high) when the BASS Module determines that the brake is applied. The BLS input to the Powertrain electronics is asserted when the BASS Module activates the driver, or when the input is open circuited. It is not asserted when grounded through the vehicle brake lamp bulbs (or brake lamp relay coil) with the driver off.

This input to the powertrain electronics is required by cruise control for disengaging cruise.

Cruise is disabled when the BLS input is asserted. Cruise will not operate unless a load is present on this input. This load is usually provided by a brake lamp filament. There is a potential problem when an LED CHMSL (Center High Mounted Stop Lamp) is used without isolated turn/hazard lamps and the hazard switch is asserted. For those architectures, refer to section 2.7.5.2 for the brake lamp load requirement. The purpose of the Brake Lamp Switch for ETC is:

1. Limit ETC authority during some failure modes.
2. Required as a redundant brake input for ETC with and without cruise control.

2.7.3.4 Cruise Disable - Clutch

This discrete input to the Powertrain electronics switch is optional on vehicles with manual transmission applications only. This switch is mandatory for all vehicles equipped with cruise control and also for all North American applications even if these applications are released in the non North American markets. However, this switch is optional for non North American applications not equipped with cruise control. This discrete input to the Powertrain electronics is used for disabling cruise control when the clutch pedal is depressed and may be used for idle speed control, and enhancing the determination of gear information. Reference Section 2.15.3.5.

2.7.3.5 +12V Cruise Mode

This analog input to the Powertrain electronics is determined by the +12V multiplexed cruise switch. This switch produces an analog signal that represents the three cruise modes of operation. These modes include Cruise On/Off, Set/Coast, and Resume/Accel.

This function shall operate ratiometrically with Run/Crank within the normal voltage operating range. Refer to section 2.1.5.1. The +12V Cruise Mode and Run/Crank analog inputs shall be read by the powertrain electronics sufficiently close in time such that the Run/Crank voltage and A/D reference voltage do not change between A/D conversions. The powertrain electronics shall then divide the +12V Cruise Mode voltage reading by the Run/Crank voltage reading and compare the result with the voltages in the table in Section 2.7.5.4 to determine the cruise mode.

2.7.4 Failure Modes and Diagnostics

Reference PPEI Section 2.10.4 for serial data failure modes and diagnostic information.

Powertrain electronics shall reduce engine power or disable engine running due to failures in the ETC system. The reduced engine power failure mode requires an audible warning and driver notification using a telltale or DIC message.

Powertrain electronics shall take appropriate failsoft action if a valid "Brakes – Brake Pedal Status" Class 2 Message, or valid GMLAN frame containing the Brake Pedal signals, is not received within a defined amount of time.

Platform and Powertrain, through coordination with STG, shall provide appropriate diagnostics and failsoft for each of their inputs and outputs. The diagnostics shall comply with the requirements specified in the Cruise Control Subsystem Requirements Specification for each program and the ETC Subsystem Requirements Document.

If "brake before cruise" requirements are not satisfied, a history code shall be set.

2.7.5 Electrical Characteristics

2.7.5.1 Cruise/ETC/TCC Brake

Transient protection for inductive loads is required.

Additional Device (e.g., BTSI <Brake Transmission Shift Interlock> solenoid):

R_{MIN} = 24.5 ohms

L_{MAX} @120Hz = 87.1 mH

Reference Section 3.3.2.

2.7.5.2 Brake Lamp Switch (BLS)

Input Circuit requirements:

Powertrain Electronics:
Provide a 10K +/-3% pullup resistor and a 16.2K +/-3% pulldown resistor. An analog or discrete input may be used. Alternately, a 51K +/-7.5% pullup resistor without a pulldown resistor is allowed.

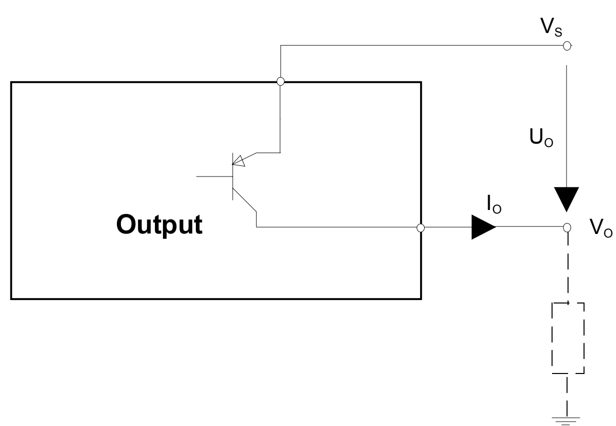
Additional Platform devices:
Implement the diode, pull-up and pull-down resistors as defined in GMI 12554 Part 1A Section 5.2.17 Three-Level Voltage Input Interface (Voltage Divider) and GMI 12554 Part 12A "Brake Lamp Switch".

Brake Lamp Load*: R_{MAX} = 6% of total vehicle pullup load on BLS circuit

(e.g., R_{MAX} = 150 Ω with 4 modules using 10 K pullup resistor. See Section 2.7.3.3 for rationale)

* Defined as total vehicle pulldown load from BLS circuit to vehicle ground.

Platform electronics output (BASS Module): This high side driver is an output of the Platform electronics system typically used for discrete signal outputs to Powertrain electronics, brake lamp relay control and CHMSL/stop lamps. The output is pulled high (energized) by the Platform system.



Symbol	Parameter
I_o	Output Current
U_O	Device Output Voltage Drop
V_S	Source Voltage
V_O	Output Voltage

The high side driver shall have the following characteristics:

High Side Driver Output Characteristics

Parameter	Value / Conditions
U_O (V_{SAT})	1.5 Volts max @ I_{max} load*, V_S = 16 Volts @ 105 °C
Leakage Current	20.0 μA max @ V_S = 16 Volts and Vout = 0 Volts

*Note: Max load will be application specific.

2.7.5.2.1 Protection

For battery voltages up to 16V, high-side drivers shall be protected from damage due to shorts to ground and shorts to battery. One method of protection is by current limiting. Overvoltage protection shall be provided to satisfy the voltage operating requirements defined in Section 2.1.5.1. High-side drivers shall return to their previous output state when the protection is no longer required, unless changed by the software.

2.7.5.3 Cruise Disable - Clutch

Reference Section 3.3.2.

2.7.5.4 +12V Cruise Mode

The following table defines the required ratiometric voltage ranges corresponding to the cruise switch states for the +12V Cruise Mode signal.

Cruise Switch State		Voltage at PCM input as a percent of Run/Crank voltage ($V_{R/C}$)	Cruise Mode
Cruise On/Off Switch	Off	$\%V_{R/C} < 4.08\%$	No cruise operation - open circuit /short to gnd
Cruise On/Off Switch	On	$4.08\% < \%V_{R/C} < 5.26\%$	Cruise on
		$5.26\% < \%V_{R/C} < 10.77\%$	No cruise operation
Resume/Accel Switch	On	$10.77\% < \%V_{R/C} < 13.82\%$	Tap-up, Resume, Accel
		$13.82\% < \%V_{R/C} < 21.15\%$	No cruise operation
Set/Coast Switch	On	$21.15\% < \%V_{R/C} < 26.93\%$	Tap-down, Set, Coast
		$\%V_{R/C} > 26.93\%$	No Cruise Operation - short to Battery

In determining the $\%V_{R/C}$ in the table above, the following implementation parameters for the PCM were assumed:

A/D Accuracy	± 78.5 mV
Pull-down resistor	402 Ω ± 3%
A/D Supply Reference	5V ±100mV
Time Constant	τ_{RC} +/- 30%

τ_{RC} = Time Constant of Run/Crank input

Cruise Switch Requirements

On/Off Resistor	8.25K Ω ± 3%
Resume/Accel Resistor	4.42K Ω ± 3%
Set/Coast Resistor	1.50K Ω ± 3%
Contact Resistance (each switch)	10 Ω max

2.7.6 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
2.7.3.1.2	Added GMLAN Signals: Cruise Control Driver Selected Speed and Cruise Control Driver Selected Speed Active Deleted GMLAN Signal Cruise Control Selected Speed from PPEI, because this is now an ETEI Signal.	ICR 320
2.7.2.1 2.7.3.4	Added Note 6 for Cruise Disable Clutch Switch to block diagrams for Vehicles with and without a BAS. Removed the optional algorithm options due to the fact this is not fully implemented.	ICR 2045
2.7.3.1.2	Comments on the following messages changed from Optional to Required with Cruise Control: 1. Cruise Control Active and 2. Cruise Control Enabled.	N/A – Comment revised to reflect PPEI rules for messaging and make consistent with Check Sheet and provide continuity with Mechanization.

2.8 Cooling Fan Control

2.8.1 Functional Overview

The cooling fans are primarily used for powertrain cooling and also provide cooling for other underhood components. This interface supports any single, multiple or PWM fan configuration. It also supports other cooling fan applications using platform drivers and relays.

Platform is responsible for defining the coolant temperature threshold for turning on the Engine Hot Coolant telltale. This information is needed by Powertrain for each vehicle in order to meet government emissions requirements for certain engine protection modes (e.g., engine hot coolant fuel enrichment for gasoline engines).

2.8.1.1 Fan Configurations

The cooling fan control algorithm is executed by Powertrain. Cooling fan control requirements are captured in the Cooling Fan Control algorithm description in Section 4.02. On GMNA applications, Platform is responsible for calibration of the cooling fan control algorithm.

Powertrain is responsible for executing the following:

- Process data from coolant temperature, vehicle speed, and optional engine oil and transmission fluid temperature sensors and optional fan speed sensor to determine the fan command speed for normal powertrain cooling and afterboil control.
- Process A/C pressure data to determine fan speed for reducing A/C head pressure.
- Provide control signals to fan relays or a PWM driver.
- Control fan state staging.
- Determine service tool request.
- Process optional Platform cooling fan speed adjustment (e.g., based on outside air temperature or electrical load management).
- Command A/C clutch off based on coolant temperature, if needed, to improve cooling system performance.
- Command Platform via serial data to turn on the Engine Hot Coolant telltale based on a coolant temperature threshold (calibrated by Platform).
- For engine driven fan systems, calculate engine accessory belt driven fan load.
- For engine driven fan systems, disable fan load for engine performance reasons (i.e., wide open throttle, engine stall prevention, heavy vehicle launch, etc.) (Powertrain optional)

If there is a coolant temperature fault, Powertrain shall:

- Command the fan to 100% fan power.
- Command A/C clutch off.

Platform may optionally execute the following:

- Request a fan speed adjustment via serial data for electrical load management or other platform-specific reasons.

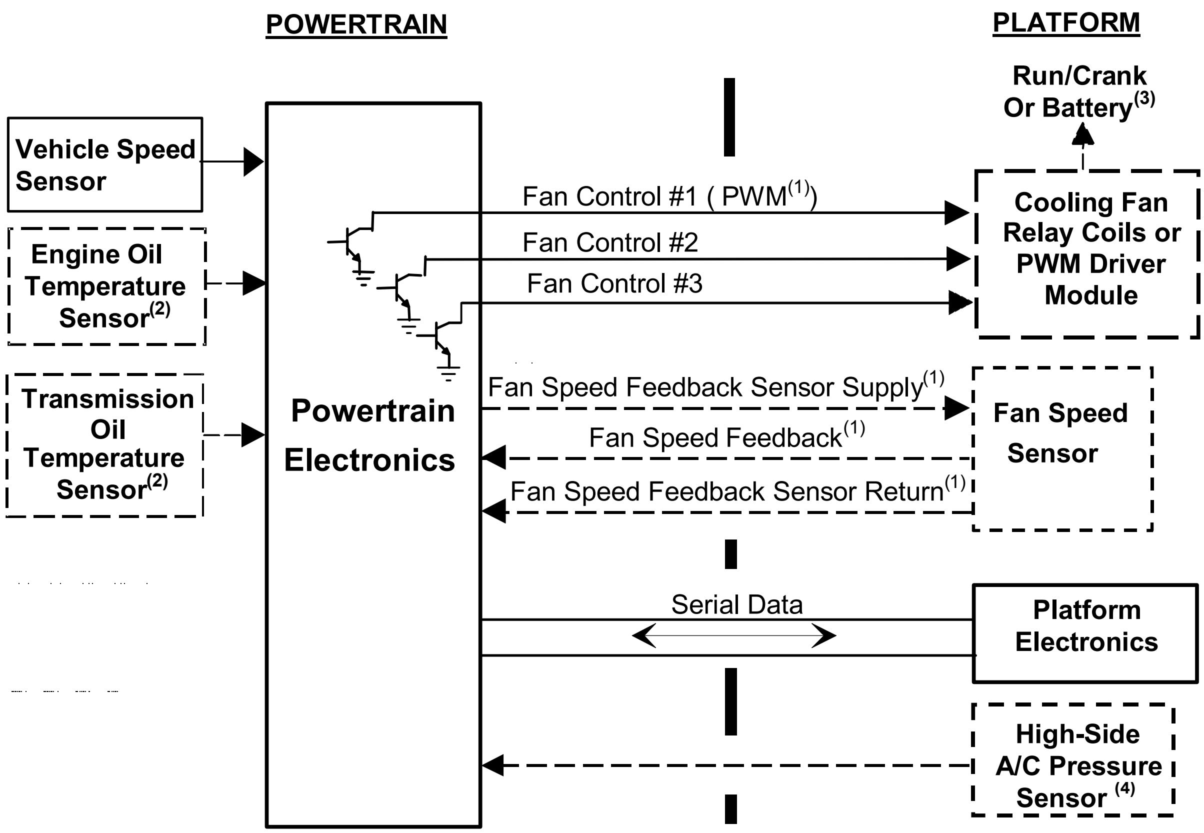
- Provide measured fan speed to Powertrain via hardwire signal from Platform.

2.8.2 *Hardware Overview*

The description of this subsystem covers the electrical interface between Powertrain electronics and cooling fan controls, and the serial data link between the Platform and Powertrain electronics.

2.8.2.1 Block Diagram

The following block diagram depict typical mechanizations for cooling fan control. The electrical interface between Platform and Powertrain is the only standard defined.



NOTES:
(1) Used on engine-driven, PWM-controlled fan systems.
(2) Powertrain optional.
(3) Battery power required to support After-run Cooling Fan Control.
(4) See section 2.9 for details.

2.8.3 *Interface Description*

2.8.3.1 Serial Data Links

Reference Section 5.0 for definitions of messages and signals.

2.8.3.1.1 Class 2 Serial Data Link

Serial Data Content	Transmitter	Primary ID	Secondary ID	Extended ID	Notes
Vehicle Speed - High Resolution - Metric	Powertrain	28	02	N/A	Optional
Engine Coolant - Fan 1 (All) Speed	Powertrain	48	01	N/A	Optional
Engine Coolant - Fan Speed Offset	Platform	48	0B	N/A	Optional
Displays - Driver Notification - Engine Coolant Hot	Powertrain	EA	20	9D	Required
Displays - Driver Notification - A/C Off for Engine Protection	Powertrain	EA	20	B4	Optional
A/C Clutch - Clutch Permission	Platform	14	10	N/A	Req'd if A/C pressure sensor not used

2.8.3.1.2 GMLAN Serial Data Link

Signal Name	*Transmitter*	*Notes*
Air Conditioning Compressor Clutch Request	Platform	Required with A/C
Air Conditioning Off Indication On	Powertrain	Optional
Engine Coolant Hot Indication On	Powertrain	Required
Engine Cooling Fan Speed	Powertrain	Optional
Engine Cooling Fan Speed Adjustment	Platform	Optional
Vehicle Speed	Powertrain	Optional
Vehicle Speed Validity	Powertrain	Optional

2.8.3.2 Fan Control Drivers

The fan control drivers are discrete low side driver outputs from the powertrain electronics to the platform cooling fan controls. These signals shall be pulled low to activate the cooling fan controls when the system is requesting fan operation. For electric PWM configurations driver #1 shall be PWM capable.

The fan control drivers shall provide control for the following types of systems:

System Type	Required Drivers
Single Speed Fan	#1
Dual Speed Fan	#1, #2
Multiple Speed Fan	#1, #2, #3
Variable Speed Fan	#1

The state of each cooling fan driver is determined based on a table of calibrations defined in Section 4.2.4.1. This allows any combination of driver states to be assigned to specific fan speeds, according to the mechanization used.

2.8.3.3 Fan Speed Feedback

The fan speed feedback signal is optionally used on engine driven, electronically controlled fan systems. The fan speed feedback signal is generated by the platform fan electrical subsystem and read by the cooling fan control algorithm. This signal shall produce 6 pulses per revolution.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.8.4 Failure Modes and Diagnostics

Reference Section 2.10.4 for serial data failure modes and diagnostic information.

Platform and Powertrain, through coordination with STG, shall provide appropriate diagnostics and failsoft for each of their inputs and outputs.

All fan drivers shall be diagnosed for proper continuity to the cooling fan relay(s) or PWM driver that drive(s) the cooling fan(s).

2.8.5 Electrical Characteristics

2.8.5.1 Fan Control #1

Only fan control driver #1 shall be capable of being activated in all power modes including the OFF power mode for afterboil control.

Fan control driver #1 from the Powertrain system shall have the characteristics of a low side relay driver, LSD3, as described in Section 3.1. This output shall be PWM capable as described in Section 3.1 and meet the PWM requirements in the table below:

Parameter	Electric PWM Fans	Engine-Driven EV Fan	Engine-Driven MRF Fan	Comments
Frequency Range	100 Hz	2 Hz*	70-150 Hz*	Accuracy of ± 5.0%
Duty Cycle Range**	0 to 100%	0 to 100%	0 to 100%	
Resolution	0.5%	0.5%	0.1%	PWM duty cycle
Accuracy	± 1.0%	± 1.0%	± 1.0%	PWM duty cycle
Repeatability	n/a	n/a	0.2%	over any 100 msec time period
R_{PU}	1KΩ			DC Test load pull-up
C_{LOAD}	0.01uF			DC Test load cap to gnd

*ECM must support a single PWM frequency at any Platform desired point in this range.

** 0% Duty Cycle is defined as the output driver continuously in the not active (high impedance) state.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.8.5.2 Fan Control #2

Fan control driver #2 from the Powertrain system shall have the characteristics of a low side relay driver, LSD3, as described in Section 3.1. For the dual fan series/parallel configuration, there are two relay coils in parallel on this driver.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.8.5.3 Fan Control #3

Fan control driver #3 from the Powertrain system shall have the characteristics of a low side relay driver, LSD3, as described in Section 3.1.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.8.5.4 Fan Speed Feedback

The fan speed feedback input interface shall be read by the Powertrain electronics in the Crank and Run power modes. This signal interface shall meet the requirements in the table below:

Parameter	Limits		Units	Conditions / Definitions
	Min	Max		
V_{IL}		2.2	V	V_{IL} = -2.6mA
V_{IH}	2.8		V	V_{IH} = -2.1mA
VI_{HYST}	180		mV	
$R_{PULL-UP}$	1.1	1.3	kΩ	
C_{IN}	750	1250	pF	1000pF +/-25%
τ	7.2	9.2	us	8.2us (Nominal RC time constant)
Frequency	0	11,500	Hz	
Pulse Count **Range** **Resolution**	 0 1	 65535 -	 Counts Count	6 pulses per revolution
Pulse Count Period **Range** **Resolution**	 0 15.3	 500,000 -	 usec usec	
Scaling				Fan RPM = 10 * Frequency (Hz)

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.8.5.5 Fan Speed Feedback Sensor Supply

Parameter	Value
Supply Voltage Nominal	5.0 ±0.5 Volts
Supply Current Maximum Steady State	5.5 mA

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.8.5.6 Fan Speed Feedback Sensor Return

This is a dedicated ground return line provided at the ECM specifically restricted to sensor return.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.8.6 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
2.8.1.1	Added the following text to "Powertrain shall be responsible for	ICR 2080

	the following functions:" – For engine driven fan systems, calculate engine accessory belt driven fan load. – For engine driven fan systems, disable fan load for engine performance reasons (i.e., wide open throttle, engine stall prevention, heavy vehicle launch, etc. (Powertrain optional)	

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2.9 Compressor Control

2.9.1 Functional Overview

This Section applies for all vehicles equipped with air conditioning.

Three configurations of A/C compressor control systems are addressed by this document:

- Cycling clutch control for fixed displacement compressors
- Pneumatic control for variable displacement compressors
- Electronic control for variable displacement compressors

A standard A/C compressor control algorithm is executed in the Powertrain for any of the above compressors. Reference Section 4.3 for the standard Powertrain-executed algorithm. Platform is the owner of the algorithm and is responsible for algorithm definition.

Powertrain is responsible for executing the following portions of the algorithm:

- Control the compressor relay
- Protect the compressor based on engine speed
- Disengage the A/C clutch for under / over pressure conditions
- Disable the compressor for low and high voltage
- Engage the A/C clutch during crank, when required, in order to remove any liquid refrigerant (slug) from the compressor
- Process service tool
- Process high side pressure transducer data and transmit the data via the Serial Data link
- Perform compressor minimum off timer and remember Platform request

Platform shall transmit the A/C clutch permission message to Powertrain based on A/C request from the HVAC control head. Platform may optionally execute the following additional A/C compressor control algorithms and communicate clutch disengagement via the A/C clutch permission message:

- Engage / disengage the A/C clutch for under / over pressure control
- Process low side temperature sensor data

In order to regulate the compressor load on the engine, Powertrain shall perform the following:

- Delay clutch engagement to prevent engine speed “droop”
- Maintain/force clutch engagement to prevent engine speed “flare”
- Disengage the clutch to prevent engine stall
- Optionally disengage the clutch during wide-open-throttle for vehicle performance

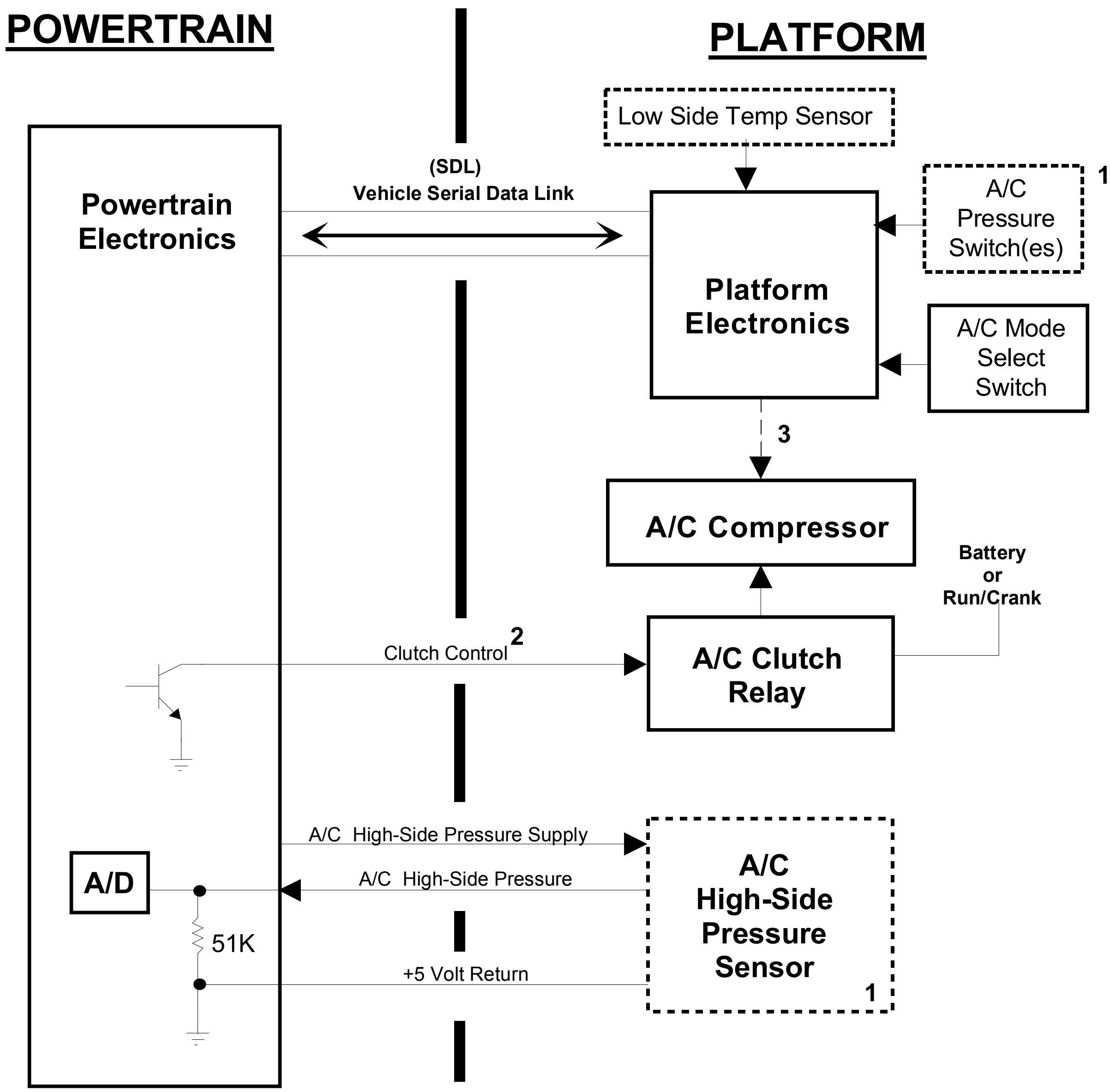
A/C load calculations shall be executed in the powertrain electronics for the purpose of engine load management. Development of the A/C load algorithm requires Platform support and is the responsibility of Powertrain.

2.9.2 Hardware Overview

The description of this subsystem covers the discrete low side driver output to drive the clutch relay, the serial data link between the Powertrain and Platform Electronics, and the A/C High-Side pressure sensor interface signals.

2.9.2.1 Block Diagram

The following block diagram depicts a typical mechanization for a compressor. The electrical interface between Powertrain and Platform is the only standard defined.



NOTE: 1. Either the A/C Pressure Switch(es) or the A/C High-Side Pressure Sensor is used but not both on the same application
2. Optional with electronically controlled compressor
3. Used with electronically-controlled compressor only

2.9.3 Interface Description

2.9.3.1 Serial Data Links

Reference Section 5.0 for definitions of messages and signals. If A/C is not present on the vehicle, the following shall not be transmitted.

2.9.3.1.1 Class 2 Serial Data Link

Serial Data Content	*Transmitter*	*Primary ID*	*Secondary ID*	*Extended ID*	*Notes*
A/C Clutch - Enable	Powertrain	14	01	N/A	Optional
A/C Clutch - Clutch Permission	Platform	14	10	N/A	Required
Climate Control (HVAC) - Fluid Pressure, High Side	Powertrain	B2	11	N/A	Optional
Climate Control (HVAC) - Low Side Fluid Temp	Platform	B2	20	N/A	Optional
Climate Control (HVAC) - A/C Options	Platform	B2	3C	N/A	Required for vehicles that have optional A/C

2.9.3.1.2 GMLAN Serial Data Link

Signal Name	**Transmitter**	**Notes**
Air Conditioning Compressor Clutch Engaged	Powertrain	Optional
Air Conditioning Compressor Clutch Request	Platform	Required for clutched compressor
Air Conditioning Compressor Normalized Load	Platform	Required with Electronically Controlled Variable Displacement, GME only
Air Conditioning Compressor Normalized Load Validity	Platform	Required with Electronically Controlled Variable Displacement, GME only
Air Conditioning Compressor Off Indication On	Powertrain	Required
Air Conditioning Compressor Stroke Request.	Powertrain	Required with clutchless AC, GME only.
Air Conditioning Compressor Present	Platform	Required for vehicles that have optional A/C
Air Conditioning Refrigerant High Side Fluid Pressure	Powertrain	Optional
Air Conditioning Refrigerant High Side Fluid Pressure Validity	Powertrain	Optional
Air Conditioning Refrigerant Low Side Fluid Temperature	Platform	Optional
Air Conditioning Refrigerant Low Side Fluid Temperature Validity	Platform	Optional

2.9.3.2 Clutch Control

This signal is a discrete low side driver output of the Powertrain Electronics. The output shall be pulled low for compressor clutch engagement on vehicles with an A/C compressor clutch. Usage of this output is optional for electronically-controlled compressors.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.9.3.3 A/C High-Side Pressure Sensor Supply

This regulated voltage is supplied by the Powertrain Electronics to the A/C High-Side Pressure Sensor.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.9.3.4 A/C High-Side Pressure

The Powertrain Electronics provides an analog input that reads the A/C High-Side pressure sensor output. The sensor has a ratiometric output voltage that is proportional to pressure.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.9.3.5 +5 Volt Return

This signal is the A/C High-Side Sensor ground reference that is tied to the PCM ground, internal to the PCM.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.9.4 Failure Modes and Diagnostics

Reference Section 2.10.4 for serial data failure modes and diagnostic information.

Powertrain shall diagnose the A/C High-Side Pressure Sensor for low voltage and high voltage. A diagnostic trouble code shall be set for low voltage. A second diagnostic trouble code shall be set for high voltage.

Platform and Powertrain, through coordination with STG, shall provide appropriate diagnostics and failsoft for each of their inputs and outputs.

2.9.5 Electrical Characteristics

2.9.5.1 Clutch Control

The output of the Powertrain Electronics shall have the characteristics of a low side driver, LSD3, as described in Section 3.1.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.9.5.2 A/C High-Side Pressure Sensor Supply

Parameter	Value
Supply Voltage Nominal	5.0 ±0.5 Volts
Supply Current Maximum	7.0 mA

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.9.5.3 A/C High-Side Pressure

Sensor Output

The sensor output may range from 0.0V to Supply Voltage and shall be proportional to the input pressure.

Transfer Function: Vout = Vcc(k1* P + k2), where

Vout = sensor output voltage
Vcc = sensor supply voltage
k1 and k2 = sensor dependent calibrations, and
P = input pressure

The sensor must be capable of driving a 51K Ohm load.

Analog Input

Parameters	Value
Pull Down Resistance	51kΩ ±7.5%
Input Range	0.0 Volts to Supply Voltage
Accuracy	±1.56% of the Supply Voltage over the full input range
Electrical Time Constant	1.0 mSec typical

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.9.5.4 +5 Volt Return

Reference Section 2.1.5.10.

2.9.6 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
2.9.3.1.2	Added GMLAN Signal Air Conditioning Compressor Stroke Request.	ICR 2009
2.9.3.1.2	Added GMLAN Serial Data signal ‘Air Conditioning Compressor Off Indication On’.	ICR 2119
2.9	Removed note at the beginning, which stated that the Electronically Controlled Compressor interfaces are not yet fully defined.	ICR 2121

2.10 Serial Data Architecture

2.10.1 Functional Overview

Powertrain shall be interfaced with Platform via only one serial data link for normal communication. This data link may be Class 2 or high speed CAN. Powertrain shall not be a gateway between nodes on the link.

Class 2 is the GM corporate implementation of the standard SAE Class B Bus. This implementation addresses the Federal/CARB requirements for serial data.

High speed CAN is part of the GM Local Area Network (GMLAN) communication strategy. This implementation is approved for diagnostics by CARB in model year 2003.

2.10.2 Hardware Overview

2.10.2.1 Class 2 Serial Data Link

The Platform and the Powertrain Electronics shall communicate via Class 2 with the following SAE J-1850 options to meet GM corporate design criteria with no in-frame response: 10.4 Kbaud, variable pulse width modulation, cyclic redundancy error detection, and single wire transmission media. Reference the following documents for specific serial data specifications:

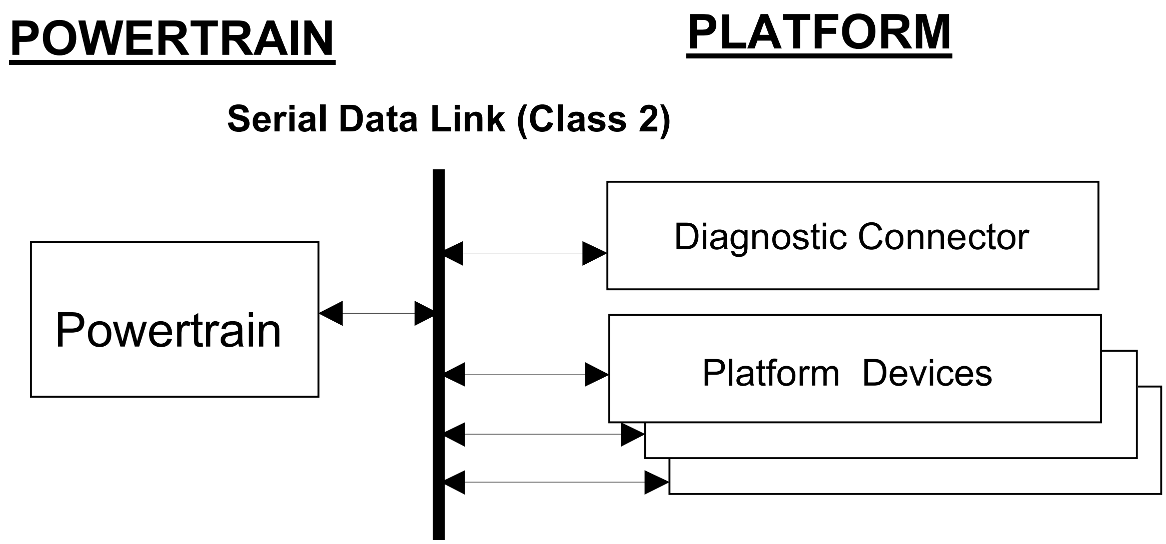
- NAO Class 2 Functional Communication Specification, Version 1.3
- NAO Class 2 Physical Message Diagnostics Strategy Document, Version 1.23
- GMNA Power Moding Specification

The Powertrain Electronics shall provide a serial data line that consists of two (2) connector pins that are adjacent and common to each other. Both pins shall share EMC protection components, so that there is a single unit load on the platform modules, and a seven unit load on the PCM except for Premium V engine applications. These PCMs shall have a single unit load. Two connector pins are required to allow for a ring configuration in the vehicle architecture.

The Powertrain Electronics shall be capable of receiving Class 2 messages within 100 ms of an active Accessory signal.

2.10.2.1.1 Block Diagram

The following block diagram depicts a typical mechanization for the serial data link. The electrical interface between Powertrain and Platform is the only standard defined.



2.10.2.2 High Speed CAN Data Link

The Platform and the Powertrain Electronics shall communicate via high speed CAN according to GMW3122 - GMLAN Dual Wire CAN Physical Layer Interface Specification and GMW3104 - GMLAN Communication Strategy Specification. Reference the following serial data documents:

- ISO 11898 Road Vehicles - Interchange of Digital Information - CAN for High Speed Communication
- ISO 14230 Road Vehicles - Diagnostics Systems Part 1-4
- SAE J-2284 Dual Wire, High Speed CAN

The ECM/PCM shall contain one termination for the high speed CAN link. The termination shall be connected between CAN_H and CAN_L bus signals.

The TCM shall provide a serial data line that consists of two (2) connector pins per CAN signal that are adjacent and common to each other. Both pins shall share EMC protection components, so that there is a single unit load on the ECM/PCM.

The Powertrain Electronics and the Platform Immobiliser device shall be able to transmit and receive data on the high speed CAN link when the battery voltage at the controller input pins is 7.0 to 16.0 Vdc. This range stems from the Voltage Requirements for Starting defined in Section 2.1.5.2. All other Platform modules shall be able to transmit and receive data on the high speed CAN link in the normal operating voltage range as defined in Section 2.1.5.1.

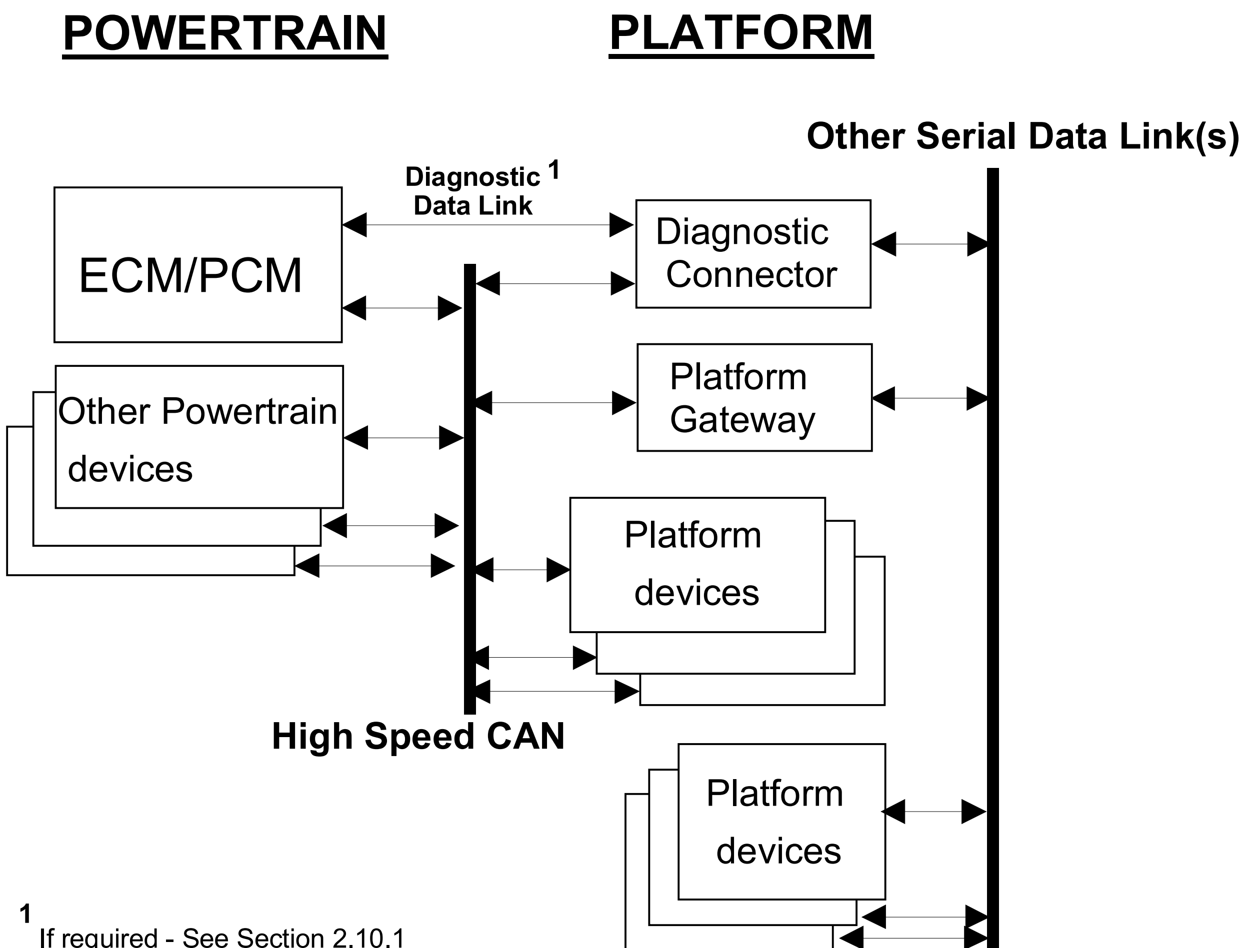
NOTE: The following paragraph states that the Powertrain Electronics shall not support two of the three methods for device wake-up identified in the GMLAN Strategy. Future platform electrical architectures may require selective wake-up on the high speed CAN link with ignition off. These proposed requirements would be ascertained by the Global Electrical Architecture Group. Analysis of the proposals and review by the PPEI Work Group may require that the Powertrain Electronics support an alternate wake-up method.

The Powertrain Electronics shall be capable of communicating high speed CAN frames within 100 ms of an active Accessory or Run/Crank input and the controller is only required to have this capability when either of these signals is active. The Powertrain Electronics will not support wake-up via serial data traffic or wake-up using a dedicated discrete signal.

Platform shall provide a gateway from any other vehicle serial data link to the high speed CAN link. This gateway shall synthesize the input frames to Powertrain Electronics.

2.10.2.2.1 Block Diagram

The following block diagram depicts a typical mechanization for the serial data link. The electrical interface between Powertrain and Platform is the only standard defined.



2.10.2.3 Diagnostic Connector

The diagnostic connector shall conform to SAE J-1962.

2.10.3 Interface Description

Class 2 serial data messages and GMLAN signals for the defined subsystems are summarized in the respective sections of this document. The detailed definitions of Class 2 messages, GMLAN signals and GMLAN standard frames are contained in Section 5.0.

All Class 2 messages are defined in the Corporate Class 2 Database. All parameters, data definition, engineering units and scaling are defined in this database. These parameters cannot be changed without the approval of the Class 2 Message Strategy Group that is sponsored by the Electrical Center Council.

All GMLAN signals are defined in the GMLAN Signal Database. All GMLAN frames to be defined in this specification shall be periodic.

For Class 2 only, Platform shall provide a serial data wake-up message prior to ignition switch rotation. This allows the PCM to utilize Class 2 wake-up capability.

The PPEI subsystem definition shall define a serial data signal or calibration(s) for communicating Platform information to Powertrain or Powertrain information to Platform. The serial data or calibration usage shall be determined by the following guidelines:

a. Data Identifier (DID) Usage Requirements

   1). DIDs may be utilized to program "non-controlled" information, which is will typically be updated in the service environment, emissions test or by an aftermarket upfitter.

   2). DIDs may be utilized to program "non-controlled" information in the vehicle electronics, which are not bound by OBD II compliance regulations.

b. Calibration Usage Requirements

   The PPEI subsystem definition shall define a calibration or calibration table in the Platform or Powertrain electronics based on the following criteria:

   1). Calibrations shall contain data, which does not change dynamically during the normal operation of the vehicle.

   2). The PPEI subsystem definition shall define calibrations, which reside in the Platform electronics, but are owned and calibrated by Powertrain, or jointly owned and calibrated by Powertrain and Platform.

   3). The PPEI subsystem definition shall define calibrations, which reside in the Powertrain electronics, but are own owned and calibrated by Platform, or jointly owned and calibrated by Platform and Powertrain

   4). Calibrations which provide specific subsystem or vehicle configuration information (i.e., "option present" and "system type") shall reside in both Platform and Powertrain controllers that require the information unless:

      a) Extreme proliferation of calibration part numbers will result, where two or more electronic modules in the vehicle require the same information. In this case, the information may reside (be calibrated) in one module and transmitted via serial data to any other module(s) that required the data.

         (1) OBD-II related calibration data shall reside in an OBD compliant controller and transmitted via serial data to other modules as required.

         (2) Non-OBD II related calibration data shall reside with the natural owner of the information and transmitted via serial data to Platform and Powertrain as required.

      b) When non-OBD II related aftermarket re-calibration is required, DIDs may be utilized. DIDs shall be partitioned to the natural owner of the information and transmitted via serial data to Platform and Powertrain as required.

c. Serial Data Usage Requirements

The PPEI subsystem definition shall define serial data signals or messages in the Platform or Powertrain electronics based on the following requirements:

1). Serial data signals shall be used to communicate data, which changes dynamically during the normal operation of the vehicle.

2). Serial data shall be used to communicate common calibration data utilized by two or more electronic modules throughout the vehicle. The intent of this requirement is to eliminate the need to support a large number of calibrations in several vehicle modules, which contain identical information. Note: In general, serial data **shall not** be used as the source for vehicle configuration information, unless this configuration data can change dynamically during normal vehicle operation.

a) Modules receiving configuration information shall determine their own default/fail-soft strategy.

b) Received serial data information may be learned when received.

c) Most recently learned information may be retained/stored over ignition cycles.

d) Once information is learned, it may be latched until a battery disconnect or a "reset" service procedure is performed

e) The descriptions of serial data used to communicate common calibration data shall reference the associated calibration by name.

2.10.3.1 Serial Data Links

Reference Section 5.0 for definitions of messages and signals. The following list includes miscellaneous serial data messages and signals that may not be described in any other section of this document.

2.10.3.1.1 Class 2 Serial Data Link

Serial Data Content	*Transmitter*	*Primary ID*	*Secondary ID*	*Extended ID*	*Notes*
Engine Air Intake - Intake Air Temperature	Powertrain	0A	20	N/A	Optional
Throttle Position Sensor – Pedal Position	Powertrain	12	11	N/A	Required with BASS
Vehicle Speed – High Resolution – Metric	Powertrain	28	02	N/A	Required with BASS
Transmission/Transaxle/PRNDL - Transmission Options	Powertrain	3A	3C	N/A	Optional
Engine System Other - Engine Run Flag	Powertrain	52	04	N/A	Required
Engine System Other - Immediate Engine Snapshot n	Platform	52	21	N/A	Optional
Displays – PRNDL	Powertrain	EA	0A	N/A	Required with BASS
Exterior Environment - Barometric Pressure (Absolute)	Powertrain	F2	11	N/A	Optional
Vehicle ID (VIN) - VIN Packet 3	Platform	FA	03	N/A	Powertrain

(digits 6 - 9)					Optional
Vehicle ID (VIN) - VIN Packet 4 (digits 10 - 13)	Platform	FA	04	N/A	Powertrain Optional
Vehicle ID (VIN) - VIN Packet 5 (digits 14 - 17)	Platform	FA	05	N/A	Powertrain Optional
Network Control - Node Alive	Platform and Powertrain	FE	03	N/A	Required

2.10.3.1.2 GMLAN Serial Data Link

Signal Name	*Transmitter*	*Notes*
Airbag System Virtual Device Availability	Platform	Required when Airbag Deployed signal is gated to Powertrain
Barometric Pressure Absolute	Powertrain	Optional
Barometric Pressure Absolute Validity	Powertrain	Optional
Climate Control Virtual Device Availability	Platform	Required when either Air Conditioning Compressor Clutch Request or Air Conditioning Refrigerant Low Side Fluid Temperature signal is gated to Powertrain
Engine Coolant Level Switch Virtual Device Availability	Platform	Required when Engine Coolant Level Low signal is gated to Powertrain
Engine Intake Air Temperature	Powertrain	Optional for HVAC fan afterblow
Engine Intake Air Temperature Validity	Powertrain	Optional for HVAC fan afterblow
Engine Running Status	Powertrain	Required
Engine System Regular Production Option Identifier	Platform	Optional use for GME Only (vehicles sold in non-North American markets)
Manual Transmission Reverse Gear Switch Virtual Device Availability	Platform	Required when Manual Transmission Reverse Gear Active signal is gated to Powertrain
Outside Air Temperature Virtual Device Availability	Platform	Required when Outside Air Temperature Corrected Value signal is gated to Powertrain
Powertrain Customer Snapshot Request	Platform	Optional
Vehicle Identification Number Digits 10-17	Platform	Powertrain Optional
Vehicle Theft Deterrent Non Immobilizer Virtual Device Availability	Platform	Required when Vehicle Security Non Immobilizer Password Status signal is gated to Powertrain

2.10.4 Failure Modes and Diagnostics

Each unit on the serial link shall provide its own diagnostics and failsoft to survive serial data link failure.

2.10.5 Electrical Characteristics

2.10.5.1 Class 2 Serial Data Link

The electrical characteristics for this link are defined in the current revision of the following documents:

SAE J-1850 Class B Data Communication Network Interface
SAE J-1962 Diagnostic Connector

2.10.5.2 High Speed CAN Data Link

The terminating resistor in the ECM/PCM shall be a 120 Ω ± 10%, 0.25 W. Refer to ISO 11898 for requirements.

2.10.6 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
2.10.2.2 2.10.3	For High Speed CAN Data Link section add minor textual clarification Expand the PPEI subsystem definition shall define guidelines for serial data signal or calibration(s) for communicating Platform information to Powertrain or Powertrain information to Platform, and guidelines for serial data or calibration usage.	ICR 2126
2.10.3.1.2	Added existing GMLAN Signal “Engine System Regular Production Option Identifier”.	ICR 2144

2.11 Brakes Subsystem

2.11.1 Functional Overview

The Brakes Subsystem defines the following platform functions.

- Anti-Lock Brake System (ABS)
- Traction Control Systems
- Vehicle Stability Enhancement System (VSES)

Traction Control Systems may consist of the Enhanced Traction System (ETS) or the Full Function Traction Control System. The TCS acronym generally is used to denote the Full Function Traction Control System.

Throttle Relaxer applications are not addressed in this document.

On GMNA applications, the Average Peak to Peak Acceleration (Rough Road) is determined by the ABS per the "GM Powertrain Rough Road Detection Algorithm Specification", Document Number TL.17.0015. This document is owned and maintained by the GM Powertrain Algorithm Technical Resource Center.

2.11.1.1 Anti-Lock Brake System

All ABS data is communicated over the Serial Data Link except for some Class 2 based vehicles which require a rear wheel speed sensor and/or a engine speed signal from Powertrain to Platform.

2.11.1.2 Traction Control Systems

2.11.1.2.1 Enhanced Traction System (ETS)

The ETS is a distributed system that uses both Platform and Powertrain electronics to implement the function. The Serial Data Link is used to communicate other information required by Platform and Powertrain in addition to the ABS-required data.

Cruise Control shall be disengaged when traction control is active for more than a calibratible time.

2.11.1.2.2 Full Function Traction System (TCS)

The TCS is a distributed system that uses both Platform and Powertrain electronics to implement the function. On Class 2 based vehicles hard-wired PWM signals are required to communicate requested and delivered torque information. In Class 2 based vehicles utilizing Engine Drag Control (EDC), the data control signal is generated by the Platform electronics to indicate the control mode.

The Serial Data Link is used to communicate other information required by Platform and Powertrain in addition to the ABS data.

Cruise Control shall be disengaged when traction control is active for more than a calibratable time.

2.11.1.3 Vehicle Stability Enhancement System (VSES)

The VSES function is vehicle closed-loop yaw control that requires Brake and Powertrain system assistance. The driver's intended vehicle path and the actual vehicle path are observed through various vehicle sensors (steering wheel position, yaw rate, lateral acceleration, etc.) and if corrections are required, Brake (in the form of active brake pressure applied to one or more wheels) and/or Powertrain intervention is initiated. When the VSES intervention occurs for more than a calibratible time, cruise control shall be disengaged.

Powertrain also uses the VSES sensor information for other non-related functions.

Notes:

1. Full Function TCS is required on the vehicle for the VSES function.
2. VSES is available independent of the Ride Control System that is present on the car.
3. The VSES function has been referred to in the past as a sub-function of Integrated Chassis control System X (ICCSX) or Vehicle Dynamic Control (VDC).

2.11.2 Hardware Overview

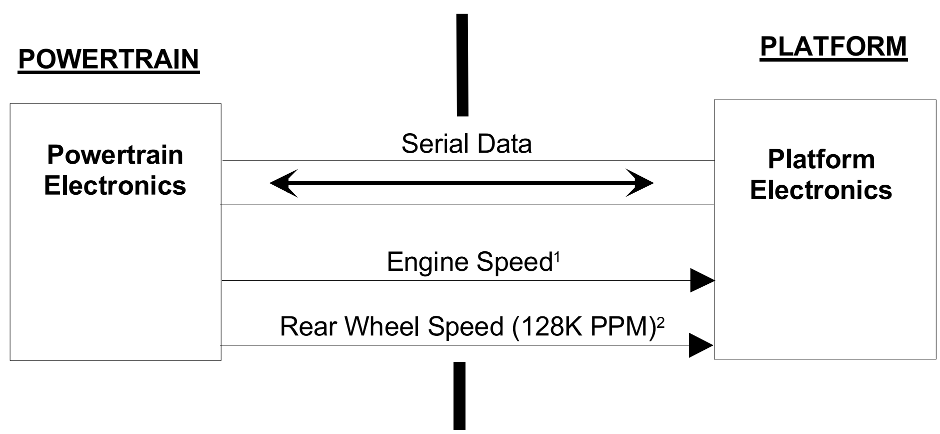
For GMLAN based vehicles, the electrical interface between the Platform Electronics and the Powertrain Electronics for the Brakes Subsystem consists of the serial data link only.

For Class 2 based vehicles, the electrical interface between the Platform consists of the serial data link and other hardware signals as shown in the following block diagrams.

2.11.2.1 Block Diagram

2.11.2.1.1 ABS, ETS, TCS (GMLAN) and VSES (GMLAN) Interface Block Diagram

The following block diagram depicts the typical mechanization for the ABS, ETS, TCS (GMLAN) and VSES (GMLAN). The electrical interface between Powertrain and Platform is the only standard



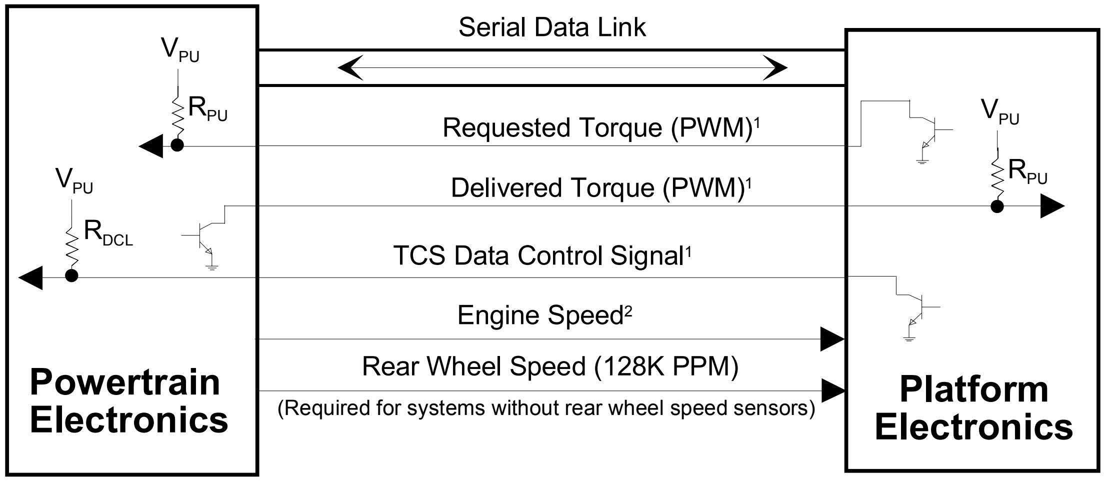
1 This signal is required for some Class 2 based vehicles

2 This signal is required for systems without rear wheel speed sensors

defined.

2.11.2.1.2 TCS (Class 2) and VSES (Class 2) Interface Block Diagram

The following block diagram depicts the typical mechanization for Class 2 based TCS and VSES. The electrical interface between Powertrain and Platform is the only standard defined.



1 These signals are required for Class 2 based vehicles only

2 This signal is required for some Class 2 based vehicles

2.11.3 Interface Description

2.11.3.1 Serial Data Links

Reference Section 5.0 for definitions of messages and signals.

2.11.3.1.1 Class 2 Serial Data Link

The Class 2 Messages between the Platform Electronics and the Powertrain Electronics for the Brakes Subsystem are listed in this section. The details of these messages are specified in Section 5. It is not intended that every message is used in every application.

2.11.3.1.1.1 Non ABS and ABS Class 2 Messages

Serial Data Message Content	Transmitter	Primary ID	Secondary ID	Extended ID	Notes
Engine RPM - High Resolution	Powertrain	1A	10	N/A	Required
Wheels - Wheel Reference Vehicle Speed Metric	Platform	24	03	N/A	Required
Wheels - Maximum Driven Wheel Velocity Metric	Platform	24	05	N/A	Optional
Wheels - Average Peak to Peak Acceleration (Rough Road)	Platform	24	07	N/A	Required for vehicles that require rough road detection
Wheels - Individual Wheel Speeds	Platform	24	09	N/A	Required on systems with 4 wheel speed sensors
Traction Control - Options	Platform	2A	3C	N/A	Optional
Brakes - Variable Proportioning	Platform	32	03	N/A	Required
Brakes - System Fault	Platform	32	0A	N/A	Required
Brakes - Brake Light Switch, Brake Switch Active	Powertrain	32	22	N/A	Required for vehicles without BASS
Brakes - Options This message may not be sent by the ABS module	Platform	32	3C	N/A	Required on vehicle programs where ABS is optional
Transmission/Transaxle/PRNDL - Driven Wheel Configuration	Powertrain	3A	35	N/A	Optional for Non-Truck All Wheel Drive
Tires - Spare Status	Platform	E4	18	N/A	Optional for Non-Truck All Wheel Drive

2.11.3.1.1.2 ETS Class 2 Messages

For ETS, the ABS Class 2 messages are also required.

Serial Data Message Content	Transmitter	Primary ID	Secondary ID	Extended ID	Notes
Engine Torque - Wheel Slip Prevent Required Torque	Platform	08	11	N/A	
Engine Torque - Driver Intended Torque	Powertrain	08	20	N/A	
Engine Torque - Requested Torque	Platform	08	21	N/A	
Engine Torque - Delivered Torque	Powertrain	08	22	N/A	
Throttle Position Sensor - Pedal Position	Powertrain	12	11	N/A	Required
Traction Control - Platform Temporary Inhibit of TCS	Platform	2A	07	N/A	Required
Traction Control - PT Traction Failure Status	Powertrain	2A	0B	N/A	Required
Transmission/Transaxle/PRNDL - Estimated Trans. Gear Engaged	Powertrain	3A	03	N/A	Required
Transmission/Transaxle/PRNDL –	Powertrain	3A	36	N/A	Platform-

Transmission Gear Shift Direction					Optional
Transmission/Transaxle/PRNDL - Commanded Gear	Platform	3A	06	N/A	Required
Transmission/Transaxle/PRNDL - Transmission Options	Powertrain	3A	3C	N/A	Required
Engine System Other - Engine Type	Powertrain	52	22	N/A	Required
Displays - PRNDL	Powertrain	EA	0A	N/A	Required

Note: The Driver Intended Torque data from Powertrain is used in conjunction with Wheel Slip Prevent Required data from Platform. The Delivered Torque data from Powertrain is used in conjunction with Wheel Slip Prevent Torque data from Platform.

Platform shall specify which of these data pairs is used for an ETS application.

2.11.3.1.1.3 Full Function TCS Class 2 Messages

For TCS, the ABS Class 2 messages are also required.

Serial Data Message Content	Transmitter	Primary ID	Secondary ID	Extended ID	Notes
Engine Torque-Driver Intended Torque	Powertrain	08	20	N/A	Optional
Engine Air Intake - Intake Air Temperature	Powertrain	0A	20	N/A	Required
Throttle Position Sensor - Pedal Position	Powertrain	12	11	N/A	Required
Traction Control - Platform Temporary Inhibit of TCS	Platform	2A	07	N/A	Required
Traction Control - Initiate Engine Drag Control Test	Powertrain	2A	09	N/A	Required
Traction Control - PT Traction Failure Status	Powertrain	2A	0B	N/A	Required
Transmission/Transaxle/PRNDL - Estimated Trans. Gear Engaged	Powertrain	3A	03	N/A	Required
Transmission/Transaxle/PRNDL- Transmission Shift Solenoids State	Powertrain	3A	0E	N/A	Optional
Transmission/Transaxle/PRNDL – Transmission Gear Shift Direction	Powertrain	3A	36	N/A	Platform-Optional
Transmission/Transaxle/PRNDL- Transmission Gear Ratio	Powertrain	3A	38	N/A	Required for traction control with CVT
Transmission/Transaxle/PRNDL - Transmission Options	Powertrain	3A	3C	N/A	Required
Transmission/Transaxle/PRNDL - Tire / Axle Correction Factor (GMTG ONLY)	Powertrain	3A	3D	N/A	Opitonal
Engine System Other - Engine Type	Powertrain	52	22	N/A	Required
Displays - Driver Notification - Traction control System Off *	Platform	EA	20	9B	optional with TCS

2.11.3.1.1.4 VSES Class 2 Messages

For VSES, the ABS and TCS Class 2 messages are also required.

Serial Data Message Content	Transmitter	Primary ID	Secondary ID	Extended ID	Notes
Engine Torque - Driver Intended Torque	Powertrain	08	20	N/A	Required
Brakes - Active Brake Control Active	Platform	32	06	N/A	Required
Brakes - Brake Extended Travel Switch	Powertrain	32	24	N/A	Optional for vehicles without BAS
Vehicle Motion - Actual Lateral Accel	Platform	84	03	N/A	Required for Performance Shift Algorithm

2.11.3.1.2 GMLAN Serial Data Link

The GMLAN signals between the Platform Electronics and the Powertrain Electronics for the Brakes Subsystem are listed in this section. The details of these signals are specified Section 5. It is not intended that every message is used in every application.

2.11.3.1.2.1 Non ABS and ABS GMLAN Signals

Signal Name	Transmitter	Notes
Antilock Brake System Active	Platform	Required for GMNAwith ABS
Antilock Brake System Failed	Platform	Required with ABSfor GMNA
Antilock Brake System Present	Platform	Required on vehicle programs where ABS is optional.
Brake Pedal Switch Active	Powertrain	Required for vehicles without BASS
Brake Pedal Switch Active Validity	Powertrain	Required for vehicles without BASS
Spare Tire Status	Platform	Optional for Non-Truck all wheel drive
Wheel Angular Velocity Front Left	Platform	Required with ABS
Wheel Angular Velocity Front Left Validity	Platform	Required with ABS
Wheel Angular Velocity Front Right	Platform	Required with ABS
Wheel Angular Velocity Front Right Validity	Platform	Required with ABS
Wheel Angular Velocity Rear Left	Platform	Required with ABS
Wheel Angular Velocity Rear Left Validity	Platform	Required with ABS
Wheel Angular Velocity Rear Right	Platform	Required with ABS
Wheel Angular Velocity Rear Right Validity	Platform	Required with ABS
Wheel Speed Sensing Diagnostic Completed	Platform	Required
Wheels Average Peak to Peak Acceleration	Platform	Required for GMNA vehicles that require rough road detection
Wheels Average Peak to Peak Acceleration Validity	Platform	Required for GMNA vehicles that require rough road detection

2.11.3.1.2.2 Traction Control GMLAN Signals

For Traction Control, the following ABS GMLAN signals are also required.

Signal Name	Transmitter	Notes
Accelerator Actual Position	Powertrain	Required
Accelerator Actual Position Validity	Powertrain	Required
Accelerator Effective Position	Powertrain	Required
Accelerator Effective Position Validity	Powertrain	Required
Accelerator Kickdown Detected	Powertrain	Automatic transmission only
Cruise Control Clutch Switch Active	Powertrain	Optional on Man Trans
Cruise Control Clutch Switch Active Validity	Powertrain	Optional on Man Trans
Engine Calculated Actual Gear	Powertrain	Optional
Engine Calculated Actual Gear Validity	Powertrain	Optional
Engine Coolant Temperature	Powertrain	Required
Engine Coolant Temperature Validity	Powertrain	Required
Engine Intake Air Temperature	Powertrain	Required
Engine Intake Air Temperature Validity	Powertrain	Required
Engine Running Status	Powertrain	Required
Engine Speed	Powertrain	Required
Engine Speed Validity	Powertrain	Required
Engine System Regular Production Option Identifier	Powertrain	Required
Engine Torque Actual	Powertrain	Required
Engine Torque Actual Validity	Powertrain	Required
Engine Torque Driver Requested	Powertrain	Required
Engine Torque Driver Requested Validity	Powertrain	Required
Engine Torque Maximum	Powertrain	Required
Engine Torque Maximum Validity	Powertrain	Required
Engine Torque Minimum	Powertrain	Required
Engine Torque Minimum Validity	Powertrain	Required
Engine Torque Reduction Failed	Powertrain	Required
Engine Torque Reduction Failure Status	Powertrain	Required
Engine Torque Traction Control Request Failed	Powertrain	Required
Powertrain Brake Pedal Discrete Input Status	Powertrain	Optional (For GME Use Only)
Powertrain Brake Pedal Discrete Input Validity	Powertrain	Optional (For GME Use Only)
Powertrain Brake Pedal Secondary Discrete Input Status	Powertrain	Optional (For GME Use Only)
Powertrain Brake Pedal Secondary Discrete Input Validity	Powertrain	Optional (For GME Use Only)
Traction Control Alive Rolling Count	Platform	Required
Traction Control System Active	Platform	Required
Traction Control System Enabled	Platform	Required
Traction Control System Failed	Platform	Required
Traction Control System Present	Platform	Required
Traction Control Torque Request	Platform	Required
Traction Control Torque Request Protection	Platform	Required
Traction Control Torque Request Validity	Platform	Required
Traction Torque Decay Control	Platform	Required
Traction Torque Decay Control Active	Platform	Required
Transmission Actual Gear	Powertrain	Required
Transmission Actual Gear Validity	Powertrain	Required
Transmission Gear Ratio	Powertrain	Required for traction control with CVT transmission

Signal Name	Transmitter	Notes
Transmission Gear Ratio Validity	Powertrain	Required for traction control with CVT transmission
Transmission Gear Selector Position	Powertrain	Required
Transmission Gear Selector Position Validity	Powertrain	Required
Transmission Gear Shift Direction	Powertrain	Required

2.11.3.1.2.3 VSES GMLAN Signals

For VSES, the ABS and Traction Control GMLAN signals are also required.

Signal Name	Transmitter	Notes
Brake Extended Travel Switch Active	Powertrain	Optional for vehicles without BASS
Brake Extended Travel Switch Active Validity	Powertrain	Optional for vehicles without BASS
Vehicle Dynamics Lateral Acceleration	Platform	Required
Vehicle Dynamics Lateral Acceleration Validity	Platform	Required
Vehicle Dynamics Control Active	Platform	Required

2.11.3.2 Engine Speed

The Engine Speed hardwire signal shall be provided by Powertrain for Platform use. This signal is optional on Class 2 based vehicles only. This Engine Speed signal shall have a frequency of two pulses per engine revolution for all Powertrains.

2.11.3.3 Rear Wheel Speed Signal (128K PPM)

The Rear Wheel Speed hard-wire signal shall be provided by Powertrain for Platform use on vehicles that do not have rear wheel speed sensors.

2.11.3.4 TCS Circuits (Class 2 based vehicles)

2.11.3.4.1 Requested and Delivered Torque Signals

These PWM signals are asynchronous. The PWM duty cycle can represent any desired vehicle parameter. This duty cycle can also be partitioned to represent any number of vehicle parameters. It should be remembered that partitioning the PWM duty cycle causes resolution and accuracy to decrease.

2.11.3.4.1.1 Full Duty Cycle Range Applications

2.11.3.4.1.1.1 Requested Torque

Requested torque is the Platform estimated engine (or other) torque required to meet TCS performance objectives. The Requested Torque is represented by a PWM signal where the duty cycle region between 10% and 90% equates to a minimum and maximum torque value, respectively. The minimum torque value can be less than zero.

2.11.3.4.1.1.2 Delivered Torque

Delivered torque is the Powertrain estimated engine (or other) torque provided by the powertrain. The Delivered Torque is represented by a PWM signal where the duty cycle region between 10% and 90% equates to a minimum and maximum torque value, respectively. The minimum torque value can be less than zero.

2.11.3.4.1.2 Reduced Duty Cycle Range Applications

2.11.3.4.1.2.1 Requested Torque

These applications may or may not utilize engine drag control.

Requested torque is the Platform estimated engine (or other) torque required to meet TCS performance objectives. Applications utilizing engine drag control use the Platform to Powertrain PWM duty cycle signal to convey two sets of information. The PWM duty cycle region between 10% and 90% is partitioned into two segments with a dead-band in between them. EDC torque requests are communicated in one region (i.e. 10% to 35%) and TCS torque requests are communicated in the other region (i.e. 40% to 90%). The PWM duty cycle region between 35% and 40% is a dead-band.

During operation when engine drag control is not active, indicated by the EDC signal (Data Control Signal) being high, TCS requested torque is communicated on this PWM signal. The PWM duty cycle region between 40% and 90% equates to a minimum and maximum torque value, respectively. The minimum value can be less than zero.

During operation when engine drag control is active, indicated by the EDC signal asserted low by the Platform, EDC requested torque is communicated on this PWM signal. The PWM duty cycle region between 10% and 35% equates a minimum and maximum torque value, respectively. Engine drag control is utilized to improve vehicle stability during conditions of high engine drag such as with rapid throttle release.

For applications that do not utilize engine drag control, the Requested Torque will be represented by a PWM signal where the duty cycle region between 40% and 90% equates to a minimum and maximum torque value, respectively.

2.11.3.4.1.2.2 Delivered Torque

Delivered torque is the Powertrain estimated engine (or other) torque provided by the powertrain. The delivered torque is represented by a PWM signal where the duty cycle region between 30% and 90% equates to a minimum and maximum torque value, respectively. The minimum can be less than zero. For manual transmissions, a PWM duty cycle between 10% and 25% indicates engine stall protection mode is active. For automatic transmissions, a PWM duty cycle between 10% and 25% indicates transmission shifts are occurring. The PWM duty cycle region between 25% and 30% represents a dead-band.

2.11.3.4.2 TCS Data Control Signal

The TCS Data Control Signal is used for applications utilizing Engine Drag Control (EDC). This signal is generated by the Platform electronics. Platform uses the data control signal to send the Engine Drag Control signal to the Powertrain to indicate the control mode (Engine Drag Control is active or a drop throttle condition exists). This provides a redundancy for the EDC function with the requested torque signal.

The following table describes the possible conditions.

Requested Torque Signal	TCS Data Control Signal	Control Mode
Inactive (90% duty cycle)	Inactive	Normal
Inactive (90% duty cycle)	Active	Drop Throttle
TCS Region (40% to 90% Duty Cycle)	Inactive	TCS Active
TCS Region (40% to 90% Duty Cycle)	Active	TCS Active and Drop Throttle
EDC Region (10% to 35% Duty Cycle)	Inactive	Invalid
EDC Region (10% to 35% Duty Cycle)	Active	EDC Active

2.11.4 Failure Modes and Diagnostics

Reference Section 2.10.4 for serial data failure modes and diagnostic information.

Platform and Powertrain through coordination with STG shall provide appropriate diagnostics and failsoft for each of their inputs and outputs.

Powertrain shall diagnose the Requested Torque signal for PWM out of range and set the appropriate diagnostic trouble codes.

2.11.5 Electrical Characteristics

2.11.5.1 Engine Speed

Reference Section 2.3.5.1.

2.11.5.2 Rear Wheel Speed Signal (128K PPM)

This signal shall be an active low output of the Powertrain electronics, with a Powertrain-provided pull-up resistor to Run/Crank voltage. The signal shall have the following characteristics:

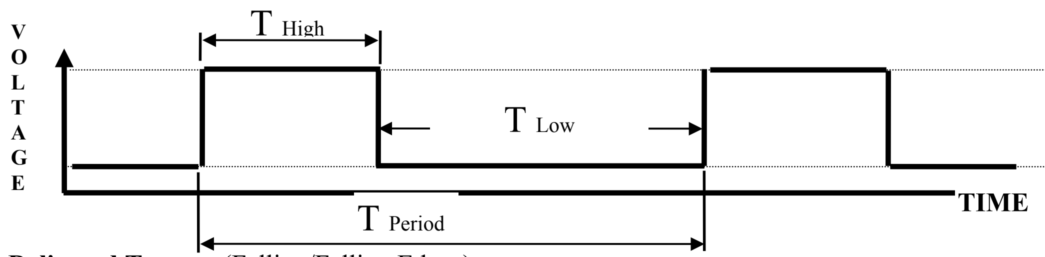
Parameter	Limits	Comments
V_{OL}: @ I_{load} = 20 mA	1.00 V Maximum	Output driver on
V_{OH}: @ I_{load} = 0 mA	7.00 V Minimum	Output driver off
I_O Shorted	10 mA Maximum	Output driver off
Load - Current	30 mA Maximum	
Load - Capacitive	0.015 µF Maximum	
Leakage Current @ 16 V	100 µA Maximum	
Output Frequency	128K Pulses/Mile	
Duty Cycle	50 ±10%	
Output Period Jitter	1% Maximum	Powertrain system.
@ <100 Hz input frequency or < 3 MPH , output must be high, or output must go high within 80 ms of absence of pulse input.		
Within 100 ms of Ignition "ON" output must go high (assuming speed < 30 MPH).		

2.11.5.3 Requested and Delivered Torque

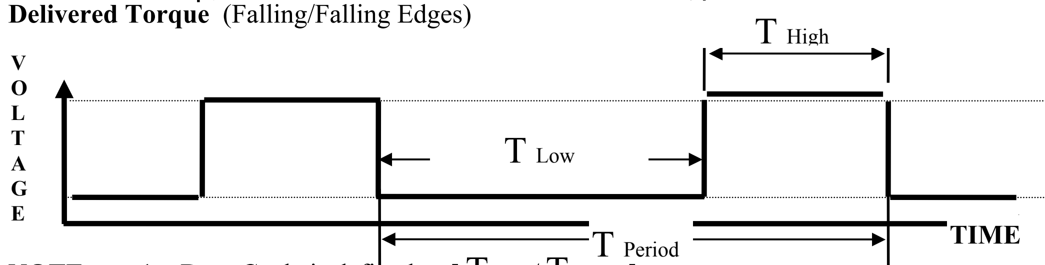
2.11.5.3.1 Definitions

2.11.5.3.1.1 PWM Duty Cycle

Requested Torque (Rising/Rising Edges)



Delivered Torque (Falling/Falling Edges)

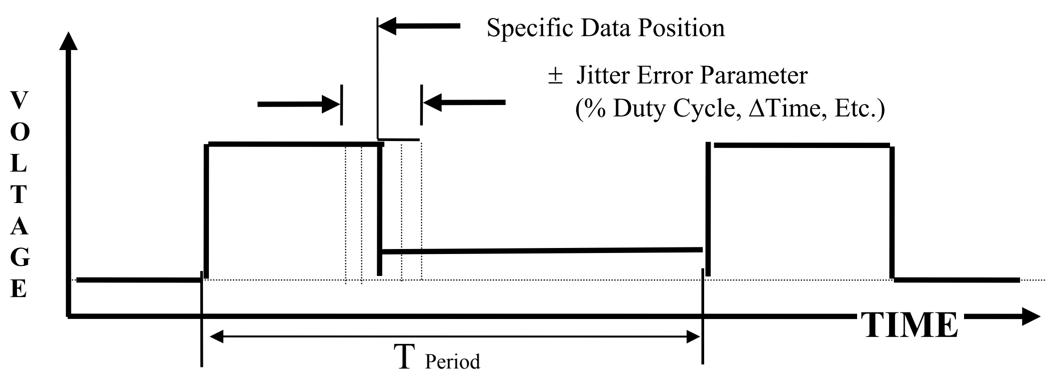


NOTE:

1. Duty Cycle is defined as [T_{high} / T_{period}] .
2. Duty Cycle percentage is defined as [T_{high} / T_{period}] * [100].
3. The PWM frequency is a selected constant frequency.
4. T_{peroid} is one full frequency cycle.

2.11.5.3.1.2 Jitter

Jitter is the instability or small rapid irregularities about a specific data position in a periodic electrical signal waveform from cycle-to-cycle due to signal interferences such as ground differences, power supply voltage fluctuations, noise interference, hysteresis, etc. The signal variations are usually abrupt and spurious.



2.11.5.3.2 General Parameters

The following table specifies the electrical characteristics of the Low Side Drive (LSD), variable duty cycle, single wire PWM signal intended to drive Platform and Powertrain input circuits as shown in block diagram 2.11.2.1.2.

FREQUENCY	
- Nominal Frequency (Reference Note 1)	128 Hz +/- 5%
- Frequency Tolerance (Reference Note 2)	+/- 0.1%
DUTY CYCLE BAND DEFINITIONS	
- Data (Duty Cycle partitioning is acceptable)	≥ 10 to ≤ 90%
- Diagnostic	≥ 0 to < 5% and ≥ 95 to ≤ 100%
- Dead Band	≥ 5 to < 10% and > 90 to < 95%
PERIOD CALCULATION EDGE REFERENCE	
- Requested Torque (Reference Note 3)	Rising/Rising
- Delivered Torque (Reference Note 3)	Falling/Falling
DUTY CYCLE	
- Resolution	≤ 0.4 % Duty Cycle
SYSTEM DATA TRANSFER ACCURACY	
- Duty Cycle Jitter (cycle to cycle)	± 0.5% Duty Cycle (Max.)
- Total (Transmitter data word to Receiver data word) - Example of Duty Cycle Parameter Errors • Receiver Input Timer Resolution and Calculation • Output Timer Resolution and Calculation • Vdiff - Transmitter/Receiver Ground Difference • Vpu- Receiver Pull-Up voltage variation • Vcc - Receiver supply voltage variation • Vil/Vih - Receiver input threshold variation • VRC - Receiver input filter variation - (Reference Note #4 and #5)	± 1.0 % Duty Cycle (Max.)

1. The receiving module shall measure the PWM period (Tperiod), and High time (Thigh) or Low time (Tlow).
2. The selected PWM frequency has an accuracy tolerance of ± 0.1 %
3. Duty cycle is defined as high time divided by frequency period.
4. Data transfer error due to communication path (vehicle wiring) is assumed to be negligible.
5. Duty Cycle percentage is in reference to the frequency period.

2.11.5.3.3 Driver Output Parameters:

(Reference Block Diagram - 2.11.2.1.2)

DRIVER DEVICE	**Open Collector/Drain @ Test Load Equal to Receiver Input Ref. Paragraph 2.11.5.3.4**
ITEM PARAMETERS	
- Vol (Max.) @ I Sink = 6 mA	0.3 Vdc
- Ioh Current leakage at 16 V (Transmitter Driver in off state)	100 µA max.
WAVE SHAPE	
- Rise Time @ 10 - 90 % Vout	0.85 to 10.0 V/µS (Note #2)
- Fall Time @ 90 - 10 % Vout	0.85 to 10.0 V/µS (Note #2)
DATA TRANSFER ERROR - Transmitter (from data word to pulse voltage waveform) - Example of Parameter Errors • Output Timer Resolution and Calculation - (Reference Note #1)	± 0.40 % Duty Cycle Combined Error (Maximum)

<u>NOTE:</u>

1. Data transfer error due to communication path (vehicle wiring) is assumed to be negligible.
2. EMC consideration - The test load shall be 3.0KΩ to 16.0 Volts and 1300 pF to ground.

2.11.5.3.4 Receiver Input Parameters:

(Reference Block Diagram - Paragraph 2.11.2.1.2)

ITEM PARAMETERS	Values
- Vpu Resistor Pull up Voltage Source	4.5 Volts to 16.0 Volts
- Iil (max) Transmitter Current Sourced with Receiver load (Vi = 0.3 Volt)	6.0 mA
- Iil (min) Transmitter Current Sourced with Receiver load (Vi = 0.3 Volts)	1.4 mA
- Vil (max.) Max. voltage required for a Low state to be recognized	1.5 Vdc
- Vih (min.) Min. voltage required for a High state to be recognized	3.5 Vdc
- Hysteresis (Nominal)	0.5 Vdc
INPUT RECEIVER TIMER RESOLUTION (Software Application)	16.0 µsec (Max.)
TAU (τ - Time Constant of input filter)	73 µsec (Max.)
ERROR ACCURACY - Transmitter to Receiver Data Transfer Errors - Receiver (from pulse voltage waveform to data word) - Example of Parameter Errors • Δ Vdiff - Transmitter/Receiver Ground Difference • Δ Vpu - Receiver Pull-Up voltage Variation • Δ Vcc - Receiver supply voltage variation • ΔVil/Vih - Receiver input threshold variation • ΔVRC - Receiver input filter variation - (Reference Note # 1)	± 0.60% Duty Cycle Combined Error (Absolute) (Maximum)

NOTE:
1. Data transfer error due to communication path (vehicle wiring) is assumed to be negligible.

2.11.5.4 Data Control Signal

2.11.5.4.1 Output Parameters

The following table specifies the electrical characteristics of the Low Side Drive (LSD) Data Control Signal, intended to drive the Powertrain input circuit as shown in block diagram 2.11.2.1.2.

DRIVER OUTPUT	**Open Collector/Drain @ Test Load Equal to Receiver Input**
I Leakage @ 16 V (Output driver in off state)	100 uA (Max.)
Vol (Max.) @ I Sink = 6 mA	0.5 Vdc
WAVE SHAPE	
Rise Time @ 10 - 90 % Vout	0.85 to 10.0 V/µS (Note #1)
Fall Time @ 90 - 10 % Vout	0.85 to 10.0 V/µS (Note #1)

<u>Note:</u>

1. EMC consideration - The test load shall be 3.0KΩ to 16.0 Volts and 1300 pF to ground.

2.11.5.4.2 Input Parameters

Reference Section 3.3.1 for the PCM input requirements.

2.11.6 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
2.11.3.1.1.3	Added Class 2 message “"Engine Torque-Driver Intended Torque" ($08/$20) to the Full Function TCS table.	ICR 2102
2.11.3.1.1.3	Added Class 2 Message Transmission/Transaxle/PRNDL-Transmission Gear Ratio ($3A/$38) to the Full Function TCS table.	ICR 2103

2.12 Enhanced Evaporative Emissions and Fuel System

2.12.1 Functional Overview

This section defines the interface between powertrain and platform components required to manage the vapors generated by the fuel system, the components necessary to meet the OBDII requirements of the evaporative emissions system, Engine Off Natural Vacuum (EONV), and fuel system control for both single and dual fuel tank applications. Evaporative emissions diagnostics and EONV are not required by European OBD and on those vehicles, neither Platform nor Powertrain are required to support the canister vent solenoid and fuel tank vapor pressure sensor interfaces.

The primary fuel pump delivers pressurized liquid fuel from the fuel tank to the fuel injection system at the engine. The primary fuel pump can be a constant speed fuel pump or a variable speed fuel pump. For a constant speed fuel pump, the ECM shall control the fuel pump via a fuel pump relay. For variable speed fuel pump, the ECM will transmit a PWM hardwired signal to a Fuel Pump Speed Control (FPSC) module. The FPSC module will vary the speed of the fuel pump based upon the PWM signal. The FPSC module shall provide diagnostic information about the variable speed fuel pump system to the ECM via a separate PWM hardwire. Refer to section 4.10 for algorithm description.

For a single fuel tank application, the Powertrain electronics controls the operation of the fuel pump. For dual fuel tank applications, the Powertrain electronics controls the primary and secondary fuel pumps. The secondary fuel pump transfers fuel from the secondary fuel tank to the primary fuel tank based on the fuel level of each fuel tank. This second ECM high side driver is only required on vehicles that utilize a secondary fuel pump.

If the diagnostic detects an evaporative system failure, or a diagnostic failure, Powertrain electronics shall illuminate the Service Engine Soon (MIL) telltale.

Powertrain shall determine fuel level information for the evaporative emissions diagnostic. Refer to Section 4 for the algorithm description.

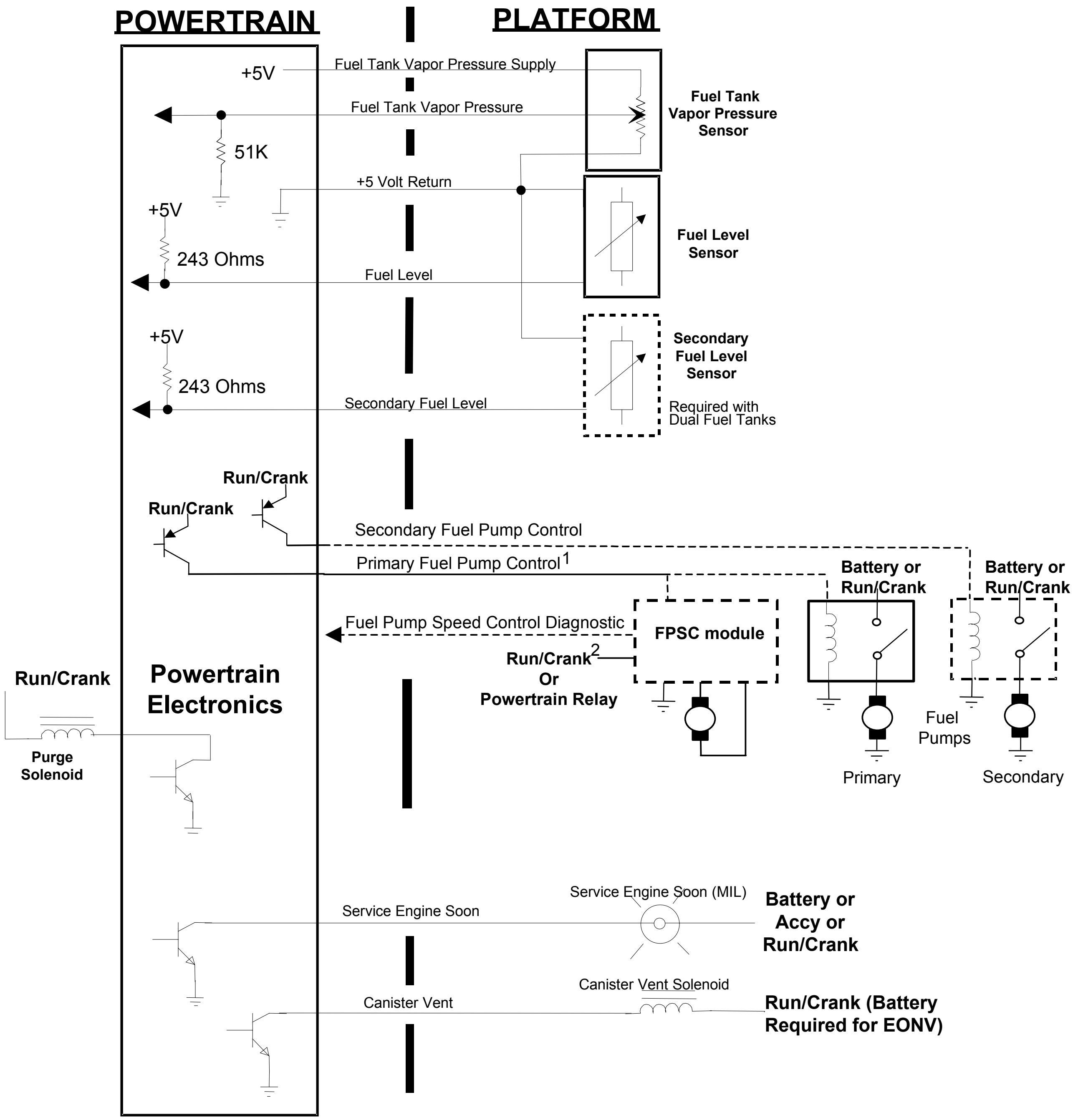
2.12.2 Hardware Overview

Platform shall provide a canister vent solenoid, a fuel tank vapor pressure sensor, a fuel level sensor(s), fuel pump(s), and FPSC module. These components are used by the Powertrain electronics in detecting fuel vapor system leaks, diagnosing the operation of the purge system, diagnosing the proper operation of the OBDII leak detection hardware, and fuel system control. The Powertrain electronics shall provide the signal conditioning for these components and shall directly read the sensor outputs through a hard-wired interface. The Powertrain electronics controls both the purge solenoid, the canister vent solenoid used in the enhanced evaporative emissions and OBDII diagnostics, and the fuel pump(s).

2.12.2.1 Block Diagram

The following block diagram depicts typical mechanization for the Enhanced Evaporative Emission system and fuel pump control. The electrical interface between Platform and Powertrain is the only standard defined.

2.12.2.1.1 *Enhanced Evaporative Emission System and Fuel Pump Control with Optional Dual Tank*



Notes:

1. This signal shall connect to the fuel pump relay for constant speed fuel pumps or the FPSC module for variable speed fuel pumps.

2. The FPSC module must connect to Run/Crank power for NA applications. Saab vehicles with Saab powertrains may connect the FPSC module to the powertrain relay.

2.12.2.2 Power and Ground Requirements

The purge solenoid and canister vent solenoid shall be powered from a fused Run or Run/Crank source supplied by Platform. This source shall be from an "Emission Critical" source that is not an "Engine Run Critical" source. For EONV applications, the canister vent solenoid shall be powered from the battery.

The fused power to the fuel pump is an "Engine Run Critical" source and it is recommended that only Powertrain essential systems be supplied power from the same fuse to minimize walk home failures.

The Powertrain electronics shall provide a regulated +5 Volt supply and return for the fuel tank vapor pressure sensor and the fuel level sensor.

2.12.3 Interface Description

2.12.3.1 Serial Data Links

Reference Section 5.0 for definitions of messages and signals.

2.12.3.1.1 Class 2 Serial Data Link

Serial Data Content	Transmitter	Primary ID	Secondary ID	Extended ID	Notes
Fuel System - Fuel Level - Percent (Filtered)	Powertrain	82	12	N/A	Required
Fuel System - Fuel Capacity Metric	Powertrain	82	16	N/A	Required
Display - Driver Notification - Check Gas Cap	Powertrain	EA	20	CC	Optional

2.12.3.1.2 GMLAN Serial Data Link

Signal Name	Transmitter	Notes
Check Fuel Filler Cap Indication On	Powertrain	Optional
Fuel Capacity	Powertrain	Required
Fuel Level Percent	Powertrain	Required
Fuel Level Percent Validity	Powertrain	Required

2.12.3.2 Primary Fuel Pump High Side Driver

In both configurations described in section 2.12.2.1, this output must be capable of providing a discrete high side driver. This driver is directly powered from the Run/Crank input to the Powertrain electronics.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.12.3.2.1 Constant Speed Fuel Pump

In constant speed application this output shall be used as a discrete high side driver which is used to activate a relay controlling a constant speed fuel pump.

2.12.3.2.2 Variable Speed Fuel Pump

In Variable speed applications this output shall be used as a high side PWM driver that provides a control signal to a variable speed fuel pump control module.

2.12.3.3 Secondary Fuel Pump High Side Driver

This output must be capable of providing a discrete high side driver. This driver is directly powered from the Run/Crank input to the Powertrain electronics.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines

2.12.3.4 Fuel Tank Vapor Pressure

Platform shall provide a Fuel Tank Vapor Pressure Sensor that produces an analog signal that is proportional to fuel tank vacuum/pressure. The Powertrain electronics shall provide an analog input that reads the Fuel Tank Vapor Pressure Sensor.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.12.3.5 Fuel Tank Vapor Pressure Supply

The Powertrain electronics shall provide a regulated +5 Volt supply to the Fuel Tank Vapor Pressure Sensor.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.12.3.6 Fuel Level

Platform shall provide a Fuel Level Sensor that produces an analog signal that tracks the level of fuel in the fuel tank. The Powertrain electronics shall provide an analog input that reads the Fuel Level Sensor. Refer to Section 4.6 for specific filtering requirements.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.12.3.7 Secondary Fuel Level

On dual fuel tank systems, Platform shall provide a Secondary Fuel Level Sensor that produces an analog signal that tracks the level of fuel in the secondary fuel tank. The Powertrain electronics shall provide an analog input that reads the Secondary Fuel Level Sensor. Refer to Section 4.6 for specific filtering requirements.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.12.3.8 Canister Vent

Platform shall provide a Canister Vent Solenoid to control the vent to the fuel vapor canister. The vent is normally open when the solenoid is not energized. The Powertrain electronics shall close the vent by energizing the Canister Vent Solenoid with a low-side drive output. The control of this vent allows the purge system to produce the required vacuum within the evaporative system in order for the Powertrain electronics to perform the leak detection algorithm.

Applications utilizing Engine Off Natural Vacuum (EONV) evaporative diagnostics shall power the canister vent solenoid from a battery feed. Powertrain Electronics may remain energized in the OFF power mode to perform EONV diagnostics.

Applications not utilizing EONV shall power the solenoid from a Run/Crank power feed.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.12.3.9 Service Engine Soon (MIL)

Reference Section 2.3.3.3.

2.12.3.10 +5 Volt Return

This input to the Powertrain electronics is the Fuel Tank Vapor Pressure Sensor, Fuel Level Sensor, and optional Secondary Fuel Level Sensor ground reference that is tied to the ECM ground, internal to the ECM.

2.12.4 Failure Modes and Diagnostics

Powertrain shall diagnose the following components for open, low voltage and high voltage:

1. Purge Solenoid
2. Canister Vent Solenoid
3. Fuel Tank Vapor Pressure Sensor
4. Primary Fuel Pump Relay

Powertrain shall turn on the Service Engine Soon (MIL) telltale and set the appropriate diagnostic trouble codes if faults are detected with any of the above components.

Powertrain shall diagnose the fuel level sensor(s) for low voltage, high voltage and stuck performance and set the appropriate diagnostic trouble codes.

2.12.5 Electrical Characteristics

2.12.5.1 Primary Fuel Pump High Side Driver

The output of the Powertrain electronics shall be powered by Run/Crank voltage and have the characteristics of a high side driver, as described in Section 3.2.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.12.5.1.1 Constant Speed Fuel Pump

In constant speed application this output shall be used as a discrete high side driver have the characteristics of a high side driver, as described in Section 3.2.

2.12.5.1.2 Variable Speed Fuel Pump

In variable speed applications this output shall be used as a PWM high side driver that meets the following electrical requirements:

Parameter	Value	Conditions
Frequency Range	128 Hz	Accuracy of ± 5.0%
Duty Cycle Range	0 to 100%	Accuracy of ± 1.0% duty cycle and a resolution of 0.5% duty cycle
Device Output Voltage Drop	1.2 Vdc max.	@ I_0 = 6 mA (driver output current), $V_{Run/Crank}$ = 16 Vdc, 105 °C
Device Output Voltage Drop	0.5 Vdc max.	@ I_0 = 1.3 mA (driver output current), $V_{Run/Crank}$ = 5.0 Vdc, 105 °C
Leakage Current	400 μA max.	@ $V_{Run/Crank=}$16 Vdc (Transmitter Driver in off state)

0% Duty Cycle is defined as the output driver continuously in the not active (high impedance) state.

The Platform FPSC shall meet the following electrical requirements:

Parameter	Value	Definition / Test Conditions
R_{pd} Resistor Pull down	3000Ω ± 7.5%	
C_{pd} Capacitor Pull down	10 nanofarads max.	
I_{ih} (max)	8.0 mA	Current Sink with Receiver load (VRun/Crank = 18.0 Volts)
V_{il} (max)	1.5 Vdc	Max. voltage required for a Low state to be recognized
V_{ih} (min)	3.5 Vdc	Min. voltage required for a High state to be recognized
Hysteresis (Nominal)	0.5 Vdc	

Refer to Section 4.10 for description of the transfer function of PWM duty cycle to fuel pump operation.

2.12.5.2 Secondary Fuel Pump High Side Driver

The output of the Powertrain electronics shall be powered by Run/Crank voltage and have the characteristics of a high side driver, as described in Section 3.2.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.12.5.3 Fuel Tank Vapor Pressure

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

Sensor Output

The output voltage shall range from 0V to Supply Voltage and is proportional to the input pressure. The usable range shall be from 0.25 to 4.75 volts. The remaining range at either end shall be reserved for diagnostic purposes.

Vout = Vcc (-k1 * Pd + k2)

Vcc = Fuel Tank vapor pressure supply

Pd = Differential Pressure = P (Fuel Tank) - P (Atmosphere)

where the range typically is -3.75 to 1.5 kPa.

k1 = sensor dependent calibration, typically = 0.04 to 0.16

k2 = sensor dependent calibration, typically = 0.3 to 0.5

The sensor must be capable of driving a 51K Ω load.

Analog Input

Parameters	Value
Pull down Resistance	51K ohms ±7.5%
Input Voltage Range	0.0 Volts to Supply Voltage
Accuracy	±78mV of the Supply Voltage over the full input range
Electrical Time Constant	1.0 mSec typical

2.12.5.4 Fuel Tank Vapor Pressure Supply

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

Parameter	Value
Supply Voltage Nominal	5.0 ±0.1 Volts
Supply Current Maximum	12.5 mA

2.12.5.5 Fuel Level

Sensor Output

The sensor output is a variable resistance with a minimum impedance of 40 ohms and a maximum impedance of 250 ohms.

Analog Input

Parameters	Value
Pull Up Resistance to regulated +5 volts	243 ohms ±2.5%
Input Voltage Range (minimum)	0.0 to 2.54 Volts
Accuracy	±78mV of the actual input
Electrical Time Constant	1.0 mSec typical

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.12.5.6 Secondary Fuel Level

Reference 2.12.5.4.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.12.5.7 Canister Vent

The output of the Powertrain electronics shall have the characteristics of a low-side driver, LSD2, as described in Section 3.1.

For EONV applications, Powertrain Electronics may remain energized in the OFF power mode for a maximum of 40 minutes and shall not exceed a steady state current of 2.5A.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.12.5.8 Service Engine Soon (MIL)

Reference Section 2.3.5.2.

2.12.5.9 +5 Volt Return

Reference Section 2.1.5.10.

2.12.5.10 Fuel Pump Speed Control Diagnostic

On applications utilizing a variable speed fuel pump, this shall be a PWM input to the Powertrain electronics with a resistor pulled up to a switched voltage source and shall meet the following electrical requirements:

Parameter	Value	Definition /Test Conditions
Duty Cycle Measurement Accuracy	±1%	128 Hz ± 5.0%
Rpu Resistor Pull up	3000Ω ± 7.5%	Pulled up to a switched voltage source.
Ci Input Capacitance	10 nanofarads max.	
V_{il} (max)	1.5 Vdc	Max. voltage required for a Low state to be recognized
V_{ih} (min)	3.5 Vdc	Min. voltage required for a High state to be recognized
Hysteresis (Nominal)	0.5 Vdc	
I_{il} (max)	8.0 mA	Maximum allowable source current. ($V_{Run/Crank}$ = 18.0 Volts)

0% Duty Cycle is defined as the output driver continuously in the not active (high impedance) state.

The Fuel Pump Speed Controller shall provide the PWM low side driver with the following electrical requirements:

Parameter	Value	Definition / Test Conditions
Frequency Range	128 Hz	Accuracy of ± 5.0%

Duty Cycle Range	0 to 100%	Accuracy of ±1% duty cycle and a resolution of 0.5% duty cycle
Co Capacitance maximum	10 nanofarad	
V_{ol}	0.3 Vdc Max	@ I Sink = 6 mA
$I_{leakage}$	100 µA Max.	Current leakage at Vo = 16 Volts Transmitter Driver in off state
Data Transfer Error	± 1.0 % Duty Cycle (max)	Example of Parameter Errors: Output Timer Resolution and Calculation

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.12.6 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
2.12.1	Added implementation for variable speed fuel pump and fuel pump controller.	ICR 2010
2.12.2, 2.12.2.1.1,	Modified Hardware Overview and Block Diagram to include variable fuel pump speed control diagnostic and FPSC module.	
2.12.3.2	Added calibration section, corresponding to the new algorithm section (4.10) for variable speed fuel pump control.	
2.12.3.3.1, 2.12.3.3.2, 2.12.5.1.1, 2.12.5.1.2	Added separate driver information for constant speed and variable speed fuel pump.	
2.12.5.10	Added fuel pump speed control diagnostic section for use with a variable speed fuel pump.	

2.13 Exhaust After-Treatment

2.13.1 Functional Overview

This section includes the electrical interfaces required for both Electrically Heated Catalyst (EHC) and Air Injection Reaction (AIR). One or both of these functions are needed by various powertrains in order to meet TLEV, LEV and/or ULEV emissions standards.

The AIR system introduces air flow into the exhaust system to increase oxygen that reacts with the hydrocarbons. This reduces the hydrocarbons from the engine exhaust gas.

The EHC system introduces a supplemental heat source to the engine exhaust gas. Increasing the exhaust gas temperature improves catalyst efficiency and results in improved emission performance.

The EHC is commanded on by the Powertrain electronics only during a cold start. This system regulates the generator output voltage to 25V and directs all electrical energy to a resistive heating element residing in the exhaust path. During the 15-20 seconds the EHC is on, all other electrical loads in the vehicle are supplied by the battery. When commanded off, the generator output voltage is returned to normal regulated system voltage. The generator is then redirected back to the battery and the vehicle electrical system. The algorithm is owned by Powertrain and implemented in the Powertrain electronics.

Generator control by the Powertrain electronics is required with EHC. The generator must be disabled before EHC is commanded on or off.

The EHC status may be required by Platform for electrical load management. This information is communicated over the serial data link.

2.13.2 Hardware Overview

The interface for AIR consists of a discrete AIR Pump Command output from the powertrain electronics to a platform relay. The platform relay provides a controlled power feed to the powertrain AIR Pump. Some AIR systems may have additional Powertrain controls which do not impact the interface with platform. Additionally, some vehicles may be required to provide an additional relay to provide power to the AIR valves.

The EHC interface consists of:

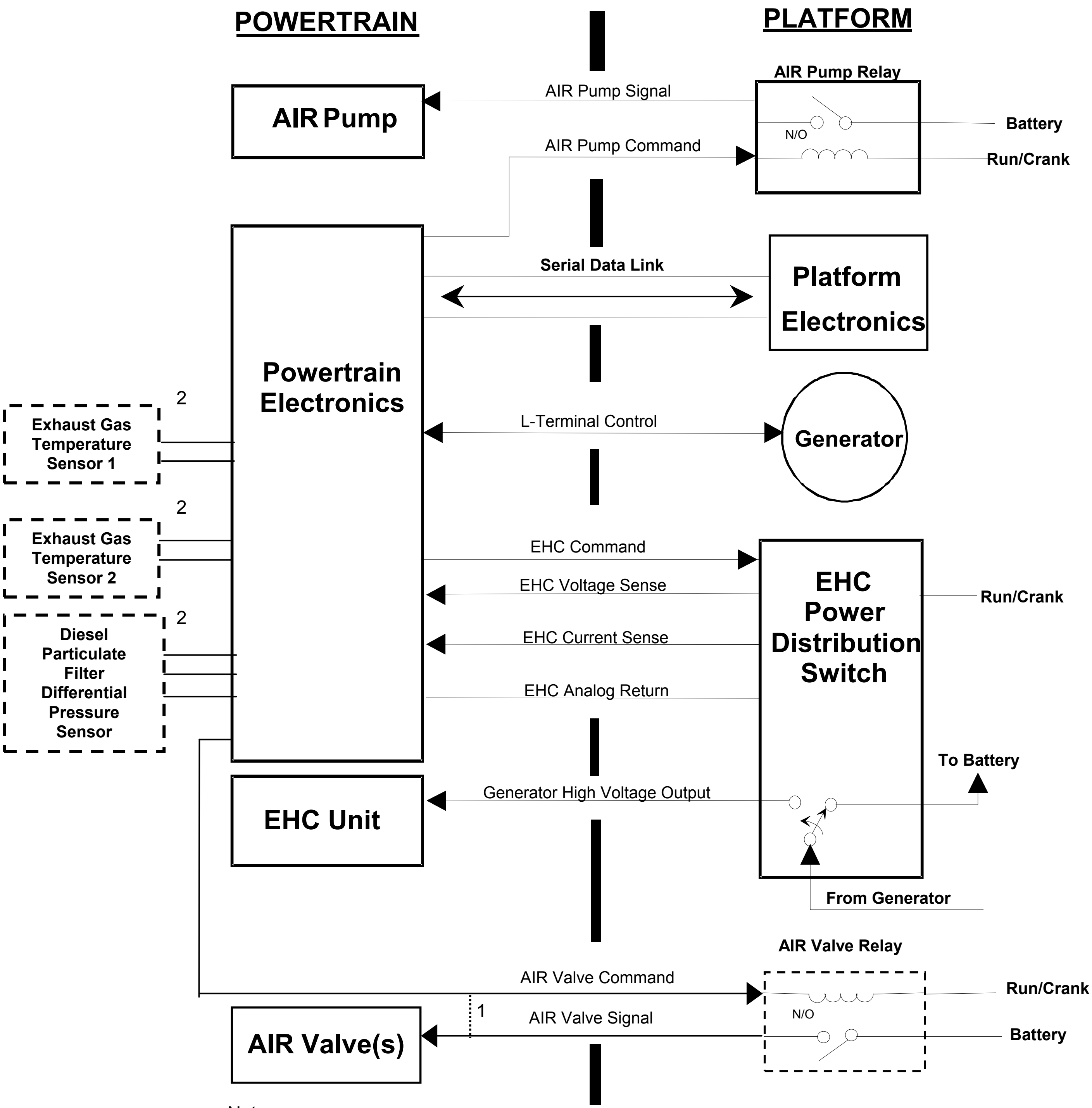
1) The AIR interface described above;
2) A discrete EHC Command output from the Powertrain electronics to the Platform EHC Power Distribution Switch;
3) A voltage-sense signal from the switch to the Powertrain electronics;
4) A current-sense signal from the switch to the Powertrain electronics;
5) A single analog return for both the voltage-sense and current-sense signals;
6) A High-Voltage Generator output from the Platform EHC Power Distribution Switch to the Powertrain EHC Unit; and
7) An L-Terminal control signal from the Powertrain electronics to the generator.

Reference Section 2.16 for other Generator interfaces.

The EHC Unit requires a high-current ground.

2.13.2.1 Block Diagram

The following block diagram depicts a typical mechanization. The electrical interface between Powertrain and Platform is the only standard defined.



Note:
1. Some applications may drive a low current AIR valve directly from the Powertrain electronics without implementing the AIR valve relay.
2. Differential Pressure Sensor and Exhaust Gas Temperature Sensors are Optional to meet emissions for Diesel Engines

2.13.2.2 Power and Ground Requirements

The maximum circuit resistance for the EHC system (excluding the EHC Power Distribution Switch) is 30 milliohms maximum over all temperature conditions. This resistance comes from the following components:

Component	Maximum Circuit Resistance (mΩ)
The wiring between the generator and the EHC Power Distribution Switch.	17
The wiring between the EHC Power Distribution Switch and the EHC unit pigtail.	
The EHC unit pigtail	5
EHC return consisting of the exhaust pipe and/or ground strap to the engine block.	8

2.13.3 Interface Description

2.13.3.1 Serial Data Links

Reference Section 5.0 for definitions of messages and signals.

2.13.3.1.1 Class 2 Serial Data Link

Serial Data Content	Transmitter	Primary ID	Secondary ID	Extended ID	Notes
Engine System Other - Electrically Heated Catalyst Status	Powertrain	52	09	N/A	Optional with EHC

2.13.3.1.2 GMLAN Serial Data Link

Signal Name	Transmitter	Notes
Powertrain Exhaust Particle Filter Warning Indication On	Powertrain	Optional with Diesel
Powertrain High Electrical Load Requested	Powertrain	Optional with Diesel

2.13.3.2 AIR Pump Signal

This signal is a power feed to the AIR Pump from the AIR Relay. It is switched to Battery voltage when the AIR Pump Command is low.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.13.3.3 AIR Pump Command

This signal is a discrete low-side driver output of the powertrain electronics to the AIR Pump Relay. The AIR Pump is commanded on through the relay when this signal is asserted low. The AIR Pump shall not be commanded on prior to engine starting.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.13.3.4 AIR Valve Signal

This signal is a power feed to the AIR Valve from the AIR Valve Relay. It is switched to Battery voltage when the AIR Valve Command is low.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.13.3.5 AIR Valve Command

This signal is a discrete low-side driver output of the powertrain electronics to the AIR Valve Relay. The AIR Valve is commanded on through the relay when this signal is asserted low. The AIR Valve shall not be commanded on prior to engine starting. Platform shall power the relay coil from a Run/Crank feed.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.13.3.6 EHC Command

This signal is a discrete low-side driver output of the powertrain electronics to the EHC Power Distribution Switch. The EHC system is commanded on when this signal is asserted low.

2.13.3.7 EHC Voltage Sense

This 0-5V analog signal is an input to the powertrain electronics from the EHC Power Distribution Switch. The signal is 20% of the Generator High Voltage Output.

2.13.3.8 EHC Current Sense

This 0-5V analog signal is an input to the powertrain electronics from the EHC Power Distribution Switch. The signal is proportional to the current flowing from the Power Distribution Switch to the EHC unit with a scaling of 1 Volt/25 Amperes.

2.13.3.9 Generator High Voltage Output

This signal is the High-Voltage output of the generator that is connected to the Powertrain EHC Unit via the Platform EHC Power Distribution Switch when the EHC Command is asserted low. There is no other device connected to this signal.

2.13.3.10 EHC Analog Return

This signal is the ground reference for both the EHC voltage and current sense. It is connected to the PCM ground, internal to the PCM.

2.13.3.11 L-Terminal Control

Reference Section 2.16.3.2.2.

2.13.4 Failure Modes and Diagnostics

The current flowing from the EHC power distribution switch to the EHC unit, and EHC voltage are monitored to ensure the EHC Unit is providing supplemental heat to the catalyst, as designed, to meet OBDII requirements.

2.13.5 Electrical Characteristics

2.13.5.1 AIR Pump Signal

Specific voltage, current, and recommended fusing requirements shall be provided by Powertrain.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.13.5.2 AIR Pump Command

The output of the Powertrain electronics shall have the characteristics of a low-side driver, LSD3, as described in Section 3.1.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.13.5.3 AIR Valve Signal

Specific voltage, current, and recommended fusing requirements shall be provided by Powertrain.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.13.5.4 AIR Valve Command

The output of the Powertrain electronics shall have the characteristics of a low-side driver, LSD3, as described in Section 3.1.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.13.5.5 EHC Command

The output of the Powertrain electronics shall have the characteristics of a low-side driver, LSD3, as described in Section 3.1. The input of the Platform EHC Power Distribution Switch shall have the characteristics of any of the loads described in Section 3.1.1.

2.13.5.6 EHC Voltage Sense

This output is a 0 to 5 Volt signal capable of driving a 51K Ohm load. This signal shall have an accuracy of ±2% at the EHC Power Distribution switch..

Analog Input

Parameters	Value
Pull Down Resistance	51kΩ ±7.5%
Input Range	0.0 Volts to 5 Volts
Accuracy	±1.56% over the full input range
Electrical Time Constant	1.0 mSec typical

2.13.5.7 EHC Current Sense

This output is a 0 to 5 Volt signal capable of driving a 51K Ohm load. The accuracy of this signal in the 0 to 3 volt range shall be ±10% at the EHC Power Distribution switch. In the 3 to 5 volt range the accuracy shall be ±3% at the EHC Power Distribution switch.

Analog Input

Parameters	Value
Pull Down Resistance	51kΩ ±7.5%
Input Range	0.0 Volts to 5 Volts
Accuracy	±1.56% over the full input range
Electrical Time Constant	1.0 mSec typical

2.13.5.8 Generator High Voltage Output

When the EHC Command is asserted low, this signal is the Generator High-Voltage output consisting of:

25V @ 150A max.

2500 Watts minimum at the EHC Unit

When the EHC Command is unasserted (high), this signal is an open circuit.

2.13.5.9 EHC Analog Return

Reference Section 2.1.5.10.

2.13.5.10 L-Terminal Control

Reference Section 2.16.5.1.2.

2.13.6 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
2.13.3.1.2	Added GMLAN Signals: Powertrain Exhaust Particle Filter Warning Indication On and Powertrain High Electrical Load Requested	ICR 2023
2.13.2.1 2.13.3.1.2	Updated block diagram to add Diesel Particle Filter Differential Pressure Sensor, and the two Exhaust Gas Temperature Sensors. Updated notes column to state, “Optional With Diesel” for GMLAN Signals Powertrain Exhaust Particle Filter Warning Indication On and Powertrain High Electrical Load Requested	ICR 2096

2.14 Suspension Control

2.14.1 Functional Overview

Suspension control is a Platform optional feature. Powertrain shall not provide any control for this feature. Platform shall define the functional requirements of the suspension control system for each application. The interface described in this section shall be standard for all vehicles equipped with suspension control.

For Class 2 applications, Powertrain shall provide Platform with a hard-wired lift/dive signal. The lift/dive signal is generated based on a complex algorithm and shall indicate conditions such as wide open throttle. This indication shall allow the suspension control system to compensate for changes in vehicle acceleration.

For GMLAN applications, Powertrain shall provide Platform lift and dive information via the high speed GMLAN serial data link.

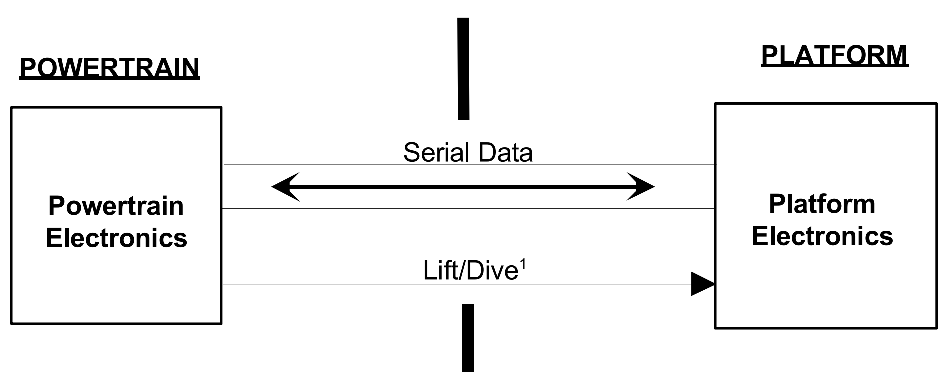
Powertrain shall transmit vehicle speed data to Platform via the serial data link for use by the suspension control algorithm.

2.14.2 Hardware Overview

The description of this subsystem covers the lift/dive signal and the serial data link.

2.14.2.1 Block Diagram

The following block diagram depicts a typical mechanization for suspension control. The electrical interface between Powertrain and Platform is the only standard defined.



1 This signal is required for some Class 2 based vehicles

2.14.3 Interface Description

2.14.3.1 Serial Data Links

Reference Section 5.0 for definitions of messages and signals.

2.14.3.1.1 Class 2 Serial Data Link

Serial Data Content	Transmitter	Primary ID	Secondary ID	Extended ID	Notes
Engine Air Intake - Intake Air Temperature	Powertrain	0A	20	N/A	Required
Vehicle Speed - High Resolution -	Powertrain	28	02	N/A	Required
Suspension - Failure Status	Platform	58	0B	N/A	Required
Suspension - Suspension Options	Platform	58	3C	N/A	Optional
Vehicle Speed Control - Speed Limit Value	Powertrain	62	10	N/A	Optional
Displays - Driver Notification - Reduce Top Speed	Powertrain	EA	20	D5	Optional

2.14.3.1.2 GMLAN Serial Data Link

Signal Name	Transmitter	Notes
Engine Intake Air Temperature	Powertrain	Required
Engine Intake Air Temperature Validity	Powertrain	Required
Real Time Damping System Present	Platform	Optional
Suspension System Dampers Failed Full Soft	Platform	Required
Vehicle Lift/Dive Status	Powertrain	Optional
Vehicle Lift/Dive Status Validity	Powertrain	Optional
Vehicle Speed	Powertrain	Required
Vehicle Speed Validity	Powertrain	Required
Vehicle Top Speed Limit Value	Powertrain	Optional
Vehicle Top Speed Limitation Indication On	Powertrain	Optional

2.14.3.2 Lift/Dive

This signal is used for Class 2 applications only. Lift/dive is a discrete low side driver output of the Powertrain electronics. The output shall be pulled low for lift/dive condition.

2.14.4 Failure Modes and Diagnostics

Reference Section 2.10.4 for serial data failure modes and diagnostic information.

Platform and Powertrain, through coordination with STG, shall provide appropriate diagnostics and failsoft for each of their inputs and outputs.

2.14.5 Electrical Characteristics

2.14.5.1 Lift/Dive

This signal is used for Class 2 applications only. The output of the Powertrain electronics shall be a low side driver, with at minimum the capability of an LSD5 driver, as described in Section

3.1. Platform shall provide the required pull-up to switched battery voltage during the Run/Crank power mode.

2.14.6 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
	There were no changes made to this section for PPEI 2.5 Release.	

2.15 Transmission

2.15.1 Functional Overview

This interface shall be applicable to all vehicles, equipped with manual or automatic transmissions. Powertrain shall define the functional requirements of the transmission control system for each application.

Powertrain shall determine selected gear state and shift preference state (optional) for use in transmission shift control.

Tap-Up/Tap-Down (TUTD) is an optional function, which allows an automatic transmission to be operated like a manual transmission. Platform is required to have a TUTD display for the driver in order to have the TUTD feature. The customer must first enable the system with a TUTD On/Off switch. The customer makes gear change requests with the TUTD Switch. If Powertrain accepts the enable, it sends a confirmation to Platform that the TUTD mode is active. Powertrain will maintain the transmission in the current gear unless transmission protection or engine stall calibrations are reached, the customer commands a gear change or the customer turns the TUTD On/Off switch Off. Typically, the TUTD display will display transmission gear data from Powertrain when the TUTD active signal is received. The display may also optionally have an additional indication that the TUTD mode is requested. When in TUTD mode, the customer can use the TUTD switch to request the transmission to shift up or down in single gear increments. If Powertrain cannot accept the customer gear request because of transmission protection, or engine stall calibrations, Powertrain may transmit a driver shift control denied message and may override customer requested gear selections. Not all automatic transmissions have the capability for TUTD shifting.

Electronic Range Select is an optional function, which uses the TUTD switches to electronically shift the gear range of an automatic transmission. This function is enabled with the TUTD On/Off switch. The customer makes gear range requests to shift up or down with the TUTD Switch. If the gear range request is accepted, Powertrain will update the PRNDL range selected data. Powertrain will maintain the transmission in the current gear unless transmission protection or engine stall calibrations are reached, the customer commands a gear range change or the customer turns the TUTD On/Off switch Off.

Clutch state and Park/Neutral state are used by Powertrain for idle speed control in some applications. Platform may also use this information in other subsystems.

Brake Lamp Switch (BLS) state is used by Powertrain for disengaging the torque converter clutch.

2.15.2 Hardware Overview

For all automatic transmissions, Powertrain shall determine selected gear state based on the signals from the Mode Indication switch. This information is communicated to Platform using the serial data link.

For all automatic transmissions, Platform shall provide a hard-wired BLS signal to Powertrain for disengaging the torque converter clutch.

For Tap-Up/Tap-Down shifting, GMNA Platform shall provide an analog multiplexed TUTD Switch hardwired to Powertrain. GME Platform shall provide an analog multiplexed TUTD

Switch hardwired to Powertrain, and can optionally provide TUTD Switch information via GMLAN. GME powertrain shall always provide the analog input for the TUTD switch, but shall support GMLAN as an optional source of the switch information. Platform shall also read a TUTD On/Off switch and provide the appropriate information via the serial data link.

For applications that use GMLAN to communicate TUTD Switch information, the maximum latency to recognize a change of state for an input shall be 40 msec. The latency time is defined as the time from when the switch is initially activated by the driver until the information transmittal on the data link has been completed.

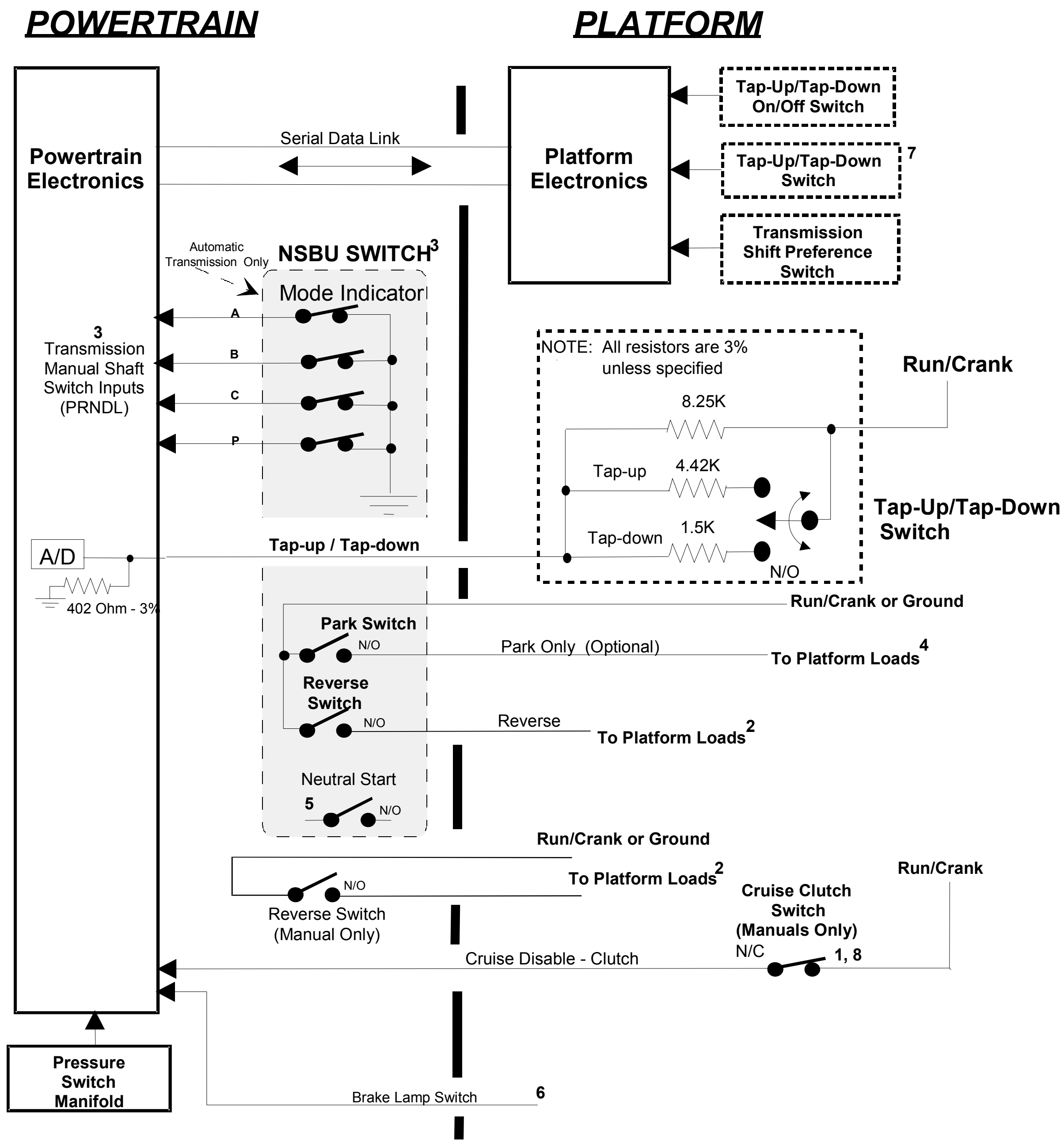
Platform shall provide appropriate debounce logic for TUTD switch inputs. The software interfacing to the input switches shall allow for a minimum debounce time of 10 msec as measured from the initial contact opening or closing. Any change of state lasting less than this duration is to be ignored. The software shall require at least two successive reads of the input reflecting the new state before recognizing the change of state as valid. Depending on the sample time, more than two successive reads can be applied.

For manual transmissions, Platform shall provide a hard-wired Clutch switch signal to the Powertrain electronics.

Automatic transmissions with Internal Mode Switches do not support an external NSBU switch.

2.15.2.1 Block Diagram

The following block diagram depicts a typical mechanization for transmission control. The electrical interface between Powertrain and Platform is the only standard defined.



Notes:

1. Optional on manual transmissions only.
2. Reference Reverse electrical characteristics for switch current requirements.
3. A NSBU switch is not supported on transmissions with Internal Mode Switches (IMS).
4. Possible Platform loads include: BTSI, Fuel Door Release, Auto Door Locks, and Deck Lid Release.
5. Neutral Start switch is part of the NSBU although it is not used in this section. Reference PPEI Section 2.5.2.1.
6. See Section 2.7.2.1 for more details on Brake Lamp Switch signal.
7. Optional for GME applications.
8. The Cruise Clutch Switch is required for North American applications even if these applications are released in the non North American markets. However the cruise clutch switch is optional for manual transmission systems that are released in non North American markets that are not North American applications.

2.15.2.2 Power and Ground Requirements

For systems implementing the Tap-up/Tap-down hardwired interface, the maximum voltage difference between the Run/Crank feed at the switch and the PCM Run/Crank pin shall be 0.7V.

2.15.3 Interface Description

2.15.3.1 Serial Data Links

Reference Section 5.0 for definitions of messages and signals.

2.15.3.1.1 Class 2 Serial Data Link

Serial Data Content	*Transmitter*	*Primary ID*	*Secondary ID*	*Extended ID*	*Notes*
Brakes - Parking Brake Active	Platform	32	20	N/A	Required on vehicles with Auto Trailering Mode
Brakes - Brake Pedal Status	Platform	32	2A	N/A	Required with BASS
Brakes - Brake Light Switch, Brake Switch Active	Powertrain	32	22	N/A	Required on vehicles without BASS
Transmission/ Transaxle/ PRNDL - Estimated Trans Gear Engaged	Powertrain	3A	03	N/A	Optional
Transmission/Transaxle/ PRNDL -Transmission Shift Solenoids State	Powertrain	3A	0E	N/A	Optional
Transmission/Transaxle/ PRNDL -Tap Up/Tap Down Target Gear	Powertrain	3A	0F	N/A	Optional
Transmission/ Transaxle/ PRNDL - Shift Feel	Platform	3A	30	N/A	Optional
Transmission/Transaxle/ PRNDL - Performance Shift Mode	Powertrain	3A	31	N/A	Optional
Transmission/Transaxle/ PRNDL - Tap Up/Tap Down Mode Status	Platform	3A	32	N/A	Required for Tap Up/Tap Down
Transmission/Transaxle/ PRNDL - Winter Mode Status	Platform	3A	33	N/A	Optional
Displays - PRNDL	Powertrain	EA	0A	N/A	Required with electronic PRNDL
Displays - Driver Notification - Transmission Skip Shift	Powertrain	EA	20	88	Optional
Displays - Driver Notification - Transmission UpShift	Powertrain	EA	20	89	Optional
Displays - Driver Notification - Tap Up/Tap Down Mode	Powertrain	EA	20	F7	Required for Tap Up/Tap Down

Displays-Driver Notification-Tap Up/ Tap Down Request Denied	Powertrain	EA	22	A4	Optional with Tap Up/Tap Down

2.15.3.1.2 GMLAN Serial Data Link

Signal Name	Transmitter	Notes
Antilock Brake System Active	Platform	Optional
Antilock Brake System Present	Platform	Optional
Brake Pedal Initial Travel Achieved	Platform	Required on vehicles with BASS
Brake Pedal Position Failure	Platform	Required on vehicles with BASS
Brake Pedal Switch Active	Powertrain	Optional on vehicles without BASS
Brake Pedal Switch Active Validity	Powertrain	Optional on vehicles without BASS
Continuous Variable Transmission Present	Powertrain	GME Required with CVT
Driver Shift Control Request Denied Indication On	Powertrain	Optional for Tap Up/Tap Down
Engine Calculated Actual Gear	Powertrain	Optional
Engine Calculated Actual Gear Validity	Powertrain	Optional
Engine Recommended Shift Indication	Powertrain	Optional
Manual Transmission Reverse Gear Active	Platform	Optional
Manual Transmission Reverse Gear Active Validity	Platform	Optional
Powertrain Brake Pedal Discrete Input Status	Powertrain	Optional (For GME Use Only)
Powertrain Brake Pedal Discrete Input Validity	Powertrain	Optional (For GME Use Only)Optional
Powertrain Brake Pedal Secondary Discrete Input Status	Powertrain	Optional (For GME Use Only)Optional
Powertrain Brake Pedal Secondary Discrete Input Validity	Powertrain	Optional (For GME Use Only)Optional
Transmission Actual Gear	Powertrain	Optional
Transmission Actual Gear Validity	Powertrain	Optional
Transmission Electronic Range Select Mode Request	Platform	Optional
Transmission Gear Indication	Powertrain	Optional
Transmission Gear Indication Validity	Powertrain	Optional
Transmission Gear Ratio	Powertrain	Required for traction control with CVT transmission
Transmission Gear Ratio Validity	Powertrain	Required for traction control with CVT transmission
Transmission Gear Selector Position	Powertrain	Required
Transmission Gear Selector Position Validity	Powertrain	Required
Transmission Load Management Shift Pattern Request	Platform	Optional
Transmission Load Management Shift Pattern Status	Powertrain	Optional
Transmission Performance Algorithm Shift Mode Active	Powertrain	Optional
Transmission Shift Lever Lock Requested	Powertrain	Required with CVT
Transmission Skip Shift Indication	Powertrain	Optional
Transmission Sport Shift Pattern Request	Platform	Optional
Transmission Sport Shift Pattern Status	Powertrain	Optional
Transmission Tap Up/Tap Down Mode Indication On	Powertrain	Required for Tap Up/Tap Down

Transmission Tap Up/Tap Down Mode Request	Platform	Required for Tap Up/Tap Down
Transmission Tap Up/Tap Down Request	Platform	GME optional for Tap Up/Tap Down- See *Note
Transmission Tap Up/Tap Down Request Validity	Platform	GME optional for Tap Up/Tap Down- See *Note
Transmission Trailering Shift Pattern Request	Platform	Optional
Transmission Trailering Shift Pattern Status	Powertrain	Optional
Transmission Winter Mode Request	Platform	Optional
Transmission Winter Mode Status	Powertrain	Optional

*Note: Since GM Powertrain automatic transmissions require a hardwired analog TUTD signal, this GMLAN signal will not be used on North American vehicles.

2.15.3.2 Park Only

The Park Only signal is produced from a normally-open switch that closes when the transmission manual shaft is in the Park position. This switch usage is Platform-optional and is part of the NSBU switch assembly. Applications that do not utilize this switch shall use serial data information to determine Park Only information as required.

2.15.3.3 Reverse

The Reverse signal is produced from a normally-open switch that closes when the transmission manual shaft is in the Reverse position. This signal drives the Backup Lamps, a relay, or provides an input to the Platform electronics.

For automatic transmissions, this switch usage is Platform-optional and is part of the NSBU switch assembly. Applications that do not use this switch utilize serial data information to determine reverse information.

For manual transmissions, the separate reverse switch is required.

2.15.3.4 Brake Lamp Switch (BLS)

Refer to Section 2.7.3.3.

2.15.3.5 Cruise Disable - Clutch

This input to the Powertrain electronics is determined by the Clutch switch on manual transmissions. This switch is a momentary contact switch, normally closed to Run/Crank voltage. The Clutch switch opens when the operator depresses the clutch pedal. This switch is required for North American applications even if these applications are released in the non North American markets. However, this switch is optional for manual transmission systems that are released in non North American markets that are not North American applications.

2.15.3.6 Tap-up/Tap-down

This analog input to the Powertrain electronics is required for GMNA. For GME, it is required only when Platform does not provide TUTD switch information via GMLAN. It is determined by a single Tap-up/Tap-down switch. This switch produces an analog signal that represents one of two modes of operation: Tap-up, or Tap-down.

In addition, Platform shall transmit a serial data signal based on the Tap-up/Tap-down on/off switch to determine when Tap-up/Tap-down is enabled for operation.

2.15.4 Failure Modes and Diagnostics

Reference Section 2.10.4 for serial data failure modes and diagnostic information.

Platform and Powertrain, through coordination with STG, shall provide appropriate diagnostics and failsoft for each of their inputs and outputs.

2.15.5 Electrical Characteristics

2.15.5.1 Park Only

The Park Only switch must be capable of sourcing up to 10A of current.

2.15.5.2 Reverse

The Reverse switch must be capable of sourcing a minimum of 10 mA and up to 8.4A of steady state current, and 55A peak current for a time duration of 10 mS.

2.15.5.3 Brake Lamp Switch (BLS)

Reference Section 2.7.5.2

2.15.5.4 Cruise Disable - Clutch

Reference Section 3.3.2.

2.15.5.5 Tap-up/Tap-down

This analog input is from a multiplexed Tap-up/Tap-down switch to the Powertrain electronics. This function shall operate ratiometrically with Run/Crank within the normal voltage operating range. Refer to Section 2.1.5.1. The Tap-up/Tap-down and Run/Crank analog inputs must be read by the PCM sufficiently close in time such that the Run/Crank voltage and A/D reference voltage do not change between A/D conversions. The PCM must then divide the Tap-up/Tap-down voltage reading by the Run/Crank voltage reading and compare the result with the voltages in the following table to determine the mode.

Tap-up/Tap-down Switch State		Voltage at PCM input as a percent of Run/Crank voltage ($V_{R/C}$)	Tap-up/Tap-down Mode
		$\%V_{R/C} < 4.08\%$	No operation - open circuit/short to gnd
Tap-up and Tap-down Switches	Off	$4.08\% < \%V_{R/C} < 10.77\%$	No operation
Tap-up Switch	On	$10.77\% < \%V_{R/C} < 13.82\%$	Transmission Tap-up
		$13.82\% < \%V_{R/C} < 21.15\%$	No operation
Tap-down Switch	On	$21.15\% < \%V_{R/C} < 26.93\%$	Transmission Tap-down
		$\%V_{R/C} > 26.93\%$	No Operation - short to Battery

In determining the $\%V_{R/C}$ in the table above, the following implementation parameters for the PCM were assumed:

A/D Accuracy	± 78.5 mV
Pull-down resistor	402 Ω ± 3%
A/D Supply Reference	5V ±100mV

Tap-up/Tap-down Switch Requirements

Source Resistor	8.25K Ω ± 3%
Tap-up Resistor	4.42K Ω ± 3%
Tap-down Resistor	1.50K Ω ± 3%
Contact Resistance (each switch)	10 Ω max

2.15.6 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
2.15.1 2.15.3.1.2	Revise Tap-Up/Tap-Down description to identify Driver Shift Control signal. Added GMLAN signal to the Signal Summary table: Driver Shift Control Request Denied Indication On.	ICR 2040
2.15.2.1 2.15.3.5	Added as a Note 8 for Cruise Clutch Switch to block diagram. This switch is required for North American applications even if these applications are released in the non North American market. However this switch is optional for manual transmission systems that are released in non North American Market that are not North American applications. Revised Cruise Disable – Clutch switch requirements accordingly.	ICR 2045
2.15.3.1.1	Added Class-2 Message' Displays-Driver Notification-Tap Up/ Tap Down Request Denied.	ICR 2052

2.16 Generator Control

2.16.1 Functional Overview

There are two standard mechanizations for generators.

The Case 1 mechanization (F-Terminal Monitor and L-Terminal Monitor) provides for generator turn-on and monitoring of generator field duty cycle and fault indication. The generator L-Terminal is used to both initiate turn-on and monitor fault indication. The F-Terminal is used to monitor field duty cycle and diagnose fault conditions.

The Case 2 mechanization (F-Terminal Monitor, L-Terminal Monitor, and L-Terminal Control) additionally provides generator on/off control. This mechanization is required for Regulated Voltage Control (RVC), engine load management, and Electrically Heated Catalyst (EHC). RVC is a platform optional feature that utilizes a PWM scheme to adjust the regulator setpoint voltage and load. Engine load management and EHC are powertrain optional features.

NOTE: RVC, as defined in this section, has been approved as a standard optional feature only for GM North America applications. Although RVC has not been approved by Opel for European applications, it would be implemented in Opel ECMs when required on GM North America applications.

For the Case 2 mechanization, the Powertrain Electronics will turn on the generator by pulling the L-Terminal high after the engine starts and is running properly. With a high applied on the L-Terminal, the generator regulator shall apply generator field excitation and regulate generator output when proper operating speed is detected.

Without RVC, generator turn-on is initiated by pulling the L-Terminal high. With RVC, generator turn-on is initiated by pulse-width modulating the L-Terminal to match the duty cycle commanded by Platform.

With RVC, Powertrain shall provide a PWM high-side driver output for generator control via the L-Terminal. This enables Platform to adjust regulator setpoint voltage and Powertrain to momentarily shed generator load on the engine when RPM falls below a calibratible threshold. The associated benefits of L-Terminal control include reduced RPM droop/flare and lower engine stall potential during idle.

For either mechanization, Powertrain shall monitor generator L-Terminal voltage and transmit its diagnostic status to Platform via the serial data link. The generator voltage regulator shall pull the L-Terminal low when the generator is near zero speed or not operating properly. Platform may control the generator telltale for other conditions (e.g., when ignition is ON and the engine is not running).

Powertrain shall monitor F-Terminal duty cycle if the signal is provided. This duty cycle is an indication of the generator load on the engine and a diagnostic aid. Powertrain may utilize the duty cycle for idle stability purposes. If required by Platform, Powertrain shall transmit the F-Terminal duty cycle to Platform via the serial data link.

Refer to PPEI Section 4 for the algorithm descriptions for generator status and control.

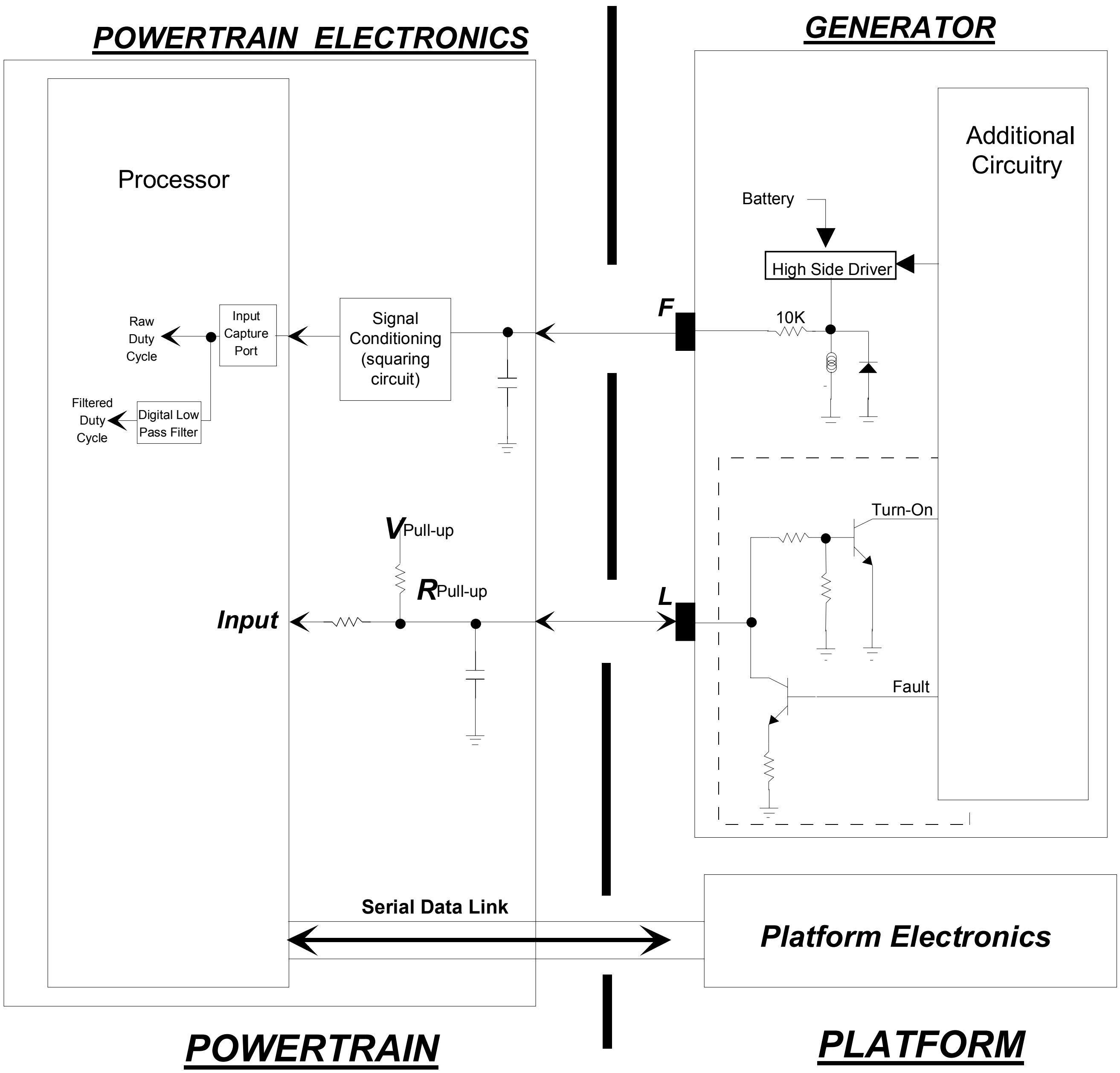
2.16.2 Hardware Overview

The description of this subsystem covers the F and L-Terminals and the serial data link between the Powertrain and Platform Controllers. The generator voltage regulator shall provide a discrete low side driver (L-Terminal) and a PWM high-side driver (F-Terminal) as signals to the Powertrain Controller. In the Case 2 mechanization, the Powertrain Controller shall provide a high-side driver on the L-Terminal as input to the voltage regulator.

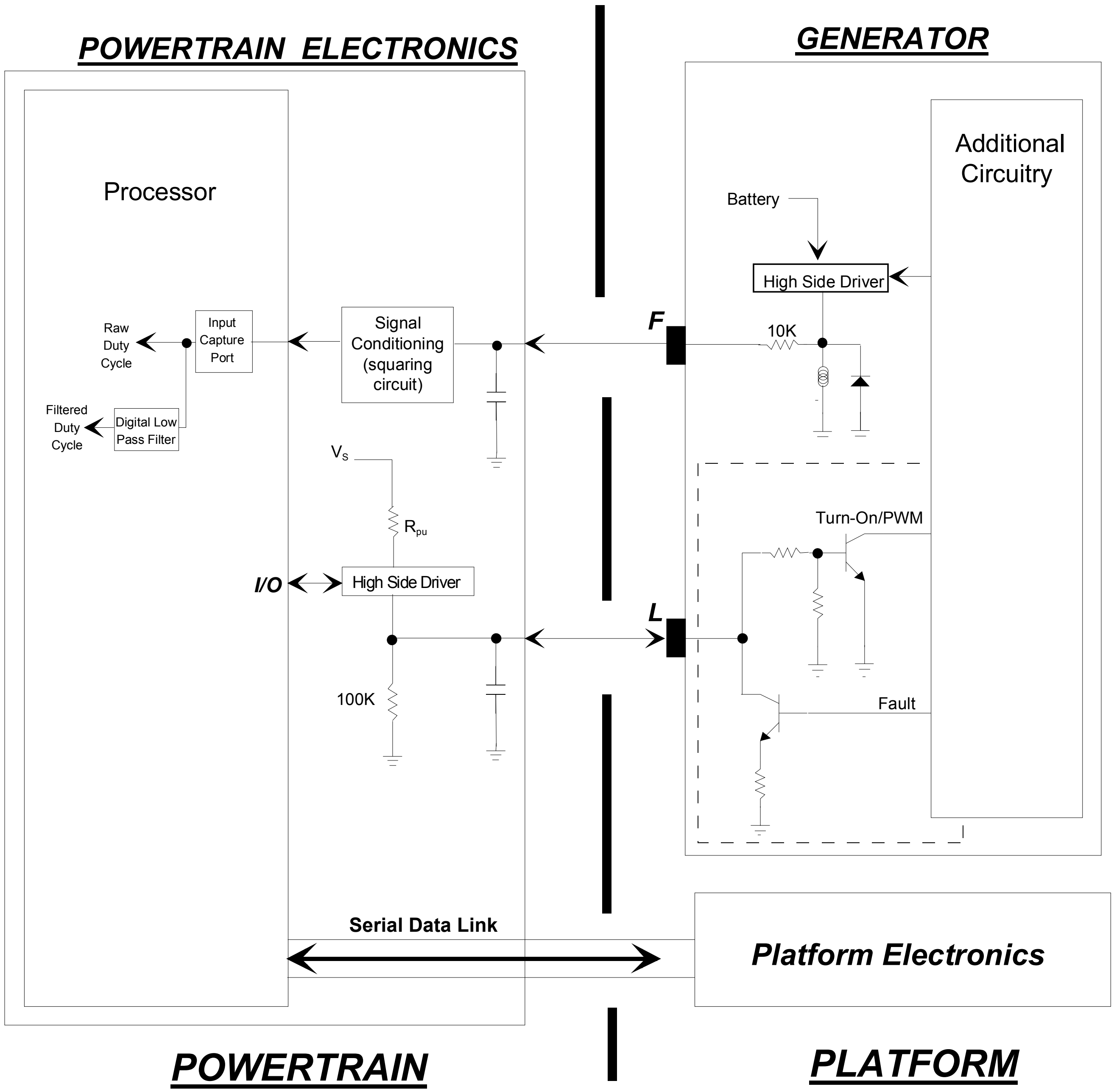
2.16.2.1 Block Diagrams

The following two block diagrams depict the standard mechanizations for generator control. The L-Terminal circuits are examples only and may not reflect an actual implementation of the voltage regulator circuit.

2.16.2.1.1 Case 1: F -Terminal Monitor and L-Terminal Monitor



2.16.2.1.2 Case 2: F -Terminal Monitor, L-Terminal Monitor, and L-Terminal Control



2.16.3 Interface Description

2.16.3.1 Serial Data Links

Reference Section 5.0 for definitions of messages and signals.

2.16.3.1.1 Class 2 Serial Data Link

Serial Data Content	Transmitter	Primary ID	Secondary ID	Extended ID	Notes
Engine Coolant - Fan 1 (All) Speed	Powertrain	48	01	N/A	Required with RVC
Engine Air Intake - Intake Air Temperature	Powertrain	0A	20	N/A	Required with RVC
Charging System - Field Duty Cycle	Powertrain	72	20	N/A	Required with RVC
Charging System - L Terminal Duty Cycle	Platform	72	24	N/A	Required with RVC
Displays - Driver Notification - Charging System Volts / Generator Fault	Powertrain	EA	20	8E	Required if EA 20 E2 not used
Displays - Driver Notification - Generator Indicator	Powertrain	EA	20	E2	Required if EA 20 8E not used
Exterior Environment – Estimated Outside Air Temperature	Powertrain	F2	08	N/A	Required with RVC

2.16.3.1.2 GMLAN Serial Data Link

Signal Name	Transmitter	Notes
Engine Cooling Fan Speed	Powertrain	Required with RVC
Engine Intake Air Temperature	Powertrain	Required with RVC
Engine Intake Air Temperature Validity	Powertrain	Required with RVC
Generator Enabled	Powertrain	Optional
Generator Failed	Powertrain	Required
Generator Field Duty Cycle	Powertrain	Required with RVC
Generator Field Duty Cycle Validity	Powertrain	Required with RVC
Generator Regulator Setpoint Duty Cycle Request	Platform	Required with RVC
Outside Air Temperature Powertrain Estimated	Powertrain	Required with RVC
Outside Air Temperature Powertrain Estimated Mask	Powertrain	Required with RVC
Outside Air Temperature Powertrain Estimated Validity	Powertrain	Required with RVC

2.16.3.2 L-Terminal

The L-Terminal is used to initiate generator turn-on and indicate generator status. For RVC, the L-Terminal is also used for setpoint voltage control.

2.16.3.2.1 L-Terminal Monitor

The Powertrain Controller shall provide a pull-up resistor or high-side driver on the L-Terminal to ensure sufficient current for proper state monitoring and power moding of the voltage regulator. For non-RVC applications, without sufficient current to the voltage regulator, the generator is disabled yielding no generator output.

The generator voltage regulator shall provide a low-side drive to pull the L-Terminal low when the generator is near zero speed or not operating properly.

2.16.3.2.2 L-Terminal Control

The Powertrain controller shall provide a discrete high-side driver and a pull-down resistor for generator on/off control. When the high-side driver is turned on, the voltage regulator is commanded on and the L-terminal monitor is enabled. When the high-side driver is turned-off, the voltage regulator is commanded off and the L-terminal monitor is disabled.

For RVC applications, the L-Terminal high-side driver shall be pulse-width modulated. The PWM duty cycle is communicated to Powertrain from Platform via serial data. Powertrain shall be able to reduce the generator load by commanding a duty cycle of 10%.

2.16.3.3 F-Terminal

This input to Powertrain shall be a PWM voltage signal that replicates the duty cycle being applied to the generator field. This signal shall switch between ground and battery voltage, and its *average* duty cycle generally shall be proportional to the generator's output current and torque load. However, on a transient basis, the torque lags the PWM signal by the field's L/R time constant (typically 100 milliseconds).

The Powertrain Controller shall digitize the voltage signal from the generator PWM high-side driver and determine the corresponding PWM percent high time (i.e., duty cycle). Powertrain can use this raw duty cycle information in its idle speed control algorithm to anticipate changes in generator load. Powertrain shall process this raw duty cycle information with a digital low pass filter and send the filtered duty cycle output to Platform via the serial data link. The digital filter time constant shall be a calibratible value between 0.5 and 5.0 seconds. For Class 2 applications, Powertrain shall transmit a report when the filtered field duty cycle changes by 5%.

At full output (with full field), the duty cycle can go to 100% and result in a constant high state for an indefinite time. Conversely, when the load is reduced, the duty cycle may go to zero for a maximum of two seconds in order to decrease the generator field current and help prevent overvoltage. Moreover, the *instantaneous* duty cycle can change significantly from one cycle to the next due to ripple within the voltage regulation loop.

Upon generator turn-on, the voltage regulator shall limit the field current by limiting the initial duty cycle to a value between 5% and 35%.

With the engine idling and the generator above cut-in speed, the voltage regulator shall limit the rate of increase of the field duty cycle to avoid sudden increases in engine load. This limited rate, known as Load Response Control (LRC), shall be 40% of rated field per second (2.5 seconds/100% field change) for <u>all</u> applications. The LRC tolerance shall be ±20%, i.e. 2.0 to 3.0 seconds/100% field change. LRC is in effect until the LRC cut-out speed of 3100 ±15% generator rpm is exceeded.

Above the LRC cut-out speed, only the field L/R time constant (typically 100 ms) will limit the rate of torque loading and unloading.

2.16.4 Failure Modes and Diagnostics

Reference Section 2.10.4 for serial data failure modes and diagnostic information.

A fault detection circuit within the generator voltage regulator shall sense when the generator voltage is outside a specified range. The regulator shall be protected from shorts to ground or battery voltage on either the L- or the F-Terminal.

The generator diagnostic and telltale control algorithm monitors both the F- and the L-Terminals and commands the telltale. Reference Section 4.4 for diagnostic description.

2.16.5 Electrical Characteristics

2.16.5.1 L-Terminal

2.16.5.1.1 Case 1 Mechanization

The electrical characteristics described in this section pertain to the requirements for using the L-Terminal to turn on the generator and monitor for generator fault or insufficient rotation.

The powertrain electronics shall provide the following to <u>turn-on the generator</u>:

$V_{L\text{-term}}$ = 1.2 V minimum @ $I_{L\text{-term}}$ = 6.0 mA minimum available

The voltage, $V_{L\text{-term}}$, is referenced to PCM ground.

The powertrain electronics shall provide the following to <u>hold-on the generator</u>:

$V_{L\text{-term}}$ = 4.0 V minimum @ $I_{L\text{-term}}$ = 1.5 mA minimum available

The voltage, $V_{L\text{-term}}$, is referenced to PCM ground.

The generator shall <u>signal a fault</u> or low rotational speed by clamping the L-Terminal low to 1.5V maximum referenced to regulator ground.

Powertrain shall provide the following:

$R_{pull\text{-}up}$ = 1.5 KΩ ± 7.5%

$V_{pull\text{-}up}$ = Run/Crank switched battery voltage

Note: It is not necessary to design for generator turn-on during cranking. Generator turn-on after cranking from a battery voltage of 11V is sufficient.

<u>PCM L-Terminal Fault Monitor Characteristics</u>

The Powertrain Electronics shall interpret the L-Terminal as a logic low state when

$V_{L\text{-term}} \leq 2.0$ V at the PCM.

The Powertrain Electronics shall interpret the L-Terminal as a logic high state when

$V_{L\text{-term}} \geq 4.0$ V at the PCM.

The Powertrain Electronics shall filter the L-Terminal signal with an electrical time constant equal to 1 ms ± 30% (measured at the comparator).

A 0.5V maximum ground voltage difference between the PCM and the regulator has been used for worst case analysis. Reference Section 2.1.5.3.2.

2.16.5.1.2 Case 2 Mechanization

The electrical characteristics described in this section pertain to the requirements for using the L-Terminal to turn-on or turn-off the generator and monitor for generator fault or insufficient rotation.

The powertrain electronics shall provide the following to turn-on the generator:

$V_{L\text{-}term}$ = 1.2V minimum @ $I_{L\text{-}term}$ = 6.0 mA minimum available

The voltage, $V_{L\text{-}term}$, is referenced to PCM ground.

The powertrain electronics shall provide the following to hold-on the generator:

$V_{L\text{-}term}$ = 3.5V minimum @ $I_{L\text{-}term}$ = 1.5 mA minimum available

The voltage, $V_{L\text{-}term}$, is referenced to PCM ground.

In order to turn-off the generator, the powertrain electronics shall limit the L-Terminal leakage current to less than 25 microamps with L-Terminal shorted to PCM ground.

The generator shall signal a fault or low rotational speed by clamping the L-Terminal within the following limits:

$V_{L\text{-}term}$ = 1.5 V maximum @ $I_{L\text{-}term}$ = 10.0 mA maximum

Note: It is not necessary to design for generator turn-on during cranking. Generator turn-on after cranking from a battery voltage of 11V is sufficient.

The Powertrain Controller shall provide the L-Terminal turn-on current and have the capability of switching the L-Terminal pull-up source voltage using a high-side driver.

For RVC this output shall be PWM capable as defined in the table below:

Parameter	Value	Comments
Frequency	128 Hz	Accuracy of ± 5.0%
Duty Cycle Range	0 to 100%	Accuracy of ± 1.0% duty cycle and a resolution of 0.5% duty cycle

0% Duty Cycle is defined as the output driver continuously in the not active (high impedance) state.

PCM L-Terminal Fault Monitor Characteristics

The Powertrain Electronics shall interpret the L-Terminal as a fault when $V_{L\text{-}term} \leq 1.5V$ at the PCM while the output driver is on. The pull-down resistance shall be 100KΩ ± 10%.

A 0.5V maximum ground voltage difference between the PCM and the regulator should be used for worst case analysis. Reference Section 2.1.5.3.2.

2.16.5.2 F-Terminal

The generator shall provide a PWM voltage on the F-Terminal through a series resistor according to the following specifications:

$V_{F\text{-}Terminal\ High}$	Open Circuit Voltage: 8.0 to 16.0 V
$V_{F\text{-}Terminal\ Low}$	Open Circuit Voltage: 1.0 to -1.0 V
Series Resistance	10 KΩ ± 30%
PWM range	0% to 100%
Control Frequency	60 to 500 Hz

PCM Input Characteristics

Duty cycle input range	5% to 100%
Accuracy	± 1.0% duty cycle
Minimum resolution	0.5% duty cycle

2.16.6 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
2.16.3.1.2	Added GMLAN signals "Outside Air Temperature Powertrain Estimated, Outside Air Temperature Powertrain Estimated Validity and Outside Air Temperature Powertrain Estimated Mask".	ICR 2071
2.16.3.1.1 2.16.3.1.2	Added Class 2 message "Engine Coolant - Fan 1 (All) Speed, $48/$01" Added GMLAN signal "Engine Cooling Fan Speed"	ICR 2073
2.16.3.1.1	Added Class 2 message "Engine System Other – Estimated Outside Air Temperature ($F2/$08)".	ICR 2111

2.17 Supplemental Inflatable Restraints

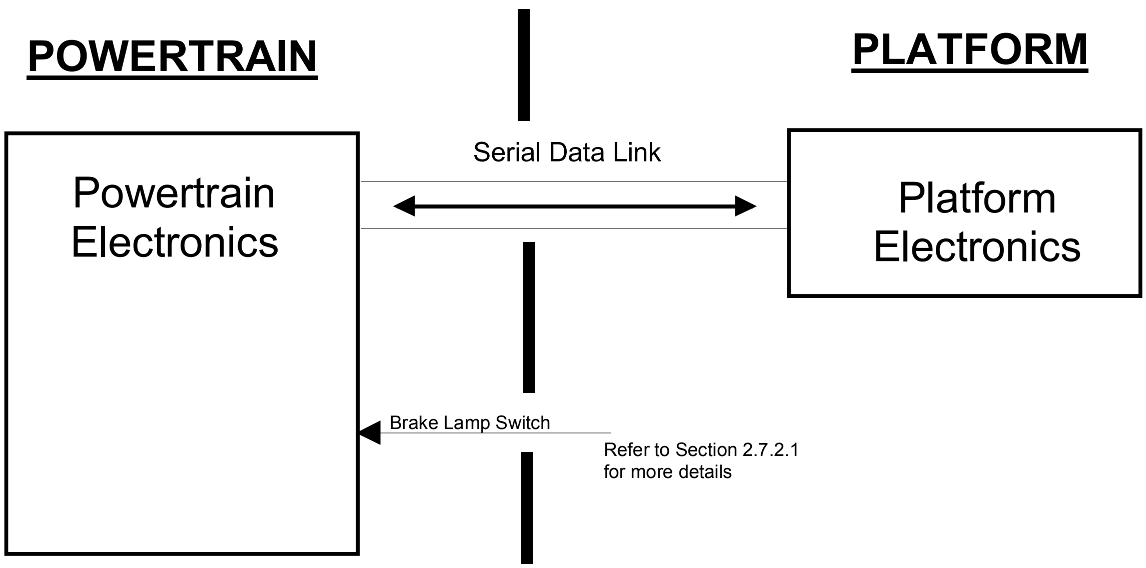
2.17.1 Functional Overview

Supplemental Inflatable Restraints (SIR) is a Platform-owned system that interfaces with Powertrain. The SIR subsystem uses information from Powertrain for crash recording and electronic keying purposes.

2.17.2 Hardware Overview

2.17.2.1 Block Diagram

The following block diagram depicts a typical mechanization for the SIR Platform-Powertrain electrical interface. This interface is the only standard defined.



2.17.3 Interface Description

2.17.3.1 Serial Data Links

Reference Section 5.0 for definitions of messages and signals.

2.17.3.1.1 Class 2 Serial Data Link

Serial Data Content	Transmitter	Primary ID	Secondary ID	Extended ID	Notes
Throttle Position Sensor - Pedal Position	Powertrain	12	11	N/A	Required
Engine RPM - High Resolution	Powertrain	1A	10	N/A	Required
Vehicle Speed - High Resolution - Metric	Powertrain	28	02	N/A	Required
Brakes - Brake Light Switch, Brake Switch Active	Powertrain	32	22	N/A	Required for vehicles without BASS

Serial Data Content	Transmitter	Primary ID	Secondary ID	Extended ID	Notes
Restraints - Airbags Deployed	Platform	D2	07	N/A	Powertrain Optional with ETC

2.17.3.1.2 GMLAN Serial Data Link

Signal Name	Transmitter	Notes
Accelerator Actual Position	Powertrain	Required
Accelerator Actual Position Validity	Powertrain	Required
Airbag Deployed	Platform	Powertrain Optional with ETC
Brake Pedal Switch Active	Powertrain	Required for vehicles without BASS
Brake Pedal Switch Active Validity	Powertrain	Required for vehicles without BASS
Cruise Control Active	Powertrain	Required with cruise control
Engine Calculated Actual Gear	Powertrain	Required with manual trans and ECM
Engine Calculated Actual Gear Validity	Powertrain	Required with manual trans and ECM
Engine Emissions Related Malfunction Active	Powertrain	Required
Engine Limp Home Mode Active	Powertrain	Required if vehicle has ETC
Engine Speed	Powertrain	Required
Engine Speed Validity	Powertrain	Required
Service Engine System Non Emission Related Indication Request	Powertrain	Platform Optional
Throttle Position	Powertrain	Required for GMNA
Throttle Position Validity	Powertrain	Required for GMNA
Transmission Actual Gear	Powertrain	Required on vehicles with Auto Trans or with PCM
Transmission Actual Gear Validity	Powertrain	Required on vehicles with Auto Trans or with PCM
Vehicle Speed	Powertrain	Required
Vehicle Speed Validity	Powertrain	Required

2.17.3.2 Brake Lamp Switch (BLS)

Reference Section 2.7.3.3

2.17.4 Failure Modes and Diagnostics

Reference Section 2.10.4 for serial data failure modes and diagnostic information.

2.17.5 Electrical Characteristics

2.17.5.1 Brake Lamp Switch (BLS)

Reference Section 2.7.5.2

2.17.6 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
	There are no changes to this section for PPEI 2.5 Release.	

2.18 Power Take-Off – (Not Available)

(Not Available)

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2.19 Vehicle Speed and Rough Road Sensing

2.19.1 Functional Overview

Vehicle speed information is provided by Powertrain for various Platform functions. This information is available via serial data. Some truck applications require a hard-wired signal for up-fitter use.

A distance rolling count serial data message provided by Powertrain is required for display and navigation purposes. It may contain up to two independent distance rolling counters (i.e., EITHER one for the driven wheels and one for the non-driven wheels; OR one for the left non-driven wheel and one for the right non-driven wheel).

Each counter shall be a function of at most two independent sources of data. The data sources available may be any of the following: (1) Platform-supplied wheel rotation rolling counters (one defined for each of the four wheels); or (2) Platform hardwired wheel speed sensor signal; or (3) Powertrain hardwired transmission output speed sensor.

When more than one independent source of wheel rotation data is desired to compute a single distance rolling counter, Powertrain shall use a Primary/Backup strategy to compute the distance rolling counter. This means that:

1) One of the sources shall be designated as the primary source of data and another shall be designated as the backup source of data.
2) The primary source shall be used exclusively until a fault condition is detected with that source (e.g., validity bit = INVALID; or signal is missing; or sensor fault is detected).
3) Once a primary source fault condition is detected, the powertrain controller shall begin using the backup source immediately and shall not revert to using the primary source even if the primary source “heals” itself.

The powertrain controller shall continue to use the backup source until the end of the ignition cycle. If the backup source subsequently fails, all distance rolling computations shall cease and the outgoing validity flag shall indicate INVALID. If the backup source subsequently “heals” itself, distance rolling computations shall resume, even during the same ignition cycle.

Tire size information shall reside in the Powertrain electronics since it is required for vehicle speed and distance rolling count calculation. GMNA applications also require axle ratio information for the vehicle speed and distance rolling count calculation.

Rough road information is used for Powertrain diagnostics. On GMNA applications that require rough road sensing, the rough road parameter shall be calculated in the ABS module and transmitted to Powertrain via the serial data link. On GME applications that require rough road sensing, the rough road parameter shall be calculated in the ECM. The calculation shall be based on wheel speed sensor data available via serial data or by hard-wire.

2.19.2 Hardware Overview

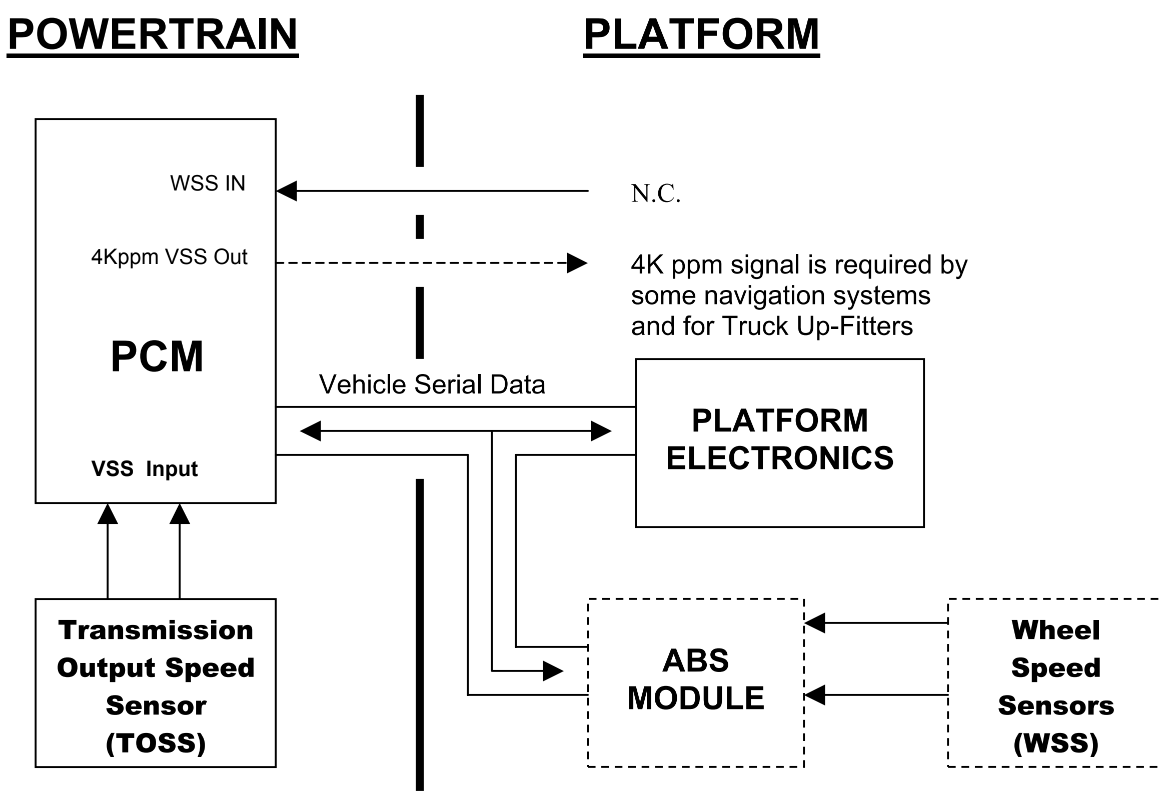
2.19.2.1 GMNA Applications

Powertrain shall calculate vehicle speed and distance rolling count based on the transmission output speed sensor. Vehicle speed and distance rolling count shall be transmitted by Powertrain to

Platform via the serial data link. This serial data link may be Class 2 or GMLAN. Optionally, a hard-wired 4K ppm vehicle speed output shall be provided by Powertrain.

2.19.2.1.1 Block Diagram

The following block diagram depicts a typical mechanization for the GMNA Platform-Powertrain electrical interface. This interface is the only standard defined.



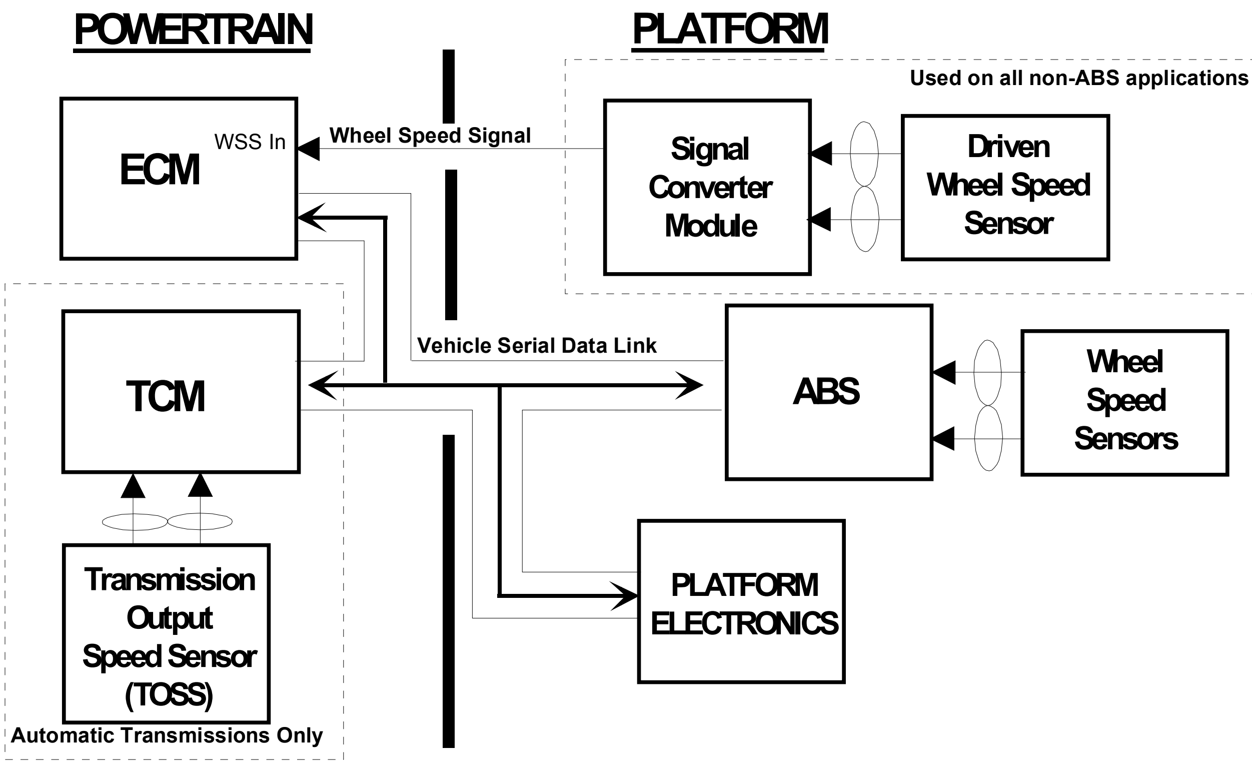
Note: Items shown using dashed lines to indicate optional usage as negotiated between platform and powertrain.

2.19.2.2 GME Applications

Powertrain shall calculate vehicle speed and distance rolling count based either on a wheel speed frequency signal or on wheel speed data transmitted by the ABS module via the serial data link. The serial data link shall be GMLAN.

2.19.2.2.1 Block Diagram

The following block diagram depicts a typical mechanization for the GME Platform-Powertrain electrical interface. This interface is the only standard defined.

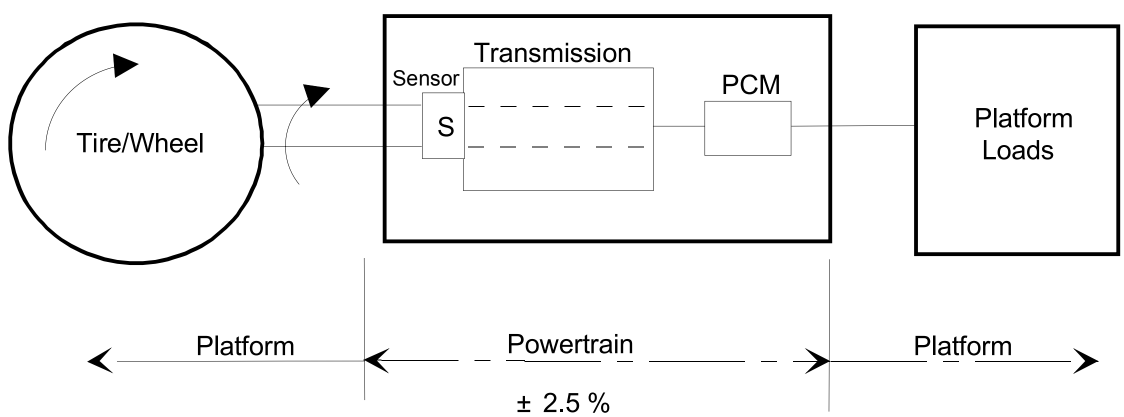


2.19.3 Interface Description

2.19.3.1 GMNA Applications

In order to meet California and Hawaii state laws for odometer accuracy, the total odometer system accuracy shall be within ± 4%. Measurement errors due to target wheel tooth spacing, sensor construction and mounting, and PCM processing shall not exceed ± 2.5%. This limit applies to the transmittal of information via hard-wired signal or serial data link.

<u>Tolerance Limits for Odometer</u>



2.19.3.1.1 Serial Data Links

Reference Section 5.0 for definitions of messages and signals.

2.19.3.1.1.1 Class 2 Serial Data Link

Serial Data Content	*Transmitter*	*Primary ID*	*Secondary ID*	*Extended ID*	*Notes*
Vehicle Speed - High Resolution - Metric	Powertrain	28	02	N/A	Required
Odometer - Rolling Count	Powertrain	7A	06	N/A	Required
Wheels - Average Peak to Peak Acceleration (Rough Road)	Platform	24	07	N/A	Required for vehicles that require rough road detection
Wheels - Maximum Driven Wheel Velocity Metric	Platform	24	05	N/A	Optional

2.19.3.1.1.2 GMLAN Serial Data Link

Signal Name	*Transmitter*	*Notes*
Distance Rolling Count Driven Wheel	Powertrain	Required - See Note
Distance Rolling Count Driven Wheel Reset Occurred	Powertrain	Required - See Note
Distance Rolling Count Driven Wheel Validity	Powertrain	Required - See Note
Distance Rolling Count Left Non Driven Wheel	Powertrain	Required - See Note
Distance Rolling Count Left Non Driven Wheel Reset Occurred	Powertrain	Required - See Note
Distance Rolling Count Left Non Driven Wheel Validity	Powertrain	Required - See Note
Distance Rolling Count Non Driven Wheel	Powertrain	Required - See Note
Distance Rolling Count Non Driven Wheel Reset Occurred	Powertrain	Required - See Note
Distance Rolling Count Non Driven Wheel Validity	Powertrain	Required - See Note
Distance Rolling Count Right Non Driven Wheel	Powertrain	Required - See Note
Distance Rolling Count Right Non Driven Wheel Reset Occurred	Powertrain	Required - See Note
Distance Rolling Count Right Non Driven Wheel Validity	Powertrain	Required - See Note
Vehicle Speed	Powertrain	Required
Vehicle Speed Validity	Powertrain	Required
Wheel Angular Velocity Front Left	Platform	Required with ABS
Wheel Angular Velocity Front Left Validity	Platform	Required with ABS
Wheel Angular Velocity Front Right	Platform	Required with ABS
Wheel Angular Velocity Front Right Validity	Platform	Required with ABS
Wheel Angular Velocity Rear Left	Platform	Required with ABS
Wheel Angular Velocity Rear Left Validity	Platform	Required with ABS
Wheel Angular Velocity Rear Right	Platform	Required with ABS
Wheel Angular Velocity Rear Right Validity	Platform	Required with ABS
Wheel Average Peak to Peak Acceleration	Platform	Required for vehicles that require rough road detection
Wheel Average Peak to Peak Acceleration Validity	Platform	Required for vehicles that require rough road detection

Note: Only the following Distance Rolling Count signal pair and the associated Reset Occurred and Validity signals currently are utilized on GMNA applications:

Distance Rolling Count Driven Wheel

Distance Rolling Count Non Driven Wheel

2.19.3.1.2 4K PPM Vehicle Speed Signal

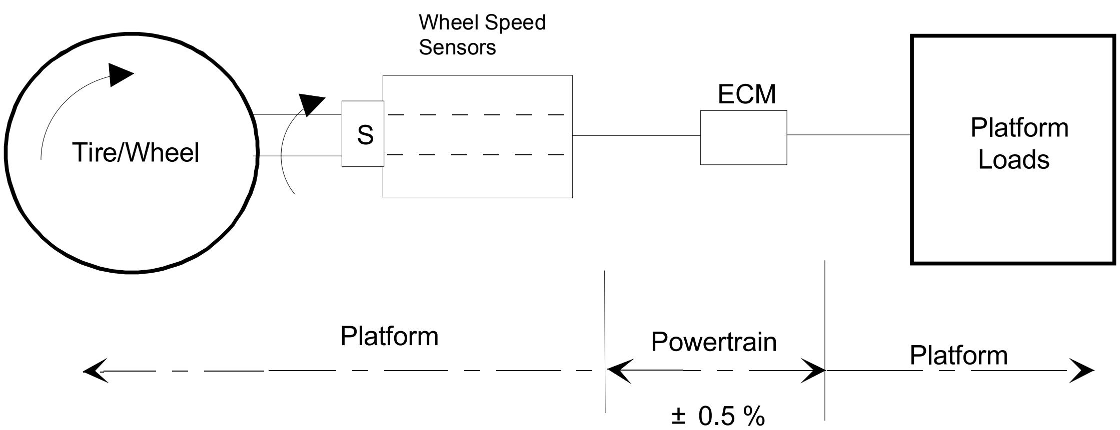
This signal is a variable frequency output that is proportional to vehicle speed.

This signal shall transmit a value equal to zero vehicle speed, when all input sources of vehicle speed to the Powertrain controller are unavailable.

2.19.3.2 GME Applications

In order to meet European laws for odometer and vehicle speed accuracy, the ECM processing error shall not exceed ± 0.5%. This limit applies to the transmittal of information via hard-wired signal or serial data link.

Tolerance Limits for Odometer/Vehicle Speed Accuracy



2.19.3.2.1 GMLAN Serial Data Link

Signal Name	*Transmitter*	*Notes*
Distance Rolling Count Driven Wheel	Powertrain	Required - See Note
Distance Rolling Count Driven Wheel Reset Occurred	Powertrain	Required - See Note
Distance Rolling Count Driven Wheel Validity	Powertrain	Required - See Note
Distance Rolling Count Non Driven Wheel	Powertrain	Required - See Note
Distance Rolling Count Non Driven Wheel Reset Occurred	Powertrain	Required - See Note
Distance Rolling Count Non Driven Wheel Validity	Powertrain	Required - See Note
Distance Rolling Count Left Non Driven Wheel	Powertrain	Required - See Note
Distance Rolling Count Left Non Driven Wheel Reset Occurred	Powertrain	Required - See Note
Distance Rolling Count Left Non Driven Wheel Validity	Powertrain	Required - See Note
Distance Rolling Count Right Non Driven Wheel	Powertrain	Required - See Note
Distance Rolling Count Right Non Driven Wheel Reset Occurred	Powertrain	Required - See Note
Distance Rolling Count Right Non Driven Wheel Validity	Powertrain	Required - See Note
Vehicle Speed	Powertrain	Required
Vehicle Speed Validity	Powertrain	Required

Signal Name	*Transmitter*	*Notes*
Wheel Angular Velocity Front Left	Platform	Required with ABS
Wheel Angular Velocity Front Left Validity	Platform	Required with ABS
Wheel Angular Velocity Front Right	Platform	Required with ABS
Wheel Angular Velocity Front Right Validity	Platform	Required with ABS
Wheel Angular Velocity Rear Left	Platform	Required with ABS
Wheel Angular Velocity Rear Left Validity	Platform	Required with ABS
Wheel Angular Velocity Rear Right	Platform	Required with ABS
Wheel Angular Velocity Rear Right Validity	Platform	Required with ABS
Wheel Rotations Left Driven Rolling Count	Platform	Required with ABS
Wheel Rotations Left Driven Rolling Count Reset Occurred	Platform	Required with ABS
Wheel Rotations Left Driven Rolling Count Validity	Platform	Required with ABS
Wheel Rotations Left Non Driven Rolling Count	Platform	Required with ABS
Wheel Rotations Left Non Driven Rolling Count Reset Occurred	Platform	Required with ABS
Wheel Rotations Left Non Driven Rolling Count Validity	Platform	Required with ABS
Wheel Rotations Right Driven Rolling Count	Platform	Required with ABS
Wheel Rotations Right Driven Rolling Count Reset Occurred	Platform	Required with ABS
Wheel Rotations Right Driven Rolling Count Validity	Platform	Required with ABS
Wheel Rotations Right Non Driven Rolling Count	Platform	Required with ABS
Wheel Rotations Right Non Driven Rolling Count Reset Occurred	Platform	Required with ABS
Wheel Rotations Right Non Driven Rolling Count Validity	Platform	Required with ABS

Note: Only the following Distance Rolling Count signal pair and the associated Reset Occurred and Validity signals currently are utilized on GME applications:

Distance Rolling Count Left Non Driven Wheel
Distance Rolling Count Right Non Driven Wheel

2.19.3.2.2 Wheel Speed Signal

This is a variable frequency signal that is proportional to wheel speed. It is an input to the ECM from the wheel speed sensor.

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.19.4 Failure Modes and Diagnostics

Reference Section 2.10.4 for serial data failure modes and diagnostic information.

2.19.5 Electrical Characteristics

2.19.5.1 GMNA Applications

2.19.5.1.1 4K PPM Vehicle Speed Signal

This signal shall be an active low output of the Powertrain electronics, with a Powertrain-provided pull-up resistor to Run/Crank voltage. The signal shall have the following characteristics:

Parameter	Limits	Comments
V_{OL}: @ I_{load} = 20 mA	 1.00 V Maximum	Output driver on
V_{OH}: @ I_{load} = 0 mA	 7.00 V Minimum	Output driver off
I_O Shorted	10 mA Maximum	Output driver off
Load - Current	30 mA Maximum	
Load - Capacitive	0.015 µF Maximum	
Leakage Current @ 16 V	100 µA Maximum	
Output Frequency	4K Pulses/Mile	
Duty Cycle	50 ±10%	
Output Period Jitter	1% Maximum	Powertrain system.
@ <100 Hz input frequency or < 3 MPH, output must be high, or output must go high within 80 ms of absence of pulse input.		
Within 100 ms of Ignition "ON" output must go high (assuming speed < 30 MPH).		

2.19.5.2 GME Applications

2.19.5.2.1 Wheel Speed Signal

Reference GMI 12554 Part 1A, 5.2.12 Pull-up Input Interface (Multiple Receiver) and GMI 12554 Part 2A "Vehicle Speed".

Input Frequency Range: 0 to 2 kHz

Resolution: 48 pulses per wheel revolution

This interface may be emissions-related. Refer to Section 1.7 for platform design guidelines.

2.19.6 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
	There are no changes to this section for PPEI 2.5 Release.	

3. ELECTRICAL

This section defines the electrical characteristics of signals that are utilized throughout the document. They are defined in detail here so that each functional area definition can reference the same characteristics. A bipolar transistor symbol is used only to represent low side and high side drivers and is not intended to be a restriction on the actual design. Components must provide internal protection against all traditional battery, switched battery, and ground transients per GMW3097GS General Specification for Electrical/Electronic Components and Subsystems, Electromagnetic Compatibility (EMC), Requirements.

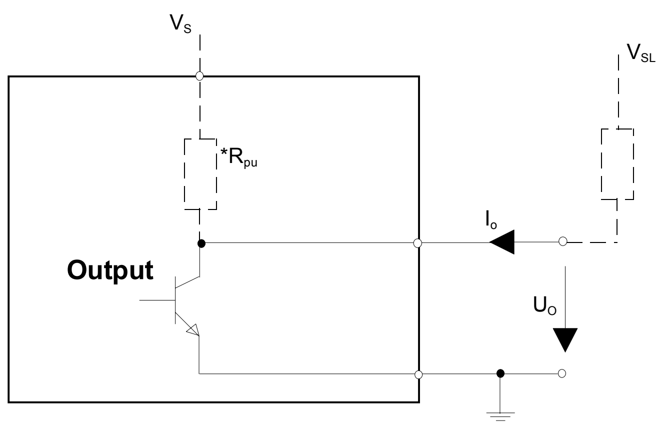
The parameters specified in this section are valid over the normal operating voltage range for the component. For powertrain electronics reference Section 2.1.5.1.

3.1 Low Side Driver

The low side driver is a discrete, active low, solid state, low side driver output of the control system. This driver is typically used for relay or telltale control.

Driver control shall exhibit characteristics defined in the tables below under normal system conditions. For example, the output should remain constant even with a temporary negative voltage applied to the controller Run/Crank input and positive voltage applied to the controller Battery input.

For low side drivers with PWM capability, the maximum frequency is dependent on the load. This maximum frequency is defined in the table below where R is the load resistance and L is the load inductance.



* R_{pu} only required for LSD5

Symbol	Parameter
I_o	Output Current
U_O	Output Voltage
V_S	Source Voltage of Controller
V_{SL}	Source Voltage of Load
Rpu	Pull-up Resistance (only used for LSD5)
V_{GND}	Ground Voltage

Low Side Driver Output Characteristics (**LSD1 - LSD5**)	
Parameter	**Value / Conditions**
Ground Difference	The receiving module must function with a ±1 volt peak (0 - 200 Hz bandwidth) ground difference between receiving module ground and the controller ground
Leakage Current	20µA, max, Vout = 16 Vdc, control driver off, controller un-powered 100µA, max, Vout = 16 Vdc, control driver off, controller powered
Fall Time	15.0 µSec Maximum up to 2 kHz (load 3.0 kΩ to 16.0 V and 1300 pF to ground)
LSD1 Driver Characteristics	
Parameter	**Value / Conditions**
U_O (V_{SAT})	1.2V max @ I_0 = 1.4 A @ 105 °C
Load (max)	7.5 Ω (min) and 70 mH (max) @ 1kHz @ -40 °C
PWM Frequency (max)	R^2 / (15.6*L), where R=Load Resistance and L=Load Inductance
LSD2 Driver Characteristics	
Parameter	**Value / Conditions**
U_O (V_{SAT})	1.2V max @ I_0 = 700 mA @ 105 °C
Load (max)	15 Ω (min) and 70 mH (max) @ 1kHz @ -40 °C
PWM Frequency (max)	R^2 / (63.3*L), where R=Load Resistance and L=Load Inductance
LSD3 Driver Characteristics	
Parameter	**Value / Conditions**
U_O (V_{SAT})	1.2V max @ I_0 = 400 mA @ 105 °C
Load (max)	25 Ω (min) and 70 mH (max) @ 1kHz @ -40 °C
PWM Frequency (max)	R^2 / (169*L), where R=Load Resistance and L=Load Inductance
LSD4 Driver Characteristics	
Parameter	**Value / Conditions**
U_O (V_{SAT})	1.2V max @ I_0 = 250 mA @ 105 °C
Load (max)	Reference Section 3.1.1
PWM Frequency (max)	N/A
LSD5 Driver Characteristics	
Parameter	**Value / Conditions**
U_O (V_{SAT})	0.7V max @ I_0 = 20 mA @ 105 °C
Load (max)	800 Ω (min), 10nF (max)
PWM Frequency (max)	N/A

3.1.1 Lamp Type Loads

LSD1, LSD2 and LSD3 drivers are capable of driving an incandescent lamp with a filament resistance of 3.6 Ω minimum cold, 36 Ω minimum hot. LSD4 drivers are capable of driving an incandescent lamp with a filament resistance of 7.2 Ω minimum cold, 72 Ω minimum hot.

3.1.2 Electronic Module Type Loads

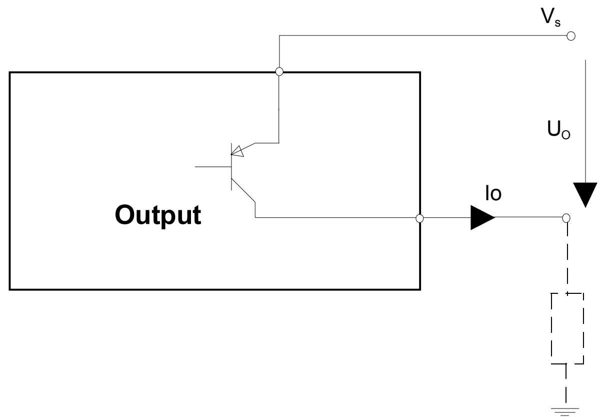
LSD1- LSD5 drivers are capable of driving an electronic module type loads. A pull-up resistor to a nominal 11V to 16V source is required in the receiver module. A nominal 11V to 16V source is required so that voltage levels are high enough for the low side driver fault detection feature to function properly. The recommended range for the resistor is 800 Ω to 10.0 KΩ to prevent problems due to leakage current.

3.1.3 Protection

Low side drivers shall be protected from damage due to shorts up to 16V. One method of protection is by current limiting. Overvoltage protection shall be provided to satisfy the voltage operating requirements defined in Section 2.1.5.1. Low side drivers shall return to their previous output state when the protection is no longer required, unless changed by the software.

3.2 PCM High Side Driver

This high side driver is an output of the Powertrain system typically used for relay control. The output is pulled high (energized) by the Powertrain system.



Symbol	Parameter
I_o	Output Current
U_O	Device Output Voltage Drop
V_S	Source Voltage

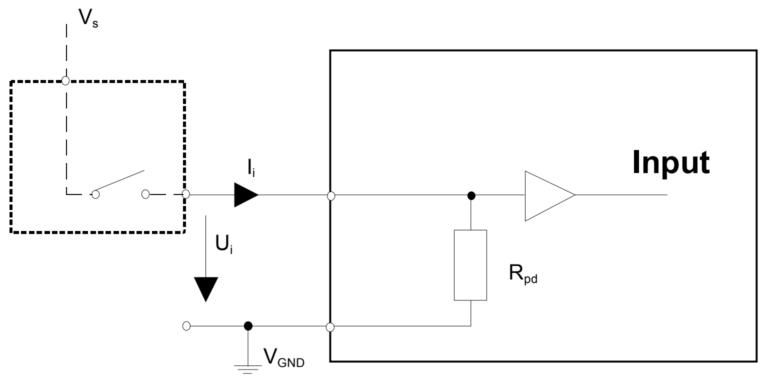
The high side driver shall have the following characteristics:

High Side Driver Output Characteristics	
Parameter	**Value / Conditions**
U_O (V_{SAT})	1.2 Volts max @ I_0 = 800 mA, V_S = 16 Volts @ 105 °C
Leakage Current	1.0 mA max @ V_S = 16 Volts
Overcurrent Limit	2.5 A min
Maximum Load	20 Ω (min) and 80 mH (max) @ -40 °C

3.2.1 Protection

For battery voltages up to 16V, high-side drivers shall be protected from damage due to shorts to ground and shorts to battery. One method of protection is by current limiting. Overvoltage protection shall be provided to satisfy the voltage operating requirements defined in Section 2.1.5.1. High-side drivers shall return to their previous output state when the protection is no longer required, unless changed by the software.

3.3 PCM Discrete Inputs (Switched High)



Symbol	Parameter
Rpd	Pull-down Resistance
Vs	Source voltage of switch
Ui	Input voltage
Ii	Input current
V_{GND}	Ground Voltage

3.3.1 Input Discrete Low 1 (IDL1)

This discrete input accepts switch closures to 5.5 volts or greater, or similar low frequency state change indicators. The open circuit state is a logic 0 (low).

Input Requirements:

Parameter	Condition	Min.	Typ.	Max.
Rpd		2775 Ω	3000 Ω	3225 Ω
Input Low-state U_{il}	11 V ≤ Vs ≤ 16 V	-1 V	0 V	2.0 V
Input High-state U_{ih}	11 V ≤ Vs ≤ 16 V	5.5 V	V_{nom}	V_S +1V
Input Current High I_{ih}	U_{ih} = 12V	3.8 mA	4 mA	4.2 mA
Input Time Constant			1 mSec	

Switch Requirements:

Open Resistance:	50K Ω minimum
Closed Resistance:	50 Ω maximum

The pull-up current is sourced from the voltage feed of the switch**.**

3.3.2 Input Discrete Low 2 (IDL2)

This discrete input accepts switch closures to 5.5 volts or greater. The open circuit state is a logic 0 (Low).

Input Requirements:

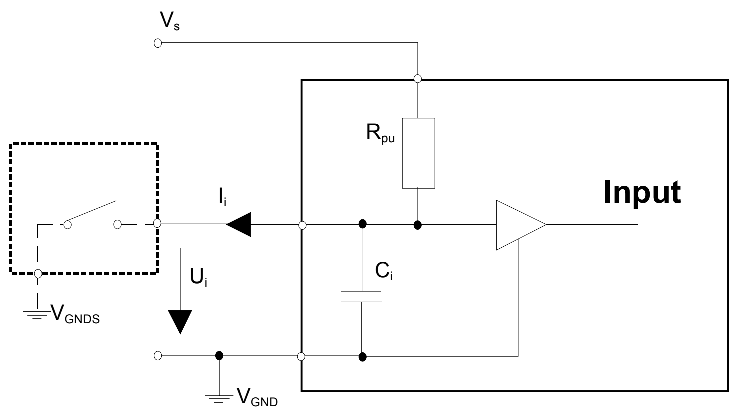
Parameter	Condition	Min.	Typ.	Max.
Rpd		1100 Ω	1200 Ω	1290 Ω
Input Low-state U_{il}	11 V ≤ Vs ≤ 16 V	-1 V	0 V	2.0 V
Input High-state U_{ih}	11 V ≤ Vs ≤ 16 V	5.5 V	V_{nom}	V_s +1V
Input Current High I_{ih}	U_{ih} = 12V	9.5 mA	10 mA	10.5 mA
Input Time Constant			1 mSec	

Switch Requirements:

Open Resistance:	50K Ω minimum
Closed Resistance:	50 Ω maximum

The pull-up current is sourced from the voltage feed of the switch.

3.4 PCM Discrete Input (Switched Low)



Symbol	Parameter
Rpu	Pull-up Resistance
V_S	Source voltage of controller
Ui	Input voltage
Ii	Input current
V_{GND}	Ground Voltage
V_{GNDS}	Switch Ground Voltage

This discrete input accepts switch closures to Ground, or similar low frequency state change indicators. The open circuit state is a logic 1 (high).

Input Requirements:

Parameter	Condition	Min.	Typ.	Max.
Rpu		2775 Ω	3000 Ω	3225 Ω
Input Low-state U_{il}	11 V ≤ Vs ≤ 16 V	-1 V	0 V	2.0 V
Input High-state U_{ih}	11 V ≤ Vs ≤ 16 V	5.5 V	V_{nom}	V_S +1V
Input Current Low I_{il}	U_{il} = 0 V V_S = 12V	3.8 mA	4 mA	4.2 mA
Input Time Constant			1 mSec	

Switch Requirements:

Open Resistance:	50K Ω minimum
Closed Resistance:	50 Ω maximum

The pull-down current is sinked to the ground side of the switch.

3.5 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
	There were no changes to this section for PPEI 2.5 Release.	

4. ALGORITHM DESCRIPTIONS

This section contains the descriptions for Platform control algorithms and Powertrain control algorithms that require Platform input. These algorithms are executed in the Powertrain electronics. These algorithms are standard across all PPEI-compliant Platforms.

Also included in this section are data dictionaries for the algorithms and definitions of Platform-owned calibrations.

The following algorithm descriptions (4.1 through 4.7 and 4.10) are contained in this section:

4.1 Starter Control

4.2 Cooling Fan Control

4.3 Compressor Control

4.4 Generator Status

4.5 Generator L - Terminal Control

4.6 Fuel Volume

4.7 Remote Vehicle Start Monitor

4.8 *Algorithm not Defined for PPEI 2.5*

4.9 *Algorithm not Defined for PPEI 2.5*

4.10 Variable Speed Fuel Pump Control

4.1 Starter Control Algorithm Requirements

4.1.1 General Overview

Refer to Section 2.5 for the hardware interface and serial data summary.

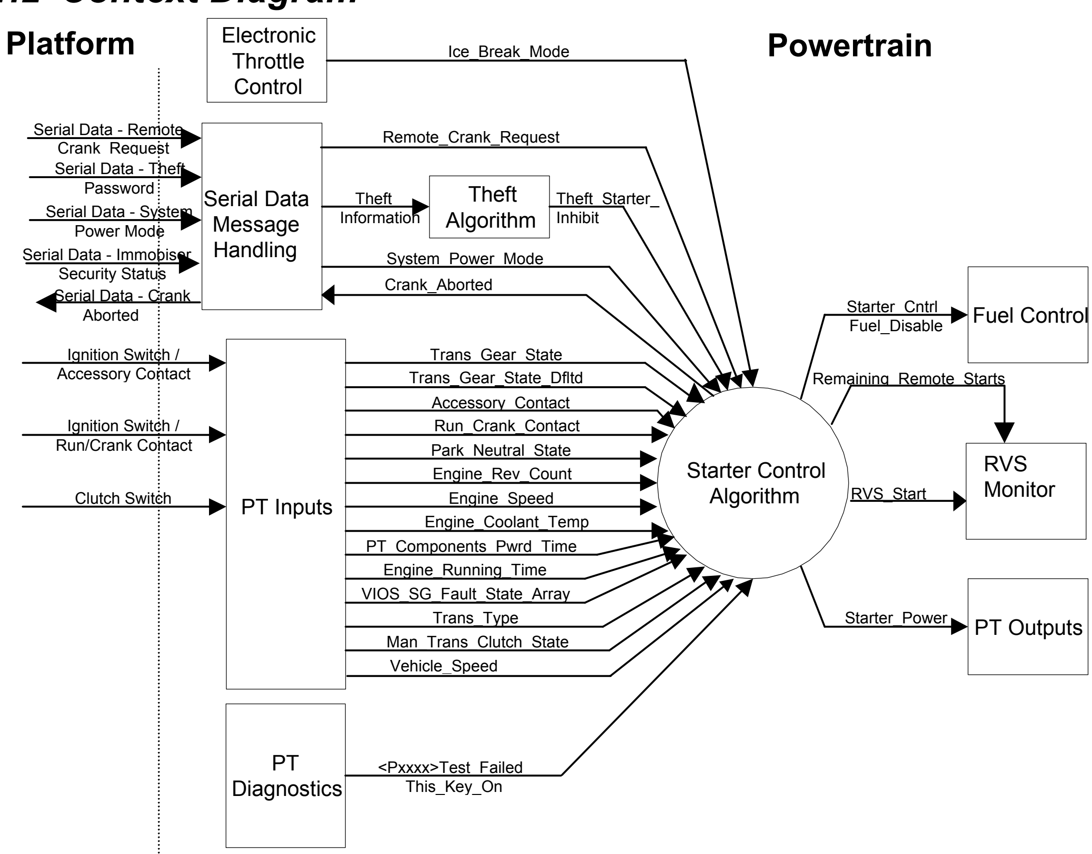
The Starter Control algorithm monitors various engine and vehicle operating conditions to determine whether to enable or disable the starter control relay. The algorithm is designed to allow the Powertrain electronics to have full control over the starter.

The Starter Control Algorithm is mainly partitioned to Powertrain. The only information needed via serial data from Platform is the theft password and the system power mode. For GMNA VTD, starting is inhibited until a valid theft password and a system power mode indicating “Crank Request” is received. For European Immobilizer, starting is inhibited until a pre-release (based on a valid fixed key code) and a system power mode indicating “Crank Request” is received.

This algorithm also accommodates vehicles with Remote Vehicle Start (RVS). For RVS, a Remote_Vehicle_Start_Request signal is required from the Platform via serial data. Specific RVS criteria for enabling the start motor are defined in Section 4.1.3.1.

An additional function of the starter control algorithm is to monitor for a short to ground condition on the starter control relay circuit. This is done so that fuel can be disabled in order to prevent the engine from starting.

4.1.2 Context Diagram



4.1.3 Starter Control Algorithm Description

4.1.3.1 Starter Enable Criteria

If the starter is currently disabled, then the starter shall be enabled if **all** of the following conditions are satisfied: (once enabled, the starter shall stay enabled until any of the disable criteria defined in section 4.1.3.3 are met):

1. System_Power_Mode received over serial data is equal to Crank for at least **K_PwrModeDelay** milliseconds.
2. The ignition switch was never in the Crank position since the starter was last enabled.
3. The engine is not rotating.
4. Theft algorithms in the powertrain controller have determined starting is allowed based on theft system criteria.
5. The delay time for fuel pump priming to expire since the Run/Crank input initially becomes active (Powertrain Optional).
6. The transmission is not in gear (Park or Neutral or Clutch depressed).
7. There are no failures present which require the Powertrain electronics to inhibit starting the vehicle (Powertrain Specific).
8. Ice Break Mode is not active within the Electronic Throttle Control (ETC) algorithm (Powertrain Optional).

4.1.3.1.1 *The exact requirements listed above (1-8) are further defined in the following sections:**System_Power_Mode received over serial data is equal to Crank for at least K_PwrModeDelay milliseconds.***

Power_Mode shall be equal to the System_Power_Mode signal received over serial data unless one of the following conditions exists.

A) **IF** the System_Backup_Power_Mode_Enabled signal is equal to “True”
AND the Backup_Power_Mode_Master_VDA is signal equal to “Available”
THEN Power_Mode shall be equal to the System_Backup_Power_Mode signal.

B) **IF** the ECM/PCM detects that the device transmitting the System Power Mode signal over serial data has failed (no longer communicating).
THEN the Power_Mode shall be determined from the ECM/PCM’s Accessory and Run_Crank_Inputs

C) **IF** the System_Backup_Power_Mode_Enabled is equal to “True” **AND** the System Backup_Power_Mode_Master_VDA signal is equal to “Not Available”.
THEN the Power_Mode shall be determined from the ECM/PCM’s Accessory and Run_Crank_Inputs

ECM/PCM Cranking is only initiated via receiving a serial data Crank Power Mode except when the ECM/PCM is in Post Release Stall Mode, this exception is defined in the following:

IF ‘B’ or ‘C’ (above) is True **AND** the ECM/PCM is in Post Release Stall Mode operation

THEN the ECM/PCM shall allow initiation of Cranking if it's Accessory_Input transitions from Active to Inactive and Run_Crank_Input is equal to Active or if the Accessory_input is equal is Inactive and the Run_Crank_input transitions from Inactive to Active.

The Post Release Stall mode operation requires the following: the ECM/PCM VTD or Immobilizer system is in Post Release state implying that vehicle authentication passed during current ignition cycle and the engine transitioned from rotating to not rotating.

NOTE: The loss of Power Mode Master may result in a transition of the accessory line. This transition will not result in a crank due to the delay in setting the Power Mode Master loss of communication Flag.

4.1.3.1.1.1 Automatic Transmission (Global requirement)

While the automatic transmission is not in gear as defined by 4.1.3.1.6.1 the System_Power_Mode state shall transition from a non-CRANK_Request state into the CRANK_Request state for at least the **K_PwrModeDelay** time before allowing the starter to be enabled. This delay allows for the platform modules to shed loads prior to the engine cranking event.

4.1.3.1.1.2 Manual Transmission (NA market requirement for FMVSS)

While the clutch input indicates that the clutch is depressed, the System_Power_Mode state shall transition from a non-CRANK_Request state into the CRANK_Request state for at least the **K_PwrModeDelay** time before allowing the starter to be enabled.

4.1.3.1.1.3 Manual Transmission (European market requirement)

The System_Power_Mode is required to remain equal to CRANK for at least **K_PwrModeDelay** before allowing the starter to be enabled.

4.1.3.1.2 The ignition switch was never in the Crank position since the starter was last enabled

This check requires that the ignition switch be released from the Crank position before cranking is allowed again following a starter disable. The ignition switch is determined to no longer be in the Crank position when the System_Power_Mode is not equal to Crank.

4.1.3.1.2.1 Platform Requirements

After the Platform determines that the engine is in a running state it shall discontinue sending System_Power_Mode equal to Crank and send System_Power_Mode equal to Run. Platform shall not send out System_Power_Mode equal to Crank until the following sequence has been satisfied:

1. Platform receives ***Engine_Running_Status*** equal to "Not Running".
2. Ignition switch is in the Accessory, Off, or Run state.
3. Platform receives Ignition Switch input in Crank Request State.

4.1.3.1.2.2 Powertrain Requirements

A suggested method for performing this function is to monitor a parameter (Crank_Request_Off_Since_Enable = TRUE). Crank_Request_Off_Since_Enable is set equal to FALSE when Starter_Power = ENABLED. Crank_Request_Off_Since_Enable is set equal to TRUE when either the ignition switch is no longer in the Crank position (System_Power_Mode is not equal to Crank), or a Stall or the powertrain controller goes through a power-up reset.

4.1.3.1.3 The engine is not rotating

Powertrain has determined the Engine is not rotating.

4.1.3.1.4 Theft algorithms in the powertrain controller have determined starting is allowed based on theft system criteria

4.1.3.1.4.1 GMNA Vehicle Theft Deterrent Systems (VTD)

The VTD Algorithm sets Theft_Starter_Inhibit to "True" until a correct password has been received by the Platform theft algorithm. Otherwise Theft_Starter_Inhibit is equal to "False" and starting is allowed. The powertrain controller shall inhibit the starter until Theft_Starter_Inhibit is equal to "False".

4.1.3.1.4.2 European Immobilizer Systems

The Immobilizer algorithm in the powertrain controller sets Theft_Starter_Inhibit equal to "True" until a correct fixed code of the transponder is received. The Theft_Starter_Inhibit variable is again set equal to "True" when an incorrect rolling code has been determined. Otherwise Theft_Starter_Inhibit is equal to "False" and starting is allowed. The powertrain controller shall inhibit the starter until Theft_Starter_Inhibit is equal to "False".

4.1.3.1.5 The delay time since power-up for fuel pump priming has expired

This powertrain optional check allows the fuel system to be fully primed before starting. The fuel pump shall be enabled for at least **K_FuelPumpDelay** before allowing the starter to be enabled. This can be accomplished by monitoring the time since the powertrain components have been powered (PT_Components_Pwrd_Time).

4.1.3.1.6 The transmission is not in gear

This check protects against vehicle movement while the engine is cranking and the transmission is engaged. The transmission is not in gear when in Park or Neutral or Clutch depressed.
For RVS applications: The transmission is not in gear when in Park only.

4.1.3.1.6.1 Automatic Transmission (Global requirement)

For an automatic transmission application, Park_Neutral_State is used to determine if the transmission is not in gear. Park_Neutral_State is determined from either a Park/Neutral switch input or the Internal Mode Switch (IMS) inputs to the Powertrain electronics (whichever is available). Grey Code PRNDL (from an NSBU Mode Indicator Switches) is not acceptable to use for ECM/PCM controlled start applications.

4.1.3.1.6.2 Manual Transmission (NA market requirement for FMVSS)

For a manual transmission application, Man_Trans_Clutch_State is used to determine if the transmission is not in gear. Man_Trans_Clutch_State is determined from a clutch input switch, if available. (A clutch switch is not required on European applications.)

4.1.3.1.7 There are no failures present whose action requires the Powertrain electronics to inhibit starting the vehicle

This powertrain optional check is needed if there are any failures present, typically identified through a diagnostic code, that require the Powertrain electronics to inhibit starting the vehicle. This may be required during detection of certain memory failures. This is accomplished by monitoring the <Pxxxx>Test_Failed_This_Key_On fault indicator for the diagnostic whose failure action requires the inhibit of starting.

4.1.3.1.8 Ice Break Mode is not active within the Electronic Throttle Control (ETC) algorithm

This powertrain optional check ensures that the starter will not be enabled while the throttle is being activated in an attempt to break through ice that has formed in the throttle bores. Ice Break Mode is indicated by Ice_Break_Mode = Active. An undesirable engine flare or stall may result if the engine starts while Ice Break Mode is active.

4.1.3.2 Starter Enable Criteria for Remote Vehicle Start

In addition to the above starter enable criteria; the following criteria shall be used on vehicles with RVS. The starter shall be enabled when conditions 3, 5, 7, and 8 from the list above are **all** satisfied and **all** of the following conditions are satisfied (once enabled, the starter shall stay enabled until any of the disable criteria defined in section 4.1.3.3 are met):

1. Remote_Vehicle_Start_Request received over serial data transitions from “Inactive” to “Active” (the default state is Inactive).
2. System_Power_Mode received over serial data is equal to “Off”.
3. There are no theft-related Diagnostic Trouble Codes (DTCs) set.
4. The Malfunction Indicator Lamp is not illuminated.
5. Vehicle_Speed is equal to zero.
6. The vehicle has an automatic transmission.
7. Remaining_Remote_Starts >0
8. Transmission_Shift_Lever_Position is equal to PARK and data is valid (transmission is in Park).

When the starter is enabled, RVS_Start shall be set equal to “Inactive” and RVS_Crank shall be set equal to Remote_Vehicle_Start_Request. If the engine is running in Remote Mode and stops running (due to any of the conditions in section 4.7.4.3 of the Remote Start Monitor Algorithm spec.) then RVS_Start shall be set = “Inactive”.

4.1.3.2.1 Remote_Vehicle_Start_Request received over serial data is equal to "Active"

The Remote_Vehicle_Start_Request shall be equal to "Active" before allowing the starter to be enabled for RVS. When Remote_Vehicle_Start_Request is equal to "Active", it is considered to be a RVS-initiated crank request.

4.1.3.2.2 System_Power_Mode received over serial data is equal to "Off"

For RVS-initiated cranking, System_Power_Mode shall be equal to "Off" before allowing the starter to be enabled.

4.1.3.2.3 There are no theft-related Diagnostic Trouble Codes (DTCs) set

For RVS-initiated cranking, there shall be no active theft system DTCs (P1630, P1631, and P1626) before allowing the starter to be enabled.

4.1.3.2.4 The Malfunction Indicator Lamp is not illuminated

For RVS-initiated cranking, there shall be no active or history DTCs that require illumination of the Malfunction Indicator Lamp (MIL) before allowing the starter to be enabled.

4.1.3.2.5 Vehicle_Speed is equal to zero

For RVS-initiated cranking, Vehicle_Speed shall be equal to zero before allowing the starter to be enabled. On vehicles that use serial data as the source of vehicle speed, this starter enable criteria shall be by-passed.

4.1.3.2.6 The vehicle has an automatic transmission.

For RVS-initiated cranking, Trans Type shall be equal to Automatic in order to allow the starter to be enabled.

4.1.3.2.7 Remaining_Remote_Starts >0.

For RVS-initiated cranking, the ECM/PCM shall decrement a counter each time a remote start is completed with no intervening normal Run operation. The decrementing of this counter is done via the algorithm in PPEI section 4.7.4. No Remote Vehicle Starts shall be allowed once this counter reaches 0. This counter is reset to its initial value, **K_Max_Starts_Allowed**, each time the vehicle passes the full vehicle theft authentication. This is to enhance the theft system security. This counter is required to be implemented using ignition non-volatile memory. This counter shall only be allowed to be written to by an external device, e.g. via a Diagnostic Mode, when the Engine Module's (ECM/PCM) Manufactures Enable Counter is not = $00. It can be read at any time. See the GMPT GMLAN Diagnostic Test Mode Configuration Specification for further details.

4.1.3.2.8 Transmission_Shift_Lever_Position is equal to PARK and data is valid (transmission is in Park).

For RVS-initiated cranking, the starter shall not be enabled if the serial data signal Transmission_Shift_Lever_Position is not equal to PARK OR the data signal has been diagnosed as invalid.

4.1.3.3 Starter Disable Criteria

The Starter shall be disabled at any time if the following conditions are satisfied:

1. The transmission is in gear.
2. Engine has reached running speed.

The Starter shall be disabled after it has been enabled for at least **K_MinCrank** if **any** of the following conditions is satisfied:

1. Starter has been enabled for **K_MaxCrank**.
2. Accessory_Input transitions from Inactive to Active.
3. (System Power Mode is **not** equal to CRANK) AND (RVS_Crank is equal to “Inactive”).
4. (Remote_Vehicle_Start_Request is equal to “Inactive”) AND (RVS_Crank is equal to “Active”).
5. For European Immobilizer, an incorrect rolling code is determined and Theft_Starter_Inhibit equals “True”.

When the starter is disabled, RVS_Crank shall be set equal to “Inactive”.

4.1.3.3.1 Transmission has been placed into gear

This check protects against vehicle movement while the engine is cranking and the transmission is engaged.

For an automatic transmission application, Park_Neutral_State is used to determine if the transmission is not in gear. Park_Neutral_State is determined from either a Park/Neutral switch input or the Internal Mode Switch (IMS) inputs to the Powertrain electronics (whichever is available). Grey Code PRNDL (from an NSBU Mode Indicator Switches) is not acceptable to use for ECM/PCM/ECM controlled start applications.

For a manual transmission application, Man_Trans_Clutch_State is used to determine if the transmission is not in gear. Man_Trans_Clutch_State is determined from a clutch input switch, if available. (A clutch switch is not required on European applications.)

4.1.3.3.2 Starter has been enabled for K_MaxCrank

This disable criterion prevents the starter from being continuously enabled for too long which could lead to overheating of the starter. The starter is disengaged if the starter has been enabled continuously for **K_MaxCrank**. If the starter was disabled due to this criterion, the ignition key is required to be released from the Crank position before the algorithm allows the starter to be re-engaged.

4.1.3.3.3 Engine has reached running speed

Engine has reached running speed if Engine_Speed has been above **K_EngThresh***[Engine_Coolant_Temp]* continuously for **K_Cnt_EngRevs***[Engine_Coolant_Temp]* number of engine revolutions. Engine_Rev_Count is used to count the number of engine revolutions when the Engine_Speed reaches **K_EngThresh***[Engine_Coolant_Temp]*.

The engine has not reached running speed if the engine speed is less than **K_EngThresh***[Engine_Coolant_Temp]*.

When the starter is disabled because the engine has reached running speed, RVS_Start shall be set equal to “Active” if Remote_Vehicle_Start_Request = "Active" was the reason for starting.

4.1.3.3.4 Accessory_Input transitions from Inactive to Active

The starter shall be disabled when the Accessory_Input transitions from Inactive to Active while the starter is enabled.

Accessory_Input is monitored in addition to System_Power_Mode so that the latency due to serial data message transmission is not a factor when disabling of the starter. Accessory_Input is equal to Active when no longer in the Crank position, i.e., in the Accessory and Run key positions.

4.1.3.3.5 (System_Power_Mode is NOT equal to CRANK) AND (RVS_Crank is equal to "Inactive").

The starter shall be disabled when both of the following are True:

1. System_Power_Mode is NOT equal to CRANK; and
2. RVS_Crank is equal to "Inactive"

System_Power_Mode equal to a state other than CRANK is an indication that the ignition switch is no longer in the Crank position. RVS_Crank equal to "Inactive" indicates that engine cranking was not initiated by the RVS system.

4.1.3.3.6 (Remote_Vehicle_Start_Request is equal to "Inactive") AND (RVS_Crank is equal to "Active").

The starter shall be disabled when both of the following are True:

1. Remote_Vehicle_Start_Request is equal to "Inactive"; and
2. RVS_Crank is equal to "Active"

Remote_Vehicle_Start_Request equal to "Inactive" indicates that the RVS system is no longer requesting engine cranking. RVS_Crank equal to "Active" indicates that engine cranking was initiated by the RVS system.

4.1.3.3.7 An incorrect rolling code is determined.

For European Immobilizer systems only. When the challenge-response algorithm is completed, the Immobilizer algorithm in the powertrain controller sets Theft_Starter_Inhibit equal to "True", if an incorrect rolling code is determined. Otherwise Theft_Starter_Inhibit is left equal to "False". The powertrain controller shall disable the starter if Theft_Starter_Inhibit is equal to "True".

4.1.4 Execution / Activation Requirements

Algorithm Section	Nominal Execution Interval
Starter Enable Criteria	12.5 ms., max
Starter Disable Criteria	25.0 ms., max
Starter Control Relay Short to Ground Action	50.0 ms., max

4.1.5 Powertrain System State Transition Requirements

The following parameters shall be initialized during the controller power-up reset:

Starter_Power ← Disabled
Starter_Cntrl_Fuel_Disable ← False

4.1.6 Diagnostic Action Requirements

4.1.6.1 Starter Control Relay Circuit Short To Ground Action

If a short to ground condition is detected with the starter control relay circuit, the Powertrain electronics shall disable fuel for the remainder of the ignition cycle. The action is required for automatic transmissions with Internal Mode Switch (IMS) in order to prevent the engine from starting while in gear if the starter control relay circuit is shorted to ground. The action is not suggested for manual transmission applications due to the difficulty in diagnosing the circuit when a clutch switch is in the starter control relay circuit. The action taken by the Fuel subsystem is to disable fuel if Starter_Cntrl_Fuel_Disable = True. Starter_Cntrl_Fuel_Disable shall be set and latched to True for the remainder of the ignition cycle if the following conditions are all satisfied for 5 consecutive executions of the logic:

1. Trans_Type is equal to Automatic.
2. A short to ground failure on the starter control circuit is detected.
3. Engine_Running_Time < **K_ShortLowEngRunTime**, (Note: Engine_Running_Time equals 0 when the engine is not running)
4. Trans_Gear_State is currently equal to a drive gear (NOT equal to Park or Neutral)
5. Trans_Gear_State_Dfltd is currently equal to False

4.1.7 On-Vehicle Communications / Serial Data Interaction Requirements

The Crank_Aborted serial data signal shall be set equal to “False” when either of the following are true:

1. Power_Mode is **not** equal to CRANK; and
   Remote_Vehicle_Start_Request is equal to “Inactive”.
2. Starter is enabled.

The Crank_Aborted serial data signal shall be set equal to “True” when any of the following conditions exist:

1. The transmission is in gear (as defined in section 4.1.3.3.1) and the engine is not running, when Power_Mode is equal to CRANK.
2. Starter has been enabled for **K_MaxCrank**.
3. For European Immobilizer, an incorrect rolling code is determined and Theft_Starter_Inhibit equals “True”.

The following additional conditions are required for remote vehicle start. The Crank_Aborted signal shall be set equal to “True” when Remote_Vehicle_Start_Request is equal to “Active” and any of the following conditions exist:

4. The Malfunction Indicator Lamp is illuminated.

5. Vehicle_Speed is not equal to zero.
6. Remaining_Remote_Starts = 0.
7. Transmission is not in Park.

Starter Control Serial Data Messages			
Specification Name	Transmitter	Class 2 Name	GMLAN Name
Crank_Aborted	Powertrain	86-15 Ignition Switch/Starter - – Crank Aborted	Powertrain Crank Aborted
Remote_Vehicle_Start_ Request	Platform	86-16 Ignition Switch/Starter - Remote Start Crank	Remote Vehicle Start Request
System_Power_Mode	Platform	FE-06 Network Control - System Power Modes	System Power Mode

4.1.8 Off-Vehicle Communications / Serial Data Interaction Requirements

The following data should be made available through PIDs:

1. Starter_Power
2. Remaining_Remote_Starts
3. Remote_Vehicle_Start_Request

No device control overrides are required.

Powertrain shall provide to Platform the last eight reasons why it has disabled remote vehicle start. See the GMPT GMLAN Diagnostic Test Mode Configuration Specification for further details.

4.1.9 Data Dictionary

4.1.9.1 Calibrations

All calibrations are Powertrain-owned unless otherwise specified.

K_Cnt_EngRevs = 17 point calibration table which provides the number of continuous engine revolutions vs. engine coolant temperature which the engine speed must be high enough to indicate that the engine has reached running speed.
Minimum Range: 0 to 256 revolutions
Minimum Resolution: 1 revolution
Table Breakpoints: -40 to 152 °C ; every 12 °C
Typical Values: -40 °C = 3 revolutions
56 °C = 2 revolutions

K_EngThresh = 17 point calibration table which provides the engine speed threshold vs. engine coolant temperature above which the engine is considered to have reached running speed.
Minimum Range: 0 to 1000 RPM
Minimum Resolution: 25 RPM
Table Breakpoints: -40 to 152 °C; every 12 °C
Typical Values: -40 °C = 500 RPM
56 °C = 400 RPM

K_FuelPumpDelay = calibration which defines the time period which the fuel pump must be on for before enabling the starter.
Minimum Range: 0 to 200 msec.
Minimum Resolution: 10 msec.
Typical Value: 100 msec.

K_MaxCrank = calibration which defines the maximum continuous starter engagement time to prevent overheating.
Minimum Range: 0 to 300 seconds
Minimum Resolution: 1 second
Typical Value: 30 seconds

K_Max_Starts_Allowed = Number of remote start attempts allowed. This is a platform owned calibration.
Minimum Range: 0 to 5
Minimum Resolution: 1
Typical Value: 2

K_MinCrank = calibration which defines the minimum time that the starter should remain enabled after initial turn on for relay contact protection and backfire protection. Note: This calibration shall be limited in software to a minimum of 190 msec even if calibrated to a value less than 190 ms. This is a Powertrain and Platform-owned calibration.
Minimum Range: 0 to 1.5 seconds
Minimum Resolution: 10 msec.
Typical Value for conventional ignition key vehicles: 700 msec.
Typical Value for Easy Key Vehicles: 190 msec.

K_PwrModeDelay = calibration which defines the time that the crank request input needs to indicate CRANK before the starter is enabled. This allows a time delay for the platform modules to shed loads in anticipation of the engine cranking event. This is a Platform-owned calibration.
Minimum Range: 0 to 200 msec.
Minimum Resolution: 10 msec.
Typical Value: 50 msec.

K_ShortLowEngRunTime: Engine running time below which a starter control circuit shorted to ground will cause a fuel shutoff if the transmission is in gear.
Minimum Range: 0 to 3 seconds
Minimum Resolution: 0.1 second
Typical Value: 1 second

4.1.9.2 Variables

Accessory_Input = state of the accessory signal from the ignition switch. Accessory_Input is equal to Active in the Accessory and Run key positions. Accessory_Input is equal to Inactive in the Crank key positions.
Minimum Range: Active or Inactive

Crank_Aborted = an indication that the starter output has been disabled due to transmission shifted into gear or maximum crank time has elapsed.
Minimum Range: True or False
Initial Value: False

Engine_Coolant_Temp = calculated coolant temperature within the engine.
Minimum Range: -40 to 140 °C
Minimum Resolution: 12 °C

Engine_Rev_Count = continuously running counter of engine revolutions since power-up.
Minimum Range: 0 to 100 revolutions
Minimum Resolution: 1 revolution

Engine_Running_Time = time that the engine has been running.
Minimum Range: 0 to 200 seconds
Minimum Resolution: 1 second

Engine_Speed = calculated speed of the engine based on available engine position sensor(s).
Minimum Range: 0 to 1000 RPM

Minimum Resolution: 25 RPM

Ice_Break_Mode = indication of whether ETC is activating the throttle blade to break away ice which has formed on the throttle bores.
Minimum Range: Active or Inactive

Man_Trans_Clutch_State = state of the manual transmission clutch pedal switch or sensor.
Minimum Range: Depressed or Not_Depressed
Initial Value: Not_Depressed

Park_Neutral_State = Park or Neutral selected gear state of the automatic transmission. Park_Neutral_State is determined from either a Park/Neutral switch input or the Internal Mode Switch (IMS) inputs (whichever is available). Grey Code PRNDL is not acceptable to use for full starter control applications. Park_Neutral_State shall be set to False if the sensor(s) used to determine selected gear state indicate an invalid gear state (this includes IMS disconnected) or have been diagnosed with a failure. This assures that the starter cannot be enabled if the selected gear state cannot be accurately determined.
Minimum Range: True or False
Initial Value: False

PT_Components_Pwrd_Time = period of time that all powertrain components are supplied with power. Time since the Powertrain electronics has been powered by the Run/Crank signal.
Minimum Range: 0 to 200 msec.
Minimum Resolution: 10 msec.

<Pxxxx>Test_Failed_This_Key_On = indicates whether a particular diagnostic <Pxxxx> has reported a failure since power-up.
Minimum Range: True or False

Power_Mode = indicates the internal power mode of the ECM as determined by the ECM using either the System_Power_Mode, the Backup_System_Power_Mode or the hardwired inputs to the ECM.

Remaining_Remote_Starts = variable which indicates if remote start is allowed. Used to limit the number of consecutive remote start attempts for security purposes. This variable is to be set to its initial value after a full theft authentication has passed after entering the Run power mode.
Minimum Range: 0 – 5
Minimum Resolution: 1
Initial Value: K_Max_Starts_Allowed

Remote_Vehicle_Start_Request = the request to crank the vehicle in remote mode from the RVS system. It is based on a serial data signal transmitted by the Platform Electronics on RVS vehicles only.
Minimum Range: Active (GMLAN: Remote Start Requested, Class 2: True) or Inactive (GMLAN: Remote Start Not Requested, Class 2: False)
Initial Value: Inactive

Run_Crank_Input = state of the run/crank signal from the Run/Crank relay. Run_Crank_Input is equal to Active in the Run and Crank key positions.
Minimum Range: Active or Inactive

RVS_Crank = set to "Active" when the engine is cranking due to an RVS request to crank. It is used to modify the starter disable criteria for RVS cranking vs. normal cranking.
Minimum Range: Active or Inactive
Initial Value: Inactive

RVS_Start = set to "Active" when the engine has been started due to an RVS request. This is used to initiate execution of the RVS Monitor algorithm.

Minimum Range: Active or Inactive
Initial Value: Inactive

Starter_Cntrl_Fuel_Disable = indicates whether the starter control system is requesting fuel shutoff due to a starter control circuit short to ground.
Type: RAM
Minimum Range: True or False
Initial Value: False

Starter_Power = output control of the starter control algorithm to the starter control relay.
Type: RAM
Minimum Range: Enabled or Disabled
Initial Value: Disabled

System_Power_Mode = power mode for the vehicle. Transmitted by the power mode master over serial data. Default based on the hardwired ignition switch signals if a failure is detected with the transmitter of the serial data message.
Minimum Range: OFF or ACCESSORY or RUN or CRANK REQUEST

Theft_Starter_Inhibit = flag from the theft algorithm (VTD or Immobilizer) that determines if starting is allowed based on theft criteria. Starting is allowed when this flag is set equal to "False".
Minimum Range: True, False

Trans_Gear_State = provides the indication of the current transmission gear for both an automatic and manual transmission.
Range: D1, D2, D3, D4, D5, Neutral, Reverse, Park

Trans_Gear_State_Dfltd = provides the indication that Trans_Gear_State has been defaulted because the transmission gear state cannot be determined from the available sensor inputs.
Range: True, False

Trans_Type = provides the transmission type.
Range: Automatic or Manual

Vehicle_Speed = the ground speed of the vehicle as determined by the powertrain controller.
Minimum Range: 0 to 300 kph
Minimum Resolution: 1 kph

4.1.10 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
4.1.3.1.14, 4.1.8	Removed specific service parameter definitions and referenced proper service location.	ICR 303
4.1.3.1 4.1.3.2 4.1.3.2, 4.1.3.2.6 4.1.3.2.7 4.1.3.2.8, 4.1.8 4.1.7	Listed requirements under Starter Enable Criteria and added text verbiage. Updated reference number. Added header, "Starter Enable Criteria for Remote Vehicle Start. Updated reference number Added criteria and description – Transmission Shift Lever Position is equal to Park and data is valid before the starter can be enabled. Added text description for criteria, "The vehicle has an automatic transmission. Added reference text, "see the GMPT GMLAN Diagnostic Test Mode Configuration Specification," Updated reference section.	ICR 325
4.1.3.1.2.1 4.1.3.1.2.2	Revised Crank Request Processing Criteria for clarification.	ICR 917
4.1.3.1 4.1.3.1.6 4.1.3.2	Clarified Neutral state for condition no. 6. Revised RVS starter criteria to require vehicle must have an auto trans and must be in Park only. Added condition for RVS_Start if engine is running and stops running. Revised section to specifically state RVS and non-RVS conditions when the transmission is not in gear. Clarified when transmission is in gear. Revised engine has reached running speed as a criteria that the starter should be disabled.	ICR 2113

4.1.3.2.3 4.1.9.2	Revised states for RVS_Start and RVS_Crank states. Clarified states for GMLAN and Class 2 messages for Remote_Vehicle_Start_Request variable.	
4.1.3.1.1	Revise hardwire cranking to require the accessory signal to transition from active to inactive.	ICR 2131
4.1.3.1.1	Clarified Post Release Stall condition. Added conditions for Post Release Stall. Revised Revised hardwire inputs to allow a start in absence of accessory input if Run_Crank input transitions from Inactive to Active	ICR 2178
4.1.3.2 4.1.3.2.4 4.1.7	#4. Added “The Malfunction Indicator Lamp is not illuminated” and removed “There are no emissions-related DTCs set.” Added “The Malfunction Indicator Lamp is not illuminated” and removed “There are no emissions-related DTCs set.” Removed RVS_Crank is equal to “Active”. Added additional conditions for which Crank_Aborted signal will be set to “True”: ▪ The Malfunction Indicator Lamp is illuminated. ▪ Vehicle_Speed is not equal to zero. ▪ Remaining_Remote_Starts = 0 ▪ Transmission is not in Park	ICR 2209

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4.2 Cooling Fan & Hot Telltale Control Algorithm Requirements

4.2.1 General Overview

The cooling fans are primarily used for powertrain cooling and also provide cooling for other underhood components. This interface supports any single, multiple, or (engine driven or electric) PWM fan configuration.

The cooling fan control algorithm is executed by Powertrain Controller. Platform may optionally request a fan speed change via serial data for electrical load management or other platform-specific reasons.

This algorithm assumes all electric fans are mounted to the Condenser Radiator Fan Module (CRFM).

All cooling fan control algorithm calibrations are Platform owned, unless otherwise specified.

4.2.2 Cooling Fan Control Algorithm Interface

4.2.2.1 Serial Data

The following serial data signals are transmitted by the Powertrain Controller:

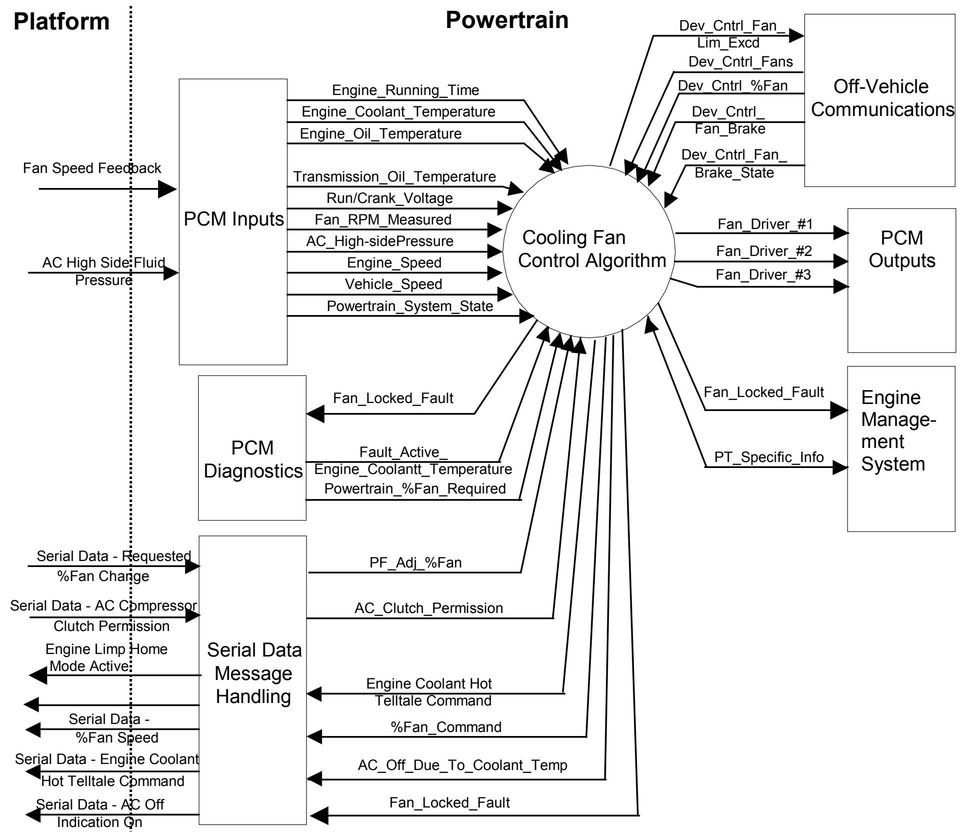
1. %Fan Speed
2. Engine Coolant Hot Telltale Command
3. A/C Off Indication On (optional)
4. Engine Limp Home Mode Active (optional)

The following serial data signals are transmitted by the Platform Controller:

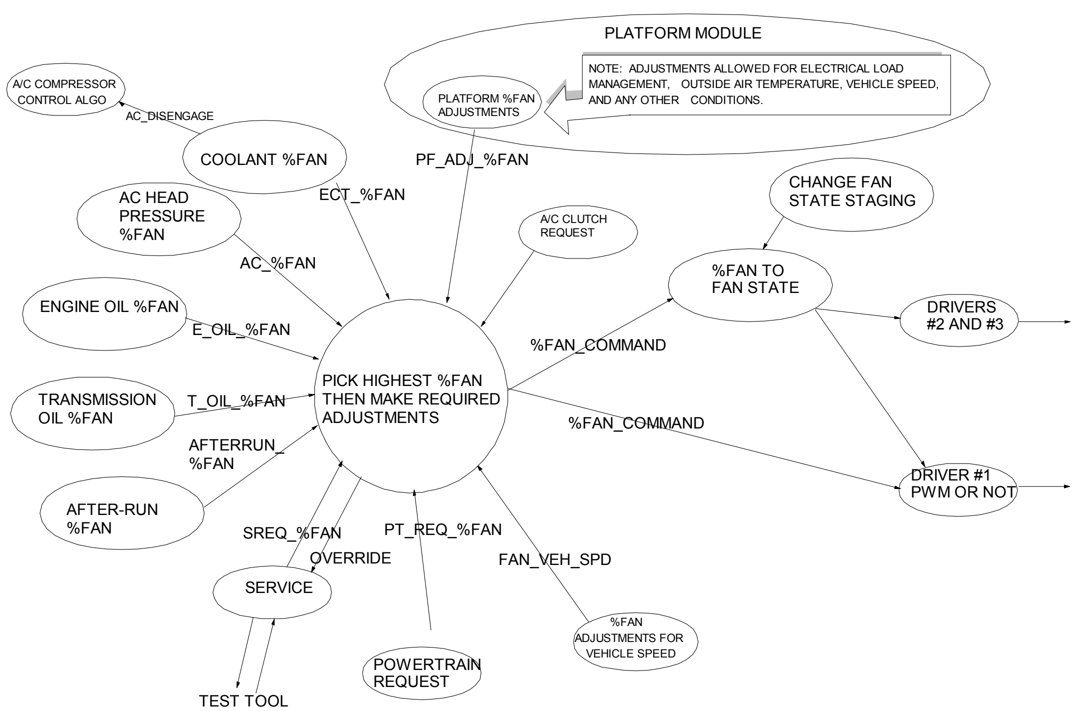
1. Requested %Fan Change (optional)
2. A/C Compressor Clutch Permission

4.2.3 Diagrams

4.2.3.1 Context Diagram

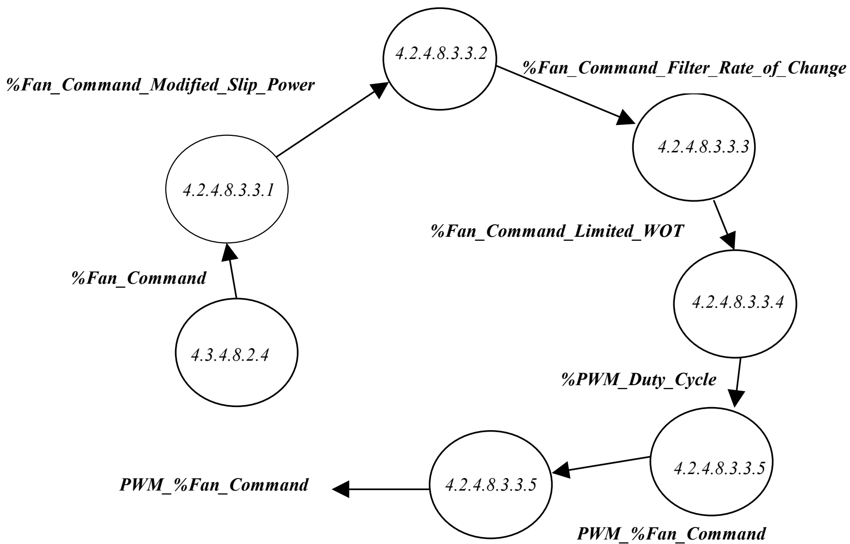


4.2.3.2 Data Flow Diagram



4.2.3.3 Algorithm State Diagram

The "%Fan_Command" value shall be detemined by the following process sequence for engine driven PWM fans



4.2.4 Cooling Fan and Hot Telltale Control Algorithm Description

This algorithm controls cooling fan speed by determining the percentage of fan power required for HVAC and powertrain cooling. The required percentage of fan power is then converted into a fan speed that is represented by either: 1) a specific state of the three outputs for discrete fan systems; or 2) a PWM duty cycle for PWM fan systems.

4.2.4.1 Cooling Fan Driver Control

4.2.4.1.1 Discrete Fan Systems

On discrete fan systems, the Powertrain controller controls the cooling fan speed by driving three output drivers. The state of each cooling fan output driver for Fan Speed 1 through Fan Speed 6 is calibratible. The following table defines the relationship between fan speed and the three output drivers:

Fan Speed	Driver #1 State	Driver #2 State	Driver #3 State
Speed 0	OFF	OFF	OFF
Speed 1	**K_D1_Speed1**	**K_D2_Speed1**	**K_D3_Speed1**
Speed 2	**K_D1_Speed2**	**K_D2_Speed2**	**K_D3_Speed2**
Speed 3	**K_D1_Speed3**	**K_D2_Speed3**	**K_D3_Speed3**
Speed 4	**K_D1_Speed4**	**K_D2_Speed4**	**K_D3_Speed4**
Speed 5	**K_D1_Speed5**	**K_D2_Speed5**	**K_D3_Speed5**
Speed 6	**K_D1_Speed6**	**K_D2_Speed6**	**K_D3_Speed6**
Speed 7	ON	ON	ON

4.2.4.1.1.1 Cooling Fan Speed Change Delays

On discrete fan systems, requested fan speed changes may be delayed for relay protection and engine load management. The following fan speed control shall be implemented:

1. The fan speed shall always transition in order through each successive speed when requesting a higher fan speed.
2. The fan speed shall always transition in order through each successive speed when requesting a lower fan speed while the engine is running.
3. The fans shall remain in each speed for at least **K_FanSpeedMinTime** amount of time.
4. When a fan speed change is requested, **K_FanChangeDelay** seconds is delayed prior to changing the fan speed to allow the engine management system to compensate for the impending change in engine load. This is a Powertrain owned calibration that must be approved by Platform.
5. If **K_FanSpdChgIdle** is equal to False, reduction in fan speed shall not be allowed when the Vehicle_Speed is less than **K_VehicleSpdIsZeroHi** and **K_VehicleSpdIsZeroLo** acting as a hysteresis pair.

4.2.4.1.2 PWM Fan Systems

On PWM fan systems, the Powertrain controller commands Driver #1 to reflect the %Fan_Command after the appropriate filtering as defined in Section 4.2.4.7.3.2 (electric PWM fan systems), or Section 4.2.4.7.3.3 (engine-driven PWM fan systems).

4.2.4.2 Engine Coolant Hot Telltale Control

The Powertrain controller shall transmit the serial data signal that commands the Engine Coolant Hot Telltale on if Engine_Coolant_Temperature is greater than (**K_EngineCoolantHotHi** and **K_EngineCoolantHotLo**) acting as a hysteresis pair.

4.2.4.3 Compressor Control Algorithm Interface

The powertrain controller shall disengage the A/C Clutch if Engine_Coolant_Temperature is greater than **K_AC_OffTempHi** and **K_AC_OffTempLo** acting as a hysteresis pair. When the A/C clutch is disengaged due to Engine_Coolant_Temperature, the powertrain controller shall transmit the A/C Off Indication serial data signal, if required by Platform.

4.2.4.4 Cooling Fan Operation in Controller_Ready State

Controller_Ready state is entered during the ACCESSORY power mode. The powertrain controller shall perform the following:

1. Allow After-Run Cooling Fan Control to continue if it is still in progress (Section 0, electric fans only).
2. Set %Fan_Command equal to 0%, if After-Run is not in progress.

4.2.4.5 Cooling Fan Operation in Powertrain_Ready State

On electric cooling fan systems, the Powertrain controller performs the following functions while in the Powertrain_Ready state (Run/Crank signal is high and the engine is not rotating):

1. Allow After-Run Cooling Fan Control to continue if still in progress. This could occur if engine off fan operation was active while in the Controller_Ready state and the Powertrain controller detected a transition to the Powertrain_Ready state prior to

powering down (ignition key cycled back to the RUN position prior to Powertrain controller powering down).

2. If After-Run is not in progress, set %Fan_Command to 0%.
3. Allow scan tool to override the fan speed via device control as long as the coolant temperature is less than **K_CoolantTempOverride**.

4.2.4.6 Cooling Fan Operation in Engine_Cranking State

While the engine is cranking, the powertrain controller shall:

1. Set %Fan_Command to 0%.

4.2.4.7 Cooling Fan Operation in the Engine Running State

The Powertrain controller shall set the %Fan_Command to 0% until the engine has been running for **K_FanPwrUpDelay**. This time is calibrated to allow enough time for idle stabilization to occur following an engine start. This is a Powertrain owned calibration that must be approved by Platform.

4.2.4.7.1 Determine %Fan_Required

The %Fan_Required represents the amount of fan power to deliver. It is determined from the following parameters:

1. Engine_Coolant_Temperature
2. AC_High-side_Pressure
3. Engine_Oil_Temperature (if available)
4. Transmission_Oil_Temperature (if available)
5. Other Powertrain Diagnostics

Parameters 1, 2, 3, and 4 each generate a %Fan_Required value by linearly interpolating calibration values in a table. %Fan_Required, for each parameter, is calculated as follows:

4.2.4.7.1.1 Determine %Fan_Required Based on Engine Coolant Temperature

ECT_%Fan_Required is determined by looking up Engine_Coolant_Temperature in the following table and using linear interpolation between rows and columns.

Engine_Coolant_Temperature	ECT_%Fan_Required
89 °C	**K_ECT_%FanReq0**
.	.
.	.
.	.
119 °C	**K_ECT_%FanReq15**
121 °C	**K_ECT_%FanReq16**

This is a 17 row table where the rows range from 89 °C to 121 °C in 2 °C increments.

4.2.4.7.1.2 Determine %Fan_Required Based on A/C High-side Pressure

1. If an A/C Pressure sensor is not present on the vehicle, AC_%Fan_Required shall be set to **K_AC_On_%FanRequired** when A/C is requested.

2. If an A/C Pressure sensor is present on the vehicle, AC_%Fan_Required is determined by looking up AC_High-side_Pressure in the following table and using linear interpolation between rows and columns.

AC_High-side_Pressure	AC_%Fan_Required
600 kPa	**K_AC_%FanReq0**
.	.
.	.
.	.
2662.5 kPa	**K_AC_%FanReq15**
2800 kPa	**K_AC_%FanReq16**

This is a 17 row table where the rows range from 600 kPa to 2800 kPa in 137.5 kPa increments.

4.2.4.7.1.3 Determine %Fan_Required Based on Engine Oil Temperature (optional)

If an Engine Oil Temperature is available from Powertrain, then TempEngOil_%Fan_Req shall be set based on the following table of TempEngOil_%Fan_Required as a function of Engine Oil Temperature. If Engine Oil Temperature is greater than **EngOilTemp[Max]**, then TempEngOil_%Fan_Required shall be set equal to 100%. If Engine Oil Temperature is less than **EngOilTemp[Min]**, or an Engine Oil Temperature Sensor is not present, then TempEngOil_%Fan_Required shall be set equal to 0%.

Engine Oil Temperature	TempEngOil_%Fan_Required
EngOilTemp[Min]	**K_TempEngOil_%FanReq0**
.	.
.	.
.	.
EngOilTemp[Max]	**K_TempEngOil_%FanReq7**

This is a 8 row table where the rows range from **EngOilTemp[Min] to EngOilTemp[Max].**

4.2.4.7.1.4 Determine %Fan_Required Based on Transmission Oil Temperature (optional)

If a Transmission Oil Temperature sensor is available from Powertrain, then TempTransOil_%Fan_Req shall be set based on the following table of TempTransOil_%Fan_Required as a function of Transmission Oil Temperature. If Transmission Oil Temperature is greater than **TransOilTemp[Max]**, then TempTransOil_%Fan_Required shall be set equal to 100%. If Transmission Oil Temperature is less than **TransOilTemp[Min]**, or a Transmission Oil Temperature Sensor is not present, then TempTransOil_%Fan_Required shall be set equal to 0%.

Transmission Oil Temperature	TempTransOil_%Fan_Required
TransOilTemp[Min]	**K_TempTransOil_%FanReq0**
.	.
.	.
.	.

TransOilTemp[Max]	**K_TempTransOil_%FanReq7**

This is a 8 row table where the rows range from **TransOilTemp[Min] to TransOilTemp[Max].**

4.2.4.7.1.5 Determine %Fan_Required Based on Other Powertrain Diagnostics

The powertrain controller may request any level of %Fan power based on internal diagnostics. Determination of Powertrain_%Fan_Required is specific to the powertrain control system.

4.2.4.7.2 Determine %Fan_Command

The Powertrain Controller must determine a resulting %Fan_Command based on the %Fan_Required from the five parameters above. The resulting %Fan_Command shall then be converted to specific fan driver output states. To determine the %Fan_Command, the PCM shall perform the following:

1. Determine the Vehicle_%Fan_Required based on the highest %Fan_Required due to Engine Coolant Temperature, A/C Pressure, Engine Oil Temperature, Transmission Oil Temperature, and Powertrain request.
2. Adjust the Vehicle_%Fan_Required, if necessary, based on the optional Platform-requested fan speed adjustment, PF_Adj_%Fan.
3. Adjust the Vehicle_%Fan_Required based on the PCM determined Vehicle Speed, resulting in Adjusted_%Fan_Required.
4. Determine the %Fan_Command by selecting between the Service Tool %Fan_Required, if present, and the Adjusted_%Fan_Required.

4.2.4.7.2.1 Determine the Vehicle_%Fan_Required

The Vehicle_%Fan_Required is determined by selecting the highest %Fan_Required from the following:

1. ECT_%Fan_Required (based on Engine Coolant Temperature)
2. AC_%Fan_Required (based on AC_High-side_Pressure or A/C Request)
3. TempEngOil_%Fan_Required (based on Engine Oil Temperature, if available)
4. TempTransOil_%Fan_Required (based on Transmission Oil Temperature, if available)
5. Powertrain_%Fan_Required (based on Powertrain DTCs)

4.2.4.7.2.2 Platform-Requested Fan Speed Adjustment

An optional Platform-requested fan speed adjustment is allowed to modify the fan speed either higher or lower than the Vehicle_%Fan_Required. If a Platform-requested fan speed adjustment is required, the Powertrain Controller shall adjust the Vehicle_%Fan_Required as follows:

1. No adjustment of the Vehicle_%Fan_Required shall be allowed if the Vehicle_%Fan_Required is greater than or equal to **K_FanAdjustLimitHi**.
2. If Vehicle_%Fan_Required is less than or equal to **K_FanAdjustLimitLo**, then Vehicle_%Fan_Required shall be modified by PF_Adj_%Fan as defined by the following equation:

   Vehicle_%Fan_Required = Vehicle_%Fan_Required + PF_Adj_%Fan

3. If Vehicle_%Fan_Required is between **K_FanAdjustLimitLo** and **K_FanAdjustLimitHi**, then Vehicle_%Fan_Required shall be modified as defined by the following equation:

$$\text{Vehicle\_\%Fan\_ Required} =$$

$$\text{Vehicle\_\%Fan\_ Required} + \text{PF\_ Adj\_\%Fan} * \left\{1 - \frac{(\text{Vehicle\_\%Fan\_ Required} - \text{K\_ FanAdjustLimitLo})}{\text{K\_ FanAdjustLimitHi} - \text{K\_ FanAdjustLimitLo}}\right\}$$

4.2.4.7.2.3 Fan Speed Adjustment Based on PCM Determined Vehicle Speed

If any of the following conditions are true, no Vehicle Speed based adjustment of the Vehicle_%Fan_Required is allowed, and Adjusted_%Fan_Required is set equal to Vehicle_%Fan_Required:

1. Vehicle_Speed is less than (**K_VehicleSpdFanAdjustHi** and **K_VehicleSpdFanAdjustLo**) acting as a hysteresis pair
2. Engine_Coolant_Temperature is greater than **K_CoolantTempOverride**
3. Engine_Oil_Temperature is greater than **K_TempEngOilHi**
4. Transmission_Oil_Temperature is greater than **K_TempTransOilHi**
5. AC_High-side_Pressure is greater than **K_AC_PressureHigh**

Otherwise, Adjusted_%Fan_Required is set equal to:

Vehicle_%Fan_Required *(1- {Vehicle_Speed / **K_MaxVehicleSpeed**})

4.2.4.7.2.4 Determine %Fan_Command

The %Fan_Command is determined by selecting between the percent fan requested by the Service Tool, if present, and the Adjusted_%Fan_Required.

A scan tool may request to override the %Fan_Command via serial data device control. An override request will be identified by Dev_Cntrl_Fans set to Enabled and Dev_Cntrl_%Fan set to the percent fan required by the service tool. The PCM shall grant the device control request if the Adjusted_%Fan_Required is less than **K_ServiceOverrideAllowed**. The %Fan_Command is then set equal to the Dev_Cntrl_%Fan. Otherwise the request is rejected by setting Dev_Cntrl_Fan_Lim_Excd = EngHot. If device control is not present, or not allowed, the final %Fan_Command is equal to the Adjusted_%Fan_Required.

4.2.4.7.3 %Fan_Command Processing

4.2.4.7.3.1 %Fan_Command Processing for Discrete Fan Systems

On discrete fan systems, the following table shall be used to determine the Fan Speed from the %Fan_Command:

Fan Speed	%Fan_Command (Moving from lower to higher fan speed)	%Fan_Command (Moving from higher to lower fan speed)
Speed 0	0%	**K_Speed0_OFF_%Fan**
Speed 1	**K_Speed1_ON_%Fan**	**K_Speed1_OFF_%Fan**
Speed 2	**K_Speed2_ON_%Fan**	**K_Speed2_OFF_%Fan**

Speed 3	**K_Speed3_ON_%Fan**	**K_Speed3_OFF_%Fan**
Speed 4	**K_Speed4_ON_%Fan**	**K_Speed4_OFF_%Fan**
Speed 5	**K_Speed5_ON_%Fan**	**K_Speed5_OFF_%Fan**
Speed 6	**K_Speed6_ON_%Fan**	**K_Speed6_OFF_%Fan**
Speed 7	**K_Speed7_ON_%Fan**	100%

4.2.4.7.3.2 %Fan_Command Processing for Electric PWM Fan Systems

On electric PWM fan systems, %Fan_Command is converted to a PWM duty cycle based on battery voltage, filtered for any resonant speed band, and filtered to control the rate of change according to the following paragraphs.

4.2.4.7.3.2.1 Battery Voltage Adjustments to %Fan_Command

An adjustment to %Fan_Command for changes in system voltage shall be made on systems with electric PWM fans. PWM_%Fan_Command shall be set equal to the minimum of:

1. %Fan_Command * **K_SysVoltsNominal** / Run/Crank_Voltage; and
2. 100%

4.2.4.7.3.2.2 PWM_%Fan_Command Filtering

On electric PWM systems only, PWM_%Fan_Command must be filtered to avoid staying in any resonant RPM band. The PWM_%Fan_Command shall be filtered as defined below:

```
IF
   PWM_%Fan_Command is between K_RPM%max_1 and K_RPM%min_1
THEN
   PWM_%Fan_Command = K_RPM%max_1
ELSEIF
   PWM_%Fan_Command is between K_RPM%max_2 and K_RPM%min_2
THEN
   PWM_%Fan_Command = K_RPM%max_2
ELSEIF
   PWM_%Fan_Command is between K_RPM%max_3 and K_RPM%min_3
THEN
   PWM_%Fan_Command = K_RPM%max_3
ELSEIF
   PWM_%Fan_Command is between K_RPM%max_4 and K_RPM%min_4
THEN
   PWM_%Fan_Command = K_RPM%max_4
ENDIF
```

4.2.4.7.3.2.3 Control of PWM_%Fan_Command Rate of Change

The PWM_%Fan_Command shall not increase by more than **K_MaxFanPWMGradientPos** % per second. The PWM_%Fan_Command shall not decrease by more than **K_MaxFanPWMGradientNeg** % per second.

The duty cycle of Fan Driver #1 shall be set to the time filtered PWM_%Fan_Command.

4.2.4.7.3.3 %Fan_Command Processing for Engine-driven PWM Fan Systems

The powertrain controller shall execute the following sub-sections in the order specified.

Note: Powertrain Implementation of the following subsections is optional on Platforms that do not support engine-driven PWM fan systems.

4.2.4.7.3.3.1 Convert %Fan_Command to Fan_Speed_Command (Fan_Speed_Command)

The %Fan_Command shall be converted to Fan_Speed_Command using the equation:

Fan_Speed_Command = %Fan_Command * (**K_FanRPM_Max** - **K_FanRPM_Offset**) + **K_FanRPM_Offset**

4.2.4.7.3.3.2 Slip Power Management (Fan_Command_Modified_Slip_Power)

The Fan_Speed_Command shall be modified by the powertrain electronics, when necessary, to control the amount of heat generated due to clutch slip.

a. The powertrain electronics shall not modify the Fan_Speed_Command to control fan slip power if Engine_Coolant_Temperature is greater than **K_SlipECT_MaxHi** and **K_SlipECT_MaxLo** acting as a hysteresis pair. Fan_Speed_Command_Modified_Slip_Power shall be set equal to Fan_Speed_Command,

-- Otherwise --

b. The powertrain electronics shall modify the Fan_Speed_Command when it would make the fan operate in the excessive slip power region as defined by the following conditions:

1) Engine_Speed is greater than **K_SlipFanDriveLo**, and
2) Fan_Speed_Command is greater than MaxFanRPMCmd, as determined in section 4.2.4.6.3.3.2(e), below.

c. When the Fan_Speed_Command would make the fan operate in the excessive slip power region, the Fan_Speed_Command_Modified_Slip_Power shall be determined as follows:

1) If Engine_Speed is less than **K_SlipFanDriveHi,** the Fan_Speed_Command_Modified_Slip_Power shall be set equal to **K_SlipFanRPMHi**.
2) If Engine_Speed is greater than or equal to **K_SlipFanDriveHi**, the Fan_Speed_Command_Modified_Slip_Power shall be set equal to MaxFanRPMCmd, as determined in section 4.3.4.6.3.3.2(e).

d. When the Fan_Speed_Command would NOT make the fan operate in the excessive slip power region, the Fan_Speed_Command_Modified_Slip_Power shall be set equal to Fan_Speed_Command.

e. MaxFanRPMCmd shall be determined as a function of engine speed as provided by the following table, where

1) The MaxFanRPMCmd is calculated by a linear interpolation of the table data.

2) The table contains 17 rows with a range from 1650 rpm to 6450 rpm in 300 rpm increments.

Engine_Speed	MaxFanRPMCmd
1650 rpm	**K_MaxFanRPMCmd0**
1950 rpm	**K_MaxFanRPMCmd1**
.	.

.	.
.	.
6150 rpm	**K_MaxFanRPMCmd15**
6450 rpm	**K_MaxFanRPMCmd16**

4.2.4.7.3.3.3 Control of FanSpeed Rate of Change (Fan_Speed_Command_Filtered_Rate_of_Change)

The Fan_Speed_Command_Filtered_Rate_of_Change shall be derived from the Fan_Speed_Command_Modified_Slip_Power with the rate of change limited as specified by the following conditions:

a. The Fan_Speed_Command_Filtered_Rate_of_Change shall be derived from the Fan_Speed_Command_Modified_Slip_Power and shall not increase by more than **K_MaxFanRampPos** rpm per second when slip power management is <u>not</u> modifying the Fan_Speed_Command.

b. The Fan_Speed_Command_Filtered_Rate_of_Change shall be derived from the Fan_Speed_Command_Modified_Slip_Power and shall not decrease by more than **K_MaxFanRampNeg** rpm per second when slip power management is <u>not</u> modifying the Fan_Speed_Command.

c. The Fan_Speed_Command_Filtered_Rate_of_Change shall be derived from the Fan_Speed_Command_Modified_Slip_Power and shall not increase by more than **K_MaxFanSPMRampPos** rpm per second when <u>slip power management is modifying the Fan_Speed_Command.</u>

d. The Fan_Speed_Command_Filtered_Rate_of_Change shall be derived from the Fan_Speed_Command_Modified_Slip_Power and shall not decrease by more than **K_MaxFanSPMRampNeg** rpm per second when <u>slip power management is modifying the Fan_Speed_Command.</u>

4.2.4.7.3.3.4 Limit Fan_Speed_Command for Fan Drive Speed Considerations (Fan_Speed_Command_Filtered_Rate_of_Change)

It is not possible to achieve fan speeds greater than fan drive speed. When fan drive speed is below **K_Max_Lockup_Speed** full lockup of the fan drive is allowed; with fan drive speeds above **K_Max_Lockup_Speed** a calibrated amount of slip is desired. The rate of change algorithm in Section 4.2.4.7.3.3.3 must be aware of this limiting; as such, this section acts on the same variable. This must be performed so that the ramp will have the proper initial conditions for the next time step.

For the EV fan systems, the fan speed command must be limited to avoid saturation of the fan clutch. For MR Fan systems, the fan speed command must prevent lock-up at high fan speeds to ensure mixing of the fan control fluid

a. If Fan_Drive_Speed is less than or equal to **K_Max_Lockup_Speed** then Fan_Speed_Command_Filtered_Rate_of_Change is set to be the minimum of Fan_Drive_Speed and Fan_Speed_Command_Filtered_Rate_of_Change.

b. If Fan_Drive_Speed is greater than **K_Max_Lockup_Speed** then Fan_Speed_Command_Filtered_Rate_of_Change is set to be the minimum of {**K_Max_Lockup_Speed** + (Fan_Drive_Speed – **K_Max_Lockup_Speed**)*__K_Max_Speed_Slope__} and Fan_Speed_Command_Filtered_Rate_of_Change.

c. The Fan_Speed_Command_Filtered_Rate_of_Change shall be limited to **K_Fan_Speed_Limi**t which is defined by the following table when Fan_Table_In_Use is not equal to "ECT" or "DIAG":

Engine_Speed	K_Fan_Speed_Limit
400	**K_Fan_Speed_Limit(0)**
600	**K_Fan_Speed_Limit(1)**
800	**K_Fan_Speed_Limit(2)**
.	.
.	.
.	.
3600	**K_Fan_Speed_Limit(16)**

4.2.4.7.3.3.5 Reduce Fan_Speed_Command during wide open throttle for vehicle performance (Fan_Speed_Command_Limited_WOT)

The Powertrain controller shall reduce the Fan_Speed_Command_Filtered_Rate_of_Change during wide open throttle maneuvers when allowed for increased vehicle performance.

a. The Fan_Speed_Command_Limited_WOT shall be set equal to **K_WOTFanRPM** if all of the following conditions are satisfied:

(1) A wide open throttle condition exists. (Note: The conditions for wide open throttle shall be jointly defined by Powertrain and Platform for a given application).

(2) Engine_Coolant_Temperature is less than **K_WOT_CoolantTemp.**

(3) Engine_Oil_Temperature is less than **K_EngOilTempHi.**

(4) Transmission_Oil_Temperature is less than **K_TransOilTempHi.**

(5) AC_High_side_Pressure is less than **K_AC_PressureHigh.**

(6) Fan_Speed_Command_Filtered_Rate_of_Change is greater than **K_WOTFanRPM**.

b. The Fan_Speed_Command_Limited_WOT shall continue to be set equal to **K_WOTFanRPM** as long as the above wide open throttle conditions (paragraph a) exist up to a maximum time period of **K_WOT_MaxDisable** seconds.

c. The Fan_Speed_Command_Limited_WOT shall be set equal to Fan_Speed_Command_Filtered_Rate_of_Change if the conditions in paragraphs a and b, above, are no longer satisfied.

d. If leaving the wide open throttle condition, then Fan_Speed_Command_Filtered_Rate_of_Change shall be set to **K_WOTFanRPM**.

4.2.4.7.3.3.6 Convert Fan_Speed_Command to PWM Duty Cycle

The Fan_Speed_Command_Limited_WOT shall be converted to %PWM_Duty_Cycle as a function of Fan_Drive_Speed by interpolating the following lookup table based on Engine_Speed and Fan_Speed_Command_Limited_WOT:

Engine_Speed →	0 RPM	500 RPM	...	≥4000 RPM
Fan_Speed_Command_ Limited_WOT	n=0	n=1		n=9
0	**K_%PWM(0,0)**	**K_%PWM(0,1)**	. . .	**K_%PWM(0,n)**
256	**K_%PWM(1,0)**	**K_%PWM(1,1)**	. . .	**K_%PWM(1,n)**
512	**K_%PWM(2,0)**	**K_%PWM(2,1)**	. . .	**K_%PWM(2,n)**
.	.	.	. . .	.
	.	.	. . .	.
	.	.	. . .	.
4096	**K_%PWM(m,0)**	**K_%PWM(m,1)**	. . .	**K_%PWM(m,n)**

This table shall be n=9 columns by m=17 rows, where the columns range from 0 to 4000 RPM in 500 RPM increments, and rows range from 0 RPM to 4096 RPM in 256 RPM increments.

4.2.4.7.3.3.7 Adjust %PWM_Duty_Cycle Based on Measured Fan Speed

If measured fan speed is available and Fan_RPM_Measured_Valid is equal to True, %PWM_Duty_Cycle shall be modified based on measured fan speed resulting in PWM_%Fan_Command. Otherwise, PWM_%Fan_Command is set equal to %PWM_Duty_Cycle, and shall be limited to be less than or equal to **K_MaxPWM%FanWithoutFeedback** and greater than or equal to 0%.

a. In order to determine the difference in commanded versus actual fan speed, fan speed shall be measured and then subtracted from Fan_Speed_Command_Limited_WOT as follows:

Delta_Fan_Speed = Fan_Speed_Command_Limited_WOT - Fan_RPM_Measured

b. Delta%PWM is determined by interpolating the following lookup table based on Engine_Speed and Delta_Fan_Speed:

Engine_ Speed →	0 RPM	500 RPM	. . .	≥4000 RPM
Delta_Fan_Speed	n=0	n=1		n=8
-1024	**K_Delta(0,0)**	**K_Delta(0,1)**	. . .	**K_Delta(0,n)**
.	**K_Delta(1,0)**	**K_Delta(1,1)**	. . .	**K_Delta(1,n)**
.	**K_Delta(2,0)**	**K_Delta(2,1)**	. . .	**K_Delta(2,n)**
.	.	.	. . .	.
0	.	.	. . .	.
.	.	.	. . .	.
.	.	.	. . .	.
.	.	.	. . .	.
+1024	**K_Delta(m,0)**	**K_Delta(m,1)**	. . .	**K_Delta(m,n)**

(1) This table shall be n=9 columns by m=17 rows where the columns range from 0 to 4000 RPM in 500 RPM increments, and rows range from –1024 RPM to +1024 RPM in 128 RPM increments.

c. The following requirements shall be executed every **K_Adjust_PWM_Exec_Rate** by the timing defined in the following look-up table. If **K_Adjust_PWM_Exec_Rat**e is equal to the maximum defined upper bound of table, then do not execute these requirements.

Engine_Speed (RPM)	**K_Adjust_PWM_Exec_Rate** (seconds)
0	**K_Adjust_PWM_Exec_Rate(0)**
400	**K_Adjust_PWM_Exec_Rate(1)**
800	.
.	.
	.
	.
6400	**K_Adjust_PWM_Exec_Rate(16)**

(1) Integral%PWM shall be determined as follows:
If the absolute value of Delta_Fan_Speed is greater than **K_I_Deadband** ***then***
If [(Delta_Fan_Speed > 0 and
PWM_%Fan_Command < **K_MaxPWM%FanCommand**)
or
(Delta_Fan_Speed < 0 and PWM_%Fan_Command > 0%)],
then Integral%PWM = Integral%PWM + **K_I_%PWM**,
else Integral%PWM = Integral%PWM (that is, keep the previous value)
else Integral%PWM = Integral%PWM (that is, keep the previous value)

Where **K_I_%PWM** is defined by the following table:

Delta_Fan_Speed (RPM)	**K_I_%PWM** (Percent PWM)
<=-512	**K_I_%PWM (0)**
.	**K_I_%PWM (1)**
.	**K_I_%PWM (2)**
-64	.
0	.
64	.
.	.
.	.
>=+512	**K_I_%PWM (16)**

(2) If Integral%PWM is greater than **K_Integrator_High**, then Integral%PWM shall be set to **K_Integrator_High**, where **K_Integrator_High** is defined by the following table:

Engine_Speed (RPM)	**K_Integrator_High** (Percent PWM)
0	**K_Integrator_High(0)**

800	**K_Integrator_High(1)**
1600	.
.	.
.	.
.	.
6400	**K_Integrator_High(8)**

(3) If Integral%PWM is less than **K_Integrator_Low**, then Integral%PWM shall be set to **K_Integrator_Low** where **K_Integrator_Low**_ is defined by the following table:

Engine_Speed (RPM)	**K_Integrator_Low** (Percent PWM)
0	**K_Integrator_Low(0)**
800	**K_Integrator_Low(1)**
1600	.
.	.
.	.
.	.
6400	**K_Integrator_Low(8)**

4.2.4.7.3.3.8 Calculate Total Fan Output PWM Duty Cycle

The output PWM duty cycle shall be defined by:

(a) PWM_%Fan_Command = %PWM_Duty_Cycle + Delta%PWM + Integral%PWM

PWM_%Fan_Command shall be limited to be less than or equal to **K_MaxPWM%FanCommand** and greater than or equal to 0%.

4.2.4.7.3.3.9 Low Fan Speed Management

a. The PWM_%Fan_Command shall be modified, when necessary to prevent the fan speed from dropping too low.

b. The PWM_%Fan_Command shall be set equal to **K_LowSpeedPWM** if all the following conditions are present:

(1) Fan_RPM_Measured is less than **K_FanSpeedLow.**

(2) Engine_Run_Time is greater than **K_FanPwrUpDelay.**

(3) The engine is not cranking.

(4) "Fan Speed Sensor Fault" is not present. Reference section 4.2.7.3.

4.2.4.9 After-Run Cooling Fan Control

The After-Run cooling fan control algorithm shall be executed on electric cooling fan systems only. The After-Run cooling fan control algorithm supports 2 after-run fan speeds, normal after-run **(K_AfterRun%Fan)** and high speed after-run **(K_AfterRunHi%Fan).**

a. After-Run algorithm shall begin when the Run/Crank signal transitions from active to inactive.

b. While the After-Run algorithm is active:

(1) %Fan_Command shall be set equal to **K_AfterRun%Fan** when Engine_Coolant_Temperature is greater than **K_AfterRunStartTempHi** and **K_AfterRunStartTempLo** acting as a hysteresis pair,

(2) %Fan_Command shall be set equal to **K_AfterRunHi%Fan** when Engine_Coolant_Temperature is greater than **K_AfterRunHiStartTempHi** and **K_AfterRunHiStartTempLo** acting as a hysteresis pair,

(3) otherwise %Fan_Command is set equal to 0%.

c. High speed after-run operation shall be terminated if any of the following occur:

(1) If less than **K_AfterRunTime[n]** seconds has elapsed since the start of After-Run cooling fan control, and:

(a) Engine_Coolant_Temperature is less than **K_AfterRunHiContinueTemp[n]**, where n = 0 to 4,

-OR-

(2) If **K_AfterRunTimeMax** seconds has elapsed since the start of After-Run cooling fan control. Note: The **K_AfterRunTimeMax** calibration, and others in this section, must be determined by balancing cooling requirements for after-boil control with the electrical energy allocated to this function.

d. Normal after-run operation shall be terminated if any of the following occur:

(1) Less than **K_AfterRunTime[n]** seconds has elapsed since the start of After-Run cooling fan control, and Engine_Coolant_Temperature is less than **K_AfterRunContinueTemp[n]**, where n = 0 to 4, or

(2) **K_AfterRunTimeMax** seconds has elapsed since the start of After-Run cooling fan control. The **K_AfterRunTimeMax** calibration, and others in this section, must be determined by balancing cooling requirements for after-boil control with the electrical energy allocated to this function.

e. When high speed after-run is terminated, if **K_AfterRunTimeMax** has not elapsed; the normal after-run control criteria should be evaluated. (i.e. the algorithm allows for a transition from high speed to normal speed if **K_AfterRunTimeMax** has not elapsed.

Optionally, an additional after-run algorithm shall be running in parallel to the above algorithm, and the after-run cooling fan control shall be an OR-function of the two algorithms.

The optional after-run control shall monitor the engine exhaust temperature while the engine is running, and determine if after-run cooling is needed when the Run/Crank signal transitions from active to inactive.

The Exhaust_Temperature can be either an algorithm or sensor.

The following shall apply while the Run/Crank signal is active and the engine is running:

1. If the Exhaust_Temperature is continuously above **K_AfterRunExhaustTempHi[n]** for a duration of **K_ExhaustTempAfterRunSetTrig[n]**, a flag, Exhaust_Temp_AfterRun_Trig[n], shall be set to True.

2. If the Exhaust_Temperature is continuously below **K_AfterRunExhaustTempHi[n]** for a duration of **K_ExhaustTempAfterRunResetTrig[n]**, Exhaust_Temp_AfterRun_Trig[n], shall be set to False.

When the Run/Crank signal transitions from active to inactive the algorithm shall monitor the data value of Exhaust_Temp_AfterRun_Trig[n]. If the data value is True, the %Fan_Command shall be set equal to **K_AfterRun%Fan** for a duration of **K_ExhaustTempAfterRunTime[n]**, whereafter the after-run algorithm shall be terminated.

The algorithm shall be able to handle two sets of different calibrations. Thus n = 0 to 1.

4.2.4.10.1 Convert After-Run %Fan_Command to Fan Speed

Refer to Section 4.2.4.7.3.1.

4.2.5 Execution / Activation Requirements

Algorithm Section	Nominal Execution Interval
Cooling Fan Control	1 sec, max.

4.2.6 Powertrain System State Transition Requirements

The following parameters shall be initialized during the powertrain controller power-up reset:

%Fan_Command ← 0%

The following parameters shall be initialized during the powertrain controller power-down:

Fan_Locked_Fault ← FALSE

4.2.7 Diagnostic Action Requirements

4.2.7.1 Coolant Temperature Faults

If there is a coolant temperature fault, the powertrain controller shall:

1. Set the %Fan_Command equal to **K_FanCommandForCTSFault**,
2. Command the fan driver(s) on according to this %Fan_Command,
3. Command A/C clutch off if **K_AC_OffTempFault** is equal to True.

4.2.7.2 A/C Pressure Sensor Faults

If there is an A/C Pressure Sensor fault, the powertrain controller shall set AC_%FanRequired to 0% since A/C is commanded off in this condition by the A/C Compressor Control Algorithm. Refer to Section 4.3.4.3.3.

4.2.7.3 Fan Speed Feedback Faults

For vehicles equipped with an engine driven fan, and a fan speed sensor, they shall be diagnosed for the following conditions:

a. Fan Speed Too Slow – Test is performed when the fan clutch is commanded on; and if the difference between Fan_Speed_Command and Fan_RPM_Measured is greater than

K_DiagFanSpeedSlowDelta then the appropriate diagnostic trouble code shall be set. This test is intended to diagnose a fan clutch that is not providing enough engagement.

b. Fan Speed Too Fast – Test is performed when the fan clutch is commanded off; and if Fan_RPM_Measured is above **K_DiagFanSpeedHiMax** then the appropriate diagnostic trouble code shall be set. This test is intended to diagnose a fan clutch that is providing too much engagement.

c. Fan Speed Sensor Fault – Test is performed when the engine is running. The fan should always be spinning at some speed when the engine is running, so the frequency output of the fan speed sensor should be non-zero. If the frequency drops below **K_DiagFanSensorFreqMin** then the appropriate diagnostic trouble code shall be set.

Additionally, a sanity check should be performed on the fan speed feedback signal (used to generate Fan_RPM_Measured) each time it is read. The fan speed should never exceed Engine_Speed * **K_WaterPumpPulleyRatio + K_FanSpeedSensorSanityMargin. K_FanSpeedSensorSanityMargin** is required because in certain deceleration conditions Fan_RPM_Measured can exceed exceed Engine_Speed * **K_WaterPumpPulleyRatio.**

When either the sanity check fails or the Fan Speed Sensor test fails (c above) hold the last valid value of Fan_RPM_Measured, and set Fan_RPM_Measured_Is_Old equal to True. When the sanity check has failed **K_FanSpeedSanityFailLimit** out of **K_FanSpeedSanityWindow** or the Fan Speed Sensor test has failed set Fan_RPM_Measured_Valid to False, and set Integral%PWM equal to 0.

When both the sanity check and the Fan Speed Sensor test pass update Fan_RPM_Measured, and set Fan_RPM_Measured_Is_Old equal to False. When Fan_RPM_Measured_Valid is equal to False the sanity check must pass **K_FanSpeedSanityPassLimit** out of **K_FanSpeedSanityWindow** and the Fan Speed Sensor test must pass to set Fan_RPM_Measured_Valid to True.

When Fan_RPM_Measured_Valid is equal to False conditions a and b above cannot be diagnosed. When Fan_RPM_Measured_Valid is equal to False the Fan Speed Sensor Fault DTC shall be set.

4.2.7.4 Fan Output Driver Faults

The following hardware outputs (from Platform or Powertrain electronics) shall be diagnosed for open circuit, and short to battery/ignition voltage or ground, and verified for commanded action:

a. Fan Control 1 Output

b. Fan Control 2 Output (not used for PWM Control Fan systems)

4.2.7.5 Fan Clutch Lock-up Faults (required with engine driven PWM fans)

The conditions for fan clutch lock-up shall be evaluated each ignition cycle if Engine Speed becomes greater than **K_MinRPMtoDetectFanLockup,** Fan_RPM_Measured_Is_Old is equal to False, and Fan_RPM_Measured_Valid is equal to True:

(1) Fan_Locked_Fault shall be set to "True" when Fan_RPM_Measured is greater than **K_FanFailSpeed RPM** for a time period greater than **K_FanLockUpTime** seconds.

(2) When Fan_Locked_Fault is "True", then engine speed shall be limited to **K_FanLockUpEngineRPM** RPM, and the Reduced Engine Power (REP) Lamp is commanded "On" via the serial data signal, ***Reduced Power Indication On*** equal to "True", if selected by calibration.

(3) When Fan_Locked_Fault is equal to "True", the appropriate diagnostic trouble code(s) shall be set if selected by OBD calibration.

(4) Diagnostic trouble code(s) shall have the option to turn on the Service Engine Soon telltale if selected by calibration.

(5) Once fan lock-up is detected, the Fan_Locked_Fault shall remain set to True until the next ignition cycle.

If Fan_RPM_Measured_Valid is equal to False the ability to detect a fan clutch lock-up fault has been lost. If that occurs set Fan_Locked_Fault to True and perform steps 2 through 5 from above.

4.2.7.6 Fan Clutch Lock-up Faults (required with engine driven PWM fans)

The conditions for fan clutch lock-up shall be evaluated each ignition cycle if Engine Speed becomes greater than **K_MinRPMtoDetectFanLockup**:

(1) Fan_Locked_Fault shall be set to "True" when Fan_RPM_Measured is greater than **K_FanFailSpeed RPM** for a time period greater than **K_FanLockUpTime** seconds.

(2) When Fan_Locked_Fault is "True", then engine speed shall be limited to **K_FanLockUpEngineRPM** RPM, and the Reduced Engine Power (REP) Lamp is commanded "On" via the serial data signal, "***Reduced Power Indication On"*** equal to "True", if selected by calibration.

(3) When Fan_Locked_Fault is equal to "True", the appropriate diagnostic trouble code(s) shall be set if selected by OBD calibration.

(4) Diagnostic trouble code(s) shall have the option to turn on the Service Engine Soon telltale if selected by calibration.

(5) Once fan lock-up is detected, the Fan_Locked_Fault shall remain set to True until the next ignition cycle.

4.2.8 Off-Vehicle Communications / Serial Data Interaction Requirements

The following data should be made available through PIDs:

1. Engine_Coolant_Temperature
2. Engine_Oil_Temperature
3. Transmission_Oil_Temperature
4. A/C Pressure
5. Fan_RPM_Measured
6. Fan_Speed_Command
7. %Fan_Command
8. %PWM_Duty_Cycle

The device control overrides that should be made available are included in Section 4.2.4.5 and 4.2.4.7.2.4.

4.2.9 Data Dictionary

4.2.9.1 Calibrations

K_%PWM(m,n) = calibration table that determines the PWM duty cycle required on the output driver, prior to adjustment due to fan speed feedback. The table is based on the desired percentage of fan power (**%Fan_Command**) and the **Engine_Speed**.
Minimum Range: 0 to 100%
Minimum Resolution: 0.5%

K_AC_%FanReq[n] = Calibration table that contains the percentage of fan power required for the corresponding A/C high-side pressure, where n = 0 to 16.

Minimum Range: 0 to 100%

Minimum Resolution: 0.5%

Typical Values: **K_AC_%FanReq** [n] = values are application specific

K_AC_OffTempFault = Calibration that determines if the A/C Clutch should be commanded off if an engine coolant temperature fault is detected.
Minimum Range: True or False

K_AC_OffTempHi and **K_AC_OffTempLo** = Hysteresis pair of calibrations that define the **Engine_Coolant_Temperature** above which the A/C Clutch is commanded off.
Minimum Range: -40 to +140 °C
Minimum Resolution: 1 °C
Typical Values: **K_AC_OffTempHi** = 125 °C
K_AC_OffTempLo = 122 °C

K_AC_On_%FanRequired = Calibration value that contains the percentage of fan power to set **AC_%Fan_Required** to when A/C is requested and no A/C Pressure sensor is present.
Minimum Range: 0 to 100%
Minimum Resolution: 0.5%

K_AC_PressureHigh = Calibration that defines the **AC_High-side_Pressure** above which adjustments to **Vehicle_%Fan_Required** due to vehicle speed or adjustments to **%Fan_Command** due to wide open throttle are not allowed.
Minimum Range: 0 to 3570 kPa
Minimum Resolution: 14 kPa
Typical Value: 1,550kPa

K_Adjust_PWM_Exec_Rate(n) = Integral%PWM is updated at the rate defined by this table as a function of engine speed.

Minimum Range: 0.0 to 255.0 seconds
Minimum Resolution: 0.05 seconds

Typical Values: see table below:

Engine_Speed (RPM)	**K_Adjust_PWM_Exec_Rate** (Seconds)	**K_Adjust_PWM_Exec_Rate** Typical Values (EV/MRF*)
0	**K_Adjust_PWM_Exec_Rate(0)**	Note 2 / 0.05 seconds
400	**K_Adjust_PWM_Exec_Rate(1)**	8.0 / 0.05 seconds
800	**K_Adjust_PWM_Exec_Rate(2)**	6.0 / 0.05 seconds
1200	**K_Adjust_PWM_Exec_Rate(3)**	4.0 / 0.05 seconds

1600	**K_Adjust_PWM_Exec_Rate(4)**	4.0 / 0.05 seconds
2000	**K_Adjust_PWM_Exec_Rate(5)**	3.0/ 0.05 seconds
2400	**K_Adjust_PWM_Exec_Rate(6)**	3.0 / 0.05 seconds
2800	**K_Adjust_PWM_Exec_Rate(7)**	2.0 / 0.05 seconds
3200	**K_Adjust_PWM_Exec_Rate(8)**	2.0 / 0.05 seconds
3600	**K_Adjust_PWM_Exec_Rate(9)**	1.0 / 0.05 seconds
4000	**K_Adjust_PWM_Exec_Rate(10)**	1.0 / 0.05 seconds
4400	**K_Adjust_PWM_Exec_Rate(11)**	1.0 / 0.05 seconds
4800	**K_Adjust_PWM_Exec_Rate(12)**	1.0 / 0.05 seconds
5200	**K_Adjust_PWM_Exec_Rate(13)**	1.0 / 0.05 seconds
5600	**K_Adjust_PWM_Exec_Rate(14)**	1.0 / 0.05 seconds
6000	**K_Adjust_PWM_Exec_Rate(15)**	1.0 / 0.05 seconds
6400	**K_Adjust_PWM_Exec_Rate(16)**	1.0 / 0.05 seconds

*Notes:
(1) This table is calibrated to a constant value for MRF systems
(2) Maximum upper limit of calibration range

K_AfterRun%Fan = The percentage of fan power required for After-Run cooling fan operation. On discrete fan systems, this value should be calibrated such that it results in only cooling fan output driver #1 active. On PWM fan systems, this value can be calibrated to any value within the defined range.
Minimum Range: 0 to 100 %
Minimum Resolution: 0.5 %
Typical Value:

K_AfterRunHi%Fan = The percentage of fan power required for high speed After-Run cooling fan operation. On discrete fan systems, this value should be calibrated such that it results in activating output driver #2. On PWM fan systems, this value can be calibrated to any value within the defined range.
Minimum Range: 0 to 100 %
Minimum Resolution: 0.002%
Typical Value: 80%

K_AfterRunTime[n] = The time limit during After-Run operation to compare **Engine_Coolant_Temperature** to **K_AfterRunContinueTemp[n],** or **K_AfterRunHiContinueTemp[n]** in order to determine if high speed or normal After-Run should be terminated, where n = 0 to 4.
Minimum Range: 0 to 15 minutes
Minimum Resolution: 0.5 minutes
Typical Value: Platform dependant

K_AfterRunContinueTemp[n] = Calibration table that defines the **Engine_Coolant_Temperature** below which After-Run operation is terminated if less than **K_AfterRunTime[n]** has elapsed, where n = 0 to 4.
Minimum Range: -40 to +140 °C
Minimum Resolution: 1 °C

K_AfterRunExhaustTempHi[n] = calibration table that determines the exhaust temperature threshold for after-run fan control, where n = 0 to 1.
Minimum Range: 0 to +1023 °C
Minimum Resolution: 4 °C
Typical Value: 650 °C

K_AfterRunHiContinueTemp[n] = Calibration table that defines the **Engine_Coolant_Temperature** below which high speed After-Run operation is terminated if less than **K_AfterRunTime[n]** has elapsed, where n = 0 to 4.
Minimum Range: -40 to +140 °C
Minimum Resolution: 0.2 °C
Typical Value: Platform dependant

K_AfterRunHiStartTempHi and **K_AfterRunHiStartTempLo** = Hysteresis pair of calibrations that define the **Engine_Coolant_Temperature** above which high speed After-Run operation is started, and the **%Fan_Command** is set equal to **K_AfterRunHi%Fan**.
Minimum Range: -40 to +140 °C
Minimum Resolution: 0.2 °C
Typical Value: 113 °C, 110 °

K_AfterRunStartTempHi and **K_AfterRunStartTempLo** = Hysteresis pair of calibrations that define the **Engine_Coolant_Temperature** above which normal After-Run operation is started, and the **%Fan_Command** is set equal to **K_AfterRun%Fan**.
Minimum Range: -40 to +140 °C
Minimum Resolution: 1 °C
Typical Value: Platform dependant

K_AfterRunTimeMax = The maximum amount of time After-Run operation can continue.
Minimum Range: 0 to 15 minutes
Minimum Resolution: 0.5 minutes
Typical Value:

K_CoolantTempOverride = Calibration value that defines an **Engine_Coolant_Temperature** threshold used for both of the following: 1) the temperature below which the scan tool is allowed to override the fan speed via device control; and 2) the temperature below which adjustments to **Vehicle_%Fan_Required** due to vehicle speed are allowed.
Minimum Range: -40 to +140 °C
Minimum Resolution: 1 °C
Typical Value: 105 °C

K_D1_Speed1 through **K_D1_Speed6** = Calibration values that define the state of output driver #1 which corresponds with fan speed 1 through fan speed 6.
Minimum Range: ON or OFF

K_D2_Speed1 through **K_D2_Speed6** = Calibration values that define the state of output driver #2 which corresponds with fan speed 1 through fan speed 6
Minimum Range: ON or OFF

K_D3_Speed1 through **K_D3_Speed6** = Calibration values that define the state of output driver #3 which corresponds with fan speed 1 through fan speed 6
Minimum Range: ON or OFF

K_Delta(m,n) = calibration table that determines the amount of adjustment to the PWM duty cycle required on the output driver due to fan speed feedback. The table is based on **Delta_Fan_Speed** and the **Engine_Speed**.
Minimum Range: -1024 to +1024 PRM
Minimum Resolution: 1 RPM

Engine_ Speed	0	0500	1000	1500	2000	2500	3000	3500	4000
Delta_Fan _Speed	K_Delta(m,n)								
-1024 PRM	0,0	0,1	0,2	.	.	.	.	.	0,n
.	1,0	1,1	1,2	.	.	.	.	.	1,n
.	2,0	2,1	2,2	.	.	.	.	.	2,n
.	.	.	.	.	.	.	.	.	.
-256	.	.	.	.	.	.	.	.	.
-128	.	.	.	.	.	.	.	.	.
0	.	.	.	.	.	.	.	.	.
+128	.	.	.	.	.	.	.	.	.
+256	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
+1024	m,0	m,1	m,2	.	.	.	.	.	m,n

K_DiagFanSensorFreqMin = Calibration value that defines the Fan_RPM_Measured value under which the fan speed sensor is determined to be faulty.
Minimum Range: 0 to 8192 RPM
Minimum Resolution: 16 RPM
Typical Value: 500 RPM

K_DiagFanSpeedHiMax = Calibration value that defines the Fan_RPM_Measured value over which the fan speed is determined to be too high.
Minimum Range: 0 to 8192 RPM
Minimum Resolution: 16 RPM
Typical Value: 700 RPM

K_DiagFanSpeedSlowDelta = Calibration value that defines the difference between Fan_RPM_Measured and Fan_Commanded_Speed over which the fan is determined to be spinning to slowly.
Minimum Range: 0 to 8192 RPM
Minimum Resolution: 16 RPM
Typical Value: 300 RPM

K_ECT_%FanReq[n] = Calibration table that contains the percentage of fan power required for the corresponding engine coolant temperature defined by the table in Section 4.2.4.7.1.1, where n = 0 to 16.
Minimum Range: 0 to 100%
Minimum Resolution: 0.5%

Typical Values: Program specific**K_EngineCoolantHotHi** and **K_EngineCoolantHotLo** = Hysteresis pair of calibrations that define the engine coolant temperature above which the Engine Hot Coolant Telltale serial data signal is sent to command the telltale on.
Minimum Range: -40 to +140 °C
Minimum Resolution: 1 °C
Typical Values:

K_EngOilTempHi = Calibration that defines the **Engine_Oil_Temperature** above which adjustments to **Vehicle_%Fan_Required** due to vehicle speed or adjustments to **Fan_Speed_Command** due to wide open throttle are not allowed.
Minimum Range: -40 to 150 °C
Minimum Resolution: 0.2 °C
Typical Value: 140 °C

K_ExhaustTempAfterRunResetTrig[n] = calibration table that determines the duration of time the exhaust temperature shall be continuously below the temperature threshold to **reset** the condition for after-run engine cooling, where n = 0 to 1.
Minimum Range: 0 to 16 minutes
Minimum Resolution: 0.5 minute
Typical Value: 3 minutes

K_ExhaustTempAfterRunSetTrig[n] = calibration table that determines the duration of time the exhaust temperature shall be continuously above the temperature threshold to **set** the condition for after-run engine cooling, where n = 0 to 1.
Minimum Range: 0 to 16 minutes
Minimum Resolution: 0.5 minute
Typical Value: 3 minutes

K_ExhaustTempAfterRunTime[n] = calibration table that defines the amount of time after-run engine cooling based on exhaust temperature shall be active, where n = 0 to 1.
Minimum Range: 0 to 16 minutes
Minimum Resolution: 0.5 minute
Typical Value: 3 minutes

K_FanAdjustLimitHi = Calibration value that defines the percentage of fan power threshold such that when **Vehicle_%Fan_Required** is above it, no Platform-Requested adjustment of fan speed is allowed.
Minimum Range: 0 to 100%
Minimum Resolution: 0.5%
Typical Values: TBD

K_FanAdjustLimitLo = Calibration value that defines the percentage of fan power threshold such that when **Vehicle_%Fan_Required** is below it, the full amount of Platform-Requested adjustment of fan speed is used.
Minimum Range: 0 to 100%
Minimum Resolution: 0.5%
Typical Value: TBD

K_FanChangeDelay = Calibration value that defines the amount of time to delay prior to changing the fan speed (discrete fan systems).
Minimum Range: 0 to 3 seconds

Minimum Resolution: 0.1 seconds
Typical Value: TBD

K_FanCommandForCTSFault =If there is a coolant temperature fault, the powertrain controller shall set the %Fan_Command equal to this calibration value.
Minimum Range: 0 to 100%
Minimum Resolution: 1.0%
Typical Value: 85%

K_FanFailSpeed= Fan_Locked_Fault shall be set to “True” when Fan_RPM_Measured is greater than **K_FanFailSpeed** RPM for a time period greater than **K_FanLockUpTime** seconds
Minimum Range: 0 to 8192 RPM
Minimum Resolution: 16 RPM
Typical Value: 4500 RPM

K_FanLockUpEngineRPM = Calibration value defined when Fan_Locked_Fault is “True”, then engine speed shall be limited to **K_FanLockUpEngineRPM** RPM
Minimum Range: 0 to 8192 RPM
Minimum Resolution: 16 RPM
Typical Value: 4500 RPM (based on a 1:1 fan pulley ratio)

K_FanLockUpTime = Calibration value defined Fan_Locked_Fault shall be set to “True” when Fan_RPM_Measured is greater than **K_FanFailSpeed** RPM for a time period greater than **K_FanLockUpTime** seconds.

Minimum Range: 0.0 to 5.0 seconds
Minimum Resolution: 0.1 seconds
Typical Value: 3.0 seconds

K_FanPwrUpDelay = Calibration value that defines the amount of time the fan speed is below **K_FanSpeedLow** before applying the minimum fan speed **K_LowSpeedPWM**.
Minimum Range: 0 to 120 seconds
Minimum Resolution: 1 second
Typical Value: TBD

K_FanRPM_Offset = Calibration value that defines the minimum possible speed of the fan blades which corresponds to 0% fan power (engine-driven fans).
Minimum Range: 0 to 1000 RPM
Minimum Resolution: 16 RPM
Typical Value: 500 RPM

K_FanRPM_Max = Calibration value that defines the maximum possible speed of the fan blades which corresponds to maximum available fan power (engine-driven fans).
Minimum Range: 0 to 4000 RPM
Minimum Resolution: 16 RPM
Typical Value: 3600 RPM

K_FanSpdChgIdle = Calibration value that defines if fan speed reductions at idle are allowed.
Minimum Range: True or False

K_Fan_Speed_Limit(n) = The Fan_Speed_Command_Filtered_Rate_of_Change is limited to this calibration, which is defined by the following table:

Minimum Range: 0 to 4096 RPM
Minimum Resolution: 8 RPM
Typical Values: see table below.

Engine_Speed (RPM)	**K_Fan_Speed_Limit(n)**	**Typical Values** (EV/MRF)
400	**K_Fan_Speed_Limit(0)**	480 / 3600
600	**K_Fan_Speed_Limit(1)**	960 / 3600
800	**K_Fan_Speed_Limit(2)**	1440 / 3600
1000	**K_Fan_Speed_Limit(3)**	1920 / 3600
1200	**K_Fan_Speed_Limit(4)**	2400 / 3600
1400	**K_Fan_Speed_Limit(5)**	2880 / 3600
1600	**K_Fan_Speed_Limit(6)**	3360 / 3600
1800	**K_Fan_Speed_Limit(7)**	3600 / 3600
2000	**K_Fan_Speed_Limit(8)**	3600 / 3600
2200	**K_Fan_Speed_Limit(9)**	3600 / 3600
2400	**K_Fan_Speed_Limit(10)**	3600 / 3600
2600	**K_Fan_Speed_Limit(11)**	3600 / 3600
2800	**K_Fan_Speed_Limit(12)**	3600 / 3600
3000	**K_Fan_Speed_Limit(13)**	3600 / 3600
3200	**K_Fan_Speed_Limit(14)**	3600 / 3600
3400	**K_Fan_Speed_Limit(15)**	3600 / 3600
≥3600	**K_Fan_Speed_Limit(16)**	3600 / 3600

K_FanSpeedMinTime = the minimum amount of time to remain in any fan speed (discrete fan systems).
Minimum Range: 2 to 10 seconds
Minimum Resolution: 1 second
Typical Value: 3 second

K_FanSpeedSanityFailLimit = the number of sanity check failures required to set Fan_RPM_Measured_Valid to False (PWM fan systems).
Minimum Range: 0 to 255
Minimum Resolution: 1
Typical Value: 3

K_FanSpeedSanityPassLimit = the number of sanity check successes required to set Fan_RPM_Measured_Valid to True (PWM fan systems).
Minimum Range: 0 to 255
Minimum Resolution: 1
Typical Value: 5

K_FanSpeedSanityWindow = the number of consecutive fan speed readings used to determine the state of Fan_RPM_Measured_Valid (PWM fan systems).
Minimum Range: 0 to 255
Minimum Resolution: 1
Typical Value: 5

K_I_Deadband = the absolute value of Delta_Fan_Speed below which no integral control action is desired. One use of this calibration is to prevent integrator windup during clutch lockup if there is a small mismatch between Fan_Drive_Speed and Fan_Speed_Measured.
Minimum Range: 0 to 4096 RPM
Minimum Resolution: 1 RPM
Typical Value: 20 RPM

K_I_%PWM = calibration table defining the controller gain for the integral term to remove steady state error in the fan command speed, PWM_%Fan_Command.
Minimum Range: -50.000 to 50.000 (high end may be possible to adjust to keep at one byte)
Minimum Resolution: 0.002
Typical Value: see table below.

Delta_Fan_Speed (RPM)	**K_I_%PWM**	**Typical Values** (EV/MR*)
≤ -512	**K_I_%PWM (0)**	-0.6000 / -0.0002
-448	**K_I_%PWM (1)**	-0.5000 / -0.0002
-384	**K_I_%PWM (2)**	-0.4000 / -0.0002
-320	**K_I_%PWM (3)**	-0.3000 / -0.0002
-256	**K_I_%PWM (4)**	-0.2000 / -0.0002
-192	**K_I_%PWM (5)**	-0.1000 / -0.0002
-128	**K_I_%PWM (6)**	-0.0500 / -0.0002
-64	**K_I_%PWM (7)**	0.0000 / 0.0000
0	**K_I_%PWM (8)**	0.0000 / 0.0000
64	**K_I_%PWM (9)**	0.0000 / 0.136
128	**K_I_%PWM (10)**	0.0660 / 0.272
192	**K_I_%PWM (11)**	0.1300 / 0.408
256	**K_I_%PWM (12)**	0.2000 / 0.544
320	**K_I_%PWM (13)**	0.3360 / 0.680
384	**K_I_%PWM (14)**	0.5070 / 0.816
448	**K_I_%PWM (15)**	0.6380 / 0.952
≥ +512	**K_I_%PWM (16)**	0.8000 / 1.088

* Note: The integrator for the MR Fan system is defined a signal value over the Delta_Fan_Speed operational range.

K_Integrator_High = If Integral%PWM is greater than **K_Integrator_High**, then Integral%PWM shall be set to **K_Integrator_High**, where **K_Integrator_High** is defined by this calibration table.

Minimum Range: 0.000 to 50.000
Minimum Resolution: 0.002
Typical Value: see table below.

Engine_Speed (RPM)	**K_Integrator_High**	**Typical Values** (EV/MR*)
0	**K_Integrator_High(0)**	0.0000
800	**K_Integrator_High(1)**	0.0000
1600	**K_Integrator_High(2)**	2.0000
2400	**K_Integrator_High(3)**	10.0000

3200	**K_Integrator_High(4)**	20.0000
4000	**K_Integrator_High(5)**	25.0000
4800	**K_Integrator_High(6)**	30.0000
5600	**K_Integrator_High(7)**	30.0000
6400	**K_Integrator_High(8)**	30.0000

* Note: The table values apply to the EV Fan System. For MR Fan Systems, table values are set to a constant typical value of 50.000 over the Engine_Speed operation range.

K_Integrator_Low = If Integral%PWM is less than **K_Integrator_Low**, then Integral%PWM shall be set to **K_Integrator_Low** where **K_Integrator_Low** is defined by this calibration table.

Minimum Range: -50.000 to 0.000
Minimum Resolution: 0.002
Typical Value: see table below.

Engine_Speed (RPM)	**K_Integrator_Low**	**Typical Values** (EV/MR*)
0	**K_Integrator_Low(0)**	-0.000
800	**K_Integrator_Low(1)**	-5.000
1600	**K_Integrator_Low(2)**	-5.000
2400	**K_Integrator_Low(3)**	-10.000
3200	**K_Integrator_Low(4)**	-15.000
4000	**K_Integrator_Low(5)**	-15.000
4800	**K_Integrator_Low(6)**	-15.000
5600	**K_Integrator_Low(7)**	-15.000
6400	**K_Integrator_Low(8)**	-15.000

* Note: The table values apply to the EV Fan System. For MR Fan Systems, table values are set to a constant typical value of –50.000 over the Engine_Speed operation range.

K_MaxFanRPMCmd = a lookup table giving the fan speed above which you are considered to be in the excessive slip power region (when Engine_Speed is greater than **K_SlipFanDriveLo**). It is also the value Fan_Speed_Command_Modified_Slip_Power is set at to reduce fan speed and slip power when Engine_Speed is greater than or equal to **K_SlipFanDriveHi**.

Minimum Range: 0 to 4096 RPM
Minimum Resolution: 1 RPM
Typical Values:

Engine_Speed	**MaxFanRPMCmd**
1650 rpm	**K_MaxFanRPMCmd0**
1950 rpm	**K_MaxFanRPMCmd1**
.	.
.	.
.	.
6150 rpm	**K_MaxFanRPMCmd16**
6450 rpm	**K_MaxFanRPMCmd17**

K_MaxFanPWMGradientNeg = the maximum allowed rate of change, in the decreasing direction, of the PWM output (electric PWM fans) or of the %Fan_Command (engine-driven fans).
Minimum Range: 0 to 100 % per second
Minimum Resolution: 0.002 % per second
Typical Value: 10%

K_MaxFanPWMGradientPos = the maximum allowed rate of change, in the increasing direction, of the PWM output (electric PWM fans) or of the %Fan_Command (engine-driven fans).
Minimum Range: 0 to 100 % per second
Minimum Resolution: 0.002 % per second
Typical Value: 10%

K_MaxVehicleSpeed = the maximum speed the vehicle is capable of.
Minimum Range: 0 to 300 kph
Minimum Resolution: 1 kph
Typical Value: TBD

K_MinRPMtoDetectFanLockup=The conditions for fan clutch lock-up shall be evaluated each ignition cycle if Engine Speed becomes greater than **K_MinRPMtoDetectFanLockup**.
Minimum Range: 0 to 8192 RPM
Minimum Resolution: 1 RPM
Typical Value: 4500

K_RPM%min_[n] to **K_RPM%max_[n]** = defines (n = 1 to 4) bands of fan speed, in terms of % PWM duty cycle, that are not allowed due to resonance.
Minimum Range: 0 to 100%
Minimum Resolution: 0.5%
Typical Value: TBD

K_ServiceOverrideAllowed = the percentage of fan power threshold for **Adjusted_%Fan_Required** below which device control is allowed via the scan tool.
Minimum Range: 0 to 100%
Minimum Resolution: 0.5%
Typical Value: TBD

K_SlipECT_MaxHi and **K_SlipECT_MaxLo** = Hysteresis pair of calibrations that define the engine coolant temperature, below which, slip power management is allowed.
Minimum Range: -40 to 140 °C.
Minimum Resolution: 0.2 °C
Typical Value: (Several degrees below the hot light turn on threshold)

K_SlipFanDriveHi = calibration that defines the **Fan_Drive_Speed** above which **%Fan_Command** is set equal to **K_Slip%FanLo** and below which **%Fan_Command** is set equal to **K_Slip%FanHi,** when slip power management is required.
Minimum Range: 0 to 8192 RPM
Minimum Resolution: 1 RPM

Typical Value: Defined by fan/clutch manufacturer

K_SlipFanDriveLo = calibration that defines the **Fan_Drive_Speed** below which no modification to **%Fan_Command** for slip power management is required.
Minimum Range: 0 to 8192 RPM
Minimum Resolution: 1 RPM

Typical Value: Defined by fan/clutch manufacturer

K_SlipFanRPMHi = the fan speed command that **Fan_Speed_Command_Modified_Slip_Power** is set equal to when **Engine_Speed** is less than **K_SlipFanDriveHi** and greater than or equal to **K_SlipFanDriveLo** and slip power management is required and allowed.
Minimum Range: 0 to 4096 rpm
Minimum Resolution: 1 rpm
Typical Value: Defined by fan/clutch manufacturer

K_Speed[n]_OFF_%Fan = the percentage of fan power threshold for **%Fan_Command** below which fan speed n is commanded, where n = 0 to 6.
Minimum Range: 0 to 100%
Minimum Resolution: 0.002%
Typical Value: Platform Dependant

K_Speed[n]_ON_%Fan = the percentage of fan power threshold for **%Fan_Command** above which fan speed n is commanded, where n = 1 to 7.
Minimum Range: 0 to 100%
Minimum Resolution: 0.002%
Typical Value: Platform Dependant

K_SysVoltsNominal = nominal system voltage with the engine running.
Minimum Range: 9 to 16 volts
Minimum Resolution: 0.1 volts
Typical Value: 13.8 volts

K_TransOilTempHi = Calibration that defines the **Transmission_Oil_Temperature** above which adjustments to **Vehicle_%Fan_Required** due to vehicle speed or adjustments to **Fan_Speed_Command** due to wide open throttle are not allowed.
Minimum Range: -40 to 150 °C
Minimum Resolution: 0.2 °C
Typical Value: 125 °C

K_VehicleSpdFanAdjustHi and **K_VehicleSpdFanAdjustLo** = Hysteresis pair of calibrations that define the vehicle speed below which, no fan speed adjustment due to vehicle speed is allowed. The value of these calibrations must be less than **K_MaxVehicleSpeed**.
Minimum Range: 0 to 300 kph
Minimum Resolution: 1 kph
Typical Value: Platform Dependent

K_VehicleSpdIsZeroHi and **K_VehicleSpdIsZeroLo** = Hysteresis pair of calibrations that define the vehicle speed below which the vehicle is considered at idle.
Minimum Range: 0 to 10 kph
Minimum Resolution: 0.5 kph
Typical Value: 15kph, 0kph, respectively

K_WaterPumpPulleyRatio = the pulley ratio of the accessory drive that is driving the fan.
Minimum Range: 1 to 10
Minimum Resolution: 0.1
Typical Value: 1.23

K_WOTFanRPM = the fan speed that is assigned to **Fan_Speed_Command** when a Wide Open Throttle condition exists.
Minimum Range: 0 to 4096 RPM
Minimum Resolution: 1 RPM
Typical Value: 800 RPM

K_WOT_CoolantTemp = the engine coolant temperature, below which reduction in **%Fan_Command** is allowed due to Wide Open Throttle conditions.
Minimum Range: -40 to +140 °C
Minimum Resolution: 1 °C
Typical Value: 115 °C

K_WOT_MaxDisable = the maximum amount of time that Fan_Speed_Command_Limited_WOT is set to **K_WOTFanRPM** due to a Wide Open Throttle condition.
Minimum Range: 0 to 120 seconds
Minimum Resolution: 1 second
Typical Value: 30 seconds

4.2.9.2 Numerical Values

EngOilTemp[Max]=Value of the Engine Oil Temperature table which defines the Maximum engine oil temperature look-up value. This axis of the table is owned by powertrain and determined based on engine characteristics
Minimum Range: -40 to +140 °C
Minimum Resolution: 1 °C

EngOilTemp[Min]=Value of the Engine Oil Temperature table which defines the minimum engine oil temperature look-up value. This axis of the table is owned by powertrain and determined based on engine characteristics
Minimum Range: -40 to +140 °C
Minimum Resolution: 1 °C

TransOilTemp[Max]=Value of the Transmission Oil Temperature table which defines the maximum transmission fluid temperature look-up value. This axis of the table is owned by powertrain and determined based on engine characteristics.
Minimum Range: -40 to +140 °C
Minimum Resolution: 1 °C

TransOilTemp[Min]=Value of the Transmission Oil Temperature table which defines the minimum transmission temperature look-up value. This axis of the table is owned by powertrain and determined based on engine characteristics.
Minimum Range: -40 to +140 °C

Minimum Resolution: 1 °C

4.2.9.3 Variables

%Fan_Command = The amount of fan power to deliver based on all inputs and adjustments as a percentage of total fan power available.
Minimum Range: 0 to 100%
Minimum Resolution: 0.5%

%Fan_Required = The amount of fan power to deliver as a percentage of total fan power available based on Engine Coolant Temperature, A/C High-side Pressure, Engine Oil Temperature, Transmission Oil Temperature, and Other Powertrain Diagnostics.
Minimum Range: 0 to 100%
Minimum Resolution: 0.5%

%PWM_Duty_Cycle = the duty cycle of the output driver that is required based on **%Fan_Command**, before modifying it based on fan speed feedback, or Run/Crank voltage.
Minimum Range: 0 to 100%
Minimum Resolution: 0.5%

AC_%Fan_Required = The amount of fan power required as a percentage of total fan power available based on A/C High-side Pressure.
Minimum Range: 0 to 100%
Minimum Resolution: 0.5%

AC_High-side_Pressure = A/C Pressure reading of the high pressure side of the A/C system.
Minimum Range: 0 to 3570 kPa
Minimum Resolution: 14 kPa

Adjusted_%Fan_Required = The amount of fan power to deliver as a percentage of total fan power available based on **Vehicle_%Fan_Required** after all platform and vehicle speed adjustments have been made.
Minimum Range: 0 to 100%
Minimum Resolution: 0.5%

Delta%PWM = the amount of adjustment to **%PWM_Duty_Cycle** as a result of the difference in measured fan speed from commanded fan speed.
Minimum Range: -50 to 50%
Minimum Resolution: 0.5%

Delta_Fan_Speed = the difference between **Fan_RPM_Measured** (measured fan speed) and **Fan_Speed_Command** (commanded fan speed) in RPM.
Minimum Range: 0 to 4000 RPM
Minimum Resolution: 321 RPM

Dev_Cntrl_%Fan = the desired % fan required, as requested by the service tool.
Minimum Range: 0 to 100%
Minimum Resolution: 0.5%

Dev_Cntrl_Fan_Lim_Excd = indication of which device control limit has been exceeded during a device control override request.

Minimum Range: EngHot or Null

Dev_Cntrl_Fans = indication that a service tool is requesting to override the fan outputs.
Minimum Range: Enabled or Disable

TempEngOil_%Fan_Required = The amount of fan power required as a percentage of total fan power available based on engine oil temperature.
Minimum Range: 0 to 100 %
Minimum Resolution: 0.5%

ECT_%Fan_Required = The amount of fan power required as a percentage of total fan power available based on **Engine_Coolant_Temperature**.
Minimum Range: 0 to 100%
Minimum Resolution: 0.5%

Engine_Coolant_Temperature = Temperature of the engine coolant as determined by the I/O interface of the Powertrain Controller.
Minimum Range: -40 to +140 °C
Minimum Resolution: 1 °C

Engine_Oil_Temperature: Temperature of the Engine oil as determined by the I/O interface of the Powertrain Controller. This variable is a reference into a calibration table with values from **EngOilTemp[Min] to EngOilTemp[Max]** that defines a n=0,1,…,7 row table in terms of the **TempEngOil_%Fan_Required[n]** containing values from **K_TempEngOil_%FanReq[n]**,which TempEngOil_%Fan_Required is set equal from to 100% based on a Engine Oil Temperature threshold.

Engine_Speed = calculated speed of the engine based on available engine position sensor(s).
Minimum Range: 0 to 8192 RPM
Minimum Resolution: 32 RPM

Exhaust_Temperature = The exhaust gas temperature of the engine. The data value may be based on a model.
Minimum Range: 0 to +1023 °C
Minimum Resolution: 4 °C

Exhaust_Temp_AfterRun_Trig[n] = A table of flags that controls if after-run engine cooling based on exhaust temperature shall be activated when the Run/Crank signal transitions from True to False, where n = 0 to 1.
Minimum Range: N/A
Minimum Resolution: True or False.

Fan_Drive_Speed = fan driveshaft speed (engine-driven fans) = Engine_Speed * **K_WaterPumpPulleyRatio**.
Minimum Range: 0 to 8192 RPM
Minimum Resolution: 32 RPM

Fan_Locked_Fault=This flag is set when fan locked conditions are detected for engine driven PWM fans.
Minimum Range: N/A
Minimum Resolution: True or False.

Fan_RPM_Measured = speed of fan blades (engine-driven fans) as calculated by the powertrain controller.
Minimum Range: 0 to 8192 RPM
Minimum Resolution: 16 RPM

Fan_Speed_Command = the desired fan speed (engine-driven fans) that is calculated from %Fan_Command.
Minimum Range: 0 to 4096 RPM
Minimum Resolution: 16 RPM

Fan_Speed_Command_Limited=rate of change limited value of the desired fan speed (engine-driven fans) that is calculated from Fan_Speed_Command.
Minimum Range: 0 to 4096 RPM
Minimum Resolution: 16 RPM

PF_Adj_%Fan = the amount of fan speed adjustment requested by the Platform as a percentage of total fan power.
Minimum Range: -100 to 100%
Minimum Resolution: 1%

Powertrain_%Fan_Required = The amount of fan power required as a percentage of total fan power available based on other Powertrain diagnostics.
Minimum Range: 0 to 100%
Minimum Resolution: 0.5%

Powertrain_System_State = "Powertrain_Ready" defines the state of the Powertrain control system referring to Run/Crank signal is high and the engine is not rotating. The **Powertrain_System_State** of "Controller_Ready" is entered during the ACCESSORY power mode.
Minimum Range: "Controller_Ready", "Powertrain_Ready", etc (additional states are defined and used by Powertrain)
Minimum Resolution: N/A

PWM_%Fan_Command = the duty cycle of the output driver that is required based on %Fan_Command, before modifying it based on fan speed feedback.
Minimum Range: 0 to 100%
Minimum Resolution: 0.5%

Run/Crank_Voltage = voltage read by the controller.
Minimum Range: 0 to 25.5 volts
Minimum Resolution: 0.1 volts

TempTransOil_%Fan_Required = The amount of fan power required as a percentage of total fan power available based on transmission oil temperature.
Minimum Range: 0 to 100 %
Minimum Resolution: 0.5%

Transmission_Oil_Temperature: Temperature of the transmission oil as determined by the I/O interface of the Powertrain Controller. This variable is a reference into a calibration table with values from **TransOilTemp[Min] to TransOilTemp[Max]** that defines a n=0,1,…,7 row table in terms of the **TempTransOil_%Fan_Required[n] containing**

values from K_TempTransOil_%FanReq[n],which TempTransOil_%Fan_Required is set equal from to 100% based on a Transmission Oil Temperature threshhold.
Minimum Range: -40 to +140 °C
Minimum Resolution: 1 °C

Vehicle_%Fan_Required = The amount of fan power required as a percentage of total fan power available based on the highest of: **ECT_%Fan_Required**, **AC_%Fan_Required**, **E_Oil_%Fan_Required**, **T_Oil_%Fan_Required**, and **Powertrain_%Fan_Required**.
Minimum Range: 0 to 100%
Minimum Resolution: 0.5%

Vehicle_Speed = the ground speed of the vehicle.
Minimum Range: 0 to 300 kph
Minimum Resolution: 1 kph

4.2.10 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
4.2.1	Requirements clarification in 1st paragraph	ICR 2031
4.2.4.7.3.3.1	New section 4.2.4.7.3.3.1 added from PPEI 3.3 requirements defined in section 4.2.4.6.3.3.1.	
4.2.4.7.3.3.2	Text replaced in section by PPEI 3.3 requirements defined in section 4.2.4.6.3.3.2.	
4.2.4.7.3.3.3	Text replaced in section 4.2.4.7.3.3.3 by PPEI 3.3 requirements defined in section 4.2.4.6.3.3.3.	
4.2.4.7.3.3.4	New section 4.2.4.7.3.3.4 added from PPEI 3.3 requirements (per ICR 2032 changes) defined in section 4.2.4.6.3.3.4.	
4.2.4.7.3.3.5	Text replaced in section 4.2.4.7.3.3.5 as defined in PPEI 3.3 requirements in section 4.2.4.6.3.3.5.	
4.2.4.7.3.3.6	Text replaced in section 4.2.4.7.3.3.6 with PPEI 3.3 requirements (per ICR 2032) defined in section 4.2.4.6.3.3.6.	
4.2.4.7.3.3.7	Insert new section 4.2.4.7.3.3.7 with PPEI 3.3 requirements (per ICR 2032) in section 4.2.4.3.3.7.	
4.2.4.7.3.3.8	Text replaced with PPEI 3.3 requirements (per ICR 2032) in section 4.2.4.6.3.3.8.	
4.2.4.8.3.3.7	Revised and relocated to section 4.2.7.5.	
4.2.7.3	Text replaced with PPEI 3.3 requirements defined in section 4.2.7.4.	
4.2.7.4	Text replaced with PPEI 3.3 requirements	

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
	defined in section 4.2.7.5.	
4.2.7.5	Inserted with PPEI 3.3 requirements defined in section 4.2.7.6.	
4.2.9.1	**Data Dictionary changes**: Calibration added **K_ K_EngOilTempHi** to commonized with PPEI 3.3 requirements Deleted duplicate calibration K_FanFailSpeed in data dictionary. Calibrations added to commonize with PPEI 3.3 requirements: For **K_MaxFanPWMGradientNeg,** Min Resolution revised and typical value definition added to commonize with PPEI 3.3 requirements For **K_MaxFanPWMGradientPos,** Min Resolution revised and typical value definition added to commonize with PPEI 3.3 requirements For **K_SlipECT_MaxHi** and **K_SlipECT_MaxLo,** Min Resolution revised and Typical value definition added to reflect PPEI 3.3 For **K_SlipFanDriveHi,** Min Resolution revised and Typical value definition added to commonize with PPEI 3.3 requirements For **K_SlipFanDriveLo** Min Resolution revised and Typical value definition added to commonize with PPEI 3.3 requirements Calibration **K_SlipFanRPMHi** added to commonize with PPEI 3.3 requirements **K_ SlipFanSpeed** is not used and was deleted. Change made to commonize with PPEI 3.3 requirements	

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
	K_ SlipOverrideDuration is not used and was deleted. Change made to commonize with PPEI 3.3 requirements **K_Slip%FanHi** deleted, not used. Change made to commonize with PPEI 3.3 requirements. **K_Slip%FanLo** deleted, not used. Change made to commonize with PPEI 3.3 requirements. **K_SlipTimeMax** deleted, not used. Change made to commonize with PPEI 3.3 requirements. **K_WOT%Fan** replaced with **K_WOTFanRPM** to reflect PPEI 3.3 requirements. Change made to commonize with PPEI 3.3 requirements **K_WOT_CoolantTemp** typical value added. **K_WOT_MaxDisable** data dictionary definition modified to reflect PPEI 3-3 requirements. **EngTransOil_%Fan_Required** calibration name corrected to **TempEngOil_%Fan_Required.** Added **Powertrain_System_State** which is used in determining fan control, but was not defined in algorithm.	
4.2.4.9 4.2.9	Added after-run cooling fan support for 2 after-run fan speeds. Added the following calibrations to the data dictionary: K_AfterRunHi%Fan, K_AfterRunHiContinueTemp, K_AfterRunHiStartTempHi and K_AfterRunHiStartTempLo Modified description of the following calibrations: K_AfterRunTime, K_AfterRunStartTempHi and	ICR 2099

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
	K_AfterRunStartTempLo	
4.2.4.9 4.2.9.1 4.2.9.3	Added logic for after-run fan control based on exhaust temperature. Added calibrations: K_AfterRunExhaustTempHi[n] K_ExhaustTempAfterRunResetTrig[n] K_ExhaustTempAfterRunSetTrig[n K_ExhaustTempAfterRunTime[n] Added variables: Exhaust_temperature Exhaust_Temp_AfterRun_Trig[n]	ICR 2165

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4.3 A/C Compressor Control Algorithm Requirements

4.3.1 General Overview

The PPEI A/C Compressor algorithm is partitioned between the Platform and Powertrain controllers. The Platform controller processes the A/C request from the climate control system along with other platform specific criteria and provides the request to the Powertrain controller to enable the A/C Clutch. The Powertrain controller processes the request from the Platform controller along with other common A/C control criteria to control the A/C Clutch output.

4.3.2 A/C Compressor Algorithm Interface to Platform Controller

The serial data link is the primary interface between the Platform and Powertrain controllers. The signals that are communicated for each type of compressor are listed here. Refer to Section 2.9.3.1 for specific signal/message names. Complete definitions can be found in Section 5.

4.3.2.1 Cycling Clutch Compressors

The following signal information is transmitted by the Powertrain controller.

1. A/C Clutch State
2. A/C High Side Fluid Pressure

The following signal information is transmitted by the Platform controller.

1. A/C Clutch Permission
2. A/C Options (not required for every application)
3. A/C Low Side Fluid Temp, if available (only used in engine torque management algorithm)

4.3.2.2 Electronically Controlled Compressors

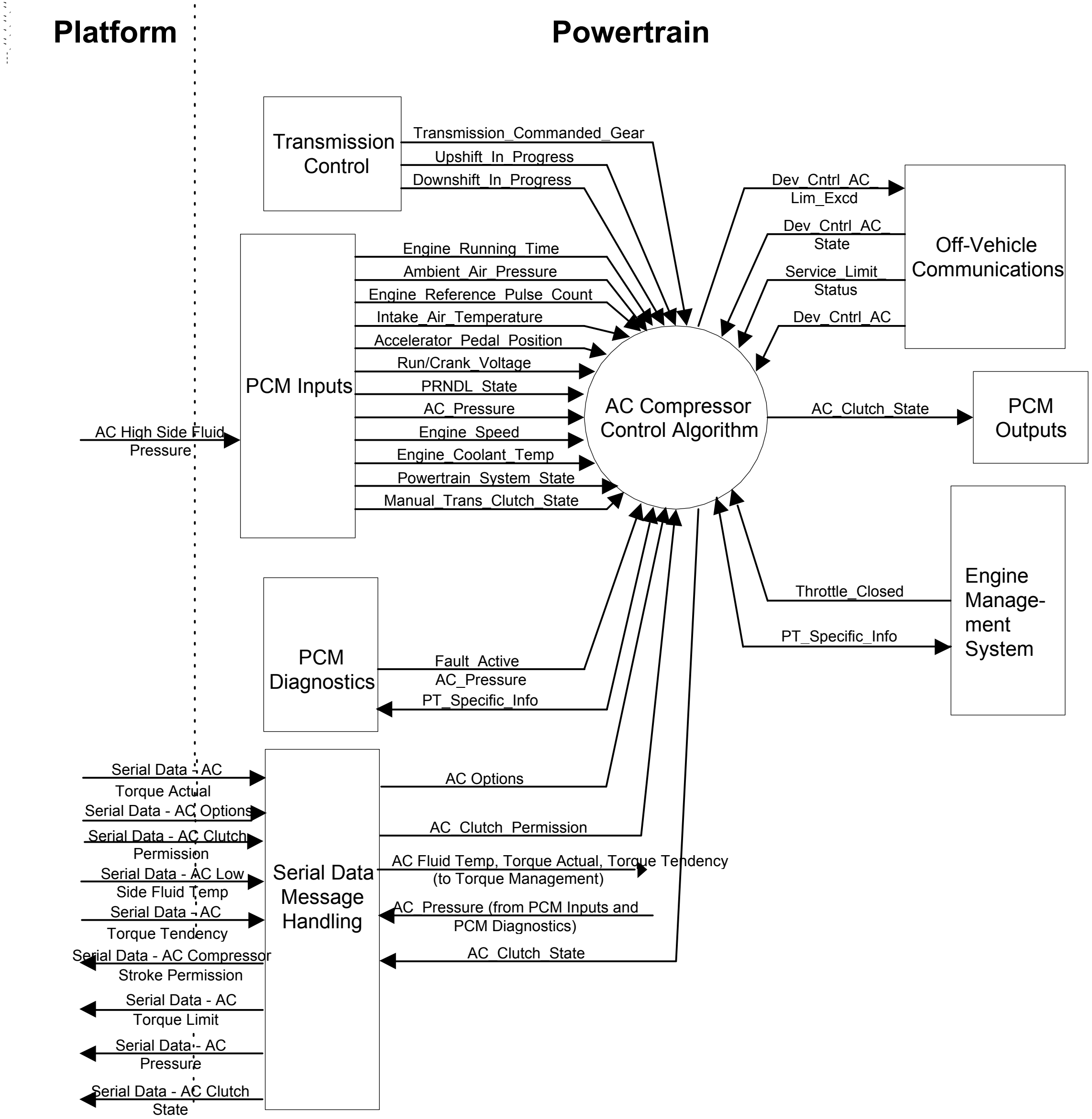
The following signal information is transmitted by the Powertrain controller.

1. A/C Compressor Stroke Permission
2. A/C Compressor Torque Limit (only used in engine torque management algorithm)
3. A/C High Side Fluid Pressure

The following signal information is transmitted by the Platform controller.

1. A/C Options (not required for every application)
2. A/C Compressor Torque Actual (only used in engine torque management algorithm)
3. A/C Compressor Torque Tendency (only used in engine torque management algorithm)

4.3.3 Context Diagram



4.3.4 A/C Compressor Control Algorithm Description

4.3.4.1 A/C Compressor Clutch Control

The Powertrain controller controls the A/C compressor clutch with a single low side driver output. This driver is pulled low for clutch engagement via a relay. The state of the A/C Clutch shall be communicated to platform using serial data.

4.3.4.2 Electronically Controlled Compressors

On electronically controlled compressors, a Platform controller controls the A/C compressor based on the internal algorithm and the serial data commands A/C Compressor Stroke Permission and A/C Compressor Torque Limit from the Powertrain controller.

4.3.4.3 A/C Compressor Operation in Engine_Running State

The Powertrain controller shall control to AC_Clutch_Permission that is received in the serial data message sent by the Platform controller while the engine is running unless one of the overrides listed below occurs.

On electronically controlled compressors, an “A/C Clutch disengage” is accomplished by first pulling the A/C clutch output driver high and then transmitting the A/C Compressor Stroke Permission serial data signal. The A/C Compressor Stroke Permission signal shall be sent with a value of “Security Shutdown” for items 1, 3 and 7 below. Items 5 and 6 below are not applicable for electronically controlled compressors. The A/C Compressor Stroke Permission serial data signal shall be sent with a value of “minimum stroke” for the remaining items. When none of the overrides occur the A/C clutch output driver shall be pulled low and the A/C Compressor Stroke Permission serial data signal shall be sent with a value of “Engage”. The Powertrain controller may limit the compressor torque for load management reasons by transmitting the serial data signal A/C Compressor Torque Limit.

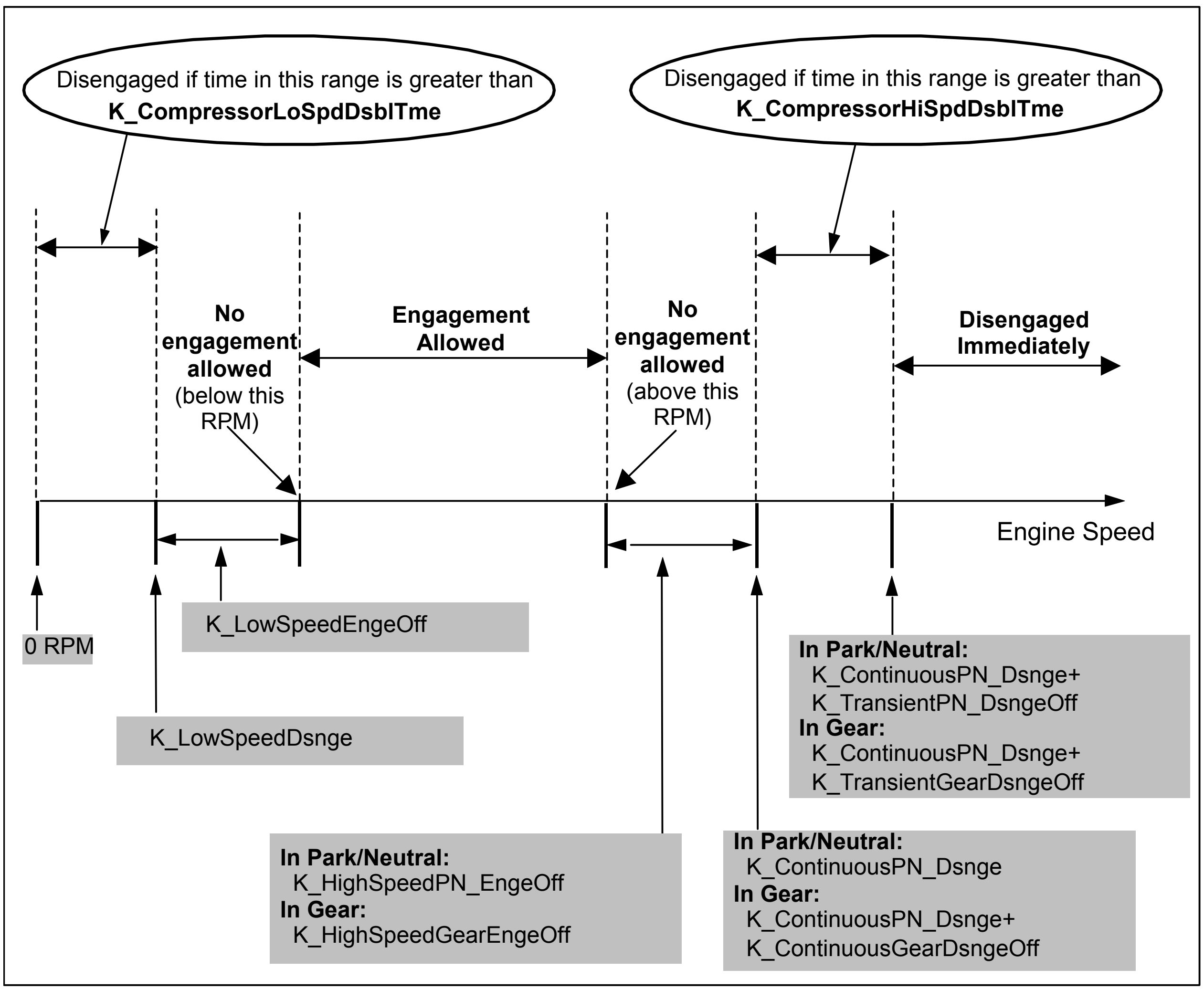
1. A/C Clutch disengaged to protect Compressor for engine speed protection reasons.
2. A/C Clutch disengaged to protect Compressor if battery voltage is out of range.
3. A/C Clutch disengaged to protect Compressor if A/C High Side Pressure is out of range.
4. A/C Clutch override requested by a Scan tool through device control.
5. A/C Clutch engagement delayed until clutch has been disengaged for a minimum period of time.
6. A/C Clutch engagement and disengagement delayed due to engine load management algorithms.
7. A/C Clutch disengaged due to cooling fan algorithm request for cooling system performance.
8. A/C Clutch engagement and disengagement delayed due to a transmission shift in progress. (Powertrain optional)
9. A/C Clutch disengaged to prevent an engine stall. (Powertrain optional)
10. A/C Clutch disengaged during wide open throttle for vehicle performance. (Powertrain optional)
11. A/C Clutch disengaged until the engine speed has stabilized following an engine start. (Powertrain optional)
12. Keep A/C Clutch disengaged due to a transition to closed throttle (pedal). (Powertrain optional)
13. A/C Clutch disengaged due to a transmission downshift. (Powertrain optional)

14. A/C Clutch engagement and disengagement delayed due to Powertrain diagnostics. (Powertrain optional)
15. A/C clutch disengaged to improve vehicle launch performance. (Powertrain optional)

4.3.4.3.1 A/C Clutch disengaged to protect Compressor for engine speed protection reasons.

The Powertrain controller shall disengage the A/C Clutch if the engine speed is not within an acceptable range to protect the Compressor from damage. The A/C Clutch disengagement and engagement due to engine speed is shown in Figure 1 below. All the calibrations in the figure are Platform owned calibrations. PRNDL_State is used to determine Park/Neutral vs. Gear for an automatic transmission. If a Clutch Switch is available for a manual transmission, Park/Neutral will be indicated when Manual_Trans_Clutch_State is equal to Depressed. If a clutch switch is not available for a manual transmission application, In Gear will be indicated.

Figure 1 - A/C Compressor Relay Disabled/Enable Range for Engine Speed Protection



<u>Figure 1 Notes:</u>

- "Engagement Allowed" defines the band of engine speed where the powertrain controller is not prevented from enabling the A/C Compressor Relay.
- "Disengage Immediately" defines the range of engine speed where the powertrain controller shall disable the A/C Compressor Relay within 300 ms due to compressor speed protections.

- "No Engagement Allowed" defines the band of engine speed where the powertrain controller is prevented from enabling the A/C Compressor Relay due to engine stall and compressor speed protections.

4.3.4.3.2 A/C Clutch disengaged to protect Compressor if battery voltage is out of range.

The Powertrain controller shall disengage the A/C Clutch within 300 ms if either of the following conditions are satisfied:

1. Run/Crank voltage is greater than **K_HighVoltDsnge** and **K_HighVoltEnge** (platform owned calibrations) acting as a hysteresis pair.
2. Run/Crank voltage is less than **K_LowVoltDsnge** and **K_LowVoltEnge** (platform owned calibrations) acting as a hysteresis pair.

4.3.4.3.3 A/C Clutch disengaged to protect Compressor if A/C High Side Pressure is out of range.

The Powertrain controller shall disengage the A/C Clutch within 300 ms if any of the following conditions are satisfied:

1. AC_Pressure is greater than **K_HighPresDsnge** and **K_HighPresEnge** (platform owned calibrations) acting as a hysteresis pair.
2. AC_Pressure is less than **K_LowPresDsnge** and **K_LowPresEnge** (platform owned calibrations) acting as a hysteresis pair.
3. A fault with the A/C High Side Pressure Sensor (Fault_Active_AC_Pressure = True) is detected.

4.3.4.3.4 A/C Clutch override requested by a Scan tool through device control.

A scan tool may request to override the A/C Clutch via serial data device control. An override request will be identified by Dev_Cntrl_AC set to Enabled and Dev_Cntrl_AC_State set to either On or Off. The Powertrain controller will grant the device control request and override the A/C Clutch for as long as requested as long as there are no protection limits exceeded. If any of the protection limits are exceeded during A/C Clutch device control override, device control will be limited to **K_ServOvrdMaxTme** (platform owned calibration) seconds and Dev_Cntrl_AC_Lim_Excd will be set to the appropriate value depending on the specific limit which has been exceeded. The limit checks are bypassed during vehicle end of line test which is indicated by Service_Limit_Status being set to Disabled. The protection limits are:

1. Engine_Speed must not be in a range to cause Compressor damage.
2. Run/Crank voltage must not be out of range.
3. A/C High Side pressure must not be in a range to cause Compressor damage.
4. Platform controller must not be indicating that the Clutch should be disabled immediately. This is indicated in the A/C Clutch Permission signal over serial data.
5. A fault with the A/C High Side Pressure Sensor must not be detected. Fault_Active_AC_Pressure must be equal to False.

4.3.4.3.5 A/C Clutch engagement delayed until clutch has been disengaged for a minimum period of time.

The Powertrain controller shall delay the engagement of the A/C Clutch until it has been disengaged for at least **K_MinClutchDsblTme** (platform owned calibration) seconds. This delay is bypassed for device control overrides by a Scan tool. This minimum disengage time does not apply to clutch engagement/disengagement during engine cranking.

4.3.4.3.6 A/C Clutch engagement and disengagement due to engine load management algorithms.

The Powertrain controller may delay requested changes in the A/C Clutch state in order to allow the engine management system to prepare for the change in engine load. This delay is only used for the following requested changes in the A/C Clutch state:

1. Requested engagement or disengagement by Platform via the A/C Clutch Permission signal over serial data. If the A/C Clutch Permission state is equal to "Disengage Immediately", the powertrain controller shall ensure that the disengagement occurs within 300 ms.
2. Redundant with section 4.3.4.3.14.

The maximum allowable delay is defined by the calibration **K_MaxClutchDelay** (platform owned calibration).

4.3.4.3.7 A/C Clutch disengaged due to cooling fan algorithm request for cooling system performance.

The Powertrain controller shall disengage the A/C Clutch within **300 milli**seconds due to high coolant temperature, when requested by the cooling fan control algorithm (refer to Section 4.2.4.4).

4.3.4.3.8 A/C Clutch engagement and disengagement delayed due to a transmission shift in progress. (Powertrain optional)

The Powertrain controller may delay an A/C Clutch transition for up to **K_ShiftClutchDelay** seconds while an automatic transmission upshift or downshift is occurring on a automatic transmission. An upshift in indicated by Upshift_In_Progress = TRUE; a downshift is indicated by Downshift_In_Progress = TRUE. Note: A/C Clutch disengage due to a transmission downshift (Section 4.3.4.3.13) overrides this delay.

4.3.4.3.9 A/C Clutch disengaged to prevent an engine stall. (Powertrain optional)

The Powertrain controller may disengage the A/C Clutch for a period of time equal to **K_StallSaveMinDsblTme** seconds to try to prevent an engine stall. Another algorithm in the powertrain controller shall determine when the compressor shall be disengaged to prevent an engine stall. This can be based on an engine speed threshold and other idle speed control algorithm criteria.

4.3.4.3.10 A/C Clutch disengaged during wide open throttle for vehicle performance. (Powertrain optional)

The Powertrain controller may disengage the A/C Clutch during wide open throttle maneuvers for increased vehicle performance. The A/C Clutch shall be disabled immediately for a minimum time period of **K_MinFullPedDsblTme** seconds if ALL of the following conditions are satisfied:

1. The accelerator pedal position is greater than **K_FullPedDsnge**, with **K_FullPedEnge** as a hysteresis.
2. The engine speed is lower than **K_HiSpdFullPedDsnge**, with **K_HiSpdFullPedEnge** as a hysteresis.
3. Ambient_Air_Pressure is greater than **K_BarometerThreshold.**
4. A minimum time period of **K_MinFullPedDsblCycTme** seconds has elapsed since the end of the last wide open throttle A/C Clutch disable event.

To avoid a short A/C clutch engagement during a gear shift, the clutch shall continue to be disabled after leaving condition 1 for the time period of **K_LetOffPedDsblTme** seconds.

The A/C Clutch will continue to be disabled as long as the wide open throttle condition exists up to a maximum time period of **K_MaxFullPedDsblTme** seconds.

4.3.4.3.11 A/C Clutch disengaged until the engine speed has stabilized following an engine start. (Powertrain optional)

The Powertrain controller may disengage the A/C Clutch until Engine_Running_Time is greater than **K_MinEngRunningTme**. This time is calibrated to allow enough time for idle stabilization to occur following and engine start.

4.3.4.3.12 Keep A/C Clutch disengaged due to a transition to closed throttle (pedal). (Powertrain optional)

The Powertrain controller may keep the A/C Clutch disengaged if the A/C Clutch is currently disengaged at the transition to a closed throttle condition. The A/C Clutch will be disabled for a time period of **K_IdleSwClosedDsblTme** seconds if Throttle_Closed = TRUE and A/C Clutch is currently disengaged.

4.3.4.3.13 A/C Clutch disengaged due to a transmission downshift. (Powertrain optional)

The Powertrain controller may disengage the A/C Clutch due to only one automatic transmission downshift condition (3-2 or 4-3). When this downshift occurs, the A/C Clutch will be disabled for a time period of **K_DwnShftDsblTme** seconds.

4.3.4.3.14 A/C Clutch engagement and disengagement delayed due to Powertrain diagnostics. (Powertrain optional)

The Powertrain controller may delay engagement or disengagement of the A/C Clutch when requested by Powertrain diagnostics. The Catalyst Monitor Diagnostic and the EGR (Exhaust Gas Recirculation) Quick Test Diagnostic may require the A/C Clutch to remain engaged or disengaged in order to stabilize conditions, allowing the diagnostics to run and avoid any OBD-II non-compliance issues. Diagnostics will only be allowed to override Platform A/C clutch control to remain engaged if none of the A/C Compressor Protection Immediate shutdown conditions are present. The A/C Compressor Immediate Shutdown Conditions are defined (refer to section 4.3.4.3) as Engine Speed Protection, Battery Voltage Out of Range, the High Side Pressure Out of Range and if the AC_Clutch_Permission from Platform is received as "Disengage_Immediately". No priority scheme is required for diagnostic overrides since the EGR Diagnostic Request and the Catalyst Monitor Diagnostic Request operate in mutually exclusive regions.

4.3.4.3.14.1 A/C Clutch engagement and disengagement delayed due to Catalyst Monitor Diagnostic Override

When A/C clutch is disengaged the Catalyst Monitor Diagnostic can request that the air conditioning compressor remain off for up to **K_DiagClutchDelay_CatMon** seconds. When the A/C Clutch is engaged the Catalyst Monitor Diagnostic can request that the air conditioning compressor remain engaged for up to **K_DiagOverrideOnMax_CatMon** seconds.

4.3.4.3.14.2 A/C Clutch engagement and disengagement delayed due to EGR Diagnostic Override

When A/C clutch is disengaged or engaged the EGR Diagnostic can request that the air conditioning compressor state change be delayed up to **K_DiagOverrideOnMax_EGR** seconds.

4.3.4.3.15 A/C clutch disengaged to improve vehicle launch performance. (Powertrain optional)

The Powertrain controller may disengage the A/C clutch during a heavy launch condition. A heavy launch is defined when all of the following conditions exist:

1. The accelerator pedal is depressed further than **K_LaunchPedPosDsge** as a function of engine speed.
2. The vehicle speed is below **K_LowVehSpdDsnge** with the hysteresis **K_LowVehSpdEnge**.
3. Vehicle acceleration is less than **K_LowAccelDsnge** with the hysteresis **K_LowAccelEnge**.

The A/C clutch shall continue to be disabled after leaving condition 1 for the time period of **K_LetOffPedDsblTme** seconds.

Guideline for this Powertrain-owned calibration: In hot weather and on a level road, the A/C should stay engaged during a 'normal' drive-away. Heavy launch disengagement is only required for grades and 'fast drive-away'.

4.3.4.4 A/C Compressor Operation in Engine_Cranking State

On cycling clutch compressors only, the Powertrain controller may engage the A/C Clutch while the engine is cranking to remove slug in the refrigerant system. If required to remove slug, the A/C Clutch shall be enabled until Engine_Reference_Pulse_Count is equal to **K_SlugMaxRefPulses** or **K_MaxAntiSlugTme** seconds whichever occurs first. These are Platform owned calibrations. Anti-slugging shall be performed if all of the following conditions are met:

1. AC_Pressure is greater than or equal to **K_SlugUnderPresLmt.** This is a Platform owned calibration.
2. Run/Crank_Voltage is greater than or equal to **K_SlugIgnVoltThrsh**. This is a Platform owned calibration.

3. Engine_Coolant_Temp is less than **K_SlugCoolTempThrsh**. This is a Platform owned calibration.
4. Intake_Air_Temperature at last controller power down is greater than **K_SlugKoffMnfdTempThrsh**. This is a Platform owned calibration.
5. Intake_Air_Temperature at controller powerup is greater than **K_SlugMnfdTempThrsh.** This is a Platform owned calibration.

4.3.5 Execution / Activation Requirements

Algorithm Section	Nominal Execution Interval
A/C Compressor Clutch Control	25 ms., max
A/C Compressor Operation in Engine_Running State	25 ms., max
A/C Compressor Operation in Engine_Cranking State	25 ms., max

4.3.6 Powertrain System State Transition Requirements

The A/C clutch shall be commanded to the disengaged state during the controller power-up reset.

4.3.7 Diagnostic Action Requirements

The A/C Pressure Sensor diagnostic shall be enabled when A/C is present on the vehicle as indicated by A/C_Options. When A/C is not present the diagnostic shall not be enabled.

The diagnostic action that is taken by A/C Clutch Control in the presence of any faults is captured within the algorithm description.

4.3.8 Off-Vehicle Communications / Serial Data Interaction Requirements

The following data should be made available through PIDs:

1. AC_Clutch_State
2. A/C_Pressure
3. The device control overrides that should be made available are included in Section 4.3.4.3.4.

4.3.9 Data Dictionary

4.3.9.1 Calibrations

All calibrations are Platform-owned unless otherwise noted.

K_BarometerThreshold = Minimum ambient air pressure to enable wide open throttle disable function.
Minimum Range: 0 to 100 kPa
Minimum Resolution: 1 kPa
Typical Value: 85 kPa

K_CompressorHiSpdDsblTme = Time that the engine speed is allowed to be between the continuous high speed and transient high speed thresholds before A/C Clutch disengagement is commanded.
Minimum Range: 0 to 15 seconds
Minimum Resolution: 0.5 seconds

Typical Value: 5 seconds

K_CompressorLoSpdDsblTme = Time that the engine speed is allowed to be below K_LowSpeedDsnge before A/C Clutch disengagement is commanded.
Minimum Range: 0 to 15 seconds
Minimum Resolution: 0.5 seconds
Typical Value: 5 seconds

K_ContinuousGearDsngeOff = Engine speed offset above K_ContinuousPN_Dsnge, above which the compressor is only allowed to remain engaged for a calibratable time, after which it is disengaged.
Minimum Range: 0 to 8192 RPM
Minimum Resolution: 32 RPM
Typical Value: 0 RPM

K_ContinuousPN_Dsnge = Engine speed, when the transmission is in Park/Neutral, above which the compressor is only allowed to remain engaged for a calibratable time, after which it is disengaged.
Minimum Range: 0 to 8192 RPM
Minimum Resolution: 32 RPM
Typical Value: 4600 RPM

K_DiagClutchDelay_CatMon = Maximum amount of time the compressor control system is allowed to delay engagement of the A/C compressor for Powertrain Catalyst Monitor diagnostic algorithms. (Powertrain owned and optional)
Minimum Range: 0 to 25.5 seconds.
Minimum Resolution: 0.1 seconds.
Typical Value: 5 seconds

K_DiagOverrideOnMax_CatMon = Maximum amount of time the compressor control system is allowed to delay disengagement of the A/C compressor for the Powertrain Catalyst Monitor diagnostic algorithms. (Powertrain owned and optional)
Minimum Range: 0 to 25.5 seconds.
Minimum Resolution: 0.1 seconds.
Typical Value: 20 seconds

K_DiagOverrideOnMax_EGR = Maximum amount of time the compressor control system is allowed to delay an A/C compressor state change for the Powertrain EGR diagnostic algorithms. (Powertrain owned and optional)
Minimum Range: 0 to 25.5 seconds.
Minimum Resolution: 0.1 seconds.
Typical Value: 4 seconds

K_DwnShftDsblTme = time period that the A/C Clutch will be disengaged for upon detection of a downshift from third to second (or fourth to third) gear. This is a Powertrain-owned calibration.
Minimum Range: 0 to 25.5 seconds
Minimum Resolution: 0.1 seconds
Typical Value: 5 seconds

K_FullPedDsnge = Accelerator pedal position above which the A/C clutch shall be disabled.
Minimum Range: 0 to 100%
Minimum Resolution: 1%
Typical Value: 95%

K_FullPedEnge = Hysteresis to **K_FullPedDsnge.**
Typical Value: 85%

K_HighPresDsnge = A/C Pressure above which the A/C Clutch is disabled.

Minimum Range: 0 to 4096 kPa
Minimum Resolution: 14 kPa
Typical Value: 3000 kPa

K_HighPresEnge = A/C Pressure below which the A/C Clutch may be re-enabled if it had been disabled due to high A/C Pressure.
Minimum Range: 0 to 4096 kPa
Minimum Resolution: 14 kPa
Typical Value: 2300 kPa

K_HighSpeedGearEngeOff = Engine speed offset from the sum of K_ContinuousPN_Dsnge and K_ContinuousGearDsngeOff below which re-engagement of the A/C Clutch is allowed while in gear.
Minimum Range: 0 to 8192 RPM
Minimum Resolution: 32 RPM
Typical Value: 700 RPM

K_HighSpeedPN_EngeOff = Engine speed offset from K_ContinuousPN_Dsnge below which re-engagement of the A/C Clutch is allowed.
Minimum Range: 0 to 8192 RPM
Minimum Resolution: 32 RPM
Typical Value: 700 RPM

K_HiSpdFullPedDsnge = Maximum engine speed for Wide Open Throttle A/C clutch disengagement.
Minimum Range: 0 to 8192 RPM
Minimum Resolution: 32 RPM
Typical Value: 3800 RPM

K_HiSpdFullPedEnge = Hysteresis to **K_HiSpdFullPedDsnge.**
Typical Value: 4000 RPM

K_HighVoltDsnge and **K_HighVoltEnge** = Hysteresis pair of calibrations that define the voltage above which the A/C Clutch is disengaged.
Minimum Range: 0 to 25.5 volts
Minimum Resolution: 0.1 volts
Typical Value: 16 volts

K_IdleSwClosedDsblTme = A/C disable time for closed throttle condition. This is a Powertrain-owned calibration.
Minimum Range: 0 to 15 seconds
Minimum Resolution: 0.5 seconds
Typical Value: 5 seconds

K_LaunchPedPosDsnge = Accelerator pedal position as a function of engine speed, above which the A/C clutch shall be disabled during a heavy launch condition.

table with 5 calibrateable breakpoints

min range:	0 to 8192 rpm,	0 to 100%
resolution:	32 rpm,	1%
typical values:	at idle speed :	55%
	at stall speed auto trans:	80%

K_LetOffPedDsblTme = A/C continuous disable time for pedal let-off conditions.
Minimum Range: 0 to 10 seconds
Minimum Resolution: 0.1 seconds
Typical Value: 1.5 seconds

K_LowAccelDsnge = Vehicle acceleration below which a heavy launch condition is defined.
Minimum Range: 0 to 2 m/s^2
Minimum Resolution: 0.1 m/s^2

Typical Value: 0.6 m/s^2

K_LowAccelEnge = Hysteresis to **K_LowAccelDsnge.**
Typical Value: 0.9 m/s^2

K_LowPresDsnge = A/C Pressure below which the A/C Clutch is disengaged.
Minimum Range: 0 to 4096 kPa
Minimum Resolution: 14 kPa
Typical Value: 180 kPa

K_LowPresEnge = A/C Pressure above which the A/C Clutch may be re-enabled if it had been disabled due to low A/C Pressure.
Minimum Range: 0 to 4096 kPa
Minimum Resolution: 14 kPa
Typical Value: 215 kPa

K_LowSpeedDsnge = Engine speed below which the A/C Clutch is disengaged to protect the compressor from inadequate lubrication.
Minimum Range: 0 to 8192 RPM
Minimum Resolution: 32 RPM
Typical Value: 450 RPM

K_LowSpeedEngeOff = Engine speed offset from K_LowSpeedDsnge above which re-engagement of the A/C Clutch is allowed.
Minimum Range: 0 to 8192 RPM
Minimum Resolution: 32 RPM
Typical Value: 125 RPM

K_LowVehSpdDsnge = Vehicle speed below which a heavy launch condition is defined.
Minimum Range: 0 to 50 km/h
Minimum Resolution: 1 km/h
Typical Value: 22 km/h

K_LowVehSpdEnge = Hysteresis to **K_LowVehSpdDsnge**.
Typical Value: 25 km/h

K_LowVoltDsnge and **K_LowVoltEnge** = Hysteresis pair of calibrations that define the voltage below which the A/C Clutch is disengaged.
Minimum Range: 0 to 25.5 volts
Minimum Resolution: 0.1 volts
Typical Value: 9.5 volts

K_MaxAntiSlugTme = Maximum amount of time allowed to engage A/C Clutch for anti-slugging action.
Minimum Range: 100 to 7000 msec.
Minimum Resolution: 100 msec.
Typical Value: 500 msec.

K_MaxClutchDelay = Maximum amount of time the compressor control system is allowed to delay for engine load management algorithms.
Minimum Range: 3 to 10 seconds.
Minimum Resolution: 0.1 seconds.
Typical Value: 4 seconds

K_MaxFullPedDsblTme = Maximum amount of time the A/C clutch is allowed to be disabled for the wide open throttle disable function. This is a Powertrain-owned calibration.
Minimum Range: 0 to 10 seconds.
Minimum Resolution: 0.1 seconds.
Typical Value: 6 seconds

K_MinClutchDsblTme = minimum clutch off time as a function of engine speed.

Minimum Range: 0 to 10 seconds
Minimum Resolution: 0.1 seconds
Table Breakpoints: 0 to 8192 RPM; every 512 RPM
Typical Values: 0 RPM = 8 seconds
1024 RPM = 8 seconds

K_MinEngRunningTme = minimum time the A/C clutch must remain disabled after engine run is detected based on start up coolant temperature. This is a Powertrain-owned calibration.
Minimum Range: 0 to 10 seconds
Minimum Resolution: 0.1 seconds
Table Breakpoints: 0 to 128 °C; every 32 °C
Typical Values: 32 °C = 4 seconds
96 °C = 4 seconds

K_MinFullPedDsblCycTme = Minimum amount of time before the wide open throttle disable can be activated since the last time the A/C Clutch was disabled for a wide open throttle condition. This is a Powertrain-owned calibration.
Minimum Range: 0 to 10 seconds.
Minimum Resolution: 0.1 seconds.
Typical Value: 6 seconds

K_MinFullPedDsblTme = Minimum amount of time the A/C Clutch will be disabled due to a wide open throttle condition. This is a Powertrain-owned calibration.
Minimum Range: 0 to 10 seconds.
Minimum Resolution: 0.1 seconds.
Typical Value: 2 seconds

K_ServOvrdMaxTme = Maximum amount of time to allow service override of A/C Clutch when protection limits are exceeded.
Minimum Range: 0 to 25.5 seconds
Minimum Resolution: 0.1 seconds
Typical Value: 5 seconds

K_ShiftClutchDelay = Maximum amount of time the compressor control system is allowed to delay for transmission shift conditions (Powertrain owned and optional).
Minimum Range: 3 to 10 seconds.
Minimum Resolution: 0.1 seconds.
Typical Value: 4 seconds

K_SlugCoolTempThrsh = Maximum engine coolant temperature to engage anti-slugging action.
Minimum Range: -40 to 150 °C.
Minimum Resolution: 1 °C.
Typical Value: 25 °C.

K_SlugIgnVoltThrsh = Minimum vehicle system voltage to engage A/C Clutch for anti-slugging.
Minimum Range: 0 to 25.5 volts
Minimum Resolution: 0.1 volts
Typical Value: 9.5 volts

K_SlugKoffMnfdTempThrsh = Maximum Intake air temperature at end of last ignition cycle to enable anti-slugging action.
Minimum Range: -40 to 150 °C.
Minimum Resolution: 1 °C.
Typical Value: 14 °C.

K_SlugMaxRefPulses = number of engine reference pulses to engage the A/C Clutch for anti-slugging action.
Minimum Range: 0 to 255 pulses

Minimum Resolution: 1 pulse
Typical Value: 15 pulses

K_SlugMnfdTempThrsh = Maximum Intake air temperature to enable anti-slugging action.
Minimum Range: -40 to 150 °C.
Minimum Resolution: 1 °C.
Typical Value: 5 °C.

K_SlugUnderPresLmt = Minimum A/C high side pressure to enable anti-slugging action.
Minimum Range: 0 to 500 kPa
Minimum Resolution: 14 kPa
Typical Value: 150 kPa

K_StallSaveMinDsblTme = minimum time period that the A/C Clutch will be disengaged following a potential stall detection. This is a Powertrain-owned calibration.
Minimum Range: 0 to 25.5 seconds
Minimum Resolution: 0.1 seconds
Typical Value: 5 seconds

K_TransientGearDsngeOff = Engine speed offset above K_ContinuousPN_Dsnge at which the A/C Clutch is immediately disengaged when the transmission is in gear, to protect the A/C Compressor.
Minimum Range: 0 to 8192 RPM
Minimum Resolution: 32 RPM
Typical Value: 750 RPM

K_TransientPN_DsngeOff = Engine speed offset above K_ContinuousPN_Dsnge at which the A/C Clutch is immediately disengaged when the transmission is in Park or Neutral, to protect the A/C Compressor.
Minimum Range: 0 to 8192 RPM
Minimum Resolution: 32 RPM
Typical Value: 750 RPM

4.3.9.2 Variables

AC_Clutch_Permission = represents the latest request by Platform over serial data.
Minimum Range: Engage or Disengage or Disengage_Immediately
Power-up Default: Disengage

AC_Clutch_State = commanded state of the A/C Clutch output.
Minimum Range: Engage or Disengage
Power-up Default: Disengage

AC_Options = defines which A/C is present on the vehicle, based on EOL programming or the A/C Options serial data signal.
Minimum Range: Cycling Clutch AC Present, Electronic Controlled AC Present or AC Not Present
Power-up Default: AC Not Present

AC_Pressure = A/C Pressure reading of the high pressure side of the A/C system.
Minimum Range: 0 to 3570 kPa
Minimum Resolution: 14 kPa

Dev_Cntrl_AC = indication that a service tool is requesting to override the A/C Clutch output.
Minimum Range: Enabled or Disabled

Dev_Cntrl_AC_Lim_Excd = indication of which device control limit has been exceeded during a device control override request.

Minimum Range: Platform_Protections or AC_Pressure or System_Voltage or Engine_Speed

Dev_Cntrl_AC_State = desired state of the A/C Clutch output requested by the service tool.
Minimum Range: ON or OFF

Downshift_In_Progress = indicates that an automatic transmission downshift is in progress.
Minimum Range: True or False

Engine_Coolant_Temp = calculated coolant temperature within the engine.
Minimum Range: -40 to 140 °C
Minimum Resolution: 1 °C

Engine_Reference_Pulse_Count = cumulative count of reference pulses that have occurred since power-up.
Minimum Range: 0 to 200 pulses
Minimum Resolution: 1 pulse

Engine_Running_Time = time that the engine has been running.
Minimum Range: 0 to 200 seconds
Minimum Resolution: 1 second

Engine_Speed = calculated speed of the engine based on available engine position sensor(s).
Minimum Range: 0 to 8192 RPM
Minimum Resolution: 32 RPM

Fault_Active_AC_Pressure = indication that a failure has been detected with the A/C High Side Pressure sensor.
Minimum Range: TRUE or FALSE

Intake_Air_Temperature = temperature measured in the intake air flow path to the engine.
Minimum Range: -40 to 150 °C
Minimum Resolution: 1 °C

Manual_Trans_Clutch_State = state of the manual transmission clutch pedal switch or sensor.
Minimum Range: Depressed or Not_Depressed

PRNDL_State = selected gear by the driver.
Minimum Range: Illegal or Park or Reverse or Neutral or D5 or D4 or D3 or D2 or D1

Run/Crank_Voltage = voltage read by the controller.
Minimum Range: 0 to 25.5 volts
Minimum Resolution: 0.1 volts

Service_Limit_Status = indicates whether or not control limits should be checked during a service tool override. Limit checks are disabled during assembly plant testing.
Minimum Range: Enabled or Disabled

Throttle_Closed = indicates whether the powertrain controller has determined that the throttle is closed.
Minimum Range: True or False

Upshift_In_Progress = indicates that an automatic transmission upshift is in progress.
Minimum Range: True or False

4.3.10 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
4.3.4.3.1	Revised Figure 1 – A/C Compressor Relay Disabled/Enable Range for Engine Speed Protection (Originally named Figure 1 – A/C Clutch Disengagement for Engine Speed Protection.	ICR 314
4.3.4.3, 4.3.9.1	Modify A/C Compressor Override Control for Catalyst Monitor and EGR Diagnostics to prevent A/C clutch state changes from occurring during diagnostic execution and possibly causing an abort due to load changes. Revised calibration definition and name; change name from K_DiagClutchDelay to K_DiagClutchDelay_CatMon Added the following calibrations: K_DiagOverrideOnMax_CatMon K_DiagOverrideOnMax_EGR	ICR 2092
4.3.1	Removed the note that stated the Electronically Controlled Compressor Interfaces are not yet defined.	ICR 2121

4.4 L-Terminal/F-Terminal Monitor Algorithm Requirements

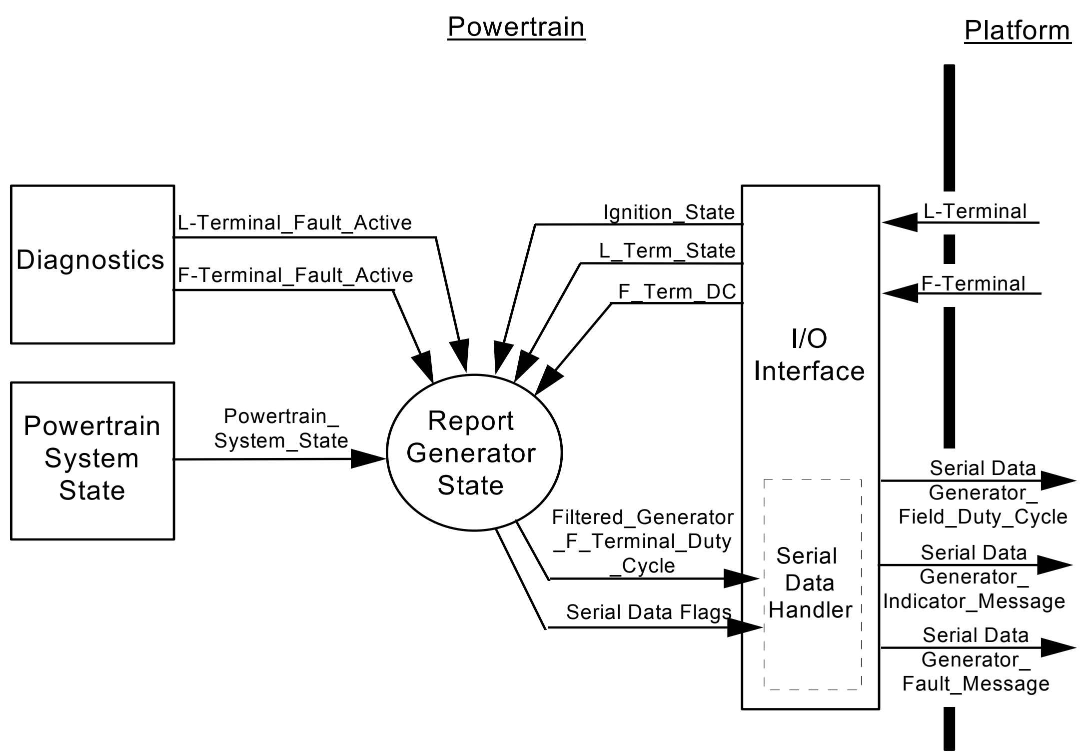
4.4.1 Overview

This software algorithm determines when to command the generator telltale or Driver Information Center (DIC) message using serial data. The generator telltale command decision is based on L-terminal diagnostic trouble code, F-terminal diagnostic trouble code, and the ignition switch and engine running state.

4.4.2 Requirements

The Powertrain electronics shall monitor the L-Terminal and F-Terminal for proper operation as defined in the following sections.

4.4.3 Context Diagram



4.4.3.1 L-Terminal Signal Processing

The Powertrain electronics shall sample the L-terminal at least once every 500 milliseconds.

4.4.3.2 Generator L-Terminal Diagnostic

The generator L-terminal circuit shall be monitored by the Powertrain controller.

The generator (voltage regulator) indicates a fault condition exists (i.e., internal fault, broken belt) to the Powertrain controller by pulling the L-terminal input to a "low" state.

<u>Set L-Terminal Fault DTC:</u> The generator L-terminal fault diagnostic trouble code (DTC) shall be logged if the following conditions for the "Key-on Test" or "Run Test" are satisfied:

1. Key-on Test.

   <u>Enable Conditions</u>

   - The **Powertrain_System_State** is set equal to "Powertrain_Ready" following a "Key-on" event, and
   - No engine crank or cam sensor DTCs are currently logged, and
   - **Engine_Speed** is equal to 0 RPM

   <u>Failure Conditions</u>

   - <u>L-Terminal with Discrete Input</u>
     The generator L-terminal is in a "high" state continuously for a time period, **L_Term_Shorted_Hi_Timer**, that is greater than or equal to **K_L_KeyOnTestTime** following a Run/Crank transition from "Off" to "On".
   - <u>L-Terminal with PWM Output</u>
     The generator L-terminal output diagnostics indicate a short to power failure or a short to ground failure continuously for a time period, **L_Term_Shorted_Hi_Timer**, that is greater than or equal to **K_L_KeyOnTestTime** following a Run/Crank transition from "Off" to "On".

2. Run-Test.

   <u>Enable Conditions</u>

   - Generator L-terminal fault is not active due to "Key-on Test", and
   - The **Powertrain_System_State** is set equal to "Engine_Running", and
   - The generator is not disabled via the L-Terminal Control function (see section 4.5), and
   - No engine crank or cam sensor DTCs are currently logged

   <u>Failure Conditions</u>

   - <u>L-Terminal with Discrete Input</u>
     The generator L-terminal is in a "low" state continuously for a time period, **L_Term_Shorted_Lo_Timer**, that is greater than or equal to **K_L_RunTestTime**.
   - <u>L-Terminal with PWM Output</u>
     The generator L-terminal output diagnostics indicate a short to power failure or a short to ground failure continuously for a time period, **L_Term_Shorted_Lo_Timer**, that is greater than or equal to **K_L_RunTestTime**.

3. Fault Timers.

- **L_Term_Shorted_Hi_Timer** shall be reset when:
  - ⇒ If the enable conditions for the Generator L-terminal Key-On test are not met or
  - ⇒ The Powertrain electronics is executing power-on initialization.
- **L_Term_Shorted_Lo_Timer** shall be reset when:
  - ⇒ If the enable conditions for the Generator L-terminal Run test are not met or
  - ⇒ The Powertrain electronics is executing power-on initialization.

4. Clear L-Terminal Fault DTC: The generator L-terminal fault diagnostic trouble code (DTC) shall be cleared if the following conditions are satisfied:

- The conditions for "Set L-Terminal Fault DTC" are not present, or
- A Service Test Tool has commanded clearing of the DTC.

4.4.3.3 F-Terminal Signal Processing

The Powertrain electronics shall sample the averaged Generator F-Terminal duty cycle at least once every 50 milliseconds. The F-Terminal duty cycle shall be averaged over the number of periods completed since the last sample of averaged duty cycle. The F-Terminal duty cycle shall be filtered using a first order lag filter, with a filter coefficient **K_F_TermInFilt**, that corresponds to a time constant between 0.5 and 5 seconds

For Class 2 applications, the powertrain controller shall transmit the serial data message, defined in Section 4.4.4, when the filtered duty cycle changes by at least 5%. The serial data message shall also be sent once when the filtered duty cycle reaches 100%.

4.4.3.4 Generator F-Terminal Diagnostic

The generator F-terminal circuit shall be monitored by the Powertrain controller.

Set F-Terminal Fault DTC: The generator L-terminal fault diagnostic trouble code (DTC) shall be logged if the following conditions for the "Key-on Test" or "Run Test" are satisfied:

1. Key-On Test: (for non-RVC applications only)

   Enable Conditions
   - **K_F_TerminalPresent** is equal to "True", and
   - The **Powertrain_System_State** is set equal to "Powertrain_Ready" following a "Key-on" event, and
   - **Engine_Speed** is equal to 0 RPM, and
   - No engine crank or cam sensor DTCs are currently logged

   Failure Conditions
   - The filtered generator F-terminal duty cycle, **Filtered_Generator_F_TerminalDC**, is greater than or equal to **K_F_DC_KeyOnTest** continuously for a time period, **F_Term_DC_High_Timer**, that is greater than or equal to **K_F_KeyOnTestTime** following a Run/Crank transition from "Off" to "On".

2. Run-Test. (all applications)

   Enable Conditions
   - **K_F_TerminalPresent** is equal to "True", and
   - Generator F-terminal fault is not active due to "Key-on Test", and
   - The generator is not disabled via the L-Terminal Control function (see section 4.5), and

- The **Powertrain_System_State** is set equal to "Engine_Running", and
- Engine_Speed is less than **K_F_RPM_RunTest**, and
- The Generator L-Terminal Fault DTC is not currently active, and
- No engine crank or cam sensor DTCs are currently logged

Failure Conditions

- The filtered generator F-terminal duty cycle, **Filtered_Generator_F_TerminalDC**, is less than or equal to **K_F_DC_RunTest** continuously for a time period, **F_Term_DC_Lo_Timer**, that is greater than or equal to **K_F_RunTestTime**.

3. Fault Timers

- **F_Term_DC_High_Timer** shall be reset when:
  ⇒ If the enable conditions for the Generator F-terminal Key-On test are not met or
  ⇒ The Powertrain electronics is executing power-on initialization.
- **F_Term_DC_Lo_Timer** shall be reset when:
  ⇒ If the enable conditions for the Generator F-terminal Run test are not met or
  ⇒ The Powertrain electronics is executing power-on initialization.

4. Clear F-Terminal Fault DTC: The generator L-terminal fault diagnostic trouble code (DTC) shall be cleared if the following conditions are satisfied:

- The conditions for "Set F-Terminal Fault DTC" are not present, or
- A Service Test Tool has commanded clearing of the DTC.

4.4.3.5 Determine Generator Indicator Message Data

This section only applies to Class 2 systems. The actual serial message name for the **Generator_Indicator_Message** status in defined in the section 4.4.4, On Vehicle Communications / Serial Data Interaction Requirements.

The **Generator_Indicator_Message** status shall be set to "True", if any of the following conditions are satisfied:

1. The ignition key is in the Accessory position, where Ignition_State is set equal to "Accessory",
   -OR-
2. The Powertrain electronics is in the run mode (the engine is not running), where Powertrain_System_State is set equal to "Powertrain_Ready",
   -OR-
3. A generator L-terminal fault has been detected,
   -OR-
4. A generator F-terminal fault has been detected.

Otherwise, the **Generator_Indicator_Message** status shall be set to "False".

4.4.3.6 Determine Generator Fault Message Data

The actual serial data message name for the **Generator_Fault_Message** status in defined in the section 4.4.4, On Vehicle Communications / Serial Data Interaction Requirements.

The **Generator_Fault_Message** status shall be set to “True”, if any of the following conditions are satisfied:

1. A generator L-terminal fault has been detected, or
2. A generator F-terminal fault has been detected.

Otherwise the **Generator_Fault_Message** status shall be set equal to “False”.

4.4.4 On Vehicle Communications / Serial Data Interaction Requirements

Generator L-Terminal and F-Terminal Serial Data Messages

Specification Name	Transmitter	Class 2 Name	GMLAN
Generator_Indicator_-Message	Powertrain	EA-20-E2 Driver Notification - Generator Indicator	N/A
Generator_Fault_-Message	Powertrain	EA-20-8E Driver Notification - Charging System / Generator Fault	Generator Failed
Filtered_Generator_-F_TerminalDC	Powertrain	72-20 Charging System - Field Duty Cycle (Byte #1)	Generator Field Duty Cycle

4.4.5 Algorithm Execution/Activation

Algorithm Section	Nominal Execution Interval
Generator Status	1 sec., max
L-Terminal Signal Processing	500ms, max
F-Terminal Signal Processing	50ms, max

4.4.6 Data Dictionary

4.4.6.1 Calibrations

All calibrations are Platform-owned.

K_F_DC_KeyOnTest = If F-Terminal Duty Cycle is equal to or greater than this threshold, the F-Terminal Key-On Test fails after a continuous amount of time.

Units:	% Duty Cycle
Minimum Range:	0 to 100
Minimum Resolution:	1
Typical Value:	65

K_F_DC_RunTest = If F-Terminal Duty Cycle is equal to or less than this threshold, the F-Terminal Run-Test fails after a continuous amount of time.

Units:	% Duty Cycle
Minimum Range:	0 to 100
Minimum Resolution:	1
Typical Value:	5

K_F_KeyOnTestTime = The conditions for F-Terminal Key-On Test shall exist for a continuous period greater than or equal to this calibration.

Units:	seconds
Minimum Range:	1 to 125
Minimum Resolution:	1
Typical Value:	5

K_F_RPM_RunTest = Engine Speed must be below this threshold to enable the F-Terminal Run-Test

Units:	RPM
Minimum Range:	0 to 8000
Minimum Resolution:	25
Typical Value:	1000

K_F_RunTestTime = The conditions for F-Terminal Run-Test Test shall exist for a continuous period greater than or equal to this calibration.

Units:	seconds
Minimum Range:	1 to 125
Minimum Resolution:	1
Typical Value:	30

K_F_TerminalPresent = Identifies the F-Terminal function is being utilized.

Units:	Logical
Minimum Range:	True, False
Minimum Resolution:	n/a
Typical Value:	True

K_F_TermInFilt = First order lag filter coefficient used to filter the generator F-Terminal duty cycle input for use with diagnostic and serial data. When sampling every 50ms, a coefficient that corresponds to a 1 second time constant is approximately 12/256.

K_F_TermInFilt = 1 – e$^{-\mathbf{SampleInterval/TimeConstant}}$

Units: factor
Minimum Range: 0 to 1 factor
Minimum Resolution: 1/256
Typical Value: 101/256

K_L_KeyOnTestTime = The conditions for L-Terminal Key-On Test shall exist for a continuous period greater than or equal to this calibration.

Units: seconds
Minimum Range: 1 to 125
Minimum Resolution: 1
Typical Value: 5

K_L_RunTestTime = The conditions for L-Terminal Run-Test Test shall exist for a continuous period greater than or equal to this calibration.

Units: seconds
Minimum Range: 1 to 125
Minimum Resolution: 1
Typical Value: 15

4.4.6.2 Variables

Engine_Speed = calculated speed of the engine based on available engine position sensor(s).

Units: RPM
Minimum Range: 0 to 8192
Minimum Resolution: 32
Initial Value: 0

F_Term_DC_High_Timer = Keeps track of the continuous amount of time the F-terminal Duty Cycle is equal to or greater than its fail threshold during the F-terminal Key-On Test.

Units: seconds
Minimum Range: 0 to 125
Minimum Resolution: 0.5
Initial Value: 0

F_Term_DC_Lo_Timer = Keeps track of the continuous amount of time the F-terminal Duty Cycle is equal to or less than its fail threshold during the F-terminal Run Test.

Units: seconds
Minimum Range: 0 to 125
Minimum Resolution: 0.5
Initial Value: 0

Filtered_Generator_F_TerminalDC = Indicates the filtered current duty cycle of the generator F-Terminal.

Units: Duty Cycle
Minimum Range: 0% to 100%

Minimum Resolution: 1%
Initial Value: 0

Generator_Fault_Message = Keeps track of the current state of the generator fault serial data message. (See section 4.4.3.7 Serial Data Message Definitions)
Units: Logical
Minimum Range: True - generator fault present
False - generator fault not present
Initial Value: False

Generator_Indicator_Message = Keeps track of the current state of the generator indicator serial data message. (See section 4.4.3.7 Serial Data Message Definitions)
Units: Logical
Minimum Range: True - generator telltale should be illuminated
False - generator telltale should not be illuminated
Initial Value: False

L_Term_Shorted_Hi_Timer = Keeps track of the continuous amount of time the L-terminal state is "high" during the L-terminal Key-On Test.
Units: seconds
Minimum Range: 0 to 125 seconds
Minimum Resolution: 1 second
Initial Value: 0 seconds

L_Term_Shorted_Lo_Timer = Keeps track of the continuous amount of time the L-terminal state is "low" during the L-terminal Run Test.
Units: seconds
Minimum Range: 0 to 125 seconds
Minimum Resolution: 1 seconds
Initial Value: 0 seconds

Ignition_State = The ignition switch input to the Powertrain electronics input interface.
Units: Logical
Minimum Range: Off, Accessory, Run, Crank
Initial Value: Off

Powertrain_System_State = Powertrain system state used for decisions
Units: Logical
Minimum Range: Controller_Ready, Powertrain_Ready, Engine_Cranking, Engine_Running
Initial Value: Controller_Ready

4.4.7 Change Log

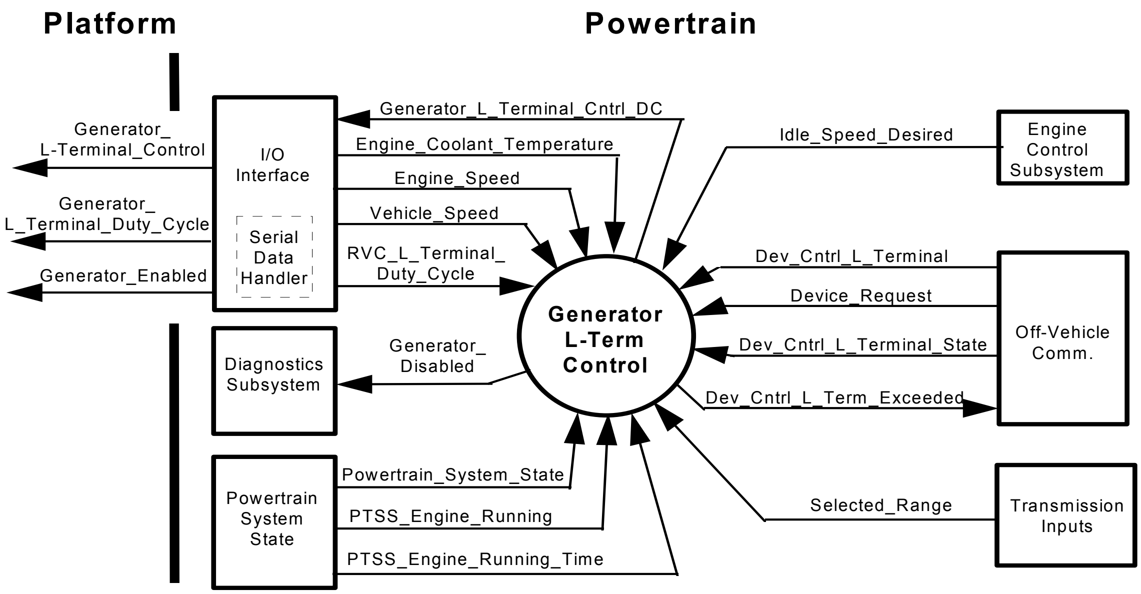
SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
	There were no changes made to this section for PPEI 2.5 Release.	

4.5 Generator L-Terminal Control Algorithm Requirements

4.5.1 General Overview

The generator L-terminal control algorithm determines when to disable the generator for engine starting and stall-saver purposes. The algorithm also processes service tool requests for controlling the generator L-terminal to disable or enable the generator output.

4.5.2 Context Diagram



4.5.3 Generator L-Terminal Control Algorithm Description

4.5.3.1 Generator Control

The Generator shall be enabled or disabled by the powertrain controller based on conditions for normal control and device control in the following table. If the Regulated Voltage Control function is being used, the calibration **K_RVC_FunctionPresent** must set to “True”. Conversely, the calibration **K_RVC_FunctionPresent** must be set “False”, if Regulated Voltage Control function is not being used.

Failsoft RVC_L_Terminal_Duty_Cycle to 100%, if the received serial data message for RVC_L_Terminal_Duty_Cycle is less than a minimum calibration, K_RVC_MinDutyCycle. Also failsoft RVC_L_Terminal_Duty_Cycle to 100%, if a serial data failure (State of Health) is detected with the serial data message for RVC_L_Terminal_Duty_Cycle.

Generator L-Terminal Control					
INPUTS			**OUTPUTS**		
K_RVC_-Function-Present	**L_Terminal_-Device_Request**	**L_Terminal_-Normal_-Control**	**Generator_L_-Terminal_-Cntrl_DC**	**Generator_L_-Terminal_-Control**	**Comments**
"False"	"No Request"	"On"	Set to **"100%"** *(For Discrete Output, set to "On")*	"On"	Generator turned "On" for Normal Control w/o RVC
"False"	"No Request"	"Off"	Set to **"0%"** *(For Discrete Output, set to "Off")*	"Off"	Generator turned "Off" for Normal Control w/o RVC
"False"	"On"	don't care	Set to **"100%"** *(For Discrete Output, set to "On")*	"On"	Generator turned "On" for Device Control w/o RVC
"False"	"Off"	don't care	Set to **"0%"** *(For Discrete Output, set to "Off")*	"Off"	Generator turned "Off" for Device Control w/o RVC
"True"	"No Request"	"On"	Set to **"RVC_L_-Terminal-_Duty_Cycle"**	"On"	Generator turned "On" for Normal Control with RVC
"True"	"No Request"	"Off"	Set to **"10%"**	"Off"	Generator turned "Off" for Normal Control with RVC
"True"	"On"	don't care	Set to **"60%"**	"On"	Generator turned "On" for Device Control with RVC
"True"	"Off"	don't care	Set to **"10%"**	"Off"	Generator turned "Off" for Device Control with RVC

4.5.3.2 Normal Control

The Generator shall be enabled for normal control, and the L_Terminal_Normal_Control set equal to "On", if all of the following conditions are satisfied:

1. The Engine is running, and
2. No engine stall conditions are present, where Stall_Genr_Dsbl_Required is equal to "False", and

3. No cold start conditions are present, where Cold_Start_Genr_Dsbl_Required is equal to "False".

Otherwise, the Generator shall be disabled for normal control, and the L_Terminal_Normal_Control set equal to "Off"

4.5.3.3 Device Control

The Generator shall be enabled via device control if L_Terminal_Device_Request is set equal to "On". Conversely, the Generator shall be disabled via device control if L_Terminal_Device_Request is set equal to "Off". Refer to section 4.5.5 Off Vehicle Communications (OFVC) Device Control of L-Terminal.

4.5.3.4 Generator Disable

1. The Generator shall be disabled by the powertrain controller when the Generator_L_Terminal_Control is set equal to "Off". The Generator_Disabled state shall be set equal to "True" anytime the Generator_L_Terminal_Control is set equal to "Off", so that the Generator L-Terminal and Generator F-Terminal diagnostics can be disabled.

4.5.3.5 Evaluate Engine Speed for Possible Stall

The generator shall be disabled by the Powertrain controller for a possible engine stall condition by setting Stall_Genr_Dsbl_Required equal to "True", when the Engine_Speed is less than or equal to **K_EngSpdCutout***[Idle_Speed_Desired, In_Park_Or_Neutral]*.

The Powertrain controller shall indicate that possible engine stall conditions no longer exist by setting Stall_Genr_Dsbl_Required equal to "False" (the generator is allowed to be enabled), when Engine_Speed is greater than **K_EngSpdCutout***[Idle_Speed_Desired, In_Park_Or_Neutral]*.

The generator shall not be disabled due to a possible engine stall condition for longer than **K_CumulativeL_TermOff** seconds within the same ignition cycle.

4.5.3.6 Evaluate Cold Start Condition

The generator shall be disabled during an engine cold start condition by setting Cold_Start_Genr_Dsbl_Required equal to "True", when the engine running time, PTSS_Engine_Running_Time, is less than **K_ColdStartDsbl***[Coolant Temperature]*, otherwise Cold_Start_Genr_Dsbl_Required shall be set equal to "False".

4.5.4 Algorithm Execution/Activation

Algorithm Section	Nominal Execution Interval
Evaluate Engine Speed for Possible Stall	12.5 ms., max
Everything Else	50 ms., max

4.5.5 On Vehicle Communications / Serial Data Interaction Requirements

Generator L-Terminal Serial Data Messages			
Specification Name	Transmitter	Class 2 Name	GMLAN Name
Generator_L_-Terminal_Control	Powertrain	72-20 Charging System - Field Duty Cycle (Byte #2)	Generator Enabled
RVC_L_Terminal_-Duty_Cycle	Platform	72-24 Charging System - L Terminal Duty Cycle	Generator Regulator Setpoint Duty Cycle Request

4.5.6 Off Vehicle Communications / Serial Data Interaction Requirements

4.5.6.1 Off Vehicle Communications (OFVC) Device Control of L-Terminal

A scan tool may request to override the generator L-terminal via serial data device control. An override request will be identified by Dev_Cntrl_L_Terminal set to Enabled and Dev_Cntrl_L_Terminal_State set to either "On" or "Off". The Powertrain controller will grant the device control request and override the generator L-terminal for as long as requested while the there are no protection limits exceeded. If any of the protection limits are exceeded during generator L-terminal device control override, Dev_Cntrl_L_Term_Exceeded will be set to the appropriate value (i.e. "EngnNotRunning", "NotParkOrNeutral", "SpdNot0", or "L_TermMaxOffTime") depending on the specific limit which has been exceeded. If the protection limits are NOT exceeded, the Dev_Cntrl_L_Term_Exceeded will be set to "Null". The limit checks are bypassed during vehicle end of line test which is indicated by Service_Limit_Status being set to Disabled. The protection limits are exceeded if any of the following occur:

1. Powertrain_System_State is NOT set to "Engine_Running", or
2. Vehicle_Spd_Is_0 is set to "False" (see section 4.5.6.2), or
3. In_Park_Or_Neutral is set to "False", or
4. L_Term_Off_Tmr_Expired to set to "True" (see section 4.5.6.3).

The following table shows the output for Generator L-Terminal Device Control. This output will be used to determine when to turn "On" and "Off" the Generator L-Terminal for Device Control.

Generator L-Terminal Device Control Output				
Dev_Cntrl_L_-Terminal	Dev_Cntrl_L_-Terminal_State	Service_Limit_-Status	Dev_Cntrl_L_-Term_Exceeded	L_Terminal_-Device_Request
"Disabled"	don't care	don't care	don't care	"No Request"
"Enabled"	"On"	"Disabled"	don't care	"On"
"Enabled"	"Off"	"Disabled"	don't care	"Off"
"Enabled"	"On"	"Enabled"	"Null"	"On"
"Enabled"	"On"	"Enabled"	"EngnNotRunning" OR "NotParkOrNeutral" OR "SpdNot0" OR "L_TermMaxOffTime"	"No Request"
"Enabled"	"Off"	"Enabled"	"Null"	"Off"
"Enabled"	"Off"	"Enabled"	"EngnNotRunning" OR "NotParkOrNeutral" OR "SpdNot0" OR "L_TermMaxOffTime"	"No Request"

4.5.6.2 Determine if Vehicle Speed is Zero

The vehicle speed shall be determined as zero, Vehicle_Spd_Is_0 is set equal to "True", if Vehicle_Speed is less than or equal to **K_ZeroSpdThresh** KPH, otherwise Vehicle_Spd_Is_0 is set equal to "False".

4.5.6.3 Determine if L-Terminal Off Time is Expired for Device Control

L_Term_Off_Tmr_Expired shall be determined from the following conditions:

If the L_Terminal_Device_Request is set to "Off" for a cumulative time, CumulativeL_TermOff**,** greater than or equal to **K_CumulL_TermOffDC** seconds, then L_Term_Off_Tmr_Expired shall be set equal to "True".

CumulativeL_TermOff timer shall accumulate anytime L_Terminal_Device_Request is set to "Off".

4.5.7 Data Dictionary

4.5.7.1 Calibrations

All calibrations are Powertrain-owned unless otherwise specified.

K_ColdStartDsbl = A calibration table of values (in seconds) dependent on coolant temperature.
Minimum Range: 0 to 5 seconds
Minimum Resolution: 0.1 seconds
Typical Values:

Coolant Temperature (°C)	Time (seconds)
-40	2
40	1
120	0.5

K_CumulativeL_TermOff = Cumulative amount of time that generator L-terminal can be disabled in normal operation during one ignition cycle (not including disable time due to cold start). This is a Platform-owned calibration.
Minimum Range: 0 to 20 seconds
Typical Value: 10 seconds

K_CumulativeL_TermOffDC = Cumulative amount of time that generator L-terminal can be off for device control during one ignition cycle. This is a Platform-owned calibration.
Minimum Range: 0 to 100 seconds
Typical Value: 30 seconds

K_EngSpdCutout = a calibration table of values dependent on the desired idle speed and Park/Neutral position
Minimum Range: 0 to 2000 RPM
Minimum Resolution: 1 RPM
Typical Values: see table

Desired Idle Speed	In_Park_Or_Neutral	Not_Park_Or_Neutral
800	750	750
1000	800	800
1500	1100	1000

K_RVC_FunctionPresent = This calibration must be set to "True" if the Regulated Voltage Control function is present. Otherwise, the calibration must be set to "False" when Regulated Voltage Control function is not being used. This is a Platform-owned calibration.
Minimum Range: "False" or "True"
Typical Value: "False"

K_RVC_MinDutyCycle = The ECM/PCM generator control algorithm shall enter default mode operation whenever the RVC duty cycle from serial data is less than this calibration. This is a Platform-owned calibration.
Minimum Range: 0.0% to 100%

Minimum Resolution: 1.0%
Typical Value: 42%

K_ZeroSpdThresh = Calibratable value, determines vehicle speed zero threshold.
Minimum Range: 0 to 10 kph
Minimum Resolution: 0.1 kph
Typical Value: 1 kph

4.5.7.2 Variables

Cold_Start_Genr_Dsbl_Required = when this variable is set to "True", the engine run time is less than a calibratable value at a certain temperature: Otherwise this variable is set to false.
Minimum Range: "True" or "False"
Initial Value: "True"

CumulativeL_TermOff = the device control timer, shall be activated/deactivated based on the state of L_Terminal_Device_Request.
Minimum Range: 0 to 100 seconds
Minimum Resolution: 1 second
Initial Value: 30 seconds

Dev_Cntrl_L_Term_Exceeded = If a technician device control request to disable L-Terminal is made and the control limits are not met, then Dev_Cntrl_L_Term_Exceeded will be assigned an appropriate exceeded limit. If the limits are met, then Dev_Cntrl_L_Term_Exceeded will be set equal to "null".
Minimum Range: "EngnNotRunning", "NotParkOrNeutral", SpdNot0", "L_TermMaxOffTime", or "Null"
Initial Value: "Null"

Dev_Cntrl_L_Terminal = Allows an Off-Board Vehicle Communication (OFVC) tool to control L-Terminal. The OFVC tool requires a response from the Powertrain electronics (Generator Control Algorithm) whether control is allowed or not.
Minimum Range: "Enabled" or "Disabled"
Initial Value: "Disabled"

Dev_Cntrl_L_Terminal_State = When the state of this variable is "On" , the Generator Sub-system is commanded to enable L-Terminal. If the Variable state is "Off", the Generator Sub-system is commanded to disable the L-Terminal.
Minimum Range: "On" or "Off"
Initial Value: "Off"

Engine_Coolant_Temperature = Temperature of the engine coolant as determined by the I/O interface of the Powertrain Controller.
Minimum Range: -40 to +140 °C
Minimum Resolution: 1 °C

Engine_Speed = calculated speed of the engine based on available engine position sensor(s).
Minimum Range: 0 to 8192 RPM
Minimum Resolution: 32 RPM

Generator_Disabled = Goes to Diagnostic. Set to True if L-terminal is Off set to False if L-terminal is On (i.e. enabled).
Minimum Range: "True" or "False"
Typical Value: "False"
Initial Value: "True"

Generator_L_Terminal_Control = Indicates whether the Generator L-Terminal output is commanded "On" or "Off".
Minimum Range: "On" or "Off"
Typical Value: "On"
Initial Value: "Off"

Generator_L_Terminal_Cntrl_DC = Outputs pulse width modulated signal to PCM output pin to enable or disable L-terminal
Minimum Range: 0% to 100%
Minimum Resolution: 1%
Typical Value: 60%
Initial Value: 10%

Idle_Speed_Desired = The final desired idle speed of the engine.
Minimum Range: 200 to 2000 RPM
Minimum Resolution: 32 RPM
Typical Value: 800 RPM

In_Park_Or_Neutral = When "True" means the vehicle is in Park or Neutral position on automatic transmissions. For manual transmissions, this variable is always equal to "True"
Minimum Range: "True" or "False"
Initial Value: "True"

L_Term_Off_Tmr_Expired = Set to "True" when the maximum amount of time L-terminal can be disabled has expired during device control.
Minimum Range: "True" or "False"
Initial Value: "False"

L_Terminal_Device_Request = When a device control request is made, it is validated and this variable, L_Terminal_Device_Request, is set to either "On" or "Off". If no request is made, the L_Terminal_Device_Request is set to "No_Request".
Minimum Range: "On", "Off", or "No_Request"
Initial Value: "No_Request"
Typical Value: "No_Request"

PTSS_Engine_Running = Indicates that the engine is considered to be running.
Minimum Range: "True" or "False"

PTSS_Engine_Running_Time = The period of time that the engine has been considered running (or the time that PTSS_Engine_Running has been equal to "True").
Minimum Range: 0 to 204.8 seconds (3.41 minutes)
Minimum Resolution: 0.003125 seconds

RVC_L_Terminal_Duty_Cycle = Commanded L-Terminal Duty Cycle from the Platform via serial data for Regulated Voltage Control.
Minimum Range: 0% to 100%
Minimum Resolution: 0.5%

Selected_Range = the operator selected automatic transmission range as indicated by the transmission range selector.
Minimum Range: "First Gear", "Second Gear", "Third Gear", "Fourth Gear", "Fifth Gear", "Sixth Gear", "Neutral", "Reverse", "Park"
Initial Value: "Park"

Service_Limit_Status = When Service_Limit_Status is set to "Disabled" (by the technician), the generator subsystem will not check any limits and will enable/disable the generator as requested by the technician via the OFVC tool.
Minimum Range: "Enabled" or "Disabled"
Initial Value: "Enabled"
Typical Value: "Enabled"

Stall_Genr_Dsbl_Required = When set to "True", this state variable indicates the actual engine speed is less than the desired idle speed; otherwise the state is set to "False".
Minimum Range: "True" or "False"
Initial Value: "False"

Vehicle_Speed = Vehicle_Speed is defined as the final ground speed of the vehicle.
Minimum Range: 0 to 350 kph
Minimum Resolution: 0.1 kph
Initial Value: 0

Vehicle_Spd_Is_0 = When "True", this state variable indicates that Vehicle_Speed is less than a calibration threshold defined as 0 vehicle speed.
Minimum Range: "True" or "False"
Initial Value: "True"

Vehicle_State_For_Dev_Cntrl = Identifies if the vehicle is in the right state to be controlled by an OFVC tool or not.
Minimum Range: "OK", "Not OK"
Initial Value: "Not OK"

4.5.8 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
	There were no changes made to this section for PPEI 2.5 Release.	

4.6 Fuel Volume Determination

Refer to Section 2.12 for the hardware interface and serial data signal summary.

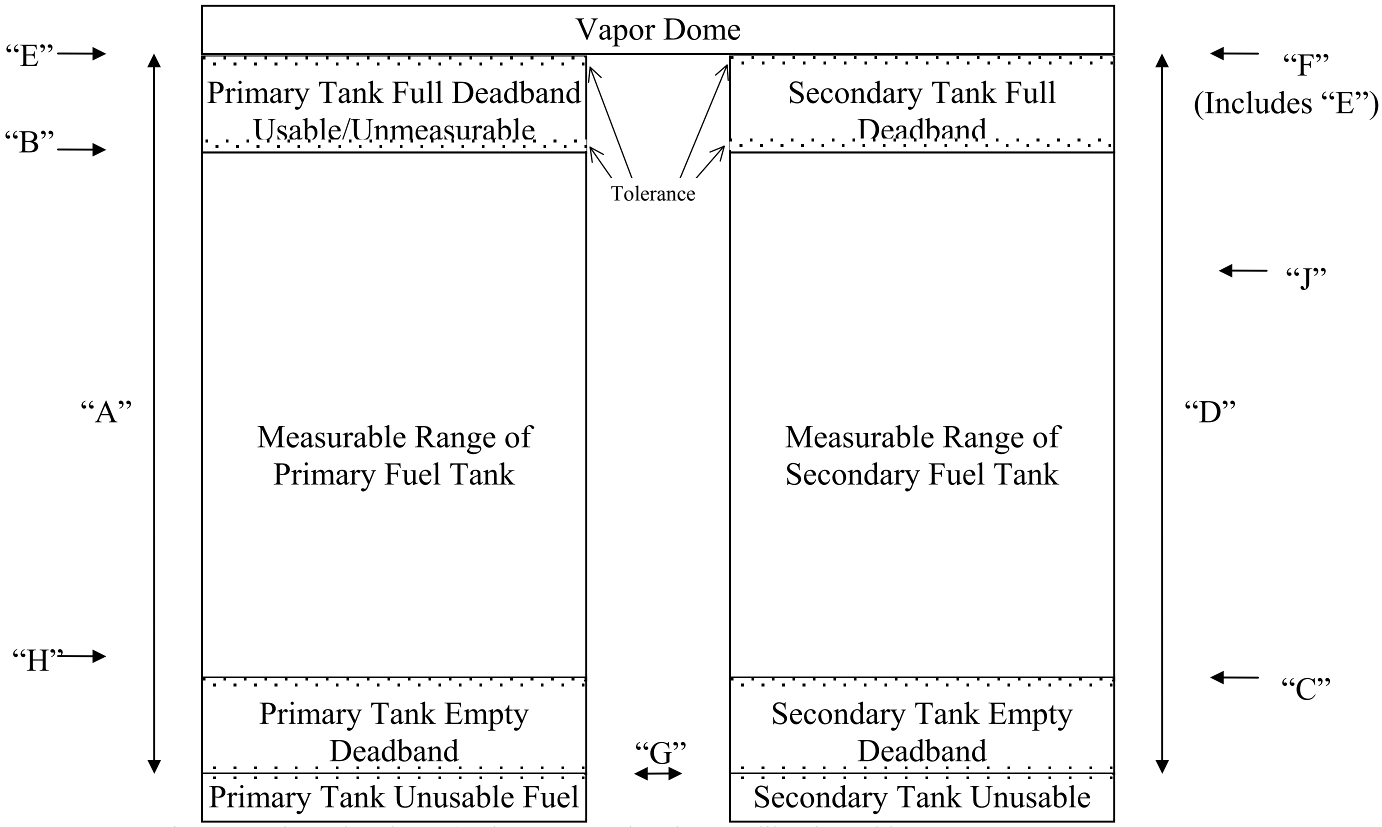
4.6.1 General Overview

This specification is intended to document the algorithm used for determining the amount of fuel remaining in the fuel tanks of a dual fuel tank system as well as a single fuel tank system. For single fuel tank applications, the secondary fuel tank parameters must be calibrated to 0 and the Primary Tank Full Threshold calibration parameter must be greater than or equal to the Primary Tank Rated Capacity calibration parameter. For dual fuel tank applications, it is assumed that the transfer of fuel between tanks is controlled by a platform module due to the different strategies being implemented. The algorithm comprehends the following known implementation strategies for dual fuel tanks:

1. Fuel is consumed from the primary tank while a transfer pump continuously transfers fuel from the secondary tank to the primary tank. Appears that fuel is consumed from the secondary tank before the primary tank.
2. Fuel is consumed from the primary tank while a transfer pump is transferring fuel from the secondary tank to the primary tank to keep the levels within the tanks equalized.
3. Fuel is consumed from the primary tank until the primary tank is empty enough at which time a transfer pump transfers all the fuel from the secondary tank to the primary tank.
4. Fuel is consumed from the primary tank, however, some fuel volume from the secondary tank is initially gravity fed to the primary tank making it appear as if the fuel is being consumed from the secondary tank. When the fuel is no longer being gravity fed to the primary tank, the fuel level decreases in the primary tank until the primary tank is empty enough at which time a transfer pump transfers all the remaining fuel from the secondary tank to the primary tank.

In general, the total fuel volume can be determined by adding the amount of fuel in the two tanks together. The total fuel volume can be accurately determined when the fuel is measurable in each of the tanks. Unfortunately, there are certain cases where one or both tanks have unmeasurable fuel in the tanks. These cases are accounted for in the algorithm and can be visualized by viewing the figures on the following pages.

Dual Fuel Tank - Fuel Volume Determination



A= Primary Tank Fuel Volume (Voltage vs. Fuel Volume calibration table)
B= Primary Tank Full Threshold (Fuel Volume calibration parameter)
C= Secondary Tank Empty Threshold (Fuel Volume calibration parameter)
D= Secondary Tank Fuel Volume (Voltage vs. Fuel Volume calibration table)
E= Primary Tank Rated Capacity (Fuel Volume calibration parameter)
F= Primary Tank Rated Capacity + Secondary Tank Rated Capacity (Fuel Volume calibration parameter)
G= Primary Tank Unusable + Secondary Tank Unusable (for EVAP calc Fuel Volume calibration parameter)
H= Primary Tank Failsoft Threshold (Fuel Volume calibration parameter)
J= Secondary Tank Estimate Threshold (Fuel Volume calibration parameter) (same as C on most applications)

Diagnostics: If A<H AND D>J (Primary Tank Almost Empty AND Secondary Tank Above Estimate Threshold indicates a potential diagnostic failure with the secondary mechanical transfer jet pump for saddle fuel tanks. Please refer to the GMPT Fuel Level Diagnostics for detectable failure modes with the fuel level system.)
Fuel Volume = 0 (failsoft the fuel level to the display because the transfer pump failed)

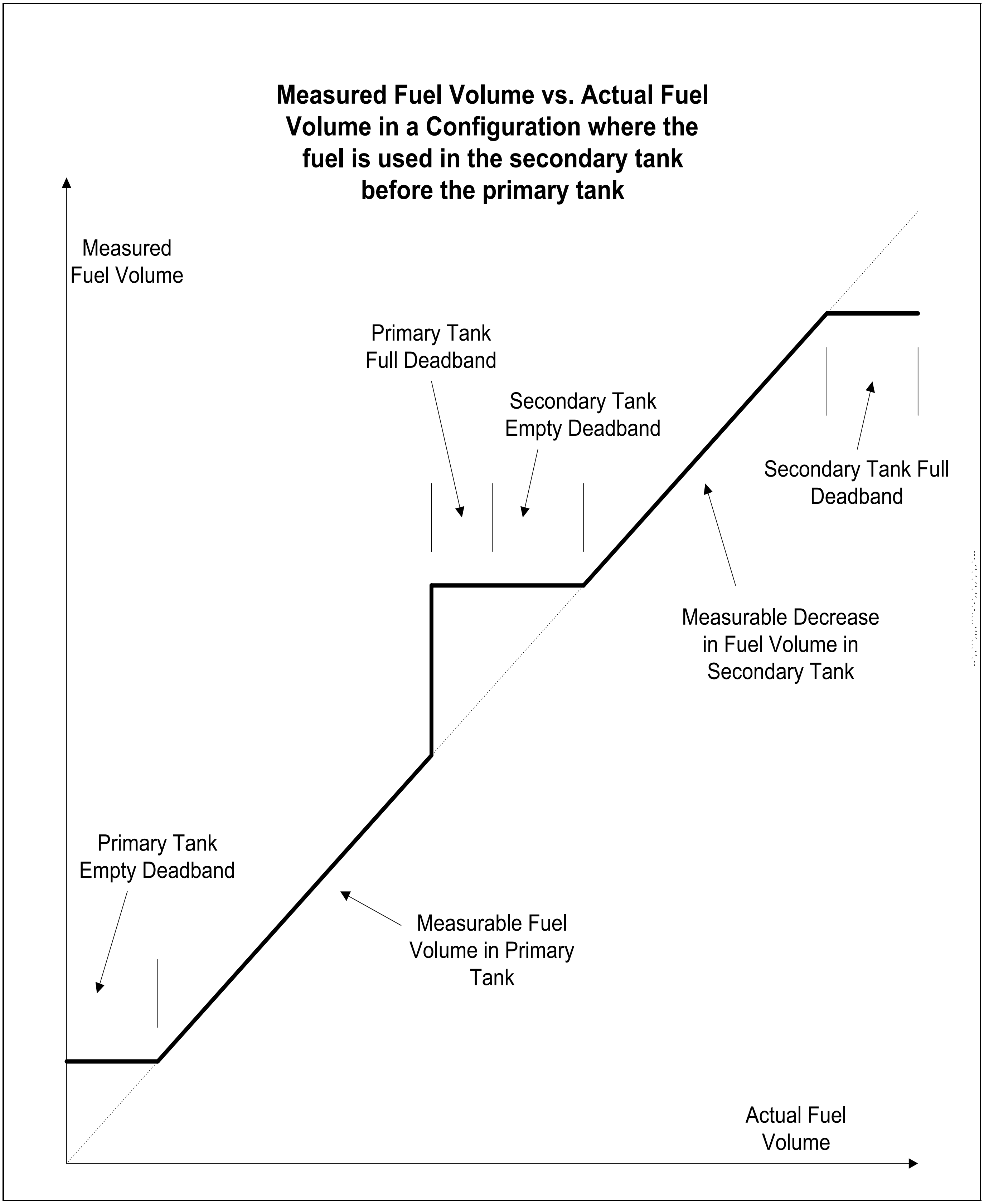
Zone 1: A≥B AND D≥J (Primary Tank Full AND Secondary Tank Above Estimate Threshold)
Fuel Volume = E + D

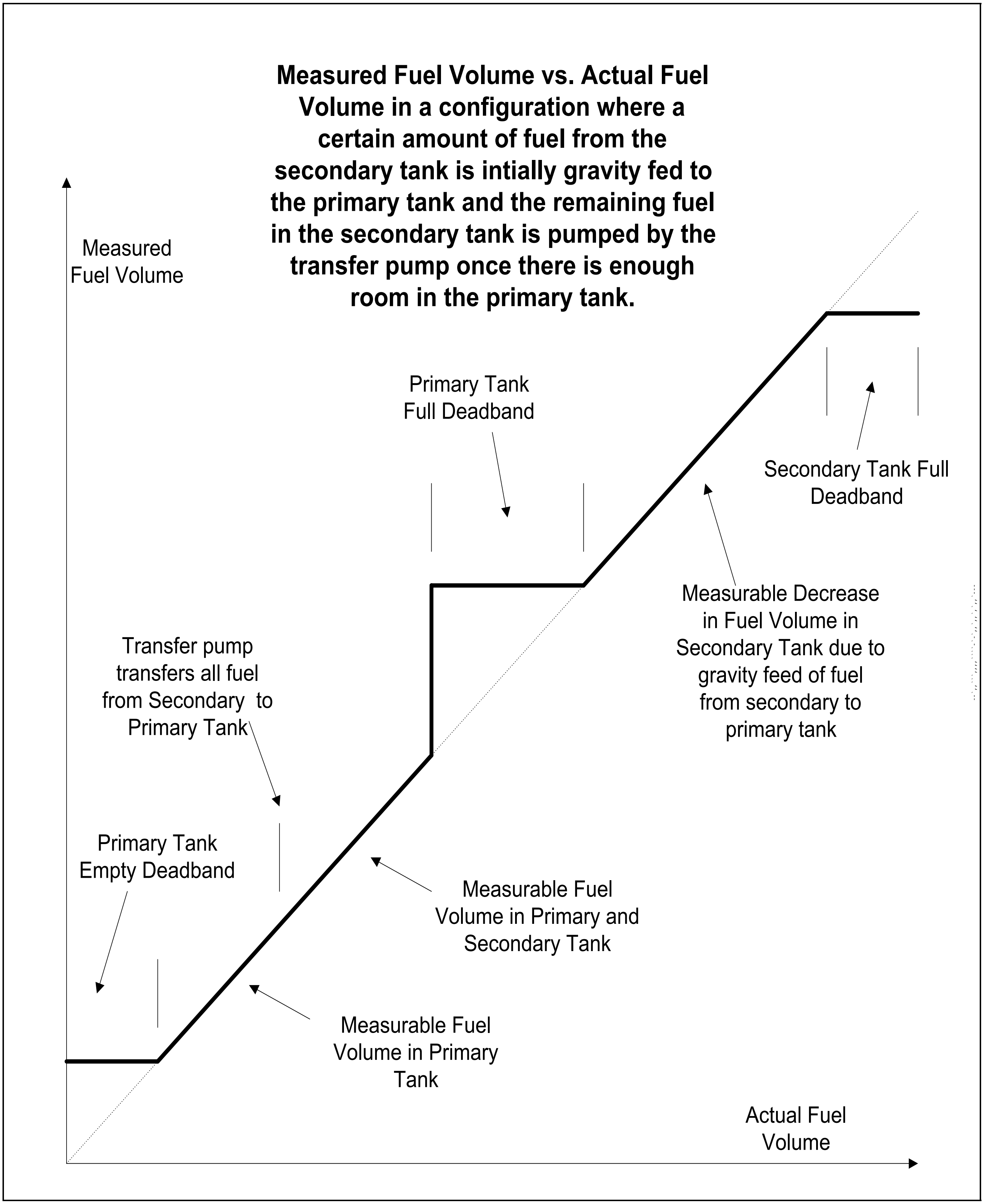
Zone 2: A≥B AND D<J (Primary Tank Full AND Secondary Tank Below Estimate Threshold)
Fuel Volume = E + J - Fuel Used while in the state (Case)

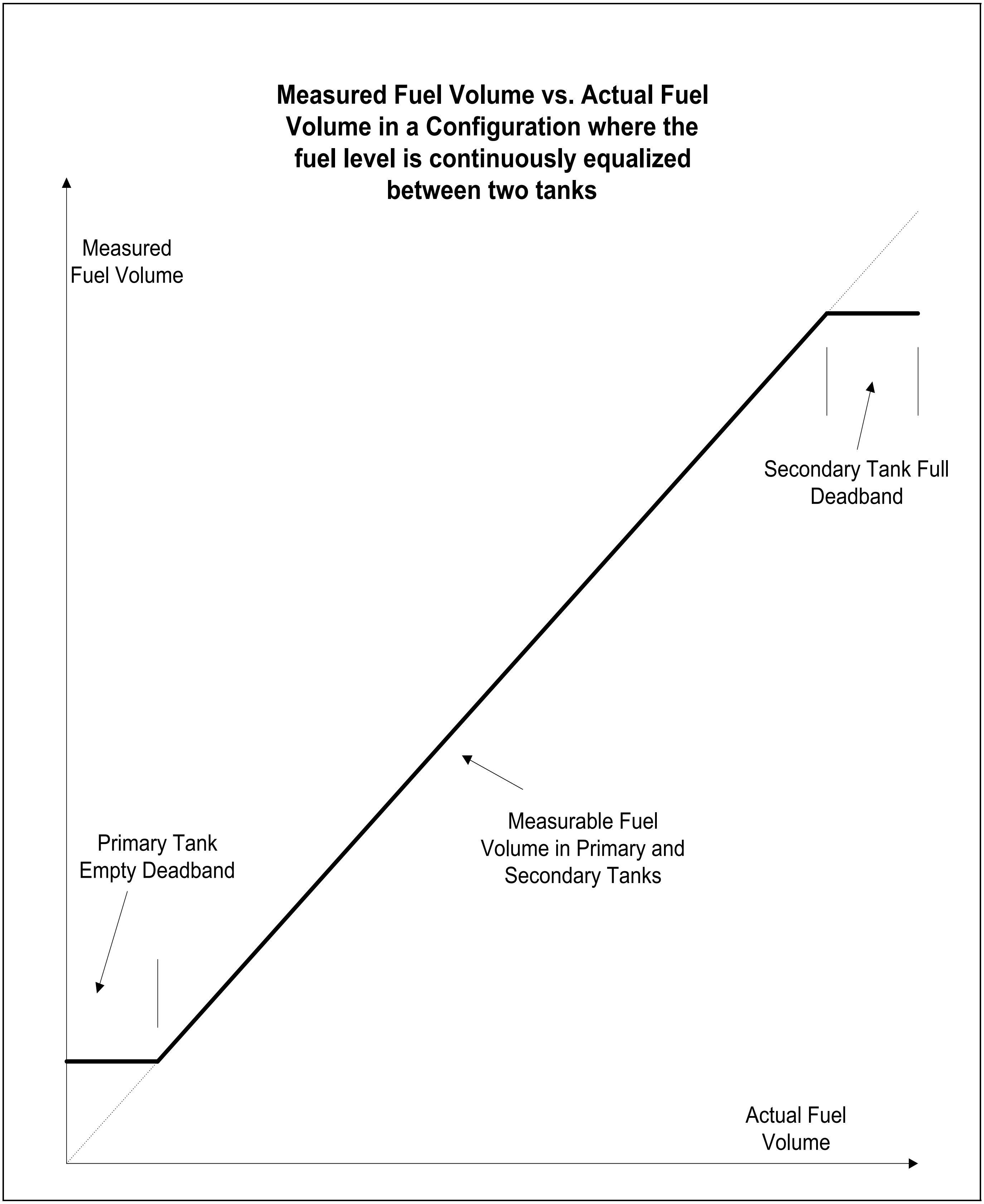
Zone 3: A<B AND D>J (Primary Tank Not Full AND Secondary Tank Above Estimate Threshold for the secondary mechanical transfer jet pump)
Fuel Volume = A + D

Zone 5: A<B AND D>C (Primary Tank Not Full AND Secondary Tank Above Empty Threshold for the secondary electrical transfer pump)
Fuel Volume = A + D

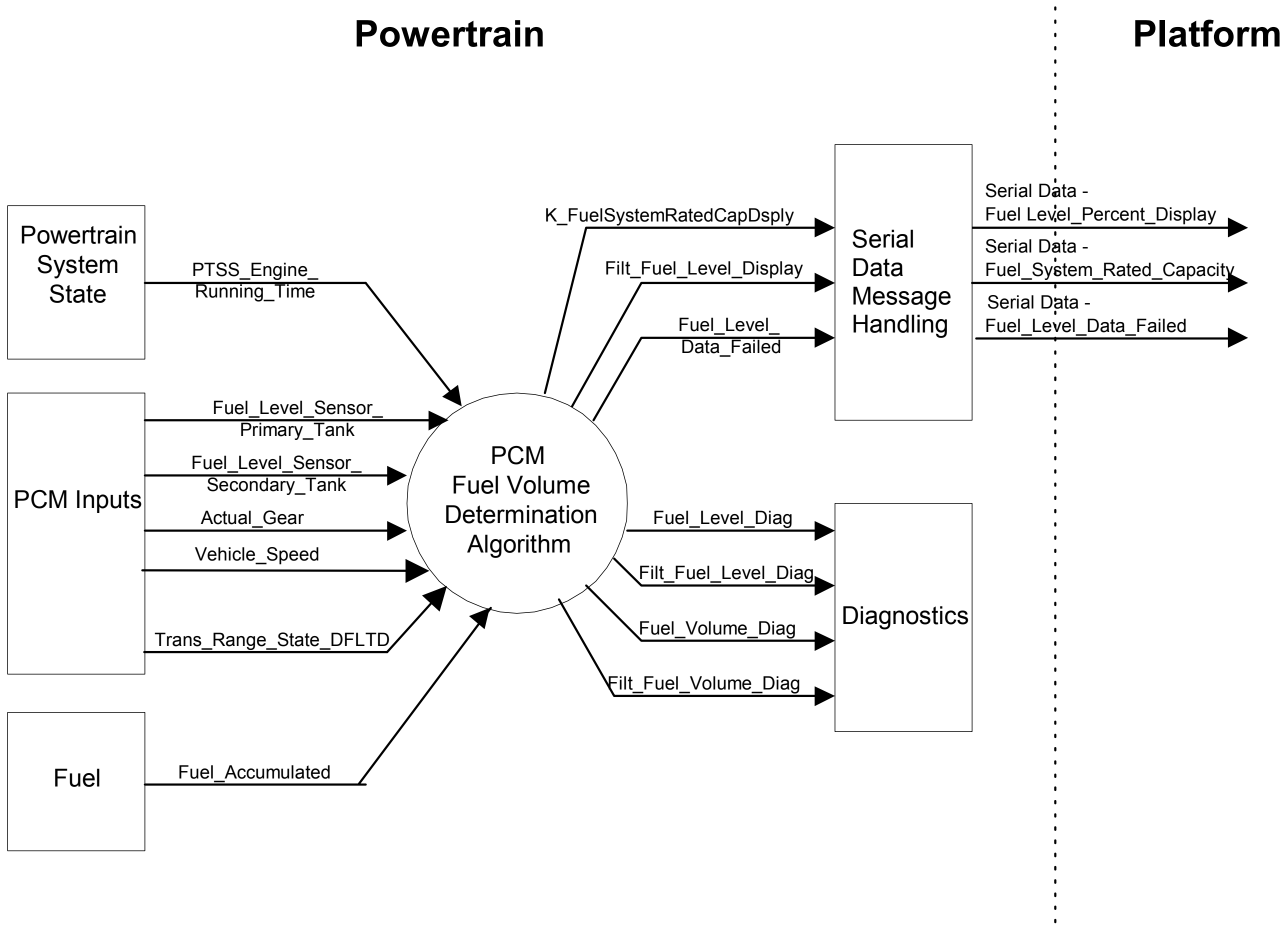
Zone 4: A<B AND D≤C (Primary Tank Not Full AND Secondary Tank Below Empty Threshold)
Fuel Volume = A


Measured Fuel Volume vs. Actual Fuel Volume in a Configuration where the fuel is used in the secondary tank before the primary tank
Measured Fuel Volume
Primary Tank Full Deadband
Secondary Tank Empty Deadband
Secondary Tank Full Deadband
Measurable Decrease in Fuel Volume in Secondary Tank
Primary Tank Empty Deadband
Measurable Fuel Volume in Primary Tank
Actual Fuel Volume


Measured Fuel Volume vs. Actual Fuel Volume in a configuration where a certain amount of fuel from the secondary tank is intially gravity fed to the primary tank and the remaining fuel in the secondary tank is pumped by the transfer pump once there is enough room in the primary tank.
Measured Fuel Volume
Primary Tank Full Deadband
Secondary Tank Full Deadband
Measurable Decrease in Fuel Volume in Secondary Tank due to gravity feed of fuel from secondary to primary tank
Transfer pump transfers all fuel from Secondary to Primary Tank
Primary Tank Empty Deadband
Measurable Fuel Volume in Primary and Secondary Tank
Measurable Fuel Volume in Primary Tank
Actual Fuel Volume


Measured Fuel Volume vs. Actual Fuel Volume in a Configuration where the fuel level is continuously equalized between two tanks
Measured Fuel Volume
Secondary Tank Full Deadband
Measurable Fuel Volume in Primary and Secondary Tanks
Primary Tank Empty Deadband
Actual Fuel Volume

4.6.2 Context Diagram



4.6.3 Fuel Volume Determination Algorithm

Fuel volume determination depends on which one of the following four states currently represents the fuel tank levels measured in the tanks:

1. (Primary Tank Full) AND (Secondary Tank Above Estimate Threshold)
2. (Primary Tank Full) AND (Secondary Tank Below Estimate Threshold)
3. (Primary Tank Not Full) AND (Secondary Tank Above Estimate Threshold)
4. (Primary Tank Not Full) AND (Secondary Tank Above Empty Threshold)
5. (Primary Tank Not Full) AND (Secondary Tank Below Empty Threshold)

A transition from one state to another state is filtered such that the conditions for entering the new state must be satisfied for a calibrated amount of continuous time before changing to the new state.

4.6.3.1 Fuel Volume Calculation for Platform Displays

Fuel Volume is the usable amount of fuel remaining in the fuel tank(s). Fuel Volume is needed for the calculation of other fuel level parameters for platform use.

4.6.3.1.1 Convert Fuel Tank Level Raw to Fuel Tank Volume for Display

The following logic is used to convert raw fuel level into fuel volume for display purposes:

```
SELECT FIRST
WHEN      (K_FuelSenderUnitType = "NoSender"

          Fuel_Level_Sender_Pri_Tank_Display ← 0.0
          Fuel_Level_Sender_Sec_Tank_Display ← 0.0
          Fuel_Volume_Pri_Tank_Display ← 0.0
          Fuel_Volume_Sec_Tank_Display ← 0.0

WHEN      (K_FuelSenderUnitType = "DualSenderMechPump") OR
          (K_FuelSenderUnitType = "DualSenderElectPump")

          Note:  Filter fuel sender input for display using a first order lag
          filter
          Fuel_Level_Sensor_Pri_Tank_Display ← filtered
             Fuel_Level_Sensor_Pri_Tank using K_FuelLvlInFiltDsplyPri as a
             first order lag filter coefficient
          Fuel_Level_Sensor_Sec_Tank_Display ← filtered
             Fuel_Level_Sensor_Sec_Tank using K_FuelLvlInFiltDsplySec as a
             first order lag filter coefficient


          Note:  Convert filtered fuel sender input into fuel volume
          Fuel_Volume_Pri_Tank_Display ←
             K_PrimaryFuelTankDsply[Fuel_Level_Sensor_Pri_Tank_Display]
          Fuel_Volume_Sec_Tank_Display ←
             K_SecondaryFuelTankDsply[Fuel_Level_Sensor_Sec_Tank_Display]

WHEN      (K_FuelSenderUnitType = "SingleSender")

          Note:  Filter fuel sender input for display using a first order lag
             filter
          Fuel_Level_Sensor_Pri_Tank_Display ← filtered
             Fuel_Level_Sensor_Pri_Tank using K_FuelLvlInFiltDsplyPri as a
             first order lag filter coefficient
          Fuel_Level_Sensor_Sec_Tank_Display ← 0.0


          Note:  Convert filtered fuel sender input into fuel volume
          Fuel_Volume_Pri_Tank_Display ←
             K_PrimaryFuelTankDsply[Fuel_Level_Sensor_Pri_Tank_Display]
          Fuel_Volume_Sec_Tank_Display ← 0.0

OTHERWISE

          NO ACTION

ENDSELECT
```

4.6.3.1.2 Determine the Fuel Tank System Zone for Display

The following logic is used to determine what fuel tank system zone the vehicle is in for display purposes:

```
Note:  Determine method for fuel volume calculation
SELECT FIRST
WHEN        (Fuel_Volume_Pri_Tank_Display ≥ K_PriTankFullDsply AND
            Fuel_Volume_Sec_Tank_Display ≥ K_SecTankEstimateDsply)
                           continuously for K_FuelTankSt1_ChgDsply

            Fuel_Level_State_Display ← "Zone_1"

WHEN        (Fuel_Volume_Pri_Tank_Display ≥ K_PriTankFullDsply AND
            Fuel_Volume_Sec_Tank_Display < K_SecTankEstimateDsply)
                           continuously for K_FuelTankSt2_ChgDsply

            Fuel_Level_State_Display ← "Zone_2"

WHEN        (Fuel_Volume_Pri_Tank_Display < K_PriTankFullDsply AND
            Fuel_Volume_Sec_Tank_Display > K_SecTankEstimateDsply AND
            K_FuelSenderUnitType ≠ "DualSenderElectPump" )
                           continuously for K_FuelTankSt3_ChgDsply

            Fuel_Level_State_Display ← "Zone_3"

WHEN        (Fuel_Volume_Pri_Tank_Display < K_PriTankFullDsply AND
            Fuel_Volume_Sec_Tank_Display > K_SecTankEmptyDsply)
                           continuously for K_FuelTankSt5_ChgDsply

            Fuel_Level_State_Display ← "Zone_5"

WHEN        (Fuel_Volume_Pri_Tank_Display < K_PriTankFullDsply AND
            Fuel_Volume_Sec_Tank_Display ≤ K_SecTankEmptyDsply)
                           continuously for K_FuelTankSt4_ChgDsply

            Fuel_Level_State_Display ← "Zone_4"

ENDSELECT
```

4.6.3.1.3 Calculate Fuel Volume based on the Fuel Tank System Zone for Display

The following logic is used to calculate fuel volume based on the fuel tank system for display purposes:

```
Note:  Calculate fuel volume
SELECT FIRST
WHEN        (Fuel_Level_State_Display = "Zone_1")

            Fuel_Volume_Display ← (K_PriTankRatedCapDsply +
                               Fuel_Volume_Sec_Tank_Display)

WHEN        (Fuel_Level_State_Display = "Zone_2")

            Fuel_Volume_Display ← (K_PriTankRatedCapDsply +
                               K_SecTankEstimateDsply -
                         Fuel_Delivered_In_State_2_Display)

WHEN        (Fuel_Level_State_Display = "Zone_3") OR
            (Fuel_Level_State_Display = "Zone_5")

            Fuel_Volume_Display ← (Fuel_Volume_Pri_Tank_Display +
                                       Fuel_Volume_Sec_Tank_Display)

WHEN        (Fuel_Level_State_Display = "Zone_4")

            Fuel_Volume_Display ← Fuel_Volume_Pri_Tank_Display

ENDSELECT

IF ((Filt_Fuel_Volume_Display > (K_PriTankRatedCapDsply +
            K_SecTankEstimateDsply)
                  OR
              (Filt_Fuel_Volume_Display < K_PriTankFullDsply))
            AND
              (Vehicle_Speed ≥  K_FuelLvlVehSpeedDsply)
THEN

            DECREMENT Fuel_Level_Integration_Timer_Display
ELSE

            Fuel_Level_Integration_Timer_Display ← K_FuelLvlIntgrTmDsply
END

IF (Fuel_Level_Integration_Timer_Display = 0.0)
THEN

            Fuel_Delivered_In_State_2_Display ← 0.0
ELSE

         IF (Fuel_Level_State_Display = "Zone_2"
         THEN

            ACCUMULATE Fuel_Delivered_In_State_2_Display
            (LIMIT Fuel_Delivered_In State_2_Display to the maximum
                  calibration value of K_MaxFuelVolDlvdInState2_Dsply
         ELSE

               NO ACTION
         END
```

```
END
```

4.6.3.1.4 Fuel Level Parameters for Platform Displays

The determination of the fuel level parameters needed by Platform for display purposes is represented by the following logic:

```
Fuel_System_Rated_Capacity ← K_FuelSystemRatedCapDsply
Fuel_Level_Display ← (Fuel_Volume_Display /
            K_FuelSystemRatedCapDsply) * 100

Filt_Fuel_Volume_Display ← filter Fuel_Volume_Display using a first order lag
            filter with the filter coefficient chosen per the criteria below:

            Use K_FuelPlatFastFilt as the filter coefficient if any of the
            following conditions are satisfied, otherwise, use
            K_FuelPlatNormalFilt as the filter coefficient:
            1.  The engine has been running for a period of time less than
                K_FastFillEngRun
            -OR-
            2.  The Actual_Gear is equal to "TransGrPark" or
                "TransGrNeutral" for K_FastFiltGearTime seconds.
                (This condition must be bypassed during a
                PRNDL failure - this will be accomplished if
                Trans_Range_State_DFLTD is set equal to TRUE.
                Also this condition must be bypassed if the vehicle has a
                manual transmission, i.e. Transmission_Type = Manual.)
            -OR-
            3.  The Vehicle_Speed is equal to 0.0 kph for
                K_FastFiltVehSpeedTime seconds.
                (This condition must be bypassed during a Vehicle Speed
                failure.)
            -OR-
            4.  Filt_Fuel_Volume_Display is less than the hysteresis pair,
                (K_FuelLvlFastFiltHysPair.fHigh and
                K_FuelLvlFastFiltHysPair.fLow) for a continuous amount of
                time, K_FuelLvlFastFiltHysPairTime.

Filt_Fuel_Level_Display ← (Filt_Fuel_Volume_Display /
            K_FuelSystemRatedCapDsply) * 100
```

4.6.3.2 Fuel Volume Calculation for Diagnostics

Fuel Volume is the usable amount of fuel remaining in the fuel tank(s). Fuel_Volume is needed for the calculation of other fuel level parameters for diagnostics use.

4.6.3.2.1 Convert Fuel Tank Level Raw to Fuel Tank Volume for Diagnostic

The following logic is used to convert raw fuel level into fuel volume for diagnostic purposes:

```
SELECT FIRST
WHEN        (K_FuelSenderUnitType = "NoSender"

         Fuel_Level_Sender_Pri_Tank_Diag ← 0.0
         Fuel_Level_Sender_Sec_Tank_Diag ← 0.0
         Fuel_Volume_Pri_Tank_Diag ← 0.0
         Fuel_Volume_Sec_Tank_Diag ← 0.0

WHEN        (K_FuelSenderUnitType = "DualSenderMechPump") OR
            (K_FuelSenderUnitType = "DualSenderElectPump")

         Note:  Filter fuel sender input for diagnostic using a first order
            lag filter
         Fuel_Level_Sensor_Pri_Tank_Diag ← filtered
            Fuel_Level_Sensor_Pri_Tank using K_FuelLvlInFiltDiagPri as a first
            order lag filter coefficient
         Fuel_Level_Sensor_Sec_Tank_Diag ←filtered Fuel_Level_Sensor_Sec_Tank
            using  K_FuelLvlInFiltDiagSec as a first order lag filter
            coefficient

         Note:  Convert filtered fuel sender input into fuel volume
         Fuel_Volume_Pri_Tank_Diag ←
            K_PrimaryFuelTankDiag[Fuel_Level_Sensor_Pri_Tank_Diag]
         Fuel_Volume_Sec_Tank_Diag ←
            K_SecondaryFuelTankDiag[Fuel_Level_Sensor_Sec_Tank_Diag]

WHEN        (K_FuelSenderUnitType = "SingleSender")

         Note:  Filter fuel sender input for display using a first order lag
            filter
         Fuel_Level_Sensor_Pri_Tank_Diag ← filtered
            Fuel_Level_Sensor_Pri_Tank using K_FuelLvlInFiltDiagPri as a first
            order lag filter coefficient
         Fuel_Level_Sensor_Sec_Tank_Diag ← 0.0


         Note:  Convert filtered fuel sender input into fuel volume
         Fuel_Volume_Pri_Tank_Diag ←
            K_PrimaryFuelTankDiag[Fuel_Level_Sensor_Pri_Tank_Display]
         Fuel_Volume_Sec_Tank_Diag ← 0.0

OTHERWISE

         NO ACTION

ENDSELECT
```

4.6.3.2.2 Determine the Fuel Tank System Zone for Diagnostic

The following logic is used to determine what fuel tank system zone the vehicle is in for diagnostic purposes:

```
Note:  Determine method for fuel volume calculation
SELECT FIRST
WHEN        (Fuel_Volume_Pri_Tank_Diag ≥ K_PriTankFullDiag AND
            Fuel_Volume_Sec_Tank_Diag ≥ K_SecTankEstimateDiag)
                           continuously for K_FuelTankSt1_ChgDiag

            Fuel_Level_State_Diag ← "Zone_1"

WHEN        (Fuel_Volume_Pri_Tank_Diag ≥ K_PriTankFullDiag AND
            Fuel_Volume_Sec_Tank_Diag < K_SecTankEstimateDiag)
                           continuously for K_FuelTankSt2_ChgDiag

            Fuel_Level_State_Diag ← "Zone_2"

WHEN        (Fuel_Volume_Pri_Tank_Diag < K_PriTankFullDiag AND
            Fuel_Volume_Sec_Tank_Diag > K_SecTankEstimateDiag AND
            K_FuelSenderUnitType ≠ "DualSenderElectPump" )
                           continuously for K_FuelTankSt3_ChgDiag

            Fuel_Level_State_Diag ← "Zone_3"

WHEN        (Fuel_Volume_Pri_Tank_Diag < K_PriTankFullDiag AND
            Fuel_Volume_Sec_Tank_Diag > K_SecTankEmptyDiag)
                           continuously for K_FuelTankSt5_ChgDiag

            Fuel_Level_State_Diag ← "Zone_5"

WHEN        (Fuel_Volume_Pri_Tank_Diag < K_PriTankFullDiag AND
            Fuel_Volume_Sec_Tank_Diag ≤ K_SecTankEmptyDiag)
                           continuously for K_FuelTankSt4_ChgDiag

            Fuel_Level_State_Diag ← "Zone_4"

ENDSELECT
```

4.6.3.2.3 Calculate Fuel Volume based on the Fuel Tank System Zone for Diagnostic

The following logic is used to calculate fuel volume based on the fuel tank system for diagnostic purposes:

```
Note:  Calculate fuel volume
SELECT FIRST
WHEN        (Fuel_Level_State_Diag = "Zone_1")

            Fuel_Volume_Diag ← (K_PriTankRatedCapDiag +
            Fuel_Volume_Sec_Tank_Diag)

WHEN        (Fuel_Level_State_Diag = "Zone_2")

            Fuel_Volume_Diag ← (K_PriTankRatedCapDiag +
                               K_SecTankEstimateDiag -
                     Fuel_Delivered_In_State_2_Diag)

WHEN        (Fuel_Level_State_Diag = "Zone_3") OR
            (Fuel_Level_State_Diag = "Zone_5")

            Fuel_Volume_Diag ← (Fuel_Volume_Pri_Tank_Diag +
                                Fuel_Volume_Sec_Tank_Diag)

WHEN        (Fuel_Level_State_Diag = "Zone_4")

            Fuel_Volume_Diag ← Fuel_Volume_Pri_Tank_Diag

ENDSELECT


IF ((Filt_Fuel_Volume_Diag > (K_PriTankRatedCapDiag + K_SecTankEstimatedDiag)
                     OR
               (Filt_Fuel_Volume_Diag > K_PriTankFullDsply))
            AND
               (Vehicle_Speed ≥ K_FuelLvlVehSpeedDiag)
THEN

            DECREMENT Fuel_Level_Integration_Timer_Diag
ELSE

            Fuel_Level_Integration_Timer_Diag ← K_FuelLvlIntgrTmDiag
END

IF (Fuel_Level_Integration_Timer_Diag = 0.0)
THEN

            Fuel_Delivered_In_State_2_Diag ← 0.0
ELSE

         IF (Fuel_Level_State_Diag = "Zone_2"
         THEN

            ACCUMULATE Fuel_Delivered_In_State_2_Diag
            (LIMIT Fuel_Delivered_In State_2_Diag to the maximum
                     calibration value of K_MaxFuelVolDlvdInState2_Diag
         ELSE

               NO ACTION
         END
```

```
END
```

4.6.3.2.4 Fuel Level Parameters for Powertrain Diagnostics

The determination of the fuel level parameters used for Powertrain diagnostics is represented by the following logic:

```
Fuel_Level_Diag ← (Fuel_Volume_Diag / K_FuelSystemRatedCapDiag) * 100

Filt_Fuel_Volume_Diag ← filter Fuel_Volume_Diag using K_FuelLvlDiagFilt as a
            first order lag filter coefficient

Filt_Fuel_Level_Diag ← (Filt_Fuel_Volume_Diag / K_FuelSystemRatedCapDiag) *
            100
```

4.6.4 Calculate Fuel Volume for Single Tank

The Fuel Volume Determination Algorithm is designed to calculate fuel volume for a single fuel tank application as well as a dual fuel tank application. If this algorithm is being used for a single fuel tank application, the following calibrations should be set equal to 0.

- **K_FuelLvlInFiltDiagSec**
- **K_FuelLvlInFiltDsplySec**
- **K_SecondaryFuelTankDsply**
- **K_SecondaryFuelTankDiag**
- **K_SecTankEmptyDsply**
- **K_SecTankEmptyDiag**
- **K_SecTankEstimateDsply**
- **K_SecTankEstimateDiag**

4.6.5 Use of First Order Lag Filters

The following equation shows the use of a first order lag filter:

[New_Filtered_Value] = [Old_Filtered_Value] +
    ([New_Unfiltered_Value] - [Old_Filtered_Value]) * [Filter_Coefficient])

where:

- Filter_Coefficient Range ⇒ 0 < [Filter_Coefficient] ≤ 1
- [Filter_Coefficient] ≅ 0; means heavy filtering
- [Filter_Coefficient] ≅ 1; means no or light filtering

4.6.6 Execution / Activation Requirements

Algorithm Section	Nominal Execution Interval
Fuel Volume Calculation for Platform Displays	500 ms.
Fuel Volume Calculation for Diagnostics	100 ms

4.6.7 Enable/Initialization Strategy

4.6.7.1 Enable Strategy

The following Fuel Volume algorithm sections must be enabled during the ACCESSORY and RUN Power Modes:

- Fuel Volume Calculation for Platform Displays
- Fuel Volume Calculation for Diagnostics

4.6.7.2 Initialization Strategy

The following logic is required to be executed at the **Init_Controller** system state transition to guarantee that all fuel level data is correctly initialized for diagnostic and platform display purposes:

```
IF  (Memory_Nonvolatile_Reset = TRUE)
THEN
            Fuel_Delivered_In_State_2_Display ← 0
            Fuel_Delivered_In_State_2_Diag ← 0
ELSE
            do nothing
ENDIF

SELECT FIRST
WHEN        (K_FuelSenderUnitType = "NoSender"

            Fuel_Level_Sensor_Pri_Tank_Display ← 0.0
            Fuel_Level_Sensor_Sec_Tank_Display ← 0.0
            Fuel_Level_Sensor_Pri_Tank_Diag ← 0.0
            Fuel_Level_Sensor_Sec_Tank_Diag ← 0.0

            Fuel_Volume_Pri_Tank_Display ← 0.0
            Fuel_Volume_Sec_Tank_Display ← 0.0
            Fuel_Volume_Pri_Tank_Diag ← 0.0
            Fuel_Volume_Sec_Tank_Diag ← 0.0

WHEN        (K_FuelSenderUnitType = "DualSenderMechPump") OR
            (K_FuelSenderUnitType = "DualSenderElectPump")

            Fuel_Level_Sensor_Pri_Tank_Display ← Fuel_Level_Sensor_Pri_Tank
            Fuel_Level_Sensor_Sec_Tank_Display ← Fuel_Level_Sensor_Sec_Tank
            Fuel_Level_Sensor_Pri_Tank_Diag ← Fuel_Level_Sensor_Pri_Tank
            Fuel_Level_Sensor_Sec_Tank_Diag ← Fuel_Level_Sensor_Sec_Tank
```

```
            Fuel_Volume_Pri_Tank_Display ←
            K_PrimaryFuelTankDsply[Fuel_Level_Sensor_Pri_Tank_Display]
            Fuel_Volume_Sec_Tank_Display ←
            K_SecondaryFuelTankDsply[Fuel_Level_Sensor_Sec_Tank_Display]
            Fuel_Volume_Pri_Tank_Diag ←
            K_PrimaryFuelTankDiag[Fuel_Level_Sensor_Pri_Tank_Diag]
            Fuel_Volume_Sec_Tank_Diag ←
            K_SecondaryFuelTankDiag[Fuel_Level_Sensor_Sec_Tank_Diag]

WHEN        (K_FuelSenderUnitType = "SingleSender")

            Fuel_Level_Sensor_Pri_Tank_Display ← Fuel_Level_Sensor_Pri_Tank
            Fuel_Level_Sensor_Sec_Tank_Display ← 0.0
            Fuel_Level_Sensor_Pri_Tank_Diag ← Fuel_Level_Sensor_Pri_Tank
            Fuel_Level_Sensor_Sec_Tank_Diag ← 0.0

            Fuel_Volume_Pri_Tank_Display ←
            K_PrimaryFuelTankDsply[Fuel_Level_Sensor_Pri_Tank_Display]
            Fuel_Volume_Sec_Tank_Display ← 0.0
            Fuel_Volume_Pri_Tank_Diag ←
            K_PrimaryFuelTankDiag[Fuel_Level_Sensor_Pri_Tank_Diag]
            Fuel_Volume_Sec_Tank_Diag ← 0.0

OTHERWISE

         NO ACTION

ENDSELECT

SELECT FIRST
WHEN        (Fuel_Volume_Pri_Tank_Display ≥ K_PriTankFullDsply AND
            Fuel_Volume_Sec_Tank_Display ≥ K_SecTankEstimateDsply)

            Fuel_Level_State_Display ← "Zone_1"
            Fuel_Volume_Display ← (K_PriTankRatedCapDsply +
                           Fuel_Volume_Sec_Tank_Display)
            Fuel_Delivered_In_State_2_Display ← 0

WHEN        (Fuel_Volume_Pri_Tank_Display ≥ K_PriTankFullDsply AND
            Fuel_Volume_Sec_Tank_Display < K_SecTankEstimateDsply)

            Fuel_Level_State_Display ← "Zone_2"
            Fuel_Volume_Display ← (K_PriTankRatedCapDsply +
                                      K_SecTankEstimateDsply -
                                 Fuel_Delivered_In_State_2_Display)
            Fuel_Delivered_In_State_2_Display ← no change
            Note:  No need to accumulate fuel delivered in state 2 because the
                   engine should not be running during initialization.

WHEN        (Fuel_Volume_Pri_Tank_Display < K_PriTankFullDsply AND
            Fuel_Volume_Sec_Tank_Display > K_SecTankEstimateDsply AND
            K_FuelSenderUnitType ≠ "DualSenderElectPump")

            Fuel_Level_State_Display ← "Zone_3"
            Fuel_Volume_Display ← (Fuel_Volume_Pri_Tank_Display +
                     Fuel_Volume_Sec_Tank_Display)
```

```
            Fuel_Delivered_In_State_2_Display ← no change

WHEN        (Fuel_Volume_Pri_Tank_Display < K_PriTankFullDsply AND
            Fuel_Volume_Sec_Tank_Display > K_SecTankEmptyDsply)

            Fuel_Level_State_Display ← "Zone_5"
            Fuel_Volume_Display ← (Fuel_Volume_Pri_Tank_Display +
                     Fuel_Volume_Sec_Tank_Display)
            Fuel_Delivered_In_State_2_Display ← no change

WHEN        (Fuel_Volume_Pri_Tank_Display < K_PriTankFullDsply AND
            Fuel_Volume_Sec_Tank_Display ≤ K_SecTankEmptyDsply)

            Fuel_Level_State_Display ← "Zone_4"
            Fuel_Volume_Display ← Fuel_Volume_Pri_Tank_Display
            Fuel_Delivered_In_State_2_Display ← 0

ENDSELECT

SELECT FIRST
WHEN        (Fuel_Volume_Pri_Tank_Diag ≥ K_PriTankFullDiag AND
            Fuel_Volume_Sec_Tank_Diag ≥ K_SecTankEstimateDiag)

            Fuel_Level_State_Diag ← "Zone_1"
            Fuel_Volume_Diag ← (K_PriTankRatedCapDiag +
                           Fuel_Volume_Sec_Tank_Diag)
            Fuel_Delivered_In_State_2_Diag ← 0

WHEN        (Fuel_Volume_Pri_Tank_Diag ≥ K_PriTankFullDiag AND
            Fuel_Volume_Sec_Tank_Diag < K_SecTankEstimateDiag)

            Fuel_Level_State_Diag ← "Zone_2"
            Fuel_Volume_Diag ← (K_PriTankRatedCapDiag +
                                           K_SecTankEstimateDiag -
                           Fuel_Delivered_In_State_2_Diag)
            Fuel_Delivered_In_State_2_Diag ← no change
            Note:  No need to accumulate fuel delivered in state 2 because the
                   engine should not be running during initialization.

WHEN        (Fuel_Volume_Pri_Tank_Diag < K_PriTankFullDiag AND
            Fuel_Volume_Sec_Tank_Diag > K_SecTankEstimateDiag AND
            K_FuelSenderUnitType ≠ "DualSenderElectPump")

            Fuel_Level_State_Diag ← "Zone_3"
            Fuel_Volume_Diag ← (Fuel_Volume_Pri_Tank_Diag +
                     Fuel_Volume_Sec_Tank_Diag)
            Fuel_Delivered_In_State_2_Diag ← no change

WHEN        (Fuel_Volume_Pri_Tank_Diag < K_PriTankFullDiag AND
            Fuel_Volume_Sec_Tank_Diag > K_SecTankEmptyDiag)

            Fuel_Level_State_Diag ← "Zone_5"
            Fuel_Volume_Diag ← (Fuel_Volume_Pri_Tank_Diag +
                     Fuel_Volume_Sec_Tank_Diag)
            Fuel_Delivered_In_State_2_Diag ← no change

WHEN        (Fuel_Volume_Pri_Tank_Diag < K_PriTankFullDiag AND
```

```
            Fuel_Volume_Sec_Tank_Diag ≤ K_SecTankEmptyDiag)

            Fuel_Level_State_Diag ← "Zone_4"
            Fuel_Volume_Diag ← Fuel_Volume_Pri_Tank_Diag
            Fuel_Delivered_In_State_2_Diag ← 0

ENDSELECT

Filt_Fuel_Volume_Display ← Fuel_Volume_Display
Filt_Fuel_Volume_Diag  ← Fuel_Volume_Diag

Fuel_System_Rated_Capacity ← K_FuelSystemRatedCapDsply
Fuel_Level_Display ← (Fuel_Volume_Display / K_FuelSystemRatedCapDsply) * 100
Filt_Fuel_Level_Display ← Fuel_Level_Display

Fuel_Level_Diag ← (Fuel_Volume_Diag / K_FuelSystemRatedCapDiag) * 100
Filt_Fuel_Level_Diag ← Fuel_Level_Diag
```

4.6.8 Diagnostic Action Requirements

Other than the consumers of the data needing an indication that there is a failure with a fuel level sensor, there are no diagnostic actions taken specifically by this algorithm.

4.6.9 On-Vehicle Communications / Serial Data Interaction Requirements

4.6.9.1 Class 2

Class 2 Message Name	Variable Name
82-16 Fuel System - Fuel Capacity Metric	Fuel_System_Rated_Capacity
82-12 Fuel System - Fuel Level - Percent (Filtered) - Byte 1	Filt_Fuel_Level_Display
82-12 Fuel System - Fuel Level - Percent (Filtered) - C-bit	Fuel_Level_Data_Failed

4.6.9.2 GMLAN

GMLAN Signal Name	Variable Name
Fuel Capacity	Fuel_System_Rated_Capacity
Fuel Level Percent	Filt_Fuel_Level_Display
Fuel Level Percent Validity	Fuel_Level_Data_Failed

4.6.9.3 Device Control

None.

4.6.10 Data Dictionary

4.6.10.1 Calibrations

K_FastFillEngRun = engine run time below which the fast filter is used to filter fuel level for displays. **(Platform Owned Calibration)**
Minimum Range: 0 to 120 seconds
Minimum Resolution: 1 second
Typical Value: 60 seconds

K_FastFiltGearTime = the amount of time that must expire while the transmission is in either Park or Neutral gear state before the fast filter is used to filter fuel level for displays. **(Platform Owned Calibration)**
Minimum Range: 0 to 120 seconds
Minimum Resolution: 1 second
Typical Value: 30 seconds

K_FastFiltVehSpeedTime = the amount of time that must expire while the vehicle speed is equal to zero before the fast filter is used to filter fuel level for displays. **(Platform Owned Calibration)**
Minimum Range: 0 to 120 seconds
Minimum Resolution: 1 second
Typical Value: 50 seconds

K_FuelLvlDiagFilt = first order lag filter coefficient used to filter fuel level information for the diagnostic uses. **(Powertrain Owned Calibration)**
Minimum Range: 0.0 to 1.0
Minimum Resolution: 0.0005
Typical Value: 0.25

K_FuelLvlFastFiltHysPair = fLow and fHigh. Hysteresis pair or calibrations which define the fuel volume below which the fast filter is used for filtering fuel level for displays. **(Platform Owned Calibration)**
Minimum Range: 0 to 200 litres
Minimum Resolution: 0.5 litres
Typical Value: fLow = 12 litres; fHigh = 13 litres

K_FuelLvlFastFiltHysPairTime = The continuous time period before transitioning to the fast filter during which the fuel level must be less than the hysteresis pair **(Platform Owned Calibration)**
Minimum Range: 0 to 120 seconds
Minimum Resolution: 1 second
Typical Value: 60 seconds

K_FuelLvlInFiltDiagPri = first order lag filter coefficient used to filter the fuel level sensor input to the primary fuel tank for diagnostic use . **(Powertrain Owned Calibration)**
Minimum Range: 0.0 to 1.0
Minimum Resolution: 0.0005
Typical Value: 0.15

K_FuelLvlInFiltDiagSec = first order lag filter coefficient used to filter the fuel level sensor input to the secondary fuel tank for diagnostic use . **(Powertrain Owned Calibration)**

Minimum Range: 0.0 to 1.0
Minimum Resolution: 0.0
Typical Value: 0.15

K_FuelLvlInFiltDsplyPri = first order lag filter coefficient used to filter the fuel level sensor input to the primary fuel tank for display use. Note: a filter coefficient value of approximately 1 is essentially no filtering at all. The smaller the value of the filter coefficient, the heavier the filtering is. **(Platform Owned Calibration)**

Minimum Range: 0.0 to 1.0
Minimum Resolution: 0.0005
Typical Value: 0.15

K_FuelLvlInFiltDsplySec = first order lag filter coefficient used to filter the fuel level sensor input to the secondary fuel tank for display use . **(Platform Owned Calibration)**

Minimum Range: 0.0 to 1.0
Minimum Resolution: 0.0005
Typical Value: 0.15

K_FuelLvlIntgrTmDiag = the fuel level integration timer will be reset to this calibration, when either the vehicle speed less than K_FuelLvlVehSpeedDiag or the fuel level state is equal to "Zone_2". **(Powertrain Owned Calibration)**

Minimum Range: 0.0 to 600.0 seconds
Minimum Resolution: 1.0
Typical Value: 0.0

K_FuelLvlIntgrTmDsply = the fuel level integration timer will be reset to this calibration, when either the vehicle speed less than K_FuelLvlVehSpeedDsply or the fuel level state is equal to "Zone_2". **(Platform Owned Calibration)**

Minimum Range: 0.0 to 600.0 seconds
Minimum Resolution: 1.0
Typical Value: 0.0

K_FuelLvlVehSpeedDiag = vehicle speed must be equal to or greater than this calibration to allow the fuel level integration timer to expire when the fuel level state is not in "Zone_2". If the fuel level integration timer expires, the value for fuel delivered in "Zone_2" will be reset to zero. **(Powertrain Owned Calibration)**

Minimum Range: 0 to 200 kph
Minimum Resolution: 1 kph
Typical Value: 0

K_FuelLvlVehSpeedDsply = vehicle speed must be equal to or greater than this calibration to allow the fuel level integration timer to expire when the fuel level state is not in "Zone_2". If the fuel level integration timer expires, the value for fuel delivered in "Zone_2" will be reset to zero. **(Platform Owned Calibration)**

Minimum Range: 0 to 100 kph
Minimum Resolution: 1 kph
Typical Value: 0

K_FuelPlatFastFilt = first order lag filter coefficient used to filter fuel level information for displays during conditions which require a faster than normal filter. **(Platform Owned Calibration)**
Minimum Range: 0.0 to 1.0
Minimum Resolution: 0.0005
Typical Value: 0.2

K_FuelPlatNormalFilt = first order lag filter coefficient used to filter fuel level information for displays during conditions which require a normal filter. **(Platform Owned Calibration)**
Minimum Range: 0.0 to 1.0
Minimum Resolution: 0.0005
Typical Value: 0.005

K_FuelSenderUnitType = Identifies the type of fuel sender for the fuel tank system. **(Platform Owned Calibration)**
Minimum Range: "NoSender", "DualSenderMechPump", "DualSenderElectPump", or "SingleSender"
Minimum Resolution: n/a
Typical Value: "SingleSender"

K_FuelSystemRatedCapDiag = rated (advertised) capacity of the fuel tank(s). **(Powertrain Owned Calibration)**
Minimum Range: 0 to 200 litres
Minimum Resolution: 0.5 litres
Typical Value: 80 litres

K_FuelSystemRatedCapDsply = rated (advertised) capacity of the fuel tank(s). **(Platform Owned Calibration)**
Minimum Range: 0 to 200 litres
Minimum Resolution: 0.5 litres
Typical Value: 80 litres

K_FuelTankSt1_ChgDiag = a continuous period of time spent in a fuel state Zone_1 which must be met before transitioning to the state for fuel volume calculation for diagnostics. **(Powertrain Owned Calibration)**
Minimum Range: 0 to 240 seconds
Minimum Resolution: 1 second
Typical Value: 20 seconds

K_FuelTankSt1_ChgDsply = a continuous period of time spent in a fuel state Zone_1 which must be met before transitioning to the state for fuel volume calculation for display. **(Platform Owned Calibration)**
Minimum Range: 0 to 240 seconds
Minimum Resolution: 1 second
Typical Value: 20 seconds

K_FuelTankSt2_ChgDiag = a continuous period of time spent in a fuel state Zone_2 which must be met before transitioning to the state for fuel volume calculation for diagnostics. **(Powertrain Owned Calibration)**

Minimum Range: 0 to 240 seconds
Minimum Resolution: 1 second
Typical Value: 20 seconds

K_FuelTankSt2_ChgDsply = a continuous period of time spent in a fuel state Zone_2 which must be met before transitioning to the state for fuel volume calculation for display. **(Platform Owned Calibration)**
Minimum Range: 0 to 240 seconds
Minimum Resolution: 1 second
Typical Value: 20 seconds

K_FuelTankSt3_ChgDiag = a continuous period of time spent in a fuel state Zone_3 which must be met before transitioning to the state for fuel volume calculation for diagnostics. **(Powertrain Owned Calibration)**
Minimum Range: 0 to 240 seconds
Minimum Resolution: 1 second
Typical Value: 20 seconds

K_FuelTankSt3_ChgDsply = a continuous period of time spent in a fuel state Zone_3 which must be met before transitioning to the state for fuel volume calculation for display. **(Platform Owned Calibration)**
Minimum Range: 0 to 240 seconds
Minimum Resolution: 1 second
Typical Value: 20 seconds

K_FuelTankSt4_ChgDiag = a continuous period of time spent in a fuel state Zone_4 which must be met before transitioning to the state for fuel volume calculation for diagnostics. **(Powertrain Owned Calibration)**
Minimum Range: 0 to 240 seconds
Minimum Resolution: 1 second
Typical Value: 20 seconds

K_FuelTankSt4_ChgDsply = a continuous period of time spent in a fuel state Zone_4 which must be met before transitioning to the state for fuel volume calculation for display. **(Platform Owned Calibration)**
Minimum Range: 0 to 240 seconds
Minimum Resolution: 1 second
Typical Value: 20 seconds

K_FuelTankSt5_ChgDiag = a continuous period of time spent in a fuel state Zone_5 which must be met before transitioning to the state for fuel volume calculation for diagnostics. **(Powertrain Owned Calibration)**
Minimum Range: 0 to 240 seconds
Minimum Resolution: 1 second
Typical Value: 20 seconds

K_FuelTankSt5_ChgDsply = a continuous period of time spent in a fuel state Zone_5 which must be met before transitioning to the state for fuel volume calculation for display. **(Platform Owned Calibration)**

Minimum Range: 0 to 240 seconds
Minimum Resolution: 1 second
Typical Value: 20 seconds

K_MaxFuelVolDlvdInState2_Diag = the maximum allowable fuel that can be delivered (consumed by the engine) in the fuel level state 2 for diagnostic use. **(Powertrain Owned Calibration)**

Minimum Range: 0 to 10 litres
Minimum Resolution: 0.05 litres
Typical Value: 2 litres

K_MaxFuelVolDlvdInState2_Dsplay = the maximum allowable fuel that can be delivered (consumed by the engine) in the fuel level state 2 for display use. **(Platform Owned Calibration)**

Minimum Range: 0 to 10 litres
Minimum Resolution: 0.05 litres
Typical Value: 2 litres

K_PrimaryFuelTankDiag = calibration table used to determine the fuel volume read by the primary fuel tank level sensor input. **(Powertrain Owned Calibration)**

Minimum Range: 0 to 200 litres
Minimum Resolution: 0.5 litres
Table Description: 33 place interpolated table (*recommend using calibratable breakpoints*) which ranges from 0 to 100 percent of A/D reference voltage (5 volts under normal voltage conditions).

Typical Values:	0%	: 2 litres
	3.125%	: 3 litres
	.	
	.	
	96.875%	: 36 litres
	100%	: 37 litres

K_PrimaryFuelTankDsply = calibration table used to determine the fuel volume read by the primary fuel tank level sensor input. **(Platform Owned Calibration)**

Minimum Range: 0 to 200 litres
Minimum Resolution: 0.5 litres
Table Description: 33 place interpolated table (*recommend using calibratable breakpoints*) which ranges from 0 to 100 percent of A/D reference voltage (5 volts under normal voltage conditions).

Typical Values:	0%	: 2 litres
	3.125%	: 3 litres
	.	
	.	
	96.875%	: 36 litres
	100%	: 37 litres

K_PriTankFullDiag = threshold above which the primary tank is assumed to be full. **(Powertrain Owned Calibration)**
Minimum Range: 0 to 200 litres
Minimum Resolution: 0.5 litres
Typical Value: 38 litres

K_PriTankFullDsply = threshold above which the primary tank is assumed to be full. **(Platform Owned Calibration)**
Minimum Range: 0 to 200 litres
Minimum Resolution: 0.5 litres
Typical Value: 38 litres

K_PriTankRatedCapDiag = rated capacity of the primary tank - value used in the fuel volume calculation when the volume is greater than the primary tank full threshold calibration. **(Powertrain Owned Calibration)**
Minimum Range: 0 to 200 litres
Minimum Resolution: 0.5 litres
Typical Value: 40 litres

K_PriTankRatedCapDsply = rated capacity of the primary tank - value used in the fuel volume calculation when the volume is greater than the primary tank full threshold calibration. **(Platform Owned Calibration)**
Minimum Range: 0 to 200 litres
Minimum Resolution: 0.5 litres
Typical Value: 40 litres

K_SecondaryFuelTankDiag = calibration table used to determine the fuel volume read by the secondary fuel tank level sensor input. **(Powertrain Owned Calibration)**
Minimum Range: 0 to 200 litres
Minimum Resolution: 0.5 litres
Table Description: 33 place interpolated table (*recommend using calibratable breakpoints*) which ranges from 0 to 100 percent of A/D reference voltage (5 volts under normal voltage conditions).

Typical Values:		
	0%	: 2 litres
	3.125%	: 3 litres
	.	
	.	
	96.875%	: 36 litres
	100%	: 37 litres

K_SecondaryFuelTankDsply = calibration table used to determine the fuel volume read by the secondary fuel tank level sensor input. **(Platform Owned Calibration)**
Minimum Range: 0 to 200 litres
Minimum Resolution: 0.5 litres
Table Description: 33 place interpolated table (*recommend using calibratable breakpoints*) which ranges from 0 to 100 percent of A/D reference voltage (5 volts under normal voltage conditions).

Typical Values:		
	0%	: 2 litres
	3.125%	: 3 litres

.
.
96.875% : 36 litres
100% : 37 litres

K_SecTankEmptyDiag = threshold below which the secondary tank is assumed to be empty.
(Powertrain Owned Calibration)
Minimum Range: 0 to 200 litres
Minimum Resolution: 0.5 litres
Typical Value: 2 litres

K_SecTankEmptyDsply = threshold below which the secondary tank is assumed to be empty.
(Platform Owned Calibration)
Minimum Range: 0 to 200 litres
Minimum Resolution: 0.5 litres
Typical Value: 2 litres

K_SecTankEstimateDiag = when the primary tank is full and the secondary tank volume is below this threshold, fuel usage is unmeasureable in this region and must be estimated based on fuel delivery to the engine. **(Powertrain Owned Calibration)**
Minimum Range: 0 to 200 litres
Minimum Resolution: 0.5 litres
Typical Value: 2 litres

K_SecTankEstimateDsply = when the primary tank is full and the secondary tank volume is below this threshold, fuel usage is unmeasureable in this region and must be estimated based on fuel delivery to the engine. **(Platform Owned Calibration)**
Minimum Range: 0 to 200 litres
Minimum Resolution: 0.5 litres
Typical Value: 2 litres

4.6.10.2 Variables

Actual_Gear = Keeps track of the actual gear state for automatic and manual transmissions. For manual transmissions, the Actual Gear state will indicate "TransGrNeut", if the clutch is engaged or the shifter is not engaged to any gear.
Type: RAM
Range: TransGr1, TransGr2, TransGr3, TransGr4, TransGr5, TransGr6, TransGrNeut, TransGrRvrs, TransGrPark, TransGrSize, or TransGrIllegal

Engine_Running_Time = period of time that the engine has been running.
Type: RAM
Minimum Range: 0 to 120 seconds
Minimum Resolution: 1 second

Filt_Fuel_Volume_Diag = filtered version of the fuel volume needed for diagnostic uses.
Type: RAM
Minimum Range: 0 to 200 litres
Minimum Resolution: 0.5 litres

Fuel_Level_Data_Failed = indication that there is a problem with the fuel level sensor input(s) as determined by the Fuel Level Sensor Diagnostics. Used to set the C-bit (Class 2) or the Validity bits (GMLAN).
Type: RAM
Minimum Range: TRUE or FALSE

Fuel_Delivered_In_State_2_Diag = amount of fuel which has been delivered while Fuel_Level_State was equal to 2 for diagnostics.
Type: Non-volatile Memory
Minimum Range: 0 to 20 litres
Minimum Resolution: defined by fuel economy algorithm

Fuel_Delivered_In_State_2_Display = amount of fuel which has been delivered while Fuel_Level_State was equal to 2 for displays.
Type: Non-volatile Memory
Minimum Range: 0 to 20 litres
Minimum Resolution: defined by fuel economy algorithm

Filt_Fuel_Level_Diag = filtered fuel level scaled in percent of advertised capacity filtered for diagnostic uses.
Type: RAM
Minimum Range: 0 to <100 percent
Minimum Resolution: 100/256 percent

Fuel_Level_Diag = unfiltered fuel level scaled in percent of advertised capacity filtered for diagnostic uses.
Type: RAM
Minimum Range: 0 to <100 percent
Minimum Resolution: 100/256 percent

Fuel_Level_Integration_Timer_Diag = keeps track of the fuel level integration time before the fuel accumulated in “Zone_2” can be cleared when the fuel level state is no longer equal to “Zone_2”.

Type: RAM
Minimum Range: 0 to 600 seconds
Minimum Resolution: 1 second

Fuel_Level_Integration_Timer_Display = keeps track of the fuel level integration time before the fuel accumulated in “Zone_2” can be cleared when the fuel level state is no longer equal to “Zone_2”.

Type: RAM
Minimum Range: 0 to 600 seconds
Minimum Resolution: 1 second

Filt_Fuel_Level_Display = total filtered fuel level scaled in percent of advertised capacity filtered for the display.

Type: RAM
Minimum Range: 0 to <100 percent
Minimum Resolution: 100/256 percent

Fuel_Level_Display = total unfiltered fuel level scaled in percent of advertised capacity filtered for the display.

Type: RAM
Minimum Range: 0 to <100 percent
Minimum Resolution: 100/256 percent

Fuel_Level_Sensor_Pri_Tank = fuel level sensor input reading of the primary tank.

Type: RAM
Minimum Range: 0 to 100 percent of A/D reference voltage (5.0 volts)
Minimum Resolution: 100/256 percent

Fuel_Level_Sensor_Pri_Tank_Diag = filtered fuel level sensor reading of the primary tank for diagnostic use.

Type: RAM
Minimum Range: 0 to 100 percent of A/D reference voltage (5.0 volts)
Minimum Resolution: 100/256 percent

Fuel_Level_Sensor_Pri_Tank_Display = filtered fuel level sensor reading of the primary tank for display use.

Type: RAM
Minimum Range: 0 to 100 percent of A/D reference voltage (5.0 volts)
Minimum Resolution: 100/256 percent

Fuel_Level_Sensor_Sec_Tank = fuel level sensor input reading of the secondary tank.

Type: RAM
Minimum Range: 0 to 100 percent of A/D reference voltage (5.0 volts)
Minimum Resolution: 100/256 percent

Fuel_Level_Sensor_Sec_Tank_Diag = filtered fuel level sensor reading of the secondary tank for diagnostic use.
Type: RAM
Minimum Range: 0 to 100 percent of A/D reference voltage (5.0 volts)
Minimum Resolution: 100/256 percent

Fuel_Level_Sensor_Sec_Tank_Display = filtered fuel level sensor reading of the secondary tank for display use.
Type: RAM
Minimum Range: 0 to 100 percent of A/D reference voltage (5.0 volts)
Minimum Resolution: 100/256 percent

Fuel_Level_State_Diag = state which represents the fuel level region used for the calculation of fuel volume for diagnostic use.
Type: RAM
Minimum Range: “Zone_1”, “Zone_2”, “Zone_3”, “Zone_4”, or “Zone_5”
Minimum Resolution: n/a

Fuel_Level_State_Display = state which represents the fuel level region used for the calculation of fuel volume for display use.
Type: RAM
Minimum Range: “Zone_1”, “Zone_2”, “Zone_3”, “Zone_4”, or “Zone_5”
Minimum Resolution: n/a

Fuel_System_Rated_Capacity = rated (advertised) capacity of the fuel tank(s) that is stored to this variable for use with serial data.
Type: RAM
Minimum Range: 0 to 200 litres
Minimum Resolution: 0.5 litres

Fuel_Volume_Diag = total unfiltered amount of fuel remaining in the fuel tank(s) for diagnostic uses.
Type: RAM
Minimum Range: 0 to 200 litres
Minimum Resolution: 0.5 litres

Fuel_Volume_Display = total unfiltered amount of fuel remaining in the fuel tank(s) for display use.
Type: RAM
Minimum Range: 0 to 200 litres
Minimum Resolution: 0.5 litres

Fuel_Volume_Pri_Tank_Diag = amount of fuel remaining in the primary fuel tank for diagnostic use. Does not include any unusable amount of fuel in the primary fuel tank.
Type: RAM
Minimum Range: 0 to 200 litres
Minimum Resolution: 0.5 litres

Fuel_Volume_Pri_Tank_Display = amount of fuel remaining in the primary fuel tank for display use. Does not include any unusable amount of fuel in the primary fuel tank.
Type: RAM
Minimum Range: 0 to 200 litres
Minimum Resolution: 0.5 litres

Fuel_Volume_Sec_Tank_Diag = amount of fuel remaining in the secondary fuel tank for diagnostic use. Does not include any unusable amount of fuel in the secondary fuel tank.
Type: RAM
Minimum Range: 0 to 200 litres
Minimum Resolution: 0.5 litres

Fuel_Volume_Sec_Tank_Display = amount of fuel remaining in the secondary fuel tank for display use. Does not include any unusable amount of fuel in the secondary fuel tank.
Type: RAM
Minimum Range: 0 to 200 litres
Minimum Resolution: 0.5 litres

Filt_Fuel_Volume_Display = total fuel volume filtered for the display.
Type: RAM
Minimum Range: 0 to 200 litres
Minimum Resolution: 0.5 litres

Trans_Range_State_DFLTD = when TRUE, indicates a PRNDL failure.
Type: RAM
Minimum Range: TRUE or FALSE

Transmission_Type = variable indicating the transmission type on the vehicle.
Type: RAM
Minimum Range: MANUAL or AUTOMATIC

Vehicle_Speed = velocity of the vehicle.
Type: RAM
Minimum Range: 0 to 200 KPH
Minimum Resolution: 1 KPH

4.6.11 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
4.6	Add functionality to the Fuel Volume Determination algorithm that shows the differences between dual fuel tank applications with either a mechanical secondary fuel transfer pump (e.g. jet pump on saddle tank applications) or an electronic secondary fuel transfer pump (e.g. electric fuel pump on large dual tank truck applications. Use separate timers for determining which fuel zone to enter. Add additional logic for resetting fuel accumulated in fuel zone 2. Remove references for transmitting individual fuel tank level to Platform for controlling the electronic secondary fuel transfer pump. Update the range and resolutions for many fuel level variables and calibrations. Add new vehicle speed criterion to enter fast filtering of fuel level for display.	ICR 2030

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4.7 Remote Vehicle Start Monitor Algorithm Requirements

4.7.1 General Overview

The Remote Vehicle Start (RVS) Monitor Algorithm is executed by the Powertrain Controller. It is required on all vehicles with RVS. The purpose of the algorithm is to both protect the engine from damage, and the vehicle from theft, while the engine is running subsequent to a remote start.

4.7.2 RVS Monitor Algorithm Interface

4.7.2.1 Serial Data

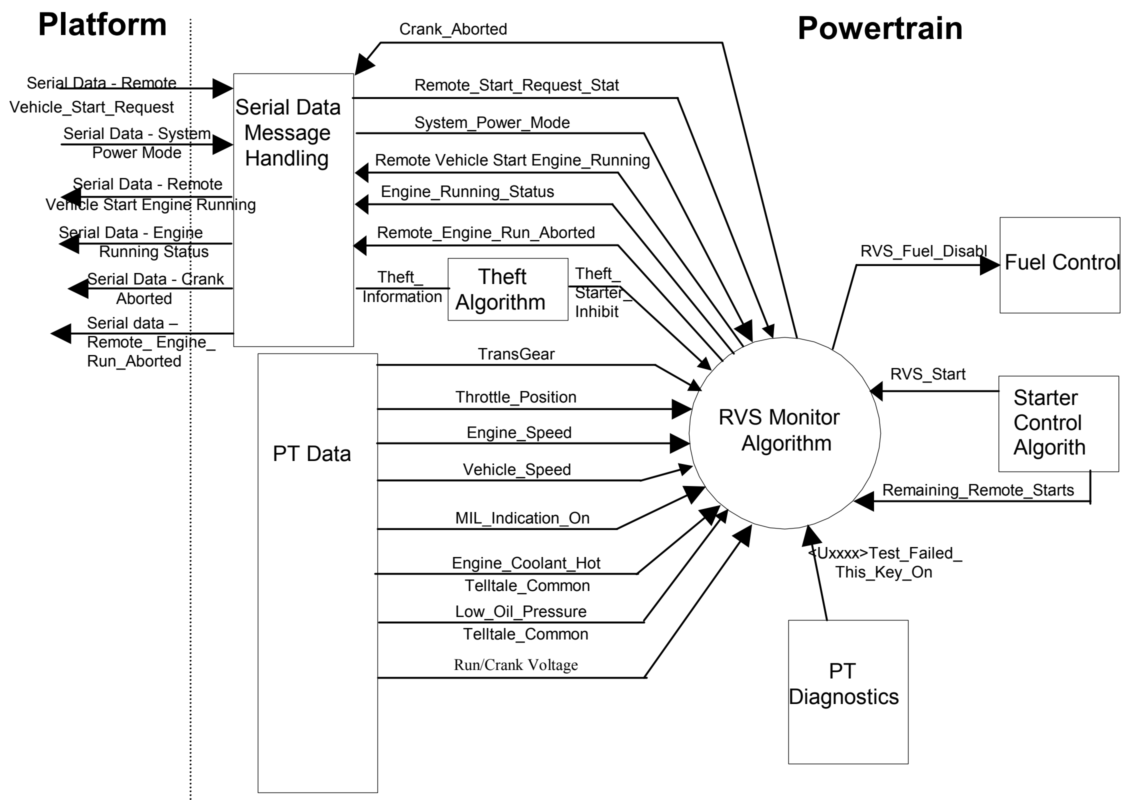
The following serial data signals are transmitted by the Powertrain Controller:

1. Remote Vehicle Start Engine Running
2. Engine Running Status
3. Remote Engine Run Aborted

The following serial data signals are transmitted by the Platform Controller:

1. Remote Vehicle Start Request
2. System Power Mode

4.7.3 Context Diagram



4.7.4 RVS Monitor Algorithm Description

NOTE: In software this section Shall be executed before executing the following sections 4.7.4.1 “Monitoring For Conditions That Do Not Allow a Re-start” and 4.7.4.2 Monitoring For Conditions That Allow a Re-start.

This algorithm shall be enabled and begin executing when RVS_Start is equal to “Active”. This is an indication from the Starter Control Algorithm that the engine has been remotely started.

When the RVS Monitor algorithm begins executing, Remote_Vehicle_Start_Engine_Running shall be set equal to “True” and Engine_Running_Status Shall be set = “False” (see 4.7.7.1). The RVS Monitor algorithm shall continue to execute until the conditions defined in Section 4.7.4.3 are satisfied.

The ECM/PCM shall keep a timer (RVS_ECM/PCM_Backup_Timer) each time the ECM/PCM executes a successful Remote Start (RVS_Start is equal to “Active”). The operation of the timer shall be as follows:

IF Remaining_Remote_Starts was > 1 when the current Remote_Vehicle_Start_Request = “Active” was received
THEN RVS_PCM_Backup_Timer = K_RVSPCMBackupTimerFirstStart
THEN Start RVS_PCM_Backup_Timer
THEN Decrement Remaining_Remote_Starts
ELSE IF Remaining_Remote_Starts was = 1 when the current Remote_Vehicle_Start_Request = “Active” was received
  THEN RVS_PCM_Backup_Timer = K_RVSPCMBackupTimerSecondStart
  THEN Start RVS_PCM_Backup_Timer
  THEN Decrement Remaining_Remote_Starts
  ENDIF
  ELSE IF Remaining_Remote_Starts was = 0 when the current Remote_Vehicle_Start_Request = “Active” was received
  THEN ECM shall not allow a Remote Vehicle Start
  ENDIF
ENDIF

IF The PCM exits Remote Start Monitoring Mode
THEN The RVS_PCM_Backup_Timer shall be stopped.
ENDIF

IF Remaining_Remote_Starts was > 0 when the current Remote_Vehicle_Start_Request = “Active” was received AND RVS_PCM_Backup_Timer becomes = 0
THEN PCM shall shutoff fuel and send Run_Abort_Status = True AND set Remaining_Remote_Starts = 0.
ENDIF

4.7.4.1 Monitoring For Conditions That Do Not Allow a Re-start

Fuel shall be disabled (set RVS_Fuel_Disable to “True”), and Remote_Engine_Run_Aborted shall be set equal to “True”, and Remaining_Remote_Starts shall be set = 0 when **any** of the following conditions exist:

1. The Powertrain controller has commanded on the Engine Coolant Hot Telltale.
2. The Powertrain controller has commanded on the Engine Oil Pressure Low Telltale for a calibrated amount of time, **K_EngOilPresLowLmpOnTime**.
3. The Malfunction Indicator Lamp (MIL) is commanded on.
4. TransGear is not equal to “Park” OR data signal is determined to be not valid (On vehicles that use serial data as the source of TransGear).
5. Vehicle_Speed is not equal to 0 OR data signal is determined to be not valid (On vehicles that use serial data as the source of vehicle speed).
6. RVS_PCM_Backup_Timer = 0.

4.7.4.2 Monitoring For Conditions That Allow a Re-start

Fuel shall be disabled (set RVS_Fuel_Disable to “True”) when **any** of the following conditions exist:

1. Engine_Speed is greater than **K_EngSpdThresh_1** for greater than **K_EngSpdThresh_1_Tme** seconds.
2. Engine_Speed is greater than **K_EngSpdThresh_2** for greater than **K_EngSpdThresh_2_Tme** seconds.
3. Throttle_Position is greater than **K_ThrottlePct** for greater than **K_ThrottlePctTme** seconds.
4. Any serial data communication errors with the messages, Remote_Vehicle_Start_Request and System_Power_Mode.
5. Run/Crank hardwire voltage goes low (< 2V).

In the event of a PCM initiated engine stop or an engine stall occurs, the PCM shall be required to see a transition of the Remote_Vehicle_Start_Request from “Inactive” to “Active” to allow another Remote Start.
When this stop or stall occurs the PCM will send Remote_Vehicle_Start_Engine_Running = False and upon receiving this Platform will exit remote start and set Remote_Vehicle_Start_Request = Inactive.

The need for PCM to see a transition of the Remote_Vehicle_Start_Request from “Inactive” to “Active” to allow another Remote Start is due to the possible race condition (after a stop or stall) between the PCM sending Remote_Vehicle_Start_Engine_Running = False and Platform sending Remote_Vehicle_Start_Request = Inactive. The PCM start algorithm could try another start (after the stop or stall) since Remote_Vehicle_Start_Request could still be = Active in PCM memory (run/crank relay would still be active) when start algorithm is executed again. (Due to Remote_Vehicle_Start_Request = Inactive having not yet been received/or processed by the PCM).

4.7.4.3 Transition Out of Remote Mode

Remote_Vehicle_Start_Engine_Running shall be set equal to "False", and the RVS Monitor Algorithm shall terminate when **all** of the following are true:

1. Theft_Starter_Inhibit is equal to "False". This is an indication that the correct vehicle theft password has been received.
2. Remote_Vehicle_Start_Request is equal to "Inactive".
3. System_Power_Mode is equal to RUN.

The RVS Monitor Algorithm shall also terminate if the engine is no longer running. This could be due to an engine stall, RVS Monitor fuel disable, Remote_Vehicle_Start_Request equal to "Inactive", or loss of Run/Crank voltage. When RVS Monitor is terminated due to the engine not running, then Remote_Vehicle_Start_Engine_Running, Engine_Running_Status, and RVS_Fuel_Disable shall all be set equal to "False". The variable RVS_Start must also be reset to "Inactive" by the Starter Control Algorithm.

4.7.5 Execution / Activation Requirements

The RVS Monitor algorithm shall be executed at a nominal interval of 100 ms, maximum.

Algorithm requirements in section 4.7.4.3 shall be evaluated before requirements in section 4.7.4.2.

4.7.6 Powertrain System State Transition Requirements

The following parameters shall be initialized during the powertrain controller power-up reset:

Remote_Vehicle_Start_Engine_Running ← "False"
Engine_Running_Status ← "False"
Remote_Engine_Run_Aborted ← "False"
RVS_Fuel_Disable ← "False"
RVS_PCM_Backup_Timer = 0

4.7.7 On-Vehicle Communications / Serial Data Interaction Requirements

4.7.7.1 Requirements for Engine_Running_Status

If RVS_Start is equal to True and the ECM is in Remote Start Running mode, then Engine_Running_Status shall be set equal to "False". Otherwise, Engine_Running_Status shall be set equal to EPSR_EngineRunningStatus (the internal engine run flag used for powertrain controls).

<u>Remote Start Use</u>:
To transition from remote start running to normal running platform needs to see:
Engine Running Status = True ($1) and Remote Vehicle Start Engine Running = ($0), to allow release of BTSI control (see note below).

Note: The ECM remote start monitoring algorithm is only assured to have transitioned from remote start running to normal running when Engine Running Status = True ($1) AND Remote Vehicle Start Engine Running = False ($0).

If only the Engine Running Status or Remote Vehicle Start Engine Running signal was looked at by platform there is a potential for an engine stall (due to platform releasing BTSI and then driver shifting out of Park) before ECM has transitioned from remote start running to normal running.

4.7.7.2 RVS Monitor Serial Data Signals

Specification Name	Transmitter	Class 2 Name	GMLAN Name
Engine_Running_Status	Powertrain	52-04 Engine System Other -– Engine Run Flag	Engine Running Status
Remote_Vehicle_Start_Engine_ Running	Powertrain	52-14 Engine System Other – Remote Start Engine Run Flag	Remote Vehicle Start Engine Running
Remote_Vehicle_Start_Request	Platform	86-16 Ignition Switch/Starter – Remote Start Crank	Remote Vehicle Start Request
Remote_Engine_Run_Aborted	Powertrain	86-18 Ignition Switch/Starter – Remote Start Aborted	Powertrain Run Aborted
System_Power_Mode	Platform	FE-06 Network Control -– System Power Modes	System Power Mode

Note: The Class 2 message and GMLAN signal associated with Engine_Running_Status do not have the same enumeration values. When Engine_Running_Status is equal to “False” then the GMLAN signal, Engine Running Status, shall be set equal to “Not Running”.

4.7.8 Off-Vehicle Communications / Serial Data Interaction Requirements

Powertrain shall provide to Platform the last eight reasons why it has disabled remote vehicle start. See the GMPT GMLAN Diagnostic Test Mode Configuration Specification for further details.

4.7.9 Data Dictionary

4.7.9.1 Calibrations

All of the following calibrations are Platform-owned.

K_EngOilPresLowLmpOnTime = calibration value that defines the amount of time the Engine Oil Pressure Low Lamp must be on before a remote vehicle start is aborted.
Minimum Range: 0 to 600 seconds
Typical Value: 60 seconds

K_EngSpdThresh_1 = calibration value that defines an engine speed threshold for disabling fuel. When the engine speed is above this value continuously for **K_EngSpdThresh_1_Tme** seconds, fuel is disabled.
Minimum Range: 0 to 8192 RPM
Typical Value: 2000 RPM

K_EngSpdThresh_1_Tme = the continuous amount of time engine speed is allowed to be above **K_EngSpdThresh_1**, before disabling fuel.
Minimum Range: 0 to 10 seconds
Typical Value: 4 seconds

K_EngSpdThresh_2 = calibration value that defines an engine speed threshold for disabling fuel. When the engine speed is above this value continuously for **K_EngSpdThresh_2_Tme** seconds, fuel is disabled.
Minimum Range: 0 to 8192 RPM
Typical Value: 4000 RPM

K_EngSpdThresh_2_Tme = the continuous amount of time engine speed is allowed to be above **K_EngSpdThresh_2**, before disabling fuel.
Minimum Range: 0 to 10 seconds
Typical Value: 2 seconds

K_Max_Starts_Allowed = See PPEI section 4.1 for definition.

K_RVSPCMBackupTimerFirstStart = the timeout value the ECM/PCM uses to stop an active remote Start if platform timer fails during the first (10 minute) Remote Start time. This Calibration **SHALL** be set to 21.
Range: 21-30
Resolution: 1 minute
Typical Value: 21minutes

K_RVSPCMBackupTimerSecondStart = the timeout value the ECM/PCM uses to stop an active remote Start if platform timer fails during the second (10 minute) Remote Start time. Due to limitations on Remote Start run time this Calibration **SHALL NOT** be set to a value greater than 11.
Range: 0-30
Resolution: 1

Typical Value: 11 minutes

K_ThrottlePct = calibration value that defines the Throttle_Position threshold before disabling fuel. When the Throttle_Position is above this value continuously for **K_ThrottlePctTme** seconds, fuel is disabled.
Minimum Range: 0 to 100%
Typical Value: 15%

K_ThrottlePctTme = the continuous amount of time Throttle_Position is allowed to be above **K_ThrottlePct**, before disabling fuel.
Minimum Range: 0 to 10 seconds
Typical Value: 2 seconds

4.7.9.2 Variables

Crank_Aborted = See PPEI section 4.1 for definition.

Engine_Running_Status = is set to True to define the engine is running and is only used for communicating engine running on serial data. EPSR_EngineRunningStatus (see below) is the internal engine run flag used for powertrain controls. This variable is transmitted on serial data to the platform electronics. See section 4.7.7.1 for definition of operation during a remote start.

Minimum Range:
$0 = Not Running
$1 = Running and Idling
$2 = Running and Not Idling

Initial Value: $0 Not Running

Engine_Speed = calculated speed of the engine based on available engine position sensor(s).
Minimum Range: 0 to 8192 RPM
Minimum Resolution: 32 RPM

EPSR_EngineRunningStatus = set to True when the engine is running as determined by the Engine Position Sensing algorithm.
Minimum Range: True or False

Remaining_Remote_Starts = variable which indicates if remote start is allowed. Used to limit the number of consecutive remote start attempts for security purposes. This variable is to be set to its initial value (K_Max_Starts_Allowed) after a full theft authentication has passed after entering the Run power mode.
Minimum Range: 0 - 5
Minimum Resolution: 1
Initial Value: K_Max_Starts_Allowed

Remote_Vehicle_Start_Engine_Running = set to “True” when the engine is running in remote vehicle start mode. This variable is transmitted on serial data to the Platform Electronics.
Minimum Range: True or False
Initial Value: False

Remote_Engine_Run_Aborted = flag indicating that Remote Start has been aborted. This flag also disables Remote Start from being re-enabled until the engine has started normally.
Minimum Range: True or False
Initial Value: False

Remote_Vehicle_Start_Request = request, from the RVS system, to crank and run the engine in remote mode. This variable is updated based on a serial data signal transmitted by the Platform Electronics.
Minimum Range: Active or Inactive
Initial Value: Inactive

RVS_Fuel_Disable = set to “True” when any of the Remote Vehicle Start monitor conditions are active. When this variable is set to “True”, fuel will be disabled.
Minimum Range: True or False
Typical Value: False

RVS_PCM_Backup_Timer = this is used to stop Remote Start engine running if the Platform module timer is failed. It uses the calibrations:
K_RVSPCMBackupTimerFirstStart (used in section 4.7.4)
K_RVSPCMBackupTimerSecondStart (used in section 4.7.4)

RVS_Start = set to “Active” by the Starter Control Algorithm when the engine has been started due to an RVS request. This is used to initiate execution of the RVS Monitor algorithm.
Minimum Range: Active or Inactive
Initial Value: Inactive

System_Power_Mode = power mode for the vehicle. Transmitted by the power mode master over serial data. Default based on the hardwired ignition switch signals if a failure is detected with the transmitter of the serial data message.
Minimum Range: OFF or ACCESSORY or RUN or CRANK REQUEST

Theft_Starter_Inhibit = flag from the theft algorithm that determines if the transition to normal mode is allowed based on theft criteria. Transition to normal mode is allowed when this flag is set equal to “False”. Note: This flag is also used for starter inhibit during normal (non-RVS) vehicle starts.
Minimum Range: True or False

Throttle_Position = the position of the throttle as measured by powertrain controller based on available sensor(s)
Minimum Range: 0 to 100%

TransGear = the actual transmission gear. It is valid for manuals and automatics and is based on any available combination of the following: clutch switch, N/V calc., PRNDL switches, etc.

Minimum Range: Park or Neutral or Reverse or 6 or 5 or 4 or 3 or 2 or 1

Vehicle_Speed = the ground speed of the vehicle as determined by the powertrain controller.
Minimum Range: 0 to 300 kph
Minimum Resolution: 1 kph

4.7.10 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE
4.7.8	Removed specific service parameter definitions and referenced proper service location.	ICR 303
4.7.4	ADDED NOTE: In software this section Shall be executed before Section 4.7.4.1 “Monitoring For Conditions That Do Not Allow a Re-start” Added Engine Running Status action. Modified operation of the timer in section RVS Monitor Algorithm Description to appropriately represent the Remote Vehicle Start Subsystem Spec.	ICR 2011
4.7.4.1	Reworded item 5 to use serial data based vehicle speed unless the signal is determined not Valid.	
4.7.9.1	Changed typical value for K_RVSPCMBackupTimerFirstStart to be 11 instead of 21 and added definition of limitations on setting this calibration value. For K_RVSPCMBackupTimerSecondStart added definition of limitations on setting this calibration value.	
Global	Changed name of variable: Remote_Engine_Running_Status (old) Remote_Vehicle_Start_Engine_Running (new)	ICR 2113
4.7.3	Updated the Context Diagram	
4.7.4	Added note to RVS Monitor Algorithm Description. Added Engine_Running_Status action. Modified RVS Monitor timer operations (including: Modified operation of the timer to handle cases where Remaining Remote Starts could be greater than 2 and Added Timer stop definition.)	
4.7.4.1	Modified fifth condition for monitoring for conditioning that do not allow a re-start.	
4.7.4.2	Added definition of PCM restart requirements if a PCM initiated engine stop or engine stall occurs.	

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE
4.7.7.1	Modified requirements for Engine_Running_Status: Added definition of remote start use of Engine_Running_Status signal.	
4.7.9.1	Added K_Max_Starts_Allowed. Changed range for K_RVSPCMBackupTimerFirstStart to be 21 to 30. Needs to be 21 at minimum for normal Remote Start continue operation (since there is no continue message).	
4.7.9.2	Added Crank_Aborted definition.	

4.8 Power Take-Off and Fast Idle Control Algorithm

Algorithm not defined for GMW3119 PPEI Version 2.5

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4.9 Transfer Case Controls Algorithm

Algorithm not defined for GMW3119 PPEI Version 2.5

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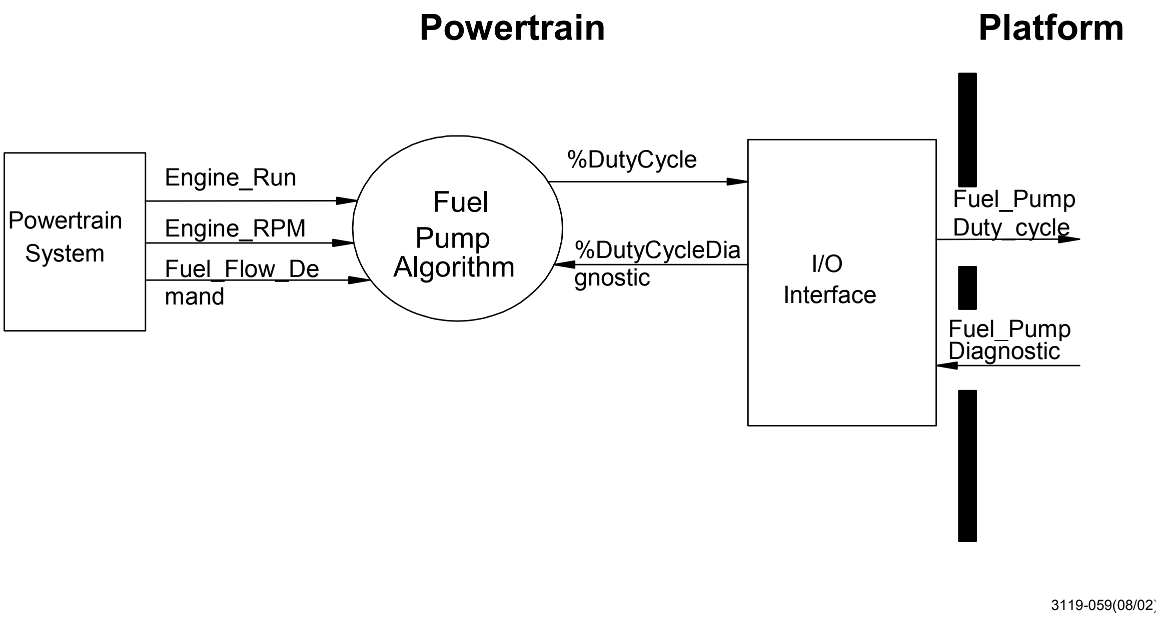
4.10 Variable Speed Fuel Pump Control Requirements

4.10.1 General Overview

This section describes the algorithm control and diagnosis of the primary fuel pump control system for variable speed fuel pumps. The output from this algorithm allows for PWM control of the variable speed fuel pump.

4.10.2 Context Diagram



4.10.3 Variable Speed Fuel Pump Control Algorithm Description

Two key inputs needed for variable fuel pump control are ECM demanded Fuel Flow and RPM. These inputs are used to determine the output **%DutyCycle** used to control the pump. For variable speed applications this process arbitrates requests to command fuel pump on and control fuel pump speed.

If **Fuel_Pump_Command** is “True” and **Engine_Running** is “True” and has been at this state for a calibratible amount of seconds, then fuel pump will be commanded from full power to a calculated duty cycle that is a function of **Engine_RPM** and **Fuel_Flow_Demand**. If the difference between the calculated duty cycle (**K_DutyCycleLookUpTable**) and the duty cycle at full power is greater than some calibratible value, then current duty cycle will be ramped down from full power to where it equals the calculated duty cycle. This is done to eliminate any large step size changes in fuel pump speed when going from full power to calculated duty cycle.

If **Fuel_Pump_Command** is “True” and **Engine_Running** is “False” then fuel pump is commanded to full power, **K_MaxDutyCycle**.

If **Fuel_Pump_Command** is "False" then fuel pump will be commanded off, **K_MinDutyCycle**.

4.10.4 Diagnostic Action Requirements

The diagnostics for the variable speed fuel pump is determined by the Fuel Pump Speed Control (FPSC) Module. The FPSC module determines the type of failure and sends a PWM duty cycle to the ECM representing the type of failure detected. The Fuel pump control algorithm receives **%DutyCycleDiagnostic** and sets the appropriate diagnostic trouble codes (DTC) required for OBD II markets and may be used in other markets. Refer to Fuel System Control Module specification #15.05.01C for diagnostic descriptions and section 2.12.5.10 for accuracy and tolerance on the duty cycle.

Refer to Section 1.7 for platform design guidelines.

4.10.5 Data Dictionary

4.10.5.1 Calibrations

K_DutyCycleLookUpTable = calibration that determines the amount of adjustment to the PWM duty cycle required on the output driver. The table is based on fuel flow and the engine RPM. This table shall be 9 columns by 9 rows, where the columns range from 0 – 50 grams/second (g/s) of fuel flow and the rows range from 0 to 8192 of engine RPM.

Minimum Range: 0 to 100 %
Minimum Resolution: 0.5 %
Cal value owner: Powertrain and Platform
Location: Powertrain
Typical Values: The values in the table shall be chosen to minimize fuel pump noise and maintain maximum engine performance.

Engine_RPM axis attributes:

axis type	Calibratable breakpoints
axis size	9
axis units	RPM
axis range	0 to 8192
axis input data flow	Engine_RPM

Fuel_Flow_Demand axis attributes:

axis type:	Calibratable breakpoints
axis size	9
axis units	grams/second (g/s)
axis range	0 to 50
axis input data flow	Fuel_Flow_Demand

Fuel Flow Demand	**0**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**50**
Engine RPM	**K_ DutyCycleLookupTable**								
0	.	90	.	.	.	.	90	.	90
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	90	.	.	.	.	90	.	90
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.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
8192	.	90	.	.	.	.	90	.	90

K_MaxDutyCycle = Maximum duty cycle of the variable speed fuel pump. This value shall be chosen to minimize fuel pump noise and maintain maximum engine performance.

Minimum Range: 0 to 100 %
Minimum Resolution: 0.5 %
Typical Value: 90 %
Cal value owner: Powertrain and Platform
Location: Powertrain

K_MinDutyCycle = Minimum duty cycle of the variable speed fuel pump. This value shall be chosen to minimize fuel pump noise and maintain maximum engine performance.

Minimum Range: 0 to 100 %
Minimum Resolution: 0.5 %
Typical Value: 10 %
Cal value owner: Powertrain and Platform
Location: Powertrain

4.10.5.2 Variables

Engine_Running = Indicates that the engine is running.
Minimum Range: True or False

Fuel_Pump_Command = Powertrain determined state that defines the fuel pump is in the "ON" state based on ETC failure, ROM faults, fuel pump prime, normal operation, device control or other.
Minimum Range: True or False

Fuel_Flow_Demand = Calculated fuel flow demand as determined in the ECM.
Minimum Range: 0- 50 grams/second (g/s)
Minimum Resolution: 0.001 g/s

Engine_RPM = Calculated speed of the engine based on available engine position sensor(s).
Minimum Range: 0 to 8192 RPM
Minimum Resolution: 12.5 RPM

%DutyCycle = Commanded PWM duty cycle value to the FPSC module.
Minimum Range: 0 to 100%
Minimum Resolution: 0.5%

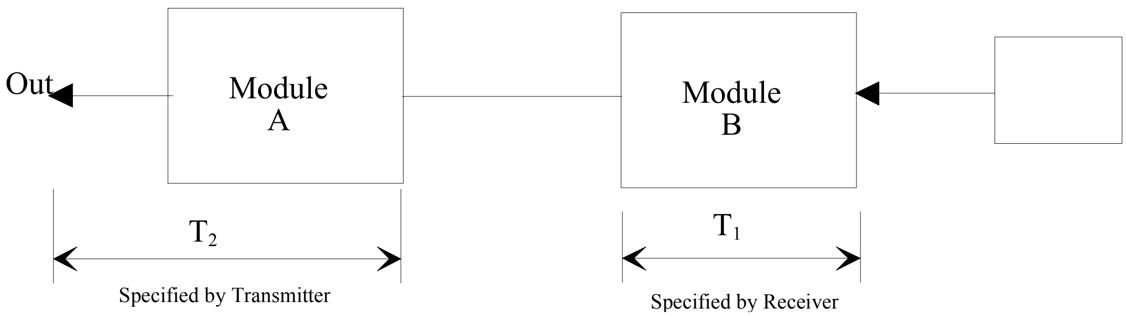
%DutyCycleDiagnostic = PWM duty cycle value from the FPSC module.
Minimum Range: 0 to 100%
Minimum Resolution: 0.5%

4.10.6 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
New Section	Added new Section 4.10 Variable Speed Fuel Pump Control Algorithm to GMW3119 PPEI 2.5.	ICR 2010

5. SERIAL DATA DEFINITION

The following delays are defined for the interface definitions associated with both Class 2 messages and GMLAN signals defined in Sections 5.1 and 5.2 respectively.



T_2 = Output Actuation Delay = time delay from receipt of the command on the serial data link until the output at the controller changes state. Includes serial data handler loop time, application loop time and output driver actuation time.

T_1 could either be a "Data Delay", or an "Input Delay"

Data Delay = time delay from an input that causes an algorithm decision to change the state of a variable until the serial data signal is transmitted. This delay includes the application and serial data handler loop times.

Input Delay = time delay from switch/sensor input change of state at the controller until the serial data signal is transmitted. This delay includes the debounce time (if applicable), application loop time and serial data handler loop time.

An Output Actuation Delay, Data Delay, or an Input Delay may not be specified in this document for every serial data signal.

5.1 Class 2

The Class 2 messages that are in this document are included for the purpose of identifying the required messages for the standard interface between Platform and Powertrain. It is not intended that every message is used in every application.

5.1.1 References

- GM Class 2 Physical Diagnostic Message Strategy Specification
- NAO Corporate Class 2 Functional Communication Specification
- GM Corporate Standard Class 2 Message Handler
- GMNA Power Moding Specification
- Class B Data Communication Network Interface - SAE J1850

5.1.2 Class 2 Message Identifiers

Class 2 messages are identified by a primary ID, a secondary ID and an extended ID. A combination of these identifiers within a Class 2 message defines the specific function that is being addressed. All functionally addressed Class 2 messages require at least the Primary ID and the Secondary ID to address a function. An example of a function that requires only these IDs would be wheel speed. The Extended ID is used to further subdivide a functional address or to define a geographic location in the vehicle. Examples would be the right front wheel speed or left front wheel speed. The IDs are defined in the GM Class 2 message database.

5.1.3 Class 2 Message Priority

A priority is assigned to each message that indicates the importance of a message such that it will win arbitrations with messages of lower priority. Since Class 2 is a "0" dominant bus, "0" is the highest priority and "7" is the lowest. Priority "0", "1" and "2" messages are reserved for sending critical information and cannot be used by any modules without prior approval.

5.1.4 Transmit Requirements Column Definition

1. **Operation**
   A. LOAD
   Used by the transmitting module to command an absolute change in a parameter. There shall always be data in this message.
   B. RACK (Report Acknowledge)
   Used by the transmitting module to verify the reception of a message. There shall never be any data in this message.
   C. REQ (Request Parameter Value)
   The message type used to request an owner to report a current parameter value.
   D. RPT (Report Parameter Value)
   The message type used to report the current value of the parameter.
   E. RPTF (Report Failure Value)
   The message type used when an owner node determines that the parameter data is in error. The owner node should respond to a request for data by sending a failure value. The original parameter launch criteria should be adhered to when sending this failure value. This message is sent in place of the report parameter message and contains the best available value for the parameter.
   F. RQCV (Request Commanded Value)
   Used by the transmitting module to request a LOAD command of a parameter's value from another module.

2. **Source**
   The module initiating the message

3. **Dest (Destination)**
   The module receiving the message

4. **Exp Resp (Expected response)**
   The message type which acknowledges the receipt of a message

5. **Repetition Interval**

The delay between messages must be implemented for all send on change parameters to ensure that a rapidly changing parameter does not dominate the bus. This value may be calibratable for some messages.

6. **Mode Trigger**
   A specified power mode triggers initialization of a parameter. A parameter requires system initialization if it meets the following criteria:
   - If the data is non-changing type, e.g. Driver ID
   - If the data is slow changing type
   - If the data requires failure action

   Each parameter requiring initialization must be associated with the power mode in which it is initialized. This requires the module to maintain a table indicating the power mode, the parameter reports, the load parameters to be sent, and the parameters that must be received.

7. **Latency Goal-Mode Init**
   The maximum delay from the time the message is queued by the transmitter due to a mode trigger to the time the message is received by the receiver. This is a system application dependent parameter that shall be defined by the Platform Class 2 Data Communications Strategy.

8. **Msg Trigger (Message Triggers)**
   The specified occurrence triggers the transmission of a message.

9. **Change Trigger**
   The trigger that controls when a message is scheduled to be transmitted on the Class 2 link. Parametric data, which is categorized parametric send on change, is sent after it has varied by some specified amount (allowable hysteresis). The parameter report is sent after it has changed by (X) (Units) but no more frequently than (Y) milliseconds as specified by the minimum repeat interval. This value may be calibratable for some messages.

10. **Latency - Norm Op**
    The maximum delay from the time the message is queued by the transmitter due to a message or change trigger to the time the message is received by the receiver. This is a system application dependent parameter that shall be defined by the Platform Class 2 Data Communications Strategy.

11. **Message Header**
    The exact bus visible format of the message header.

    NOTE: Messages transmitted by the Platform are associated to source id $SS, since it is unknown. Messages transmitted by the Powertrain are associated to source id $10.

5.1.5 Receive Requirements Column Definition

1. **Operation**

   A. LOAD
   Used by the transmitting module to command an absolute change in a parameter. There shall always be data in this message.

   B. RACK (Report Acknowledge)
   Used by the transmitting module to verify the reception of a message. There shall never be any data in this message.

   C. REQ (Request Parameter Value)
   The message type used to request an owner to report a current parameter value.

   D. RPT (Report Parameter Value)
   The message type used to report the current value of the parameter.

E. **RPTF (Report Failure Value)**
The message type used when an owner node determines that the parameter data is in error. The owner node should respond to a request for data by sending a failure value. The original parameter launch criteria should be adhered to when sending this failure value. This message is sent in place of the report parameter message and contains the best available value for the parameter.

F. **RQCV (Request Commanded Value)**
Used by the transmitting module to request a LOAD command of a parameter's value from another module.

2. **Dest (Destination)**
The module receiving the message

3. **Source**
The module initiating the message

4. **Power Up Default**
The data value the receiver of a message assumes until it actually receives the transmitted data value.

5. **Req'd Resp (Required response)**
The message which is required to sent sent upon receipt of the message.

6. **Learn Source**
Indicates if the receiver performs Source Learning and State of Health (SOH) monitoring and detection.

7. **SOH Failure Value**
The value that the receiver of the message assumes after a SOH failure has been detected.

8. **Receive Action**
A text field indicating the intended usage of a received parameter (optional).

9. **Message Header**
The bus visible format of the message header. The nibbles indicated by "X" are don't care values.

5.1.6 General Requirements

These requirements include the data dictionary and the valid message sequences for each message. These requirements are identical for all of the $EA/$20/$XX messages. Therefore, within this group of messages, the general requirements are shown only for message $EA/$20/$81.

5.1.7 Class 2 Message Summary

C2 Message Name	Trans-mitter	Pri ID	Sec ID	Ext ID	Notes	PPEI Section	EIS Reference
Engine Torque - Wheel Slip Prevent Required Torque	Platform	08	11	N/A	ETS	2.11	
Engine Torque - Driver Intended Torque	Powertrain	08	20	N/A	ETS & VSES	2.11	
Engine Torque - Requested Torque	Platform	08	21	N/A	ETS	2.11	
Engine Torque - Delivered Torque	Powertrain	08	22	N/A	ETS	2.11	
Engine Air Intake - Intake Boost Pressure - Gage	Powertrain	0A	10	N/A	Optional for super charger	2.3	

C2 Message Name	Trans-mitter	Pri ID	Sec ID	Ext ID	Notes	PPEI Section	EIS Reference
Engine Air Intake - Intake Air Temperature	Powertrain	0A	20	N/A	TCS Required for suspension control Optional for HVAC Fan Afterblow Required with RVC	2.10 2.11 2.14 2.16	
Throttle Position Sensor - Pedal Position	Powertrain	12	11	N/A	Required for SDM. Required for BASS. Required for ATC with active push button control and Truck AWD & TCS	2.2, 2.7, 2.11, 2.17	
A/C Clutch - Enable	Powertrain	14	01	N/A	Optional for A/C	2.9	
A/C Clutch - Clutch Permission	Platform	14	10	N/A	Required for A/C	2.8, 2.9	
Engine RPM - High Resolution	Powertrain	1A	10	N/A	Required	2.3, 2.11, 2.17	
Wheels - Wheel Reference Vehicle Speed Metric	Platform	24	03	N/A	Required for ETC ABS	2.7 2.11	
Wheels - Maximum Driven Wheel Velocity Metric	Platform	24	05	00	ABS	2.11, 2.19	
Wheels - Average Peak to Peak Acceleration (Rough Road)	Platform	24	07	N/A	Required for vehicles that require rough road detection	2.11, 2.19	
Wheels- Individual Wheel Speeds	Platform	24	09	N/A	Required for ABS systems that have four wheel speed sensors	2.2, 2.11	
Vehicle Speed - High Resolution - Metric	Powertrain	28	02	N/A	Required	2.2, 2.3 2.8, 2.10, 2.14, 2.17, 2.19	
Traction Control - Platform Temporary Inhibit of TCS	Platform	2A	07	N/A	ETS & TCS	2.11	
Traction Control - Initiate Engine Drag Control Test	Powertrain	2A	09	N/A	TCS	2.11	
Traction Control - PT Traction Failure Status	Powertrain	2A	0B	N/A	ETS & TCS	2.11	
Traction Control - Options	Platform	2A	3C	N/A	ABS	2.11	
Brakes - Variable Proportioning	Platform	32	03	N/A	Required for ABS	2.11	
Brakes - Active Brake Control Active	Platform	32	06	N/A	VSES	2.11	
Brakes - System Fault	Platform	32	0A	N/A	Required with ABS and cruise control	2.2, 2.7, 2.11	
Brakes – Parking Brake Active	Platform	32	20	N/A	Required with Auto Trailering Mode	2.7, 2.15	
Brakes - Brake Light Switch, Brake Sw Active	Powertrain	32	22	N/A	ABS, SDM Optional for BTSI	2.11, 2.15, 2.17	
Brakes - Brake Extended Travel Switch	Powertrain	32	24	N/A	VSES	2.11	
Brakes – Brake Pedal Status	Platform	32	2A	N/A	Required with BASS	2.4, 2.7, 2.15	
Brakes - Brake Options	Powertrain	32	3C	N/A	Optional	2.11	

C2 Message Name	Trans-mitter	Pri ID	Sec ID	Ext ID	Notes	PPEI Section	EIS Reference
Transmission/Transaxle/PRNDL - Clutch Enable	Powertrain	3A	02	N/A	Required for ATC with active push button control	2.2	
Transmission/Transaxle/PRNDL – Estimated Trans. Gear Engaged	Powertrain	3A	03	N/A	Required for ATC ETS & TCS	2.2 2.11 2.15	
Transmission/Transaxle/PRNDL - Transfer Case Front Axle	Platform	3A	05	N/A	Required for ATC	2.2	
Transmission/Transaxle/PRNDL - Commanded Gear	Platform	3A	06	N/A	ETS	2.11	
Transmission/Transaxle/PRNDL-Transmission Shift Solenoids State	Powertrain	3A	0E	N/A	Optional	2.3, 2.11, 2.15	
Transmission/Transaxle/PRNDL-Tap Up/Tap Down Target Gear	Powertrain	3A	0F	N/A	Optional	2.3, 2.15	
Transmission/ Transaxle/ PRNDL - Fluid Temperature	Powertrain	3A	10	N/A	Optional	2.3	
Transmission/Transaxle/PRNDL - Fluid Remaining Life	Powertrain	3A	14	N/A	Optional	2.3	
Transmission/Transaxle/PRNDL - Transfer Case TPS Thresholds	Platform	3A	22	N/A	Required	2.2	
Transmission/ Transaxle/ PRNDL - Shift Feel	Platform	3A	30	N/A	Optional	2.15	
Transmission/Transaxle/PRNDL - Performance Shift Mode	Powertrain	3A	31	N/A	Optional	2.3, 2.15	
Transmission/Transaxle/PRNDL – Tap Up/Tap Down Mode Status	Platform	3A	32	N/A	Required for Tap Up/Tap Down	2.15	
Transmission/Transaxle/PRNDL - Winter Mode Status	Platform	3A	33	N/A	Optional	2.15	
Transmission/Transaxle/PRNDL - Driven Wheel Configuration	Powertrain	3A	35	N/A	Optional for Non-Truck All Wheel Drive	2.2, 2.11	
Transmission/Transaxle/PRNDL – Transmission Gear Shift Direction	Powertrain	3A	36	N/A	Platform-Optional	2.11	
Transmission/Transaxle/PRNDL-Transmission Gear Ratio	Powertrain	3A	38	N/A	Required for traction control with CVT	2.11	
Transmission/Transaxle/PRNDL - Transmission Options	Powertrain	3A	3C	N/A	ETS & TCS Required for ATC	2.2, 2.11	
Transmission/Transaxle/PRNDL - Tire/Axle Correction Factor	Powertrain	3A	3D	N/A	GMTG ONLY Required for TCS & ATC	2.2, 2.11	
Engine Coolant - Fan 1 (All) Speed	Powertrain	48	01	N/A	Required for RVC	2.8 2.16	
Engine Coolant - Fan Speed Offset	Platform	48	0B	N/A	Optional	2.8	
Engine Coolant - Fluid Temperature	Powertrain	48	10	N/A	Required	2.3	
Engine Coolant - Low Coolant Level	Platform	48	32	N/A	Required for premium V6 only	2.4	
Engine Oil-Fluid Temperature	Powertrain	4A	10	N/A	Optional	2.3	
Engine Oil - Fluid Pressure	Powertrain	4A	11	N/A	Optional	2.3	

C2 Message Name	Trans-mitter	Pri ID	Sec ID	Ext ID	Notes	PPEI Section	EIS Reference
Engine Oil - Fluid Remaining Life	Powertrain	4A	14	N/A	Optional	2.3	
Engine System Other - Engine Run Flag	Powertrain	52	04	N/A	Required	2.2, 2.3, 2.10	
Engine System Other - Electrically Heated Catalyst Status	Powertrain	52	09	N/A	Optional with EHC	2.13	
Engine System Other - Remote Start Engine Run Flag	Powertrain	52	14	N/A	Required for Remote Vehicle Start	2.5	
Engine System Other - Immediate Engine Snapshot n	Powertrain	52	21	N/A	Optional	2.10	
Engine System Other - Engine Type	Powertrain	52	22	N/A	ETS & TCS Optional for displays	2.3, 2.11	
Engine System Other – Calculated RDM Clutch Temperature	Powertrain	52	26	N/A	Required on vehicles with VersaTrak	2.02	
Engine System Other - Displacement on Demand Status	Powertrain	52	30	XX	Required	2.3, 2.4	
Suspension - Failure Status	Platform	58	0B	N/A	Required for suspension control	2.14	
Suspension - Suspension Options	Platform	58	3C	N/A	Optional with suspension control	2.14	
Vehicle Speed Control - Set Speed, Low Res Metric	Powertrain	62	02	N/A	Optional with Cruise Control & PTO	2.7	
Vehicle Speed Control - Cruise Cancel	Platform	62	07	N/A	Optional with Cruise Control	2.7	
Vehicle Speed Control - Speed Limit Value	Powertrain	62	10	N/A	Optional with suspension control	2.3, 2.14	
Charging System - Field Duty Cycle	Powertrain	72	20	N/A	Required with RVC	2.16	
Charging System - L Terminal Duty Cycle	Platform	72	24	N/A	Required with RVC	2.16	
Electrical Energy Management - Requested Minimum Idle Boost Level	Platform	74	26	N/A	Optional	2.4	
Odometer - Vehicle Metric	Platform	7A	01	N/A	Optional	2.3	
Odometer- Rolling Count	Powertrain	7A	06	N/A	Required	2.3, 2.19	
Fuel System - Cumulative Fuel	Powertrain	82	0A	N/A	Optional	2.3	
Fuel System - Fuel Level - Percent (Filtered)	Powertrain	82	12	N/A	Required	2.3, 2.12	
Fuel System - Fuel Capacity Metric	Powertrain	82	16	N/A	Optional	2.3, 2.12	
Vehicle Motion - Actual Lateral Accel	Platform	84	03	N/A	Required for Performance Shift Algorithm	2.11	
Ignition Switch/Starter - Crank Aborted	Powertrain	86	15	N/A	Required with Easy Key and RVS	2.5	
Ignition Switch/Starter – Remote Start Crank	Platform	86	16	N/A	Required with Remote Vehicle Start	2.5	

C2 Message Name	Trans-mitter	Pri ID	Sec ID	Ext ID	Notes	PPEI Section	EIS Reference
Ignition Switch/Starter – Remote Start Aborted	Powertrain	86	18	N/A	Required with Remote Vehicle Start	2.5	
Vehicle Security - Password	Platform	92	01	N/A	Required for VTD	2.5, 2.6	
Vehicle Security - Powertrain Status	Powertrain	92	02	N/A	Required for VTD	2.5, 2.6	
Climate Control (HVAC) - Options	Platform	B2	3C	N/A	Required for vehicles that have optional A/C	2.9	
Climate Control (HVAC) - Fluid Pressure, High Side	Powertrain	B2	11	N/A	Optional with A/C	2.9	
Climate Control (HVAC) - Low Side Fluid Temp	Platform	B2	20	N/A	Optional with A/C	2.9	
Restraints – Airbags Deployed	Platform	D2	07	N/A	Powertrain-Optional with ETC	2.7, 2.17	
Tires - Spare Status	Platform	E4	18	N/A	Optional for Non-Truck All Wheel Drive	2.2, 2.11	
Displays - PRNDL	Powertrain	EA	0A	N/A	Required with electronic PRNDL	2.3, 2.11, 2.15	
Displays – Driver Notification – Transmission Shifts Delayed	Powertrain	EA	20	76	Platform-Optional	2.3	
Displays – Driver Notification – Engine Overspeed Warning	Powertrain	EA	20	77	Platform-Optional	2.3	
Displays - Driver Notification - Engine Oil Change Soon	Powertrain	EA	20	81	Optional	2.3	
Displays - Driver Notification - Engine Oil Change Now	Powertrain	EA	20	82	Optional	2.3	
Displays - Driver Notification - Engine Oil Low Pressure	Powertrain	EA	20	83	Required	2.3	
Displays - Driver Notification - Engine Oil Low Level	Powertrain	EA	20	84	Optional	2.3	
Displays - Driver Notification - Engine Hot / Stop Engine	Powertrain	EA	20	85	Optional	2.3	
Displays - Driver Notification - Transmission Skip Shift	Powertrain	EA	20	88	Optional	2.3, 2.15	
Displays - Driver Notification - Transmission Upshift	Powertrain	EA	20	89	Optional	2.3, 2.15	
Displays - Driver Notification - Vehicle Speed Control Active	Powertrain	EA	20	8C	Optional with cruise control	2.3, 2.7	
Displays - Driver Notification – Charging System/Generator Fault	Powertrain	EA	20	8E	Required if EA 20 E2 not used	2.3, 2.16	
Displays - Driver Notification - Service Vehicle Soon	Powertrain	EA	20	8F	Optional	2.3	
Displays - Driver Notification - Traction control system Off	Platform	EA	20	9B	Optional with TCS	2.4, 2.11	
Displays - Driver Notification - Engine Coolant Hot	Powertrain	EA	20	9D	Required	2.3, 2.8	
Displays - Driver Notification - Change Transmission Oil Now	Powertrain	EA	20	AA	Optional	2.3	
Displays - Driver Notification - A/C Off for Engine Protection	Powertrain	EA	20	B4	Optional	2.3, 2.8	
Displays - Driver Notification - Reduced Engine Power	Powertrain	EA	20	B7	Required with ETC	2.3, 2.7	

C2 Message Name	Trans-mitter	Pri ID	Sec ID	Ext ID	Notes	PPEI Section	EIS Reference
Displays - Driver Notification - Top Speed Fuel Cut Off	Powertrain	EA	20	C3	Optional	2.3	
Displays - Driver Notification - Transmission Hot	Powertrain	EA	20	CB	Optional	2.3	
Displays - Driver Notification - Check Gas Cap	Powertrain	EA	20	CC	Optional	2.3 2.12	
Displays - Driver Notification - Reduce Top Speed	Powertrain	EA	20	D5	Optional with suspension control	2.3, 2.14	
Displays - Driver Notification - Service Transmission	Powertrain	EA	20	D6	Optional	2.3	
Displays - Driver Notification - Water-in Fuel	Powertrain	EA	20	D9	Required for Diesel	2.3	
Displays - Driver Notification - Generator Indicator	Powertrain	EA	20	E2	Required if EA 20 8E not used	2.3, 2.16	
Displays - Driver Notification - Four Wheel Drive	Powertrain	EA	20	E4	Required for Truck four wheel drive with manual transfer case	2.2, 2.3	
Displays - Driver Notification - Starting Disabled ETC	Powertrain	EA	20	E7	Optional	2.3, 2.5	
Displays - Driver Notification - Tap Up/Tap Down Mode	Powertrain	EA	20	F7	Required for Tap Up/Tap Down	2.3, 2.15	
Displays – Driver Notification - All Wheel Drive Disabled	Powertrain	EA	20	FE	Optional for Non-Truck All Wheel Drive	2.2, 2.3	
Displays-Driver Notification-Tap Up/ Tap Down Request Denied	Powertrain	EA	22	A4	Optional for Tap Up/Tap Down	2.3, 2.15	
Engine System Other - Estimated Outside Air Temperature	Powertrain	F2	08	N/A	Required with RVC	2.16	
Exterior Environment - Outside Air Temperature	Platform	F2	10	N/A	Optional	2.4	
Exterior Environment - Barometric Pressure (Absolute)	Powertrain	F2	11	N/A	Optional	2.10	
Vehicle ID (VIN) - VIN Packet 3 (digits 6 - 9)	Platform	FA	03	N/A	Optional	2.10	
Vehicle ID (VIN) - VIN Packet 4 (digits 10 - 13)	Platform	FA	04	N/A	Optional	2.10	
Vehicle ID (VIN) - VIN Packet 5 (digits 14 - 17)	Platform	FA	05	N/A	Optional	2.10	
Network Control - Node Alive	Platform Powertrain	FE	03	N/A	Required	2.10	
Network Control - System Power Modes	Platform	FE	06	N/A	Required	2.1, 2.5	GMNA Power Moding Specification

5.1.8 Class 2 Message Definition

5.1.8.1 Engine Torque-Wheel Slip Prvnt Required Torque ($08/$11)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PT	PF	RPT	0.0	Run-2	750.0			0.0	A9 08 10 11
RPT	PF	PT		>100.0	Run-1	0.0	REQ	1 %, Data = 0% or 100%	0.0	88 09 SS 11

Change Trigger Definition:

The PF shall transmit the RPT when the Wheel Slip Prevention Required Torq parameter changes by 1 % and the data = 0 % or 100 % and no more than once every 100.0 ms.

Enabled Modes for Message Trigger:

(PF) REQ: Run

Enabled Modes for Change Trigger:

(PF) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PF	PT	N/A	RPT	No	N/A		X9 08 XX 11
RPT	PT	PF	100 %		Yes	100 %		X8 09 XX 11

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) REQ: Run
(PT) RPT: Run

Powertrain Interface Definition:

Wheel Slip Prevent Required Torque is monitored by Powertrain. Powertrain attempts to control the engine torque at or below the torque requested in the message in order to prevent wheel slip on Enhanced Traction Systems. Torque reduction is typically accomplished through a combination of retarding spark, upshifting the transmission, and disabling fuel to specific cylinders.

ETS Interface Definition:

Wheel Slip Prevent Required Torque is owned by the ETS. It is percent engine torque that Powertrain must control to in order to prevent wheel slip on Enhanced Traction Systems. The percent engine torque typically equates to the percent of driver intended torque.

General Requirements

Data Definition (Reports and Loads only)

Wheel Slip Prevention Required Torq - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	%	To Engineering Units	N/2.55
Resolution	100/255	To Computer Units	E*2.55
Absolute Range	0-100		

Valid Message Sequences:

REQ → RPT
RPT

5.1.8.2 Engine Torque-Driver Intended Torque ($08/$20)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT(F)	0.0	Run-2	750.0			0.0	A9 08 SS 20
RPT	PT	PF		>100.0	Run-1	0.0	REQ	1 %, Data = 0% or 100%	0.0	88 09 10 20
RPT(F)	PT	PF						Failure Condition		88 09 10 60

RPTF Transmit Value:
Data in RPTF is ignored

Change Trigger Definition:
The PT shall transmit the RPT when the Driver Intended Torque parameter changes by 1 % and the data = 0 % or 100 % and no more than once every 100.0 ms.

Enabled Modes for Message Trigger:
(PT) REQ: Run

Enabled Modes for Change Trigger:
(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	N/A	RPT(F)	No	N/A		X9 08 XX 20
RPT	PF	PT	(Platform Specific)		No	N/A	Platform Specific	X8 09 XX 20
RPT(F)	PF	PT					Platform Specific	X8 09 XX 60

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) REQ: Run
(PF) RPT: Run
(PF) RPT(F): Run

Powertrain Interface Definition:

Driver Intended Torque is owned by Powertrain. It represents what the engine torque would be during traction control if powertrain was not reducing torque for traction control. When traction control is not active, the value of Driver Intended Torque should be the same value as the PWM signal represents on TCS applications. As the name implies, it is the non-reduced torque that the driver intended.

ETS Interface Definition:

Driver Intended Torque is monitored by the ETS. ETS uses this variable to scale command torque to Powertrain for torque management.

General Requirements

Data Definition (Reports and Loads only)

Driver Intended Torque - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	%	To Engineering Units	N/2.55
Resolution	100/255	To Computer Units	E*2.55
Absolute Range	0-100		

Valid Message Sequences:
REQ → RPT(F)
RPT(F)

5.1.8.3 Engine Torque-Requested Torque ($08/$21)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PT	PF	RPT	0.0	Run-2	750.0			0.0	A9 08 10 21
RPT	PF	PT		>100.0	Run-1	0.0	REQ	10 nm	0.0	88 09 SS 21

Change Trigger Definition:
The PF shall transmit the RPT when the Torque parameter changes by 10 nm and no more than once every 100.0 ms.

Enabled Modes for Message Trigger:
(PF) REQ: Run

Enabled Modes for Change Trigger:
(PF) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PF	PT	N/A	RPT	No	N/A		X9 08 XX 21
RPT	PT	PF	(Calibratable torque value)		Yes	(Calibratable torque value)		X8 09 XX 21

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) REQ: Run
(PT) RPT: Run

Powertrain Interface Definition:

Engine Torque - Requested Torque is monitored by Powertrain. Powertrain attempts to control the engine torque to the requested torque value in the report message in order to prevent wheel slip on Enhanced Traction Systems. Torque management is typically accomplished through some combination of retarding spark, throttle control, transmission shifting, and fuel shutoff to specific cylinders.

Platform Interface Definition:

Engine Torque - Requested Torque is owned by Platform. Requested Torque is the engine torque value which the platform requires the powertrain to manage to in order to prevent wheel slip on Enhanced Traction Systems. The data within the message is essentially equivalent to the data communicated on the Requested Torque PWM line in the Full Function Traction System.

General Requirements

Data Definition (Reports and Loads only)

Torque - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	nm	To Engineering Units	(N*2.5)-100
Resolution	2.5	To Computer Units	(E+100)/2.5
Absolute Range	-100-+537.5		

Valid Message Sequences:
REQ → RPT
RPT

5.1.8.4 _Engine Torque-Delivered Torque ($08/$22)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT	0.0	Run-2	750.0			0.0	A9 08 SS 22
RPT	PT	PF		>100.0	Run-1	0.0	REQ	10 nm	0.0	88 09 10 22

Change Trigger Definition:
The PT shall transmit the RPT when the Torque parameter changes by 10 nm and no more than once every 100.0 ms.

Enabled Modes for Message Trigger:
(PT) REQ: Run

Enabled Modes for Change Trigger:
(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	N/A	RPT	No	N/A		X9 08 XX 22
RPT	PF	PT	(Platform specific)		No	N/A	Platform specific	X8 09 XX 22

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) REQ: Run
(PF) RPT: Run

Powertrain Interface Definition:
Engine Torque - Delivered Torque is owned by Powertrain. Delivered Torque is the powertrain estimated engine torque produced by the powertrain. The data within the message is essentially equivalent to the data communicated on the Delivered Torque PWM line in the Full Function Traction System.

Platform Interface Definition:
Engine Torque - Delivered Torque is monitored by Platform. Platform uses the delivered torque from powertrain as feedback to indicate that the torque is being managed to the requested value.

General Requirements

Data Definition (Reports and Loads only)

Torque - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	nm	To Engineering Units	(N*2.5)-100
Resolution	2.5	To Computer Units	(E+100)/2.5
Absolute Range	-100-+537.5		

Valid Message Sequences:
REQ → RPT
RPT

5.1.8.5 Engine Air Intake-Intake Boost Pressure - Gage ($0A/$10)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT(F)	0.0	Run-2	750.0			0.0	A9 0A SS 10
RPT	PT	PF		0.0	Run-1	0.0	REQ	2 kPaG	0.0	88 0B 10 10
RPT(F)	PT	PF						Failure Condition		88 0B 10 50

RPTF Transmit Value:
Data in RPTF is ignored

Change Trigger Definition:
The PT shall transmit the RPT when the Intake Boost Pressure - Gage parameter changes by 2 kPaG.

Enabled Modes for Message Trigger:
(PT) REQ: Run

Enabled Modes for Change Trigger:
(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	N/A	RPT(F)	No	N/A		X9 0A XX 10
RPT	PF	PT	(Platform specific)		No	N/A	Platform specific	X8 0B XX 10
RPT(F)	PF	PT					Platform specific	X8 0B XX 50

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) REQ: Run
(PF) RPT: Run
(PF) RPT(F): Run

Powertrain Interface Definition:
Engine Air Intake - Intake Boost Pressure - Gage is owned by Powertrain. It represents the boost pressure on turbocharged engine applications.

Application Loop Time: 100 ms

Platform Interface Definition:
Engine Air Intake - Intake Boost Pressure - Gage is monitored by Platform. It is used for display purposes.

General Requirements

Data Definition (Reports and Loads only)

Intake Boost Pressure - Gage - Signed Numeric (Two's Complement) (8 bits)			
Encoding		Transfer Functions	
Units	kPaG	To Engineering Units	N
Resolution	1	To Computer Units	E
Absolute Range	-128-127		

Valid Message Sequences:
REQ → RPT(F)
RPT(F)

5.1.8.6 Engine Air Intake-Intake Air Temperature ($0A/$20)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT(F)	0.0	Run-2 Accessory-2	750.0			0.0	C9 0A SS 20
RPT	PT	PF		>1000.0	Run-1 Accessory-1	0.0	REQ	1 ° C	0.0	A8 0B 10 20
RPT(F)	PT	PF						Failure Condition		A8 0B 10 60

RPTF Transmit Value:
Data in RPTF is ignored

Change Trigger Definition:
The PT shall transmit the RPT when the Intake Air Temperature parameter changes by 1° C and no more than once every 1000.0 ms.

Enabled Modes for Message Trigger:
(PT) REQ: Accessory, Run

Enabled Modes for Change Trigger:
(PT) RPT: Accessory, Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	N/A	RPT(F)	No	N/A		X9 0A XX 20
RPT	PF	PT	(Platform specific)		No	N/A	Platform specific	X8 0B XX 20
RPT(F)	PF	PT					Platform specific	X8 0B XX 60

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) REQ: Accessory, Run
(PF) RPT: Accessory, Run
(PF) RPT(F): Accessory, Run

Powertrain Interface Definition:

Intake Air Temperature is owned by Powertrain. It represents the air temperature in the fresh air inlet, either between the air cleaner and throttle body, or in the intake manifold. The placement of the temperature sensor, referred to as the MAT (Manifold Air Temperature) sensor is application dependent and could result in significant variation in temperature readings between applications. The temperature reading could be extremely high after extended idles and hot soaks.

Platform Interface Definition:

Intake Air Temperature is monitored by the Platform. TCS Brake Thermal Model uses the intake air temperature as an estimate for ambient temperature. Platform may also use this for afterblow (running the HVAC blower motor), in the Low Coolant Algorithm and battery state of charge estimate..

General Requirements

Data Definition (Reports and Loads only)

Intake Air Temperature - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	øC	To Engineering Units	N-40
Resolution	1	To Computer Units	E+40
Absolute Range	-40-+215		

Valid Message Sequences:
REQ → RPT(F)
RPT(F)

5.1.8.7 Throttle Position Sensor-Pedal Position ($12/$11)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT(F)	0.0	Run-2	0.0			0.0	A9 12 SS 11
RPT	PT	PF		>100.0	Run-1	0.0	REQ	5 %, Data = 0% or 100%	0.0	68 13 10 11
RPT(F)	PT	PF						Failure Condition		68 13 10 51

RPTF Transmit Value:
Data in RPTF is ignored

Change Trigger Definition:
The PT shall transmit the RPT when the Pedal Position parameter changes by 5 % (Min Rep for ETS=100ms, TCS and SDM=300) and the data = 0 % or 100 % and no more than once every 100.0 ms.

Enabled Modes for Message Trigger:
(PT) REQ: Run

Enabled Modes for Change Trigger:
(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	N/A	RPT(F)	No	N/A		X9 12 XX 11
RPT	PF	PT	(Platform specific)		No	N/A	Platform specific	X8 13 XX 11
RPT(F)	PF	PT					Platform specific	X8 13 XX 51

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) REQ: Run
(PF) RPT: Run
(PF) RPT(F): Run

Powertrain Interface Definition:
Pedal position is owned by Powertrain. It represents the accelerator pedal position on vehicles equipped with Electronic Throttle Control (ETC). It represents the throttle position which is an indirect indication of pedal position for applications without ETC. On certain truck applications with Active Transfer Case (ATC) there are additional change triggers which are defined through message $3A $22 (Transmission/Transaxle/PRNDL - Transfer Case TPS Thresholds). The additional change triggers function as follows:

1. Queue the message if pedal position is greater than or equal to (TPS Lower Hysteresis-High Limit) and the last time the message was queued with a pedal position less than (TPS Lower Hysteresis-High Limit).
2. Queue the message if pedal position is greater than or equal to (TPS Upper Hysteresis-High Limit) and the last time the message was queued with a pedal position less than (TPS Upper Hysteresis-High Limit).
3. Queue the message if pedal position is less than or equal to (TPS Lower Hysteresis-Low Limit) and the last time the message was queued with a pedal position greater than (TPS Lower Hysteresis-Low Limit).

Note: Only 3 of the 4 thresholds of Class 2 message $3A $22 are used. Change triggers 1 and 2 above shall be evaluated in the 12.5 ms. loop with a Min Rep Interval of 0 msec. only when the vehicle speed is less than 20 MPH, while change trigger 3 shall be evaluated in the 100 ms. loop with a Min Rep Interval of 300 ms. at all vehicle speeds.

Platform Interface Definition:
Pedal position is monitored by the Platform. The Brake Apply sensing system uses it in its algorithm for determining brake lamp operation in the event of a brake apply sensor failure. It is also used by the SDM for crash recording and by the ETS and TCS as follows.

ETS Interface Definition:
Pedal Position is monitored by the ETS. ETS uses this variable for exit logic, upshift logic, control logic (variable gains) and possibly altitude compensation.

TCS Interface Definition:

Pedal Position is monitored by the TCS. TCS uses this variable to determine if the driver's foot is off the pedal for torque management, for TCS entrance and exit decisions, and as a baseline for subsequent torque reduction decisions.

General Requirements

Data Definition (Reports and Loads only)

Pedal Position - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	%	To Engineering Units	N/2.55
Resolution	100/255	To Computer Units	E*2.55
Absolute Range	0-100		

Valid Message Sequences:

REQ → RPT(F)
RPT(F)

5.1.8.8 A/C Clutch-Enable ($14/$01)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RACK	PF	PT		0.0		0.0	RPT		0.0	A9 14 SS 41
REQ	PF	PT	RPT	0.0	Off Awake-2 Accessory-2 Run-2 RAP-2	750.0			0.0	C9 14 SS 01
RPT Disable Enable	PT	PF	RACK	0.0	Off Awake-1 Accessory-1 Run-1 RAP-1	0.0	REQ	Any	0.0	 88 15 10 01 88 15 10 81

Change Trigger Definition:
The PT shall transmit the RPT when the Q Bit changes state.

Enabled Modes for Message Trigger:
(PF) RPT: Off Awake, Accessory, Run, RAP
(PT) REQ: Off Awake, Accessory, Run, RAP

Enabled Modes for Change Trigger:
(PT) RPT: Off Awake, Accessory, Run, RAP

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RACK	PT	PF	N/A		No	N/A	halt retry of RPT	X9 14 XX 41
REQ	PT	PF	N/A	RPT	No	N/A		X9 14 XX 01
RPT Disable Enable	PF	PT	Disable	RACK	Yes	Disable	Transmit 14-10 message to disengage clutch on SOH failure.	 X8 15 XX 01 X8 15 XX 81

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) RACK: Off Awake, Accessory, Run, RAP
(PT) REQ: Off Awake, Accessory, Run, RAP
(PF) RPT: Off Awake, Accessory, Run, RAP

Powertrain Interface Definition:

A/C Clutch - Enable is owned by Powertrain. Powertrain reports to platform the final commanded state of the A/C Clutch output driver. The A/C Clutch will not be engaged by powertrain unless platform indicates that engage is allowed except during A/C Slugging prevention which can enable the A/C Clutch during crank. The A/C Clutch may be disengaged by powertrain to protect the A/C Compressor at high engine speed.

Application Loop Time: 100 ms

Platform Interface Definition:

A/C Clutch - Enable is monitored by Platform. Platform uses A/C Clutch - Enable as feedback to indicate differences between the desired and actual state of the A/C Clutch. Knowing the actual state of the A/C Clutch will avoid any potential out of synchronization conditions (e.g., Platform thinks the A/C Clutch is disengaged when it is actually engaged). This message may also be used for HVAC control in RVS vehicles.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	Disable	Yes
1	Enable	Yes

Valid Message Sequences:

REQ → RPT → RACK
RPT → RACK

5.1.8.9 A/C Clutch-Clutch Permission ($14/$10)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RACK	PT	PF		0.0		0.0	RPT		0.0	A9 14 10 50
REQ	PT	PF	RPT	0.0	Off Awake-2 Accessory-2 Run-2 RAP-2	750.0			0.0	C9 14 10 10
RPT	PF	PT	RACK	>100.0	Off Awake-1 Accessory-1 Run-1 RAP-1	0.0	REQ	Any	0.0	88 15 SS 10

Change Trigger Definition:

The PF shall transmit the RPT when the Clutch Permission parameter changes state and no more than once every 100.0 ms.

Enabled Modes for Message Trigger:

(PT) RPT: Off Awake, Accessory, Run, RAP
(PF) REQ: Off Awake, Accessory, Run, RAP

Enabled Modes for Change Trigger:

(PF) RPT: Off Awake, Accessory, Run, RAP

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RACK	PF	PT	N/A		No	N/A	halt retry of RPT	X9 14 XX 50
REQ	PF	PT	N/A	RPT	No	N/A		X9 14 XX 10
RPT	PT	PF	$01	RACK	Yes	$01 (Disengage A/C Clutch)		X8 15 XX 10

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) RACK: Off Awake, Accessory, Run, RAP
(PF) REQ: Off Awake, Accessory, Run, RAP
(PT) RPT: Off Awake, Accessory, Run, RAP

Powertrain Interface Definition:

A/C Clutch - Clutch Permission is monitored by Powertrain. Powertrain uses the reported permission from the Platform along with its own A/C Clutch control logic to ultimately determine the final commanded state of the A/C Clutch output driver.

Platform Interface Definition:

A/C Clutch - Clutch Permission is owned by Platform. Platform reports to Powertrain a permission to engage the A/C Clutch by using the following state encoded data byte values:

00 - Engage Allowed

This state indicates that platform has determined that A/C Clutch operation is allowed. This permission is determined from:

1. Occupant request
2. Climate control (when present)
3. Powertrain cooling
4. Platform executed compressor protections

01 - Disengage When Appropriate

This state indicates that platform has determined the compressor should be disengaged due to:

1. Occupant request
2. Climate control (when present)
3. Powertrain cooling

Powertrain may delay compressor disengage during transmission shifts for no longer than 2.5 seconds.

02 - Disengage Immediately

This state indicates the A/C Clutch must be disengaged due to compressor protections. Powertrain may not delay this disengage for more than 300 ms after receipt of this message.

Platform will send this message to request that Powertrain disengage the A/C Clutch if a State of Health failure is detected with the transmitter of the (14-01) A/C Clutch status message (PCM). This message may also be used for HVAC control in RVS vehicles.

General Requirements

Data Definition (Reports and Loads only)

Clutch Permission - State Encoded (8 bits)		
State	Support	State Description
00	Yes	Engage Allowed
01	Yes	Disengage When Appropriate
02	Yes	Disengage Immediately

Valid Message Sequences:

REQ → RPT → RACK
RPT → RACK

5.1.8.10 Engine RPM-High Resolution ($1A/$10)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT	0.0	Run-2	750.0			0.0	A9 1A SS 10
RPT	PT	PF		>300.0	Run-1	0.0	REQ	32 rpm	0.0	88 1B 10 10

Change Trigger Definition:

The PT shall transmit the RPT when the Engine RPM High Resolution parameter changes by 32 rpm (16 rpm delta ->100 ms Min Rep, 32 rpm delta ->300 ms Min Rep) and no more than once every 300.0 ms.

Enabled Modes for Message Trigger:

(PT) REQ: Run

Enabled Modes for Change Trigger:

(PT) RPT: Run

NOTE: A 16 rpm delta change and 100 ms Repetition Interval are used when Platform uses this message for tachometer display.

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	N/A	RPT	No	N/A		X9 1A XX 10
RPT	PF	PT	(Platform specific)		No	N/A	Platform specific	X8 1B XX 10

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PT) REQ: Run
(PF) RPT: Run

Powertrain Interface Definition:

Engine RPM - High Resolution is owned by Powertrain. It represents the high resolution engine speed in revolutions per minute determined from cylinder event pulse inputs.

Platform Interface Definition:

Engine RPM-High Resolution is monitored by Platform. The Platform electronics uses it for tachometer display and for miscellaneous body functions.

ETS Interface Definition:

Engine RPM - High Resolution is monitored by the ETS. ETS uses Engine RPM as an override for upshift command in torque management. ETS also requires Engine RPM on manual transmission applications.

TCS Interface Definition:

Engine RPM - High Resolution is monitored by the TCS. TCS use Engine RPM to detect that the engine is being started and that the TCS diagnostic initialization can be performed. Diagnostics are performed during crank on some systems such that the noise from exercising the hydraulic modulator can be masked by the engine noise for customer satisfaction. TCS also requires Engine RPM on manual transmission applications.

General Requirements

Data Definition (Reports and Loads only)

Engine RPM High Resolution - Unsigned Numeric (16 bits)			
Encoding		Transfer Functions	
Units	rpm	To Engineering Units	N/4
Resolution	1/4	To Computer Units	E*4
Absolute Range	0-16383.75		

Valid Message Sequences:

REQ → RPT
RPT

5.1.8.11 Wheels-Wheel Reference Vehicle Spd Metric ($24/$03)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PT	PF	RPT(F)	0.0	Run-2	750.0			0.0	A9 24 10 03
RPT	PF	PT		>100.0	Run-1	0.0	REQ	2 kph	0.0	88 25 SS 03
RPT(F)	PF	PT						Failure Condition		88 25 SS 43

RPTF Transmit Value:
Data in RPTF is ignored

Change Trigger Definition:
The PF shall transmit the RPT when the Wheel Reference Vehicle Spd Metric parameter changes by 2 kph and no more than once every 100.0 ms.

Enabled Modes for Message Trigger:
(PF) REQ: Run

Enabled Modes for Change Trigger:
(PF) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PF	PT	N/A	RPT(F)	No	N/A		X9 24 XX 03
RPT	PT	PF	(Indicate param invalid)		Yes	(Indicate param invalid)		X8 25 XX 03
RPT(F)	PT	PF					Indicate param invalid	X8 25 XX 43

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) REQ: Run
(PT) RPT: Run
(PT) RPT(F): Run

Powertrain Interface Definition:
Wheel Reference Vehicle Speed Metric is monitored by Powertrain. It is used for the following functions:

- Used as the actual vehicle speed in place of the Powertrain calculated vehicle speed for certain functions (ETC, etc.) when the driven wheels may be spinning on ice, snow, gravel, etc. or if the Powertrain vehicle speed sensor is failed.
- Powertrain may use Wheel Reference Vehicle Speed in the Powertrain brake switch diagnostics to detect a deceleration condition that would ensure that the brake has been depressed.
- Transmission shifting during traction control.
- Used as an indication of when to perform engine drag control line/signal diagnostics (typically below 3 kph).

Platform Interface Definition:
Wheel Reference Vehicle Speed is owned by the ABS. It is the estimated vehicle reference speed based upon information received from wheel speed sensors located at each wheel. The estimation uses filtered wheel speeds that may be normalized to accommodate spare tire(s). Note that this value is not exact and is not scaled for specific tire size.

General Requirements

Data Definition (Reports and Loads only)

Wheel Reference Vehicle Spd Metric - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	kph	To Engineering Units	N
Resolution	1	To Computer Units	E
Absolute Range	0-255		

Valid Message Sequences:
REQ → RPT(F)
RPT(F)

5.1.8.12 Wheels-Maximum Driven Wheel Speed-All ($24/$05/$00)

This message is optional (for vehicles with chassis that are susceptible to road noise)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PT	PF	RPT(F)	0.0	Run-2	750.0			0.0	AB 24 10 05 00
RPT	PF	PT		>100.0	Run-1	0.0	REQ	2 kph	0.0	8A 25 SS 05 00
RPT(F)	PF	PT						Failure Condition		8A 25 SS 45 00

RPTF Transmit Value:
Data in RPTF is ignored

Change Trigger Definition:
The PF shall transmit the RPT when the Maximum Driven Wheel Speed parameter changes by 2 kph and no more than once every 100.0 ms.

Enabled Modes for Message Trigger:
(PF) REQ: Run

Enabled Modes for Change Trigger:
(PF) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PF	PT	N/A	RPT(F)	No	N/A		XB 24 XX 05 00
RPT	PT	PF	(Calibratable value)		Yes	(Calibratable value)		XA 25 XX 05 00
RPT(F)	PT	PF					Calibratable value	XA 25 XX 45 00

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) REQ: Run
(PT) RPT: Run
(PT) RPT(F): Run

Powertrain Interface Definition:
Wheels - Maximum Driven Wheel Velocity Metric is monitored by Powertrain. Powertrain uses Wheels - Maximum Driven Wheel Velocity Metric to enhance the rough road information for the misfire diagnostic. This information if needed on vehicles with chassis that are susceptible to road noise (drive line torsionals from road input), usually stiff chassis vehicles.

Platform Interface Definition: Wheels - Maximum Driven Wheel Velocity Metric is owned by Platform. It is determined by comparing the individual driven wheel velocities and selecting the larger of the two. The wheel speeds are filtered values that may be normalized to accommodate spare tire(s). Application Loop Time: 100 ms

General Requirements

Data Definition (Reports and Loads only)

Maximum Driven Wheel Speed - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	kph	To Engineering Units	N
Resolution	1	To Computer Units	E
Absolute Range	0-255		

Valid Message Sequences:
REQ → RPT(F)
RPT(F)

5.1.8.13 Wheels-Avg Peak to Peak Accel (Rough Rd) ($24/$07)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RPT Inactive Brk Trck Active	PF	PT		>500.0	Run-1	0.0		Periodic, Q=Any,	0.0	 88 25 SS 07 88 25 SS 87
RPT(F) Inactive Brk Trck Active	PF	PT						Failure Condition		 88 25 SS 47 88 25 SS C7

RPTF Transmit Value:
Data in RPTF is ignored

Change Trigger Definition:
The PF shall transmit the RPT every >500.0 ms.

Enabled Modes for Message Trigger:
None

Enabled Modes for Change Trigger:
None

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RPT Inactive Brk Trck Active	PT	PF	Inactive+0 g's		Yes	(Accel value ignored)		 X8 25 XX 07 X8 25 XX 87
RPT(F) Inactive Brk Trck Active	PT	PF					Accel value ignored	 X8 25 XX 47 X8 25 XX C7

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) RPT: Run
(PT) RPT(F): Run

Powertrain Interface Definition:

Average Peak To Peak Acceleration is monitored by Powertrain, although it is not used in the brake system. It is defined here only because it is generated by the brake module. It is used to disable the OBD-II Misfire diagnostic on rough roads when the Average Peak To Peak Acceleration is above a Powertrain calibratable level. The Misfire diagnostic uses engine speed variations to detect engine misfire. Rough roads can cause driveline torsionals which affect the engine speed variation, causing rough roads to look like engine misfire to the Misfire diagnostic. Powertrain also needs to know if brakes are active (ABS, Brake Traction, or Dynamic Proportioning) which will be communicated by the Q bit being set in the message. Powertrain disables the Misfire diagnostic during these events since they could be interpreted as misfire. The indication that brakes are active may also be used to disable Powertrain brake diagnostics since vehicle speed used in the diagnostic may be erratic at this time. Powertrain also needs to know if a failure occurs such that the ABS is unable to determine Average Peak To Peak Acceleration which is communicated by the C bit being set in the message. Powertrain continues to run the Misfire diagnostic in this case, however if a misfire is detected, an additional diagnostic code is logged to inform the service technician that the misfire may be the result of a failure with the ABS.

Platform Interface Definition:

Average Peak to Peak Acceleration is owned by the ABS per the "GM Powertrain Rough Road Detection Algorithm Specification", Document Number TL.17.0015. This document is owned and maintained by the GM Powertrain PPEI Algorithm Technical Resource Center.

Failure Report Definition:

Failure report occurs when Average Peak to Peak Acceleration can no longer be accurately calculated due to a failure. The failure report message will be identified with the C-bit set to 1. If a failure report is received, the misfire diagnostic is informed and Average Peak to Peak Acceleration value is ignored. The Q-bit, indicating brakes are active (ABS, Brake Traction, or Dynamic Proportioning), is never set simultaneously with the C-bit indicating a failure.

Note: There are some applications until 1998 model year that are still using data values of 254 and 255 instead of the Q and C bits in the message due to carryover hardware and/or software. These applications have to be coordinated between Powertrain and the ABS groups until all have transitioned over to using the Q and C bits.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	Inactive	Yes
1	Brk Trck Active	Yes

Wheels Avg Pk-Pk Accel (Rough Road) - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	g's	To Engineering Units	N/255
Resolution	1/255	To Computer Units	E*255
Absolute Range	0-1		

Valid Message Sequences:

RPT(F)

5.1.8.14 Wheels-Individual Wheel Speeds ($24/$09)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PT	PF	RPT	0.0	Run-2	0.0			0.0	A9 24 10 09
RPT	PF	PT		>100.0	Run-1	0.0	REQ	Individual Wheel Speeds=Any, LF Wheel Speed Low Res Metric=2 kph, RF Wheel Speed Low Res Metric=2 kph, LR Wheel Speed Low Res Metric=2 kph, RR Wheel Speed Low Res Metric=2 kph	0.0	88 25 SS 09
RPT(F)	PF	PT						Failure Condition		88 25 SS 49

RPTF Transmit Value:
Data in RPTF is ignored

Change Trigger Definition:
The PF shall transmit the RPT when the Individual Wheel Speeds parameter changes state, when the LF Wheel Speed Low Res Metric parameter changes by 2 kph, when the RF Wheel Speed Low Res Metric parameter changes by 2 kph, when the LR Wheel Speed Low Res Metric parameter changes by 2 kph, when the RR Wheel Speed Low Res Metric parameter changes by 2 kph and no more than once every 100.0 ms.

Enabled Modes for Message Trigger:
(PF) REQ: Run

Enabled Modes for Change Trigger:
(PF) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PF	PT	N/A	RPT(F)	No	N/A		X9 24 XX 09
RPT	PT	PF			Yes	(Powertrain Specific)		X8 25 XX 09

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) REQ: Run
(PT) RPT: Run

Powertrain Interface Definition:

Wheels - Individual Wheel Speeds is monitored by Powertrain. It is used as one of the enabling criteria for differential score protection. Wheel speed difference of the driven wheels normalized by the wheel speed difference of the non-driven wheels must exceed a threshold before differential score protection is enabled. This message is also required by Powertrain for use in calculation of downhill grade braking on both two-wheel drive and all wheel drive transmissions.

Platform Interface Definition:

Wheels - Individual Wheel Speeds is owned by Platform. It is comprised of the calculated wheel speeds of the right and left front wheels and the calculated wheel speeds of the right and left rear wheels.

Application Loop Time: 25 ms.

The Wheel Speed values communicated in this message should be the Compensated Wheel Speed values. The Compensated Wheel Speeds are Wheel Speed values that have been corrected for unequal tire diameters (ex. a mini-spare tire is mounted, significant differences in tire inflation pressures, etc.).

Change Triggering should occur whenever a change of ± 2 kph (or greater) occurs for any of the four wheel speeds. Whenever this Change Trigger is encountered for one of the wheel speeds, the most recent values for all four wheel speeds shall be used when loading the message into the queue.

General Requirements

Data Definition (Reports and Loads only)

Packet Byte 1

LF Wheel Speed Low Res Metric - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	kph	To Engineering Units	N
Resolution	1	To Computer Units	E
Absolute Range	0-255		

Packet Byte 2

RF Wheel Speed Low Res Metric - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	kph	To Engineering Units	N
Resolution	1	To Computer Units	E
Absolute Range	0-255		

Packet Byte 3

LR Wheel Speed Low Res Metric - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	kph	To Engineering Units	N
Resolution	1	To Computer Units	E
Absolute Range	0-255		

Packet Byte 4

RR Wheel Speed Low Res Metric - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	kph	To Engineering Units	N
Resolution	1	To Computer Units	E
Absolute Range	0-255		

Valid Message Sequences:

REQ → RPT(F)
RPT(F)

5.1.8.15 Vehicle Speed-High Resolution-Metric ($28/$02)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT(F)	0.0	Run-2	750.0			0.0	A9 28 SS 02
RPT	PT	PF		>100.0	Run-1	0.0	REQ	0.2 kph	0.0	88 29 10 02
RPT(F)	PT	PF						Failure Condition		88 29 10 42

RPTF Transmit Value:

Data in RPTF is ignored

Change Trigger Definition:

The PT shall transmit the RPT when the Vehicle Speed High Resolution Metr parameter changes by 0.2 kph (.2 kph delta -> 100 ms Min Rep, .5 kph delta -> 500 ms Min Rep) and no more than once every 100.0 ms.

Enabled Modes for Message Trigger:

(PT) REQ: Run

Enabled Modes for Change Trigger:

(PT) RPT: Run

Note:The values of send on change delta and Repetition Interval are calibratable.

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	N/A	RPT(F)	No	N/A		X9 28 XX 02
RPT	PF	PT	(Platform specific)		No	N/A	Platform specific	X8 29 XX 02
RPT(F)	PF	PT					Platform specific	X8 29 XX 42

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PT) REQ: Run
(PF) RPT: Run
(PF) RPT(F): Run

Powertrain Interface Definition:

For the high resolution vehicle speed function, Powertrain uses the Vehicle Speed Sensor output to calculate high resolution vehicle speed in units of Kilometers per hour with a resolution of 1/128 KPH.

Platform Interface Definition:

High resolution vehicle speed is received by the Platform electronics for miscellaneous body functions. It is also received by some devices using the VSS signal in the event of a pulse train signal failure. The brake apply sensing system uses this in its algorithm for determining brake lamp operation in the event of a brake apply sensor failure.

General Requirements

Data Definition (Reports and Loads only)

Vehicle Speed High Resolution Metr - Unsigned Numeric (16 bits)			
Encoding		Transfer Functions	
Units	kph	To Engineering Units	N/128
Resolution	1/128	To Computer Units	E*128
Absolute Range	0-511.99		

Valid Message Sequences:

REQ → RPT(F)
RPT(F)

5.1.8.16 Traction Control-Platform Inhibit of TCS ($2A/$07)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RACK	PT	PF		0.0		0.0	RPT		0.0	A9 2A 10 47
REQ	PT	PF	RPT	0.0	Run-2	750.0			0.0	C9 2A 10 07
RPT No/False Yes/True	PF	PT	RACK	>100.0	Run-1	0.0	REQ	Any	0.0	 88 2B SS 07 88 2B SS 87

Change Trigger Definition:
The PF shall transmit the RPT when the Q Bit changes state and no more than once every 100.0 ms.

Enabled Modes for Message Trigger:
(PT) RPT: Run
(PF) REQ: Run

Enabled Modes for Change Trigger:
(PF) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RACK	PF	PT	N/A		No	N/A	halt retry of RPT	X9 2A XX 47
REQ	PF	PT	N/A	RPT	No	N/A		X9 2A XX 07
RPT No/False Yes/True	PT	PF	(Indicate parm invalid)	RACK	Yes	(Indicate parm invalid)		 X8 2B XX 07 X8 2B XX 87

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) RACK: Run
(PF) REQ: Run
(PT) RPT: Run

Powertrain Interface Definition:
Platform Inhibit of TCS is monitored by Powertrain. It is used to disable the diagnostics of the Requested Torque PWM signal and may be used to trigger an alternate method for reducing torque in the event that Powertrain determines the wheels are slipping. The alternate method used for reducing torque by Powertrain can be one or all of the following methods depending on the application:

1. Differential score function that typically disables fuel to half of the cylinders and retards spark.
2. Force 2nd gear starts.

ETS Interface Definition:
Platform Inhibit of TCS is owned by the ETS.

Q=1 when traction control is disabled because:
a) The traction disable switch has been pressed, disabling traction control
b) A fault is detected by the ETS.

Q=0 when traction control is available because:
a) Normal run
b) The traction disable switch has been pressed, reactivating traction control
c) A fault is not detected by the ETS.

TCS Interface Definition:
Platform Inhibit of TCS is owned by the TCS.

Q=1 when traction control is disabled because:
a) Brake thermal model over-temperature
b) The traction disable switch has been pressed, disabling traction control
c) A fault is detected by the TCS.

Q=0 when traction control is available because
a) Normal run:
b) Brake thermal model temperatures are once again within normal range
c) The traction disable switch has been pressed, reactivating traction control
d) A fault is not detected by the TCS.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	No/False	Yes
1	Yes/True	Yes

Valid Message Sequences:

REQ → RPT → RACK
RPT → RACK

5.1.8.17 Traction Control-Initiate Engine Drag Control Test ($2A/$09)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD No/False Yes/True	PT	PF	RPT	0.0		0.0		Pos	0.0	 68 2A 10 09 68 2A 10 89
RPT No/False Yes/True	PF	PT		0.0		0.0	LOAD		0.0	 88 2B SS 09 88 2B SS 89

Change Trigger Definition:

The PT shall transmit the LOAD when the Q Bit changes state (Sent at power up and when Wheel Reference Vehicle Speed < 3 kph) .

Enabled Modes for Message Trigger:

(PF) LOAD: Run

Enabled Modes for Change Trigger:

(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD No/False Yes/True	PF	PT		RPT	No	N/A		 X8 2A XX 09 X8 2A XX 89
RPT No/False Yes/True	PT	PF	(TCS disallows EDC and DT)		No	N/A	TCS Disallows engine drag control (EDC) and drop throttle (DT).	 X8 2B XX 09 X8 2B XX 89

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PT) RPT: Run

Powertrain Interface Definition:
Initiate Engine Drag Control Test is commanded by Powertrain. The Engine Drag Control (EDC) Active line is an input to Powertrain that can impact engine torque both positively and negatively. Powertrain diagnoses the input by sending a class 2 “LOAD” message to the TCS requesting that the EDC Active line be toggled. Typically, this test is performed at power-up and whenever Wheel Reference Vehicle Speed is below a calibration value (typically 3 kph).

Platform Interface Definition: Initiate Engine Drag Control Test is owned by the TCS. At all initializations, the TCS disallows Engine Drag Control and Drop Throttle functions until the EDC Active line has been diagnosed and is determined to be operating properly. The TCS, upon receipt of the “LOAD” message initiates the EDC Active line diagnostic and responds with a RPT message to indicate that the diagnostic has been initiated. After 90 ms. delay, the TCS asserts the EDC Active line to a low state for 90 ms., then releases it to a high state for 180 ms. Powertrain reads the toggle on the EDC Active line, and determines if the timing of the high/low/high toggle is within acceptable tolerances. Powertrain communicates the results of the EDC Active line diagnostic test using the PT Traction Failure Status message if the status has changed. Finally, the TCS allows or disallows the Engine Drag Control and Drop Throttle functions based upon the status of the message.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	No/False	Yes
1	Yes/True	Yes

Valid Message Sequences:

LOAD → RPT

5.1.8.18 Traction Control-PT Traction Failure Status ($2A/$0B)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RACK	PF	PT		0.0		0.0	RPT		0.0	A9 2A SS 4B
REQ	PF	PT	RPT	0.0	Run-2	750.0			0.0	C9 2A SS 0B
RPT	PT	PF	RACK	0.0	Run-1	0.0	REQ	Any	0.0	88 2B 10 0B

Change Trigger Definition:

The PT shall transmit the RPT when the PT Traction Failure Status parameter changes state.

Enabled Modes for Message Trigger:

(PF) RPT: Run
(PT) REQ: Run

Enabled Modes for Change Trigger:

(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RACK	PT	PF	N/A		No	N/A	halt retry of RPT	X9 2A XX 4B
REQ	PT	PF	N/A	RPT	No	N/A		X9 2A XX 0B
RPT	PF	PT	(Platform specific)	RACK	No	N/A	Platform specific	X8 2B XX 0B

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PT) RACK: Run
(PT) REQ: Run
(PF) RPT: Run

Powertrain Interface Definition:

PT Traction Failure Status is owned by Powertrain. It consists of bit mapped data as follows:

Bits 0 to 6 - Currently Undefined

Bit 7 - ($0080) SPARK RETARD DISCRETE LINE FAILURE (not used with ETS)
This bit indicates whether a failure has been detected on the discrete signal line for spark retard.

Bit 8 - ($0100) PT CAN'T REDUCE TORQUE - PERMANENT PWM FAILURE (not used with ETS)
This bit is set when powertrain diagnoses a requested torque PWM failure. This bit is not set for a serial data failure.

Bit 9 - ($0200) PT CAN'T REDUCE TORQUE - PERMANENT PT FAILURE
This bit is set when powertrain diagnoses a failure such as ETC failed or backup fuel or spark, such that Powertrain is unable to reduce torque.

Bit 10- ($0400) PT CAN'T REDUCE TORQUE - TEMPORARY FAILURE
This bit is set when powertrain is temporarily unable to perform its powertrain torque reduction due to a failure condition such as coolant, catalyst or transmission oil in an over-temperature condition that may ultimately result in damage and an OBD-2 diagnostic. Powertrain only stops torque reduction when no reduction is present to avoid an abrupt change, or slowly reduces powertrain torque reduction. When this temporary situation is over, powertrain torque reduction is resumed.

Bit 11- ($0800) TCS DISABLED (Not used with ETS)
This bit is set when powertrain disables traction control for emission testing on 2 wheel chassis dynamometers. A powertrain device control is one method used to disable traction control for a certain number of ignition cycles to allow for emission testing. If this bit is set, traction control should be disabled as if an ON/OFF switch was in the OFF position.

Bit 12- ($1000) PT TORQUE REDUCTION LIMITED

This bit is set when powertrain is temporarily unable to perform full authority torque reduction due to a condition such as cold engine or transmission operation. As the engine and transmission approach normal operating temperatures, torque reduction allowed is increased until normal operating temperatures are reached to allow full authority torque reduction.

Bit 13- ($2000) PT TORQUE REDUCTION INACCURATE DUE TO PT FAILURE (Not used with ETS)
This bit is set when powertrain detects a powertrain fault, such as MAP sensor or MAF (Mass Air Flow) sensor failure, that often results in a torque reduction inaccuracy > 10 %. Powertrain still continues torque reduction during this condition.

Bit 14- ($4000) CLASS 2 (ABS/TCS TO PCM) LOSS OF COMMUNICATION
This bit is set when powertrain detects a ABS/TCS Class 2 failure. The ABS/TCS receives this information when it can still receive messages but not transmit messages.

Bit 15- ($8000) ENGINE DRAG CONTROL LINE FAILURE (Not used with ETS)

Platform Interface Definition:

ETS Interface Definition:

PT Traction Failure Status is monitored by the ETS. It is used as follows:

Bits 0 to 6 - Currently Undefined

Bit 7 - ($0080) SPARK RETARD DISCRETE LINE FAILURE (not used with ETS)

Bit 8 - ($0100) PT CAN'T REDUCE TORQUE - PERMANENT PWM FAILURE (not used with ETS)

Bit 9 - ($0200) PT CAN'T REDUCE TORQUE - PERMANENT PT FAILURE
Upon receipt of this message, if this bit is set, traction control functions are disallowed, a Traction Control Fail indicator and a Diagnostic Trouble Code (DTC) are set.

Bit 10- ($0400) PT CAN'T REDUCE TORQUE - TEMPORARY FAILURE
Upon receipt of this message, if this bit is set, traction control functions are disallowed, a Traction Control Fail Indicator and a Diagnostic Trouble Code (DTC) are set.

Bit 11- ($0800) TCS DISABLED
Upon receipt of this message, if this bit is set, traction control functions are disallowed, but no Traction Control Fail Lamp or Diagnostic Trouble Code (DTC) is set.

Bit 12- ($1000) PT TORQUE REDUCTION LIMITED
Traction control currently continues to attempt control of drive wheel slip using engine.

Bit 13- ($2000) PT TORQUE REDUCTION INACCURATE DUE TO PT FAILURE
(Not used with ETS)
Traction control currently continues to attempt control of drive wheel slip using engine.

Bit 14- ($4000) CLASS 2 (ABS/TCS TO PCM) LOSS OF COMMUNICATION
Upon receipt of this message, if this bit is set, traction control functions are disallowed, a Traction Control Fail Indicator and a Diagnostic Trouble Code (DTC) are set.

Bit 15- ($8000) ENGINE DRAG CONTROL LINE FAILURE (not used with ETS)
Upon receipt of this message, if this bit is set, traction control functions (including all related modes, e.g. Engine Drag Control and Drop Throttle) are disallowed, a Traction Control Fail Indicator and a Diagnostic Trouble Code (DTC) are set.

2A - 0B Traction Control - PT Traction Failure Status (Continued)

TCS Interface Definition:
PT Traction Failure Status is monitored by the TCS. It is used as follows:

Bits 0 to 6 - Currently Undefined

Bit 7 - ($0080) SPARK RETARD DISCRETE LINE FAILURE
Upon receipt of this message, if this bit is set, traction control functions (including all related modes, e.g. Engine Drag Control and Drop Throttle) are disallowed, a Traction Control Fail Indicator and a Diagnostic Trouble Code (DTC) are set.

Bit 8 - ($0100) PT CAN'T REDUCE TORQUE - PERMANENT PWM FAILURE
Upon receipt of this message, if this bit is set, traction control functions are disallowed, a Traction Control Fail Indicator and a Diagnostic Trouble Code (DTC) are set.

Bit 9 - ($0200) PT CAN'T REDUCE TORQUE - PERMANENT PT FAILURE
Upon receipt of this message, if this bit is set, traction control functions are disallowed, a Traction Control Fail Indicator and a Diagnostic Trouble Code (DTC) are set.

Bit 10- ($0400) PT CAN'T REDUCE TORQUE - TEMPORARY FAILURE
Variable usage based upon platform specific situation, e.g. existence of brake thermal model in traction controller. But, generally:
Thermal Model present: Traction controller ignores this condition and still attempts to do traction control until thermal model determines brakes are over-temperature, then shuts down traction control, turns on a Traction Control Fail Indicator, but does not set a Diagnostic Trouble Code (DTC). Upon thermal model determination that brakes have sufficiently cooled, the Traction Control Fail Indicator is turned off, and traction control is once again allowed.
Thermal Model not present: Upon receipt of this message, if this bit is set, traction control functions are disallowed, a Traction Control Fail Indicator and a Diagnostic Trouble Code (DTC) are set.

Bit 11- ($0800) TCS DISABLED
Upon receipt of this message, if this bit is set, traction control functions are disallowed, but no Traction Control Fail Lamp or Diagnostic Trouble Code (DTC) is set.

Bit 12- ($1000) PT TORQUE REDUCTION LIMITED
Traction control currently continues to attempt control of drive wheel slip using engine and brake traction control.

Bit 13- ($2000) PT TORQUE REDUCTION INACCURATE DUE TO PT FAILURE
Traction control currently continues to attempt control of drive wheel slip using engine and brake traction control.

Bit 14- ($4000) CLASS 2 (ABS/TCS TO PCM) LOSS OF COMMUNICATION
Upon receipt of this message, if this bit is set, traction control functions are disallowed, a Traction Control Fail Indicator and a Diagnostic Trouble Code (DTC) are set.

Bit 15- ($8000) ENGINE DRAG CONTROL LINE FAILURE
Upon receipt of this message, if this bit is set, traction control functions (including all related modes, e.g. Engine Drag Control and Drop Throttle) are disallowed, a Traction Control Fail Indicator and a Diagnostic Trouble Code (DTC) are set.

General Requirements

Data Definition (Reports and Loads only)

PT Traction Failure Status - Bit Mapped without Mask (16 bits)					
Byte	Bit	Support	Description	Meaning of 0	Meaning of 1
1	7	Yes	Engine Drag Control Line Failure	Not Present	Present
	6	Yes	PT loss of ABS/TCS Communication	Not Present	Present
	5	Yes	PT Torq Reduct Inaccurate-PT fail	Not Present	Present
	4	Yes	PT Torq Reduction Limited	Not Present	Present
	3	Yes	TCS Disabled	Not Present	Present
	2	Yes	PT can't reduce torq-Temp Condition	Not Present	Present
	1	Yes	PT can't reduce torq-PT failure	Not Present	Present
	0	Yes	PT can't reduce torq-pwm failure	Not Present	Present
2	7	Yes	Spark Retard Discrete Line Failure	Not Present	Present
	6	No	Not Used (Reserved)		
	5	No	Not Used (Reserved)		
	4	No	Not Used (Reserved)		
	3	No	Not Used (Reserved)		
	2	No	Not Used (Reserved)		
	1	No	Not Used (Reserved)		
	0	No	Not Used (Reserved)		

Valid Message Sequences:

REQ → RPT → RACK
RPT → RACK

5.1.8.19 Traction Control-Option ($2A/$3C)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PT	PF	RPT	0.0	Run-4	750.0			0.0	E9 2A 10 3C
RPT	PF	PT		0.0	Run-3	0.0	REQ		0.0	C8 2B SS 3C

Change Trigger Definition:
None

Enabled Modes for Message Trigger:
(PF) REQ: Run

Enabled Modes for Change Trigger:
None

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PF	PT	N/A	RPT	No	N/A		X9 2A XX 3C
RPT	PT	PF	$00		No	N/A		X8 2B XX 3C

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) REQ: Run
(PT) RPT: Run

Powertrain Interface Definition:
Traction Control - Options is monitored by Powertrain. It is used to determine the traction control options present in order to be able to turn off all functions including diagnostics which may not apply. This message must be sent by the ABS since Powertrain needs to know when traction control is not present as well as the options present.

Platform Interface Definition:
Traction Control - Options is owned by the ABS. The ABS indicates the traction control options present as shown in the data dictionary below.

General Requirements

Data Definition (Reports and Loads only)

Traction Control Options - Bit Mapped without Mask (8 bits)					
Byte	Bit	Support	Description	Meaning of 0	Meaning of 1
1	7	Yes	Active Brake Yaw Control	Not Present	Present
	6	Yes	EDC - Engine Drag Control	Not Present	Present
	5	Yes	Discrete Spark Retard Line	Not Present	Present
	4	Yes	Traction Control w/Throttle Relaxer	Not Present	Present
	3	Yes	Engine TC-Torque PWM line not prsnt	Not Present	Present
	2	Yes	Brake Traction Control	Not Present	Present
	1	Yes	Engine TC-Torque PWM line present	Not Present	Present
	0	No	Not Used (Reserved)		

Valid Message Sequences:
REQ → RPT
RPT

5.1.8.20 Brakes-Variable Proportioning ($32/$03)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PT	PF	RPT	0.0	Run-2	0.0			0.0	C9 32 10 03
RPT Inactive Active	PF	PT		0.0	Run-1	0.0	REQ	Any	0.0	 88 33 SS 03 88 33 SS 83

Change Trigger Definition:
The PF shall transmit the RPT when the Q Bit changes state.

Enabled Modes for Message Trigger:
(PF) REQ: Run

Enabled Modes for Change Trigger:
(PF) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PF	PT	N/A	RPT	No	N/A		X9 32 XX 03
RPT Inactive Active	PT	PF	Inactive		Yes	Inactive		 X8 33 XX 03 X8 33 XX 83

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) REQ: Run
(PT) RPT: Run

Powertrain Interface Definition:

Powertrain resets some brake switch diagnostic tests if the vehicle is equipped with antilock brakes and antilock braking is active. The brake switch diagnostics measure deceleration rates which may be inconsistent if antilock braking is active.

Platform Interface Definition:

Platform indicates whether antilock braking is active.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	Inactive	Yes
1	Active	Yes

Valid Message Sequences:
REQ → RPT
RPT

5.1.8.21 Brakes-Active Brake/Yaw Control Status ($32/$06)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RACK	PT	PF		0.0		0.0	RPT		0.0	89 32 10 46
REQ	PT	PF	RPT	0.0	Run-2	750.0			0.0	A9 32 10 06
RPT Inactive Active	PF	PT	RACK	>100.0	Run-1	0.0	REQ	Q=Any, Active Brake/Yaw Control Status=Any	0.0	 68 33 SS 06 68 33 SS 86

Change Trigger Definition:

The PF shall transmit the RPT when the Q Bit changes state, when the Active Brake/Yaw Control Status parameter changes state and no more than once every 100.0 ms.

Enabled Modes for Message Trigger:

(PT) RPT: Run
(PF) REQ: Run

Enabled Modes for Change Trigger:

(PF) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RACK	PF	PT	N/A		No	N/A	halt retry of RPT	X9 32 XX 46
REQ	PF	PT	N/A	RPT	No	N/A		X9 32 XX 06
RPT Inactive Active	PT	PF	Inactive+$00	RACK	Yes	Inactive+$00		 X8 33 XX 06 X8 33 XX 86

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) RACK: Run
(PF) REQ: Run
(PT) RPT: Run

Powertrain Interface Definition:

Brakes - Active Brake/Yaw Control Active is monitored by Powertrain. Powertrain uses this message to disable cruise control if the Q-bit is set. Powertrain does not require any information from the bit mapped data byte that is also transmitted in the message.

Platform Interface Definition:

Brakes - Active Brake/Yaw Control Active is owned by Platform. Platform reports to powertrain whether Yaw control is active or not via the Q-bit. Platform also provides specific yaw control active and exit information in a bit mapped data byte that is only used by other platform functions.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	Inactive	Yes
1	Active	Yes

Active Brake/Yaw Control Status - Bit Mapped without Mask (8 bits)					
Byte	Bit	Support	Description	Meaning of 0	Meaning of 1
1	7	Yes	Exiting - Right Rear	False	True
	6	Yes	Exiting - Left Rear	False	True
	5	Yes	Exiting - Right Front	False	True
	4	Yes	Exiting - Left Front	False	True
	3	Yes	Active - Right Rear	False	True
	2	Yes	Active - Left Rear	False	True
	1	Yes	Active - Right Front	False	True
	0	Yes	Active - Left Front	False	True

Valid Message Sequences:

REQ → RPT → RACK
RPT → RACK

5.1.8.22 Brakes-System Fault ($32/$0A)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PT	PF	RPT	0.0	Run-2	0.0			0.0	C9 32 10 0A
RPT No/False Yes/True	PF	PT		0.0	Run-1	0.0	REQ	Any	0.0	 88 33 SS 0A 88 33 SS 8A

Change Trigger Definition:
The PF shall transmit the RPT when the Q Bit changes state.

Enabled Modes for Message Trigger:
(PF) REQ: Run

Enabled Modes for Change Trigger:
(PF) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PF	PT	N/A	RPT	No	N/A		X9 32 XX 0A
RPT No/False Yes/True	PT	PF	No/False		Yes	Disable all wheel drive (when applicable)		 X8 33 XX 0A X8 33 XX 8A

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) REQ: Run
(PT) RPT: Run

Powertrain Interface Definition:
Powertrain disables some brake switch diagnostics if the vehicle is equipped with antilock brakes and antilock braking is not functional because of a failure in the ABS system. The brake switch diagnostics measure deceleration rates which may be inconsistent if antilock braking is not functional. This message is also utilized by the All Wheel Drive software in the powertrain controller to disable the All Wheel Drive system if there is a fault detected with the ABS system.

Platform Interface Definition:
Platform indicates whether there is a failure in the ABS system that prevents antilock braking from functioning. When utilized for the All Wheel Drive system, the faults that trigger this message are to include a wheel speed ohmic or plausibility failure.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	No/False	Yes
1	Yes/True	Yes

Valid Message Sequences:
REQ → RPT
RPT

5.1.8.23 Brakes-Parking Brake Active ($32/$20)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RACK	PT	PF		0.0		0.0	RPT(F)		0.0	C9 32 SS 42
REQ	PT	PF	RPT(F)	0.0		0.0			0.0	A9 32 SS 20
RPT Disable Enable	PF	PT	RACK	>250.0	Run-3	0.0	REQ	Any	0.0	 88 33 40 02 88 33 40 A0
RPT(F) Disable Enable	PF	PT						Failure Condition		 88 33 40 60 88 33 40 E0

RPTF Transmit Value:
Data in RPTF is ignored

Change Trigger Definition:
The PF shall transmit the RPT when the Q Bit changes state and no more than once every 250.0 ms.

Enabled Modes for Message Trigger:
(PF) RPT(F): Run
(PT) REQ: Run

Enabled Modes for Change Trigger:
(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RACK	PF	PT	N/A		No	N/A	halt retry of RPT	X9 32 XX 60
REQ	PF	PT	N/A	RPT(F)	No	N/A		X9 32 XX 20
RPT Disable Enable	PT	PF	(Platform specific)	RACK	Yes	(Platform specific)		 X8 33 XX 20 X8 33 XX 80
RPT(F) Disable Enable	PT	PF					Platform specific	 X8 33 XX 40 X8 33 XX C0

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) RACK: Run
(PT) REQ: Run
(PF) RPT: Run
(PF) RPT(F): Run

Powertrain Interface Definition:

The Brakes-Parking Brake Switch Active message is monitored by the Powertrain. This message is used by the powertrain application implementing Auto-Trailering Mode.

Platform Interface Definition:

The Brakes-Parking Brake Switch Active message is owned by Platform. The message represents the state of the parking brake.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	No/False	Yes
1	Yes/True	Yes

Valid Message Sequences:
REQ → RPT(F) → RACK
RPT(F) → RACK

5.1.8.24 Brakes-Brake Light Switch, Brake Sw Active ($32/$22)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RACK	PF	PT		0.0		0.0	RPT(F)		0.0	89 32 SS 62
REQ	PF	PT	RPT(F)	0.0	Run-2	0.0			0.0	89 32 SS 22
RPT No/False Yes/True	PT	PF	RACK	>100.0	Run-1	0.0	REQ	Any	0.0	 68 33 10 22 68 33 10 A2
RPT(F) No/False Yes/True	PT	PF						Failure Condition		 68 33 10 62 68 33 10 E2

RPTF Transmit Value:
Data in RPTF is ignored

Change Trigger Definition:
The PT shall transmit the RPT when the Q Bit changes state and no more than once every 100.0 ms.

Enabled Modes for Message Trigger:
(PF) RPT(F): Run
(PT) REQ: Run

Enabled Modes for Change Trigger:
(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RACK	PT	PF	N/A		No	N/A	halt retry of RPT	X9 32 XX 62
REQ	PT	PF	N/A	RPT(F)	No	N/A		X9 32 XX 22
RPT No/False Yes/True	PF	PT	No/False	RACK	Yes	No/False		 X8 33 XX 22 X8 33 XX A2
RPT(F) No/False Yes/True	PF	PT					Use Default-0	 X8 33 XX 62 X8 33 XX E2

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) RACK: Run
(PT) REQ: Run
(PF) RPT: Run
(PF) RPT(F): Run

Powertrain Interface Definition:

Brake Light Switch, Brake Switch Active is owned by Powertrain. It represents a logical "OR" of the BLS with the Cruise/ETC/TCC brake input (when available) when either or both are detected as being "depressed". Powertrain indicates a failure when both the BLS and Cruise/ETC/TCC brake switches have failed. Otherwise, the status being reported will be for the switch that has not failed. A BLS or Cruise/ETC/TCC brake switch failure can be relatively slow to detect because the diagnostic operates during specific driving conditions.

NOTE: Only vehicles with cruise control or ETC are required to have a Cruise/ETC/TCC brake switch.

Platform Interface Definition:

Brake Light Switch, Brake Switch Active is monitored by the SDM for crash recording. It may also be monitored by Platform for use in BTSI control.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	No/False	Yes
1	Yes/True	Yes

Valid Message Sequences:

REQ → RPT(F) → RACK
RPT(F) → RACK

5.1.8.25 Brakes-Brake Extended Travel Switch ($32/$24)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT(F)	0.0	Run-2	750.0			0.0	C9 32 SS 24
RPT No/False Yes/True	PT	PF		0.0	Run-1	0.0	REQ	Any	0.0	 88 33 10 24 88 33 10 A4
RPT(F) No/False Yes/True	PT	PF						Failure Condition		 88 33 10 64 88 33 10 E4

RPTF Transmit Value:
Data in RPTF is ignored

Change Trigger Definition:
The PT shall transmit the RPT when the Q Bit changes state.

Enabled Modes for Message Trigger:
(PT) REQ: Run

Enabled Modes for Change Trigger:
(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	N/A	RPT(F)	No	N/A		X9 32 XX 24
RPT No/False Yes/True	PF	PT	(Platform specific)		Yes	(Platform specific)		 X8 33 XX 24 X8 33 XX A4
RPT(F) No/False Yes/True	PF	PT					Platform specific	 X8 33 XX 64 X8 33 XX E4

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) REQ: Run
(PF) RPT: Run
(PF) RPT(F): Run

Powertrain Interface Definition:

Brakes - Brake Extended Travel Switch is owned by Powertrain. Powertrain reports the state of the Brake Extended Travel Switch.
Application Loop Time: 100 ms

Platform Interface Definition:

Brakes - Brake Extended Travel Switch is monitored by Platform. The Integrated Chassis Control System uses this information as a confirmation that the brake pedal is applied. A failure of the yaw rate sensor or the yaw rate signal wiring could activate the pressure build mode (VSES mode) of the Integrated Chassis Control System. If the faulty yaw rate signal lies within the normal operating range, the diagnostics may not immediately detect the failure and disable the system activation. Extended travel brake switch information would indicate that the brake pedal is indeed applied and consequently, the Integrated Chassis Control System would promptly switch from the VSES mode to the Braking or ABS mode.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	No/False	Yes
1	Yes/True	Yes

Valid Message Sequences:
REQ → RPT(F)
RPT(F)

5.1.8.26 Brakes-Brake Pedal Status ($32/$2A)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RPT	PF	PT		100.0	Run-1	0.0		Periodic	0.0	48 33 XX 2A
RPT(F)	PF	PT						Failure Condition		48 33 XX 6A

RPTF Transmit Value:
Data in RPTF is ignored

Change Trigger Definition:
The PF shall transmit the RPT once every 100.0 ms.

Enabled Modes for Message Trigger:
None

Enabled Modes for Change Trigger:
None

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RPT	PT	PF	$00		No	N/A	Used for cruise control and brake torque management. See text below for more detail.	X8 33 XX 2A
RPT(F)	PT	PF					Disengage cruise control. See text below for more detail.	X8 33 XX 6A

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) RPT: Run
(PT RPT(F): Run

Powertrain Interface Definition:

Brake Pedal Status is received periodically by Powertrain. Powertrain shall decode the packeted information to obtain the Brake Pedal Initial Travel Achieved information, as well as the Brake Pedal Position Rolling Count and Brake Pedal Initial Travel Achieved Protection. Powertrain will verify that the rolling count information is in sequence and will calculate a reference protection value. The reference protection value is the two's complement of (Brake Pedal Initial Travel Achieved + Brake Pedal Position Rolling Count) with the most significant bit truncated to make the signal a 2-bit value. Calculated protection values are given in the table below for various rolling count and initial travel achieved states.

Rolling Counter	Initial Travel Achieved	Protection Value
00	0	00
00	1	11
01	0	11
01	1	10
10	0	10
10	1	01
11	0	01
11	1	00

The calculated reference protection value is compared to the Brake Pedal Initial Travel Achieved Protection received in this message. An invalid brake pedal status message is determined if the reference protection value does not match the one received or the rolling count is not in sequence. Powertrain shall take appropriate failsoft action after a defined number of invalid messages are received. Powertrain shall take appropriate failsoft action (e.g., disengage cruise control) if the report failsoft is received. In addition, Powertrain shall provide a defined timeout for disengagement of cruise control if this message is not received.

The Brake Pedal Moderate Travel Achieved portion of the message is used by Powertrain diagnostics for optional Brake Torque Management.

Platform Interface Definition:

Brake Pedal Status is transmitted by Platform. It consists of the Brake Pedal Initial Travel Achieved information, Brake Pedal Position Rolling Count, Brake Pedal Initial Travel Achieved Protection and Brake Pedal Moderate Travel Achieved.

Brake Pedal Initial Travel Achieved is set equal to true when the Brake Pedal Position as sensed by the Brake Apply Sensing System (BASS) has passed a threshold (calibratable) for release of cruise control and stop lamp activation.

Brake Pedal Position Rolling Count indicates that the Brake Apply Sensing System processing software module is alive. This signal is incremented in the following decimal order 0, 1, 2, 3, 0, … The rolling count shall be incremented each time Brake Pedal Status is transmitted. The Rolling Counter incrementation must not be done in the transport software layer. Platform shall connect the updating of the rolling count to the internal CPU core monitoring. The part of the CPU core monitoring that is selected as the update source shall have a timeout associated with it, and the monitor loop must finish with at least the same periodic rate as the rolling count update.

Brake Pedal Initial Travel Achieved Protection represents the value of the two's complement of (Brake Pedal Initial Travel Achieved + Brake Pedal Position Rolling Count) truncated to 2 bits (see previous table). This function is implemented to tie together in a single piece of data the rolling count and the critical state of the pedal position. By combining this information, any possible failure that could result in the rolling count being updated without the pedal position also being updated is eliminated. See the Brake Apply Sensing System Level Specification for more details.

Brake Pedal Moderate Travel Achieved is set to true when the Brake Pedal Position as sensed by the BASS has passed a threshold (calibratable) for optional brake torque management.

The report failsoft message shall be sent for all faults in the Brake Apply Sensing System which would cause the data for the Brake Pedal Initial Travel Achieved to be incorrect (e.g., output out of range). Platform shall send the report failsoft message even if a failsoft action is taken with the control of its BLS output in an attempt to maintain brake lamps operation.

General Requirements

Data Definition

Packet Byte 1, Bit 6-7, Not Defined

Packet Byte 1, Bit 5, Brake Pedal Moderate Travel Achieved	
State	Name
0	False
1	True

Packet Byte 1, Bit 3-4, Brake Pedal Initial Travel Achieved Protection - Unsigned Numeric (2 bits)			
Encoding		Transfer Functions	
Units	NA	To Engineering Units	N
Resolution	1	To Computer Units	E
Absolute Range	0-3		

Packet Byte 1, Bit 1-2, Brake Pedal Position Rolling Count - Unsigned Numeric (2 bits)			
Encoding		Transfer Functions	
Units	NA	To Engineering Units	N
Resolution	1	To Computer Units	E
Absolute Range	0-3		

Packet Byte 1, Bit 0, Brake Pedal Initial Travel Achieved	
State	Name
0	False
1	True

Valid Message Sequences:

(PF) RPT[F] → (PT)

5.1.8.27 Brakes-Options ($32/$3C)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PT	PF	RPT	0.0	Run-4	750.0			0.0	C9 32 10 3C
RPT	PF	PT		0.0	Run-3	0.0	REQ		0.0	88 33 SS 3C

Change Trigger Definition:
None

Enabled Modes for Message Trigger:
(PF) REQ: Run

Enabled Modes for Change Trigger:
None

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PF	PT	N/A	RPT	No	N/A		X9 32 XX 3C
RPT	PT	PF	(Use value in NVM)		No	N/A		X8 33 XX 3C

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) REQ: Run
(PT) RPT: Run

Powertrain Interface Definition:

Brakes - Brake Options is monitored by Powertrain. Powertrain monitors Bit 1 of the message to determine if ABS is present in order to enable the diagnostics which rely on ABS information. The ABS present status is stored in non-volatile memory in the PCM in case communications is lost with the platform controller sending this message.

Platform Interface Definition:

Brakes - Brake Options is owned by Platform. A Platform module other than the ABS controller is required to transmit the RPT message if ABS is optional on the vehicle. The message consists of bit mapped data as defined in the data dictionary below.

General Requirements

Data Definition (Reports and Loads only)

Options - Bit Mapped without Mask (8 bits)					
Byte	Bit	Support	Description	Meaning of 0	Meaning of 1
1	7	No	Not Used (Reserved)		
	6	No	Not Used (Reserved)		
	5	No	Not Used (Reserved)		
	4	No	Not Used (Reserved)		
	3	No	Not Used (Reserved)		
	2	No	Not Used (Reserved)		
	1	Yes	ABS	Not Present	Present
	0	No	Fluid Switch Diagnostic Enabled	Not Present	Present

Valid Message Sequences:
REQ → RPT
RPT

5.1.8.28 Transmission/Transaxle/PRNDL-Clutch Enable ($3A/$02)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RACK	PF	PT		0.0		0.0	RPT(F)		0.0	C9 3A SS 42
REQ	PF	PT	RPT(F)	0.0	Run-2	0.0			0.0	A9 3A SS 02
RPT Disable Enable	PT	PF	RACK	>300.0	Run-1	0.0	REQ	Any	0.0	 88 3B 10 02 88 3B 10 82
RPT(F) Disable Enable	PT	PF						Failure Condition		 88 3B 10 42 88 3B 10 C2

RPTF Transmit Value:
Data in RPTF is ignored

Change Trigger Definition:
The PT shall transmit the RPT when the Q Bit changes state and no more than once every 300.0 ms.

Enabled Modes for Message Trigger:
(PF) RPT(F): Run
(PT) REQ: Run

Enabled Modes for Change Trigger:
(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RACK	PT	PF	N/A		No	N/A	halt retry of RPT	X9 3A XX 42
REQ	PT	PF	N/A	RPT(F)	No	N/A		X9 3A XX 02
RPT Disable Enable	PF	PT	(Platform specific)	RACK	Yes	(Platform specific)		 X8 3B XX 02 X8 3B XX 82
RPT(F) Disable Enable	PF	PT					Platform specific	 X8 3B XX 42 X8 3B XX C2

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) RACK: Run
(PT) REQ: Run
(PF) RPT: Run
(PF) RPT(F): Run

Powertrain Interface Definition:

The Transmission/Transaxle/PRNDL-Clutch State message is owned by the Powertrain. This message is transmitted from the powertrain controller to the Platform to indicate when the clutch start switch (bottom of travel) is depressed on a manual transmission.

Q-bit		Actual Conditions		
State	Name	Switch	Pedal	Clutch
0	Disable	Open	Released	Engaged
1	Enable	Closed	Depressed	Disengaged

Platform Interface Definition:

The Transmission/Transaxle/PRNDL-Clutch State message is monitored by Platform. This message is used by the active transfer case with active push button control for slip wheel control.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support

Q Bit		
State	Name	Support
0	Disable	Yes
1	Enable	Yes

Valid Message Sequences:

REQ → RPT(F) → RACK

RPT(F) → RACK

5.1.8.29 Transmission/Transaxle/PRNDL-Estimated Trans Gear Engaged ($3A/$03)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RACK	PF	PT		0.0		0.0	RPT(F)		0.0	A9 3A SS 43
REQ	PF	PT	RPT(F)	0.0	Accessory-2 Run-2	750.0			0.0	C9 3A SS 03
RPT	PT	PF	RACK	>300.0	Accessory-1 Run-1	0.0	REQ	Any	0.0	88 3B 10 03
RPT(F)	PT	PF						Failure Condition		88 3B 10 43

RPTF Transmit Value:

Data in RPTF is ignored

Change Trigger Definition:

The PT shall transmit the RPT when the Transmission Actual Gear parameter changes state and no more than once every 300.0 ms.

Enabled Modes for Message Trigger:

(PF) RPT(F): Accessory, Run

(PT) REQ: Accessory, Run

Enabled Modes for Change Trigger:

(PT) RPT: Off Awake, RAP, Accessory, Run, Crank

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RACK	PT	PF	N/A		No	N/A	halt retry of RPT	X9 3A XX 43
REQ	PT	PF	N/A	RPT(F)	No	N/A		X9 3A XX 03
RPT	PF	PT	(Platform specific)	RACK	Yes	(Platform specific)		X8 3B XX 03
RPT(F)	PF	PT					Platform specific	X8 3B XX 43

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PT) RACK: Off Awake, RAP, Accessory, Run, Crank

(PT) REQ: Accessory, Run

(PF) RPT: Off Awake, RAP, Accessory, Run, Crank

(PF) RPT(F): Off Awake, RAP, Accessory, Run, Crank

Powertrain Interface Definition:

Estimated Transmission Gear Engaged is owned by the Powertrain. It is the engaged gear that Powertrain determines from the best available inputs such as turbine speed/vehicle speed calculated gear ratio, commanded gear, gear pressure discretes, PSM shifter position, PRNDL shifter position, P/N switch discrete, clutch discrete, etc. - depending upon application. In the Off Awake and RAP power modes, Powertrain shall transmit this message for as long as the powertrain controller is awake.

On manual transmission applications, Forward 1 through Forward 5 gear states are determined based on comparing a calculated engine speed to vehicle speed (N/V) ratio to a calibrated range of ratios for the forward gears. The Neutral gear state will be indicated if the calculated speed ratio is not within one of the calibrated range of ratios for the forward gears or if it can be determined that the clutch is depressed. Reverse and Park states are not supported on manual transmissions.

An invalid PRNDL-Estimated Trans Gear Engaged state will be commanded if the sensor providing the data has failed and a backup value cannot be determined.

Note: on an automatic transmission this parameter is not updated to the currently engaged gear until Powertrain has determined that the shift is complete and stabilized.

Platform Interface Definition:

Estimated Transmission Gear Engaged is monitored by Platform. It is used for miscellaneous body functions, remote start, backup lamps, theatre lighting, trunk release and traction control as follows:

ETS Interface Definition:

Estimated Transmission Gear Engaged is monitored by the ETS. It is used to address exit criteria, gear shifting functions and wheel torque calculations.

TCS Interface Definition:

Estimated Transmission Gear Engaged is monitored by the TCS. It is used to select the appropriate TCS ramp rate.

General Requirements

Data Definition (Reports and Loads only)

Transmission Actual Gear - State Encoded (8 bits)		
State	Support	State Description
00	Yes	Invalid
01	Yes	Reverse
02	Yes	Forward 1
04	Yes	Forward 2
08	Yes	Forward 3
10	Yes	Forward 4
20	Yes	Forward 5
21	Yes	Forward 6
40	Yes	Park
80	Yes	Neutral

Valid Message Sequences:

REQ → RPT(F) → RACK
RPT(F) → RACK

5.1.8.30 Transmission/Transaxle/PRNDL-Transfer Case Front Axle ($3A/$05)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RACK	PT	PF		0.0		0.0	RPT		0.0	C9 3A 10 45
REQ	PT	PF	RPT	0.0	Run-2	750.0			0.0	A9 3A 10 05
RPT	PF	PT	RACK	>250.0	Run-1	0.0	REQ	Any	0.0	88 3B SS 05

Change Trigger Definition:

The PF shall transmit the RPT when the Transmission Transfer Case 4x4 parameter changes state and no more than once every 250.0 ms.

Enabled Modes for Message Trigger:

(PT) RPT: Run
(PF) REQ: Run

Enabled Modes for Change Trigger:

(PF) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RACK	PF	PT	N/A		No	N/A	halt retry of RPT	X9 3A XX 45
REQ	PF	PT	N/A	RPT	No	N/A		X9 3A XX 05
RPT	PT	PF	$02	RACK	Yes	$02		X8 3B XX 05

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) RACK: Run
(PF) REQ: Run
(PT) RPT: Run

Powertrain Interface Definition:

Transmission/Transaxle/PRNDL - Transfer Case Front Axle is monitored by Powertrain. Powertrain uses the reported state of the transfer case front axle to determine four wheel drive vs. two wheel drive for torque management use. On the two speed active transfer case applications, two wheel drive vs. four wheel drive information is transmitted via this message. On all other transfer case applications, the PCM obtains this information via a hardwire input. In addition to this information, the PCM also receives a hardwired four wheel drive low input which is present on all four wheel drive applications. The PCM will assume the vehicle is in four wheel drive if the state in the message is $03 (Four Wheel Drive Low - Locked w/Front Axle Engaged), $04 (Four Wheel Drive High – Locked w/Front Axle Engaged), or or $06 (Four Wheel Drive High – Unlocked w/Front Axle Engaged, otherwise the PCM will assume the vehicle is in two wheel drive.

Platform Interface Definition:

Transmission/Transaxle/PRNDL - Transfer Case Front Axle is owned by Platform. Platform reports to powertrain the state of the transfer case front axle on two speed active transfer case applications.

General Requirements

Data Definition (Reports and Loads only)

Transmission Transfer Case 4x4 - State Encoded (8 bits)		
State	Support	State Description
00	Yes	Invalid
01	Yes	Neutral
02	Yes	Two Wheel Drive
03	Yes	4 Wheel Drv Low-Locked-Frnt Axle Engaged
04	Yes	4 Wheel Drv High-Locked-Frnt Axle Engaged
05	Yes	Active All Whl Drv-Frt Axle Engaged
06	Yes	4 Wheel Drv High-Unlocked_Frnt Axle Engaged

Valid Message Sequences:

REQ → RPT → RACK
RPT → RACK

5.1.8.31 Transmission/Transaxle/PRNDL-Commanded Gear ($3A/$06)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PT	PF	RPT	0.0	Run-2	750.0			0.0	A9 3A 10 06
RPT	PF	PT		>100.0	Run-1	0.0	REQ	Any	0.0	68 3B SS 06

Change Trigger Definition:

The PF shall transmit the RPT when the Transmission Commanded Gear parameter changes state and no more than once every 100.0 ms.

Enabled Modes for Message Trigger:

(PF) REQ: Run

Enabled Modes for Change Trigger:

(PF) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PF	PT	N/A	RPT	No	N/A		X9 3A XX 06
RPT	PT	PF	$00		Yes	$00		X8 3B XX 06

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) REQ: Run
(PT) RPT: Run

Powertrain Interface Definition:

Transmission/Transaxle/PRNDL - Commanded Gear is monitored by Powertrain. The traction control module on an Enhanced Traction System determines the minimum transmission gear the powertrain must control to during traction control. Powertrain will control the transmission gear to at least the gear reported in the message from the traction control module. Only forward gears can be controlled by powertrain. Powertrain will assume total control of transmission gear if a data value of $00 (Invalid) is received in the report message.

Platform Interface Definition:

Transmission/Transaxle/PRNDL - Commanded Gear is owned by Platform. This message is used to indicate to powertrain the minimum transmission gear required during traction control. Platform will report a $00 (Invalid) state to indicate that powertrain shall assume total control of transmission gear.

General Requirements

Data Definition (Reports and Loads only)

Transmission Commanded Gear - State Encoded (8 bits)		
State	Support	State Description
00	Yes	Invalid
01	No	Reverse
02	Yes	Forward 1
04	Yes	Forward 2
08	Yes	Forward 3
10	Yes	Forward 4
20	No	Forward 5
40	No	Forward 6 / Park
80	No	Neutral

Valid Message Sequences:

REQ → RPT
RPT

5.1.8.32 Transmission/Transaxle/PRNDL-Transmission Shift Solenoids State ($3A/$0E)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RACK	PF	PT		0.0		0.0	RPT(F)		0.0	A9 3A 28 4E
REQ	PF	PT	RPT(F)	0.0	Run-2	950.0			0.0	C9 3A 40 0E
RPT	PT	PF	RACK	>300.0	Run-1	850.0	REQ	Any	0.0	88 3B 10 0E

Change Trigger Definition:
The PT shall transmit the RPT when the Transmission Shift Solenoids State parameter changes state and no more than once every 300.0 ms.

Enabled Modes for Message Trigger:
(PF) RPT(F): Run
(PT) REQ: Run

Enabled Modes for Change Trigger:
(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RACK	PT	PF	N/A		No	N/A	Halt retry of RPT	X9 3A XX 4E
REQ	PT	PF	N/A	RPT	No	N/A	xmit RPT	X9 3A XX 0E
RPT	PF	PT	$00	RACK	Yes	$00	Used for traction control.	X8 3B XX 0E

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) RACK: Run
(PT) REQ: Run
(PF) RPT: Run
(PF) RPT(F): Run

General Requirements

Data Definition (Reports and Loads only)

Transmission Shift Solenoids State - State Encoded (8 bits)		
State	Support	State Description
00	Yes	Invalid
01	Yes	Reverse
02	Yes	Forward 1
04	Yes	Forward 2
08	Yes	Forward 3
10	Yes	Forward 4
20	Yes	Forward 5
21	Yes	Forward 6
40	Yes	Park
80	Yes	Neutral

Powertrain Usage Description:

Transmission Shift Solenoid State is owned by the Powertrain. It is the current state of the shift solenoids. When Powertrain determines that a new gear is desired, the state of the shift solenoid states will be changed to reflect the new intended gear and the shift process will begin. Only the Forward gear states (02 thru 21) are supported.

Platform Interface Definition:

Transmission Shift Solenoid State is monitored by Platform. This information may be used by traction control for improved performance or for displaying gear position when in Performance Algorithm Shift mode.

Valid Message Sequences:
REQ → RPT → RACK
RPT → RACK

5.1.8.33 Transmission/Transaxle/PRNDL-Tap Up/Tap Down Target Gear ($3A/$0F)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RACK	PF	PT		0.0		0.0	RPT(F)		0.0	A9 3A 28 4F
REQ	PF	PT	RPT(F)	0.0	Run-2	950.0			0.0	C9 3A 40 0F
RPT	PT	PF	RACK	>300.0	Run-1	850.0	REQ	Any	0.0	88 3B 10 0F

Change Trigger Definition:
The PT shall transmit the RPT when the Tap Up/Tap Down Target Gear parameter changes state and no more than once every 300.0 ms.

Enabled Modes for Message Trigger
(PF) RPT(F): Run
(PT) REQ: Run

Enabled Modes for Change Trigger:
(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RACK	PT	PF	N/A		No	N/A	Halt retry of RPT	X9 3A XX 4F
REQ	PT	PF	N/A	RPT	No	N/A	xmit RPT	X9 3A XX 0F
RPT	PF	PT	$00	RACK	Yes	$00	Used to display gear position when in tap up/tap down mode.	X8 3B XX 0F

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) RACK: Run
(PT) REQ: Run
(PF) RPT: Run
(PF) RPT(F): Run

General Requirements

Data Definition (Reports and Loads only)

Tap Up/Tap Down Target Gear - State Encoded (8 bits)		
State	Support	State Description
00	Yes	Invalid
01	Yes	Reverse
02	Yes	Forward 1
04	Yes	Forward 2
08	Yes	Forward 3
10	Yes	Forward 4
20	Yes	Forward 5
21	Yes	Forward 6
40	Yes	Park
80	Yes	Neutral

Valid Message Sequences:
REQ → RPT → RACK
RPT → RACK

Powertrain Usage Description:
Tap Up/Tap Down Target Gear is owned by the Powertrain. It is the target gear that has been selected via the tap up/tap down switches. For some driving conditions, the transmission will not immediately shift into the target gear. Also, for some conditions, the target gear may not be allowed. (For example, a 1 to 4 shift is not allowed.) The target gear value reported will always reflect the allowed gear. For some driving conditions, the target gear reported may be the gear that the customer selected initially, but then would get updated if Powertrain determines that the target gear is no longer allowed because of new conditions encountered during the shift. In general, when the target gear is achieved, the target gear value that is reported shall remain the

same until another tap up/tap down selection is received. However, if Powertrain determines that a shift is necessary to protect the transmission (i.e., upshift near fuel cutoff), the target gear will be updated to reflect this new shift and will no longer equal the original customer selection. Only the Forward gear states (02 thru 21) are supported.

Platform Interface Definition:

Tap Up/Tap Down Target Gear is monitored by Platform. It is used for displaying gear position when in Tap Up/Tap Down mode. This information enables the customer to view the gear that has been selected via the tap up/tap down switches prior to the shift being completed. For example, a customer will be able to view that a tap up to third gear (a third gear start) has been selected when vehicle speed is zero.

5.1.8.34 Transmission/Transaxle/PRNDL-Fluid Temperature ($3A/$10)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT(F)	0.0	Run-2	750.0			0.0	E9 3A SS 10
RPT	PT	PF		0.0	Run-1	0.0	REQ	3 øC	0.0	C8 3B 10 10
RPT(F)	PT	PF						Failure Condition		C8 3B 10 50

RPTF Transmit Value:
Data in RPTF is ignored

Change Trigger Definition:
The PT shall transmit the RPT when the Transmission Fluid Temperature parameter changes by 3 øC.

Enabled Modes for Message Trigger:
(PT) REQ: Run

Enabled Modes for Change Trigger:
(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	N/A	RPT(F)	No	N/A		X9 3A XX 10
RPT	PF	PT	(Platform specific)		Yes	(Platform specific)		X8 3B XX 10
RPT(F)	PF	PT					Platform specific	X8 3B XX 50

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) REQ: Run
(PF) RPT: Run
(PF) RPT(F): Run

Powertrain Interface Definition:

Transmission/Transaxle/PRNDL - Fluid Temperature is owned by Powertrain. It represents the temperature of the transmission fluid (Only applies to automatic transmissions).

Application Loop Time: 1000 ms

Platform Interface Definition:

Transmission/Transaxle/PRNDL - Fluid Temperature is monitored by Platform. It is used for display purposes and cooling fan control.

General Requirements

Data Definition (Reports and Loads only)

Transmission Fluid Temperature - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	øC	To Engineering Units	N-40
Resolution	1	To Computer Units	E+40
Absolute Range	-40-+215		

Valid Message Sequences:
REQ → RPT(F)
RPT(F)

5.1.8.35 Transmission/Transaxle/PRNDL-Fluid Remaining Life ($3A/$14)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Not Reset Reset	PF	PT	RPT	>4000.0		0.0			0.0	 A8 3A SS 14 A8 3A SS 94
REQ	PF	PT	RPT	0.0	Run-2	750.0			0.0	C9 3A SS 14
RPT Not Reset Reset	PT	PF		>1000.0	Run-1	0.0	LOAD REQ	0.39 %, Data = 0% or 100%	0.0	 A8 3B 10 14 A8 3B 10 94

Change Trigger Definition:

The PF shall transmit the LOAD (Sent with data=100% to reset.) and no more than once every 4000.0 ms.
The PT shall transmit the RPT when the Transmission Fluid Remaining Life parameter changes by 0.39 % and the data = 0 % or 100 % and no more than once every 1000.0 ms.

Enabled Modes for Message Trigger:

(PT) LOAD: Run
(PT) REQ: Run

Enabled Modes for Change Trigger:

(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Not Reset Reset	PT	PF		RPT	No	N/A		 X8 3A XX 14 X8 3A XX 94
REQ	PT	PF	N/A	RPT	No	N/A		X9 3A XX 14
RPT Not Reset Reset	PF	PT	(Platform specific)		Yes	(Platform specific)		 X8 3B XX 14 X8 3B XX 94

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PT) LOAD: Run
(PT) REQ: Run
(PF) RPT: Run

Powertrain Interface Definition: Transmission/Transaxle/PRNDL - Fluid Remaining Life is owned by Powertrain. Powertrain determines Transmission Fluid Remaining Life based on the transmission oil life determination algorithm which resides in the PCM. The algorithm is based on the principle that transmission operation will decrease oil life especially at non-optimal oil temperatures. The Fluid Remaining Life may be reset by a platform optional reset switch. For the platform optional reset switch, the platform will indicate a reset through a LOAD command to the PCM with a data value of 100% and the Q-bit = 1. Upon detection of any reset of Fluid Remaining Life, the PCM will queue a RPT message with a data value of 100% with the Q-bit = 1. Application Loop Time: 1000 ms

Platform Interface Definition:

Transmission/Transaxle/PRNDL - Fluid Remaining Life is commanded and monitored by Platform. This message (RPT) is used for display purposes. The platform may send a LOAD message with a data value of 100% and the Q-bit = 1 to command the PCM to reset the Fluid Remaining Life. Upon detection of any reset of Fluid Remaining Life, the PCM will queue a RPT message with a data value of 100% with the Q-bit = 1.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	Not Reset	No
1	Reset	No

Transmission Fluid Remaining Life - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	%	To Engineering Units	N/2.55
Resolution	100/255	To Computer Units	E*2.55
Absolute Range	0-100		

Valid Message Sequences:

REQ → RPT
LOAD → RPT
RPT

5.1.8.36 Transmission/Transaxle/PRNDL-Transfer Case TPS Thresholds ($3A/$22)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD	PF	PT	RPT	0.0	Run-1	0.0	RQCV		0.0	C8 3A SS 22
RPT	PT	PF		0.0		0.0	LOAD		0.0	C8 3B 10 22
RQCV	PT	PF		0.0	Run-2	0.0			0.0	E9 3B 10 22

Change Trigger Definition:
None

Enabled Modes for Message Trigger:
(PF) RQCV: Run
(PT) LOAD: Run

Enabled Modes for Change Trigger:
None

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD	PT	PF	(Use data in NVM)	RPT	No	N/A		X8 3A XX 22
RPT	PF	PT			No	N/A		X8 3B XX 22
RQCV	PF	PT	N/A	LOAD	No	N/A		X9 3B XX 22

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) LOAD: Run
(PF) RPT: Run
(PF) RQCV: Run

Powertrain Interface Definition:
Transmission/Transaxle/PRNDL - Transfer Case TPS Thresholds defines additional TPS change trigger thresholds for Class 2 message $12 $11 (Throttle Position Sensor - Pedal Position). This message is only used on Truck applications with an Active Transfer Case. The TPS change trigger thresholds are defined in the data dictionary below and referenced in message $12 $11. The initial power up default of TPS Thresholds should be equal to 00's to prevent any change triggered $12/$11 message from being sent prior to receiving a valid $3A/$22 message.

Platform Interface Definition:
Transmission/Transaxle/PRNDL - Transfer Case TPS Thresholds are commanded to the Powertrain Controller at initialization to define additional change triggers for Class 2 message $12 $11 (Throttle Position Sensor - Pedal Position). The additional change trigger thresholds are needed for Active Transfer Case applications on Trucks.

General Requirements

Data Definition (Reports and Loads only)

Valid Message Sequences:
RQCV → LOAD → RPT
LOAD → RPT

5.1.8.37 Transmission/Transaxle/PRNDL-Shift Feel ($3A/$30)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD	PF	PT	RPT	>100.0	Run-1	0.0	RQCV	Any	0.0	A8 3A SS 30
RPT	PT	PF		0.0		0.0	LOAD		0.0	A8 3B 10 30
RQCV	PT	PF	LOAD	0.0	Run-2	0.0			0.0	C9 3B 10 30

Change Trigger Definition:
The PF shall transmit the LOAD when the Shift Feel parameter changes state and no more than once every 100.0 ms.

Enabled Modes for Message Trigger:
(PF) RQCV: Run
(PT) LOAD: Run

Enabled Modes for Change Trigger:
(PF) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD	PT	PF	$00	RPT	Yes	$00		X8 3A XX 30
RPT	PF	PT			No	N/A		X8 3B XX 30
RQCV	PF	PT	N/A	LOAD	No	N/A		X9 3B XX 30

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) LOAD: Run
(PF) RPT: Run
(PF) RQCV: Run

Powertrain Interface Definition:
Transmission/Transaxle/PRNDL - Shift Feel is owned by Powertrain. Powertrain schedules the automatic transmission shift pattern based on the latest LOAD command from the Platform. Upon receipt of the LOAD message, the Powertrain module provides closed loop feedback to the Platform module by sending a RPT message. The transmission control software is capable of supporting two unique shift patterns other than normal. Typically, one of the two unique shift patterns is used for cruise control but since the PCM monitors cruise engaged, this Class 2 message is not required to select the cruise shift pattern. This results in one unique shift pattern remaining that the Platform may request via this Class 2 message.

Platform Interface Definition:
Transmission/Transaxle/PRNDL - Shift Feel is commanded by Platform. Platform will command the desired shift pattern for the automatic transmission. Application Loop Time: N/A

General Requirements

Data Definition (Reports and Loads only)

Shift Feel - State Encoded (8 bits)		
State	Support	State Description
00	Yes	Normal Shift Feel
01	Yes	Trailering or Towing Mode
02	Yes	Performance Mode
03	Yes	Winter Mode
04	Yes	Economy Mode
05	No	Shift Feel "E"
06	No	Shift Feel "F"
07	No	Shift Feel "G"

Valid Message Sequences:
RQCV → LOAD → RPT
LOAD → RPT

5.1.8.38 Transmission/Transaxle/PRNDL-Performance Algorithm Shift (PAS) ($3A/$31)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RACK	PF	PT		0.0		0.0	RPT		0.0	A9 3A SS 71
REQ	PF	PT	RPT	0.0	Run-2	0.0			0.0	A9 3A SS 31
RPT Inactive Active	PT	PF	RACK	0.0	Run-1	0.0	REQ		0.0	 A8 3B 10 31 A8 3B 10 B1

Change Trigger Definition:
The PT shall transmit the RPT when the Q Bit changes state

Enabled Modes for Message Trigger:
(PF) RPT: Run
(PT) REQ: Run

Enabled Modes for Change Trigger:
(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RACK	PT	PF	N/A		No	N/A	halt retry of RPT	X9 3A XX 71
REQ	PT	PF	N/A	RPT	No	N/A		X9 3A XX 31
RPT Inactive Active	PF	PT		RACK	No	N/A		 X8 3B XX 31 X8 3B XX B1

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) RACK: Run
(PT) REQ: Run
(PF) RPT: Run

Powertrain Interface Definition:
Transmission/Transaxle/PRNDL - Performance Shift Mode is owned by Powertrain. This message is sent with the Q-bit set to 1 when the high performance shift algorithm is activated.

Application Loop Time: 100 ms

Platform Interface Definition:
Transmission/Transaxle/PRNDL - Performance Shift Mode is monitored by Platform. This message is used for display purposes and may be used for other control functions in the future. The performance shift mode is utilized when the vehicle is in a high lateral acceleration maneuver. During this maneuver, the transmission will downshift to give the driver more performance through the curve. When the transmission downshifts, the signal will be read by the cluster and the PRNDL display will be changed to reflect the downshift. This mode is not selectable by the driver.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	Inactive	Yes
1	Active	Yes

Valid Message Sequences:
REQ → RPT → RACK
RPT → RACK

5.1.8.39 Transmission/Transaxle/PRNDL-Tap Up/Tap Down Mode Status ($3A/$32)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PF	PT	RPT	0.0		0.0		Any	0.0	 88 3A SS 32 88 3A SS B2
RPT Disable Enable	PT	PF		0.0		0.0	LOAD		0.0	 A8 3B 10 32 A8 3B 10 B2

Change Trigger Definition:
The PF shall transmit the LOAD when the Q Bit changes state.

Enabled Modes for Message Trigger:
(PT) LOAD: Run

Enabled Modes for Change Trigger:
(PF) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PT	PF	Disable	RPT	Yes	Disable		 X8 3A XX 32 X8 3A XX B2
RPT Disable Enable	PF	PT	Disable		No	N/A		 X8 3B XX 32 X8 3B XX B2

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) LOAD: Run
(PF) RPT: Run

Powertrain Interface Definition:

Transmission/Transaxle/PRNDL - Tap Up/Tap Down Mode Status is monitored by Powertrain. Powertrain enables/disables the Tap Up/Tap Down function based on the LOAD command from the Platform which reflects the driver requested mode. Powertrain transmits the RPT message as an acknowledgement to the LOAD message by setting the Q-bit in the RPT message to the value received in the LOAD message.

Platform Interface Definition:

Transmission/Transaxle/PRNDL - Tap Up/Tap Down Mode Status is commanded by Platform. Platform sends a LOAD message to reflect the driver selected Tap Up/Tap Down On/Off switch status. Q-bit equal to 1 indicates that the driver has selected Tap Up/Tap Down.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	Disable	Yes
1	Enable	Yes

Valid Message Sequences:
LOAD → RPT

5.1.8.40 Transmission/Transaxle/PRNDL-Winter Mode Status ($3A/$33)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RQCV	PT	PF	LOAD	0.0	Run-2	0.0			0.0	C9 3B 10 33
LOAD Disable Enable	PF	PT	RPT	0.0	Run-1	0.0		Any	0.0	 88 3A SS 33 88 3A SS B3
RPT Disable Enable	PT	PF		0.0		0.0	LOAD		0.0	 A8 3B 10 33 A8 3B 10 B3

Change Trigger Definition:
The PF shall transmit the LOAD when the Q Bit changes state.

Enabled Modes for Message Trigger:
(PT) LOAD: Run

Enabled Modes for Change Trigger:
(PF) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RQCV	PF	PT	N/A	LOAD	No	N/A		X9 3B XX 33
LOAD Disable Enable	PT	PF	Disable	RPT	Yes	Disable		 X8 3A XX 33 X8 3A XX B3
RPT Disable Enable	PF	PT			No	N/A		 X8 3B XX 33 X8 3B XX B3

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) LOAD: Run
(PF) RPT: Run

Powertrain Interface Definition:
Transmission/Transaxle/PRNDL - Winter Mode Status is monitored by Powertrain. Powertrain enables/disables the Winter Mode function based on the LOAD command from the Platform which reflects the driver requested mode. The Winter Mode function typically consists of enabling 2nd or 3rd gear starts. Powertrain transmits the RPT message as an acknowledgement to the LOAD message by setting the Q-bit in the RPT message to the value received in the LOAD message.

Platform Interface Definition:
Transmission/Transaxle/PRNDL - Winter Mode Status is commanded by Platform. Platform sends a LOAD message to reflect the driver selected Winter Mode switch status. Q-bit equal to 1 indicates that the driver has selected Winter Mode.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	Disable	Yes
1	Enable	Yes

Valid Message Sequences:
LOAD → RPT

5.1.8.41 Transmission/Transaxle/PRNDL-Driven Wheel Configuration ($3A/$35)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT	0.0	Run-4	1000.0			0.0	C9 3A XX 35
RPT	PT	PF		0.0	Run-3	700.0	REQ		200.0	88 3B 10 35

Change Trigger Definition:

Enabled Modes for Message Trigger:
(PT) RPT: Run

Enabled Modes for Change Trigger:

Received Message Requirements

Operation	Source	Dest	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RPT	PT	PF			No	N/A		X8 3B XX 35
REQ	PF	PT	N/A	RPT	No	N/A		X9 3A XX 35

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) REQ: Run
(PT) RPT: Run

Powertrain Interface Definition:

Transmission/Transaxle/PRNDL-Driven Wheel Configuration is owned by Powertrain. Powertrain sends the transmission drive configuration on vehicles which have both two wheel and all wheel drive transmissions.

Platform Interface Definition:

Transmission/Transaxle/PRNDL-Driven Wheel Configuration is monitored by Platform. On vehicles equipped with two wheel and all wheel drive transmissions, the ABS module uses this information to determine which ABS brake algorithm to run.

General Requirements

Data Definition (Reports and Loads only)

Driven Wheel Configuration - State Encoded (8 bits) (*=Power up default)		
State	Support	State Description
00	Yes	Invalid
01	Yes	Front Two Wheel Drive
02	Yes	Rear Two Wheel Drive
03	Yes	All Wheel Drive

Valid Message Sequences:
REQ → RPT
RPT

5.1.8.42 Transmission/Transaxle/PRNDL-Transmission Gear Shift Direction ($3A/$36)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RACK	PF	PT		0.0		0.0			0.0	C9 3A SS 76
REQ	PF	PT	RPT	0.0	Run-2	750.0			0.0	A9 3A SS 36
RPT	PT	PF	RACK	>300.0	Run-1	0.0	REQ	Any	0.0	88 3B 10 36

Change Trigger Definition:

The PT shall transmit the RPT when the Transmission Gear Shift Direction parameter changes state and no more than once every 300.0 ms.

Enabled Modes for Message Trigger:

(PF) RPT: Run
(PT) REQ: Run

Enabled Modes for Change Trigger:

(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RACK	PT	PF	N/A		No	N/A	halt retry of RPT	X9 3A XX 76
REQ	PT	PF	N/A	RPT	No	N/A		X9 3A XX 36
RPT	PF	PT	(Platform specific)	RACK	Yes	(Platform specific)		X8 3B XX 36

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PT) RACK: Run
(PT) REQ: Run
(PF) RPT: Run

Powertrain Interface Definition:
Transmission Gear Shift Direction is transmitted by Powertrain. The shift in progress states are used to communicate that a shift is occurring for automatic transmissions. The signal is set to the appropriate state when the respective shift solenoid state changes. The signal remains set throughout the shift delay, the ratio change and the end timing of the shift. The "No Shift in Progress" signal state is assigned when no shifts are occurring (i.e. the transmission is in the steady state operating mode).

Platform Interface Definition:
Transmission Gear Shift Direction is monitored by Platform. It is required for traction control to work effectively with a tap up/tap down transmission. This data will also result in better ETS and TCS performance on all vehicles.

General Requirements

Data Definition (Reports and Loads only)

Transmission Gear Shift Direction - State Encoded (2 bits)		
State	Support	State Description
00	Yes	No Shift in Progress
01	Yes	Upshift in Progress
02	Yes	Downshift in Progress

Valid Message Sequences:

REQ → RPT → RACK
RPT → RACK

5.1.8.43 Transmission/Transaxle/PRNDL-Transmission Gear Ratio ($3A/$38)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT(F)	0.0	Run-2	1000.0			0.0	X9 3A XX 3B
RPT	PT	PF		> 100.0	Run-1	500.0	REQ	0.03125	0.0	X8 (3A+1) XX 3B
RPT(F)	PT	PF						Failure Condition		X8 (3A+1) XX (3B+$40)

RPTF Transmit Value:
C bit set.

Change Trigger Definition:
PT shall transmit the RPT when the Transmission Gear Ratio parameter changes by 0.03125 and and no more than once every 100.0 ms..

Enabled Modes for Message Trigger:
(PT) REQ: Run, Crank

Enabled Modes for Change Trigger:
(PT) RPT: Run, Crank

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	n/a	RPT(F)	No	n/a		X9 3A XX 3B
RPT	PF	PT			Yes	Platform Specific		X8 (3A+1) XX 3B
RPT(F)	PF	PT					Platform Specific	X8 (3A+1) XX (3B+$40)

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) REQ: Run, Crank
(PF) RPT: Run, Crank
(PF) RPT(F): Run, Crank

Powertrain Interface Definition:
Transmission Gear Ratio is owned by the Powertrain. This message represents the ratio of the transmission input speed to the transmission output speed.

Platform Interface Definition:
Transmission Gear Ratio is monitored by the Platform. This message is used by ABS for traction control with the CVT transmission.

General Requirements

Data Definition (Reports and Loads only)

Transmission Gear Ratio - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units		To Engineering Units	N/32
Resolution	1/32	To Computer Units	E*32
Absolute Range	0 to 7.96875		

Valid Message Sequences:
REQ → RPT(F)
RPT(F)

5.1.8.44 Transmission/Transaxle/PRNDL-Transmissions Options ($3A/$3C)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT	0.0	Run-4	750.0			0.0	E9 3A SS 3C
RPT	PT	PF		0.0	Run-3	0.0	REQ		0.0	C8 3B 10 3C

Change Trigger Definition:
None

Enabled Modes for Message Trigger:
(PT) REQ: Run

Enabled Modes for Change Trigger:
None

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	N/A	RPT	No	N/A		X9 3A XX 3C
RPT	PF	PT	(Platform specific)		No	N/A		X8 3B XX 3C

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) REQ: Run
(PF) RPT: Run

Powertrain Interface Definition:

Transmission Options is owned by Powertrain. It is a state encoded specific transmission identifier parameter. Manual transmissions shall always be assigned states with a lower nibble of zero (0). Automatic transmissions shall never be assigned states with a lower nibble of zero (0). Automatic transmissions with Tap Up/Tap Down shall be assigned states with both nibbles not equal to zero (≠ 0).

Platform Interface Definition:

ETS Interface Definition: Transmission Options is monitored by the ETS. It is used for torque management in order to handle different transmissions with a single software set. It is important to address specific transmission control / durability variations and to identify manual transmission control logic.

TCS Interface Definition: Transmission Options is monitored by the TCS. It is used for TCS apply / release rate selection for brake control.

General Requirements

Data Definition (Reports and Loads only)

Options - State Encoded (8 bits)		
State	Support	State Description
02	Yes	3 Speed Automatic
04	Yes	4 Speed Automatic
05	Yes	4 Speed Automatic - 4L60E
06	Yes	4 Speed Automatic - 4L80E
07	Yes	4 Speed Automatic - 4T40E
08	Yes	4 Speed Automatic - 4T45E
09	Yes	4 Speed Automatic - 4T60E
0A	Yes	4 Speed Automatic - 4T80E
0B	Yes	4 Speed Automatic - 4T65E
0C	Yes	5 Speed Automatic - 5L40E
0D	No	5 Speed Automatic - LCT 1000
0E	No	5 Speed Automatic - LCT 2000
10	Yes	3 Speed Manual
20	Yes	4 Speed Manual
40	Yes	5 Speed Manual

Options - State Encoded (8 bits)		
State	Support	State Description
80	Yes	6 Speed Manual
81	Yes	6 Speed Automatic-6L45E
82	Yes	6 Speed Automatic-6L50E
83	Yes	6 Speed Automatic-6L80E
84	Yes	6 Speed Automatic-6L90E
85	Yes	6 Speed Automatic-HM6T65E
86	Yes	6 Speed Automatic-HM6T80E
2B	Yes	4 Speed Automatic - 4T65E with Tap Up/Tap Down

Valid Message Sequences:

REQ → RPT
RPT

5.1.8.45 Transmission/Transaxle/PRNDL-Tire / Axle Correction Factor ($3A/$3D)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT	0.0	Run-2	750.0			0.0	C9 3A SS 3D
RPT	PT	PF		0.0	Run-1	0.0	REQ		0.0	88 3B 10 3D

Change Trigger Definition:
None

Enabled Modes for Message Trigger:
(PT) REQ: Run

Enabled Modes for Change Trigger:
None

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	N/A	RPT	No	N/A		X9 3A XX 3D
RPT	PF	PT	(Platform specific)		No	N/A		X8 3B XX 3D

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) REQ: Run
(PF) RPT: Run

Powertrain Interface Definition:

Transmission/Transaxle/PRNDL - Tire/Axle Correction Factor is owned by Powertrain. The Tire/Axle Correction Factor corrects for the tire sizes and axle ratios in the vehicle speed calculation. The equation which used this data is as follows:

[Transmission output speed pulses per time] / [Tire/Axle Correction Factor in pulses per mile]= Vehicle Speed

Platform Interface Definition:

Transmission/Transaxle/PRNDL - Tire/Axle Correction Factor is monitored by Platform. Platform uses this factor for traction control in order to determine the torque multiplication due to the tire sizes and axle ratios. Need to add transfer case usage description.

General Requirements

Data Definition (Reports and Loads only)

Tire/Axle Correction Factor - Unsigned Numeric (16 bits)			
Encoding		Transfer Functions	
Units	ppm	To Engineering Units	N/0.256
Resolution	1000/256	To Computer Units	E*0.256
Absolute Range	0-255918		

Valid Message Sequences:
REQ → RPT
RPT

5.1.8.46 Engine Coolant-Fan 1 (All) Speed ($48/$01)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT	0.0	Run-2	0.0			0.0	A9 48 SS 01
RPT	PT	PF		>300.0	Run-1	0.0	REQ	1 %, Data = 0% or 100%	0.0	A8 49 10 01

Change Trigger Definition:

The PT shall transmit the RPT when the Engine Coolant Fan 1 (ALL) Speed parameter changes by 1 % and the data = 0 % or 100 % and no more than once every 300.0 ms.

Enabled Modes for Message Trigger:

(PT) REQ: Run

Enabled Modes for Change Trigger:

(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	N/A	RPT	No	N/A		X9 48 XX 01
RPT	PF	PT	0 %		No	N/A		X8 49 XX 01

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PT) REQ: Run
(PF) RPT: Run

Powertrain Interface Definition:

Engine Coolant - Fan 1 (All) Speed is reported by Powertrain. Powertrain will report the speed of the fan(s) as a percentage of maximum fan speed available. Fan speed is based on parameters such as coolant temperature, transmission temperature, engine oil temperature and A/C pressure.

Platform Interface Definition:

Platform uses Fan 1 (All) Speed in electrical load management for RVC calculations and other algorithms to determine if it should request a reduction in fan speed.

Application Loop Time: 1 second (typical)

General Requirements

Data Definition (Reports and Loads only)

Engine Coolant Fan 1 (ALL) Speed - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	%	To Engineering Units	N/2.55
Resolution	100/255	To Computer Units	E*2.55
Absolute Range	0-100		

Valid Message Sequences:

REQ → RPT
RPT

5.1.8.47 Engine Coolant-Fan Speed Offset ($48/$0B)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RQCV	PT	PF	LOAD	0.0	Run-2	0.0			0.0	E9 49 10 0B
LOAD	PF	PT	RPT	>300.0	Run-1			5%, Data = 0% or 100%		C8 48 SS 0B
RPT	PT	PF		0.0		0.0	LOAD		0.0	A8 49 10 0B

Change Trigger Definition:

The PF shall transmit the LOAD when the Engine Coolant Fan Speed Offset parameter changes by 5 % and the data = 0 % or 100 % and no more than once every 300.0 ms.

Enabled Modes for Message Trigger:

(PT) LOAD: Run

Enabled Modes for Change Trigger:

(PF) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RQCV	PF	PT	N/A	LOAD	No	N/A		X9 49 XX 0B
LOAD	PT	PF	0 %	RPT	Yes	0% offset		X8 48 XX 0B
RPT	PF	PT			No	N/A		X8 49 XX 0B

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PT) LOAD: Run
(PF) RPT: Run

Powertrain Interface Definition:

Fan Speed Offset is owned by Powertrain. Upon receipt of a LOAD from Platform to adjust the fan speed, Powertrain will modify the speed if the current fan speed is less than a calibration. Powertrain will modify fan speed by the amount requested if the current fan speed is below a second calibration and only a portion of the requested amount if the current fan speed is between the two calibrations. Refer to Section 4.2 for details.

Platform Interface Definition:

Fan Speed Offset is commanded by Platform. This message is used to request powertrain to modify the cooling fan speed either higher or lower. Fan speed may be requested to be lowered for Electrical Energy Management purposes. If the cooling fan is not already running, Fan speed may be requested to be increased during entended engine idle periods in order to ventilate the engine compartment.

General Requirements

Data Definition (Reports and Loads only)

Engine Coolant-Fan Speed Offset - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	%	To Engineering Units	(N/1.28)-100
Resolution	199.21875/255	To Computer Units	(E+100)*1.28)
Absolute Range	-100 -+99.21875		

Valid Message Sequences:

LOAD → RPT

5.1.8.48 Engine Coolant-Fluid Temperature ($48/$10)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT(F)	0.0	Run-2	750.0			0.0	89 48 SS 10
RPT	PT	PF		0.0	Run-1	0.0	REQ	1 øC	0.0	68 49 10 10
RPT(F)	PT	PF						Failure Condition		68 49 10 50

RPTF Transmit Value:
Data in RPTF is ignored

Change Trigger Definition:
The PT shall transmit the RPT when the Engine Coolant Temperature parameter changes by 1 øC.

Enabled Modes for Message Trigger:
(PT) REQ: Run

Enabled Modes for Change Trigger:
(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	N/A	RPT(F)	No	N/A		X9 48 XX 10
RPT	PF	PT	(Platform specific)		Yes	(Platform specific)		X8 49 XX 10
RPT(F)	PF	PT					Platform specific	X8 49 XX 50

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) REQ: Run
(PF) RPT: Run
(PF) RPT(F): Run

Powertrain Interface Definition:

Engine Coolant - Fluid Temperature is owned by Powertrain. It represents the temperature of the engine coolant. This message must have a high internal PCM scheduling priority because the Platform requires this data prior to calculating and displaying Outside Air Temperature. Powertrain shall inhibit sending the initialization message until Engine Coolant Fluid Temperature is determined.

Application Loop Time: 1000 ms

Platform Interface Definition:

Engine Coolant - Fluid Temperature is monitored by Platform. It is used for the calculation and display of Outside Air Temperature and display of coolant temperature.

General Requirements

Data Definition (Reports and Loads only)

Engine Coolant Temperature - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	øC	To Engineering Units	N-40
Resolution	1	To Computer Units	E+40
Absolute Range	-40-+215		

Valid Message Sequences:
REQ → RPT(F)
RPT(F)

5.1.8.49 Engine Coolant-Low Coolant Level ($48/$32)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RACK	PT	PF		0.0		0.0	RPT(F)		0.0	E9 48 10 72
REQ	PT	PF	RPT(F)	0.0	Run-2	750.0			0.0	C9 48 10 32
RPT No/False Yes/True	PF	PT	RACK	0.0	Run-1	0.0	REQ	Any	0.0	 A8 49 SS 32 A8 49 SS B2
RPT(F) No/False Yes/True	PF	PT						Failure Condition		 A8 49 SS 72 A8 49 SS F2

RPTF Transmit Value:
Data in RPTF is ignored

Change Trigger Definition:
The PF shall transmit the RPT when the Q Bit changes state.

Enabled Modes for Message Trigger:
(PT) RPT(F): Run
(PF) REQ: Run

Enabled Modes for Change Trigger:
(PF) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RACK	PF	PT	N/A		No	N/A	halt retry of RPT	X9 48 XX 72
REQ	PF	PT	N/A	RPT(F)	No	N/A		X9 48 XX 32
RPT No/False Yes/True	PT	PF	No/False	RACK	Yes	(Indicate parm invalid)		 X8 49 XX 32 X8 49 XX B2
RPT(F) No/False Yes/True	PT	PF					Indicate parm invalid	 X8 49 XX 72 X8 49 XX F2

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) RACK: Run
(PF) REQ: Run
(PT) RPT: Run
(PT) RPT(F): Run

Powertrain Interface Definition:

Engine Coolant - Low Coolant Level is monitored by Powertrain. Low Coolant Level is required for engine protection due to low coolant on certain engines.

Platform Interface Definition:

Engine Coolant - Low Coolant Level is owned by Platform. Platform reports to powertrain the state of the low coolant level sensor.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	No/False	Yes
1	Yes/True	Yes

Valid Message Sequences:
REQ → RPT(F) → RACK
RPT(F) → RACK

5.1.8.50 Engine Oil-Fluid Temperature ($4A/$10)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT(F)	0.0	Run-2	850.0			0.0	C9 4A SS 10
RPT	PT	PF		0.0	Run-1	0.0	REQ	1 øC	0.0	A8 4B 11 10
RPT(F)	PT	PF						Failure Condition		A8 4B 11 50

RPTF Transmit Value:
Data in RPTF is ignored

Change Trigger Definition:
The PT shall transmit the RPT when the Engine Oil Temperature parameter changes by 1 øC.

Enabled Modes for Message Trigger:
(PT) REQ: Run

Enabled Modes for Change Trigger:
(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	N/A	RPT(F)	No	N/A		X9 4A XX 10
RPT	PF	PT	(Platform specific)		Yes	Platform specific		X8 4B XX 10
RPT(F)	PF	PT					Platform specific	X8 4B XX 50

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) REQ: Run
(PF) RPT: Run
(PF) RPT(F): Run

Powertrain Interface Definition:

Engine Oil-Fluid Temperature is owned by Powertrain. It represents the temperature of the engine oil as determined from an oil temperature sensor –it shall not use modeled oil temperature.

Application Loop Time: 1000 ms

Platform Interface Definition:

Engine Oil-Fluid Temperature is monitored by Platform. It is used for display purposes.

General Requirements

Data Definition (Reports and Loads only)

Engine Oil Temperature - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	øC	To Engineering Units	N-40
Resolution	1	To Computer Units	E+40
Absolute Range	-40-+215		

Valid Message Sequences:
REQ → RPT(F)
RPT(F)

5.1.8.51 Engine Oil-Fluid Pressure ($4A/$11)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT(F)	0.0	Run-2	750.0			0.0	A9 4A SS 11
RPT	PT	PF		>500.0	Run-1	0.0	REQ	8 kPaG	0.0	88 4B 10 11
RPT(F)	PT	PF						Failure Condition		88 4B 10 51

RPTF Transmit Value:
Data in RPTF is ignored

Change Trigger Definition:
The PT shall transmit the RPT when the Engine Oil Pressure parameter changes by 8 kPaG and no more than once every 500.0 ms.

Enabled Modes for Message Trigger:
(PT) REQ: Run

Enabled Modes for Change Trigger:
(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	N/A	RPT(F)	No	N/A		X9 4A XX 11
RPT	PF	PT	(Platform specific)		No	N/A	Platform specific	X8 4B XX 11
RPT(F)	PF	PT					Platform specific	X8 4B XX 51

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) REQ: Run
(PF) RPT: Run
(PF) RPT(F): Run

Powertrain Interface Definition:
Engine Oil - Fluid Pressure is owned by Powertrain. It is the filtered fluid pressure read from the oil pressure sensor or is calculated fluid pressure determined by an algorithm in the Powertrain electronics. Powertrain shall inhibit sending the initialization message until Fluid Pressure is determined. A failure report will not occur when fluid pressure is determined by an algorithm.
Application Loop Time: 500 ms

Platform Interface Definition:
Engine Oil - Fluid Pressure is monitored by Platform. This message is used for display purposes.

General Requirements

Data Definition (Reports and Loads only)

Engine Oil Pressure - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	kPaG	To Engineering Units	N*4
Resolution	4	To Computer Units	E/4
Absolute Range	0-1020		

Valid Message Sequences:
REQ → RPT(F)
RPT(F)

5.1.8.52 Engine Oil-Fluid Remaining Life ($4A/$14)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Not Reset Reset	PF	PT	RPT	>4000.0		0.0		Q=Pos,	0.0	 C8 4A SS 14 C8 4A SS 94
REQ	PF	PT	RPT	0.0	Accessory-2 Run-2	750.0			0.0	E9 4A SS 14
RPT Not Reset Reset	PT	PF		>1000.0	Accessory-1 Run-1	0.0	LOAD REQ	Q=Pos, Engine Oil Remaining Life=0.39 %, Data = 0% or 100%	0.0	 C8 4B 10 14 C8 4B 10 94

Change Trigger Definition:

The PF shall transmit the LOAD when the Q Bit changes state, (Sent with Q=1 and data=100% to reset) and no more than once every 4000.0 ms.

The PT shall transmit the RPT when the Q Bit changes state, when the Engine Oil Remaining Life parameter changes by 0.39 % and the data = 0 % or 100 % and no more than once every 1000.0 ms.

Enabled Modes for Message Trigger:

(PT) LOAD: Accessory, Run
(PT) REQ: Accessory, Run

Enabled Modes for Change Trigger:

(PF) LOAD: Accessory, Run
(PT) RPT: Accessory, Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Not Reset Reset	PT	PF		RPT	No	N/A		 X8 4A XX 14 X8 4A XX 94
REQ	PT	PF	N/A	RPT	No	N/A		X9 4A XX 14
RPT Not Reset Reset	PF	PT	(Platform specific)		Yes	(Platform specific)		 X8 4B XX 14 X8 4B XX 94

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PT) LOAD: Accessory, Run
(PT) REQ: Accessory, Run
(PF) RPT: Accessory, Run

Powertrain Interface Definition:

Engine Oil - Fluid Remaining Life is owned by Powertrain. Powertrain determines Engine Oil - Fluid Remaining Life based on the engine oil life determination algorithm which resides in the PCM. The algorithm is based on the principle that engine operation will decrease oil life especially at non-optimal oil temperatures.

The Fluid Remaining Life may be reset by either utilizing the throttle pedal stomp procedure or a platform optional reset switch. For the platform optional reset switch, the platform will indicate a reset through a LOAD command to the PCM with a data value of 100% and the Q-bit = 1. Upon detection of any reset of Fluid Remaining Life, the PCM will queue a RPT message with a data value of 100% with the Q-bit = 1. Even if the platform module does not use Fluid Remaining Life data, a reset notification will be communicated with this same RPT message.

Application Loop Time: 1000 ms.

Platform Interface Definition:

Engine Oil - Fluid Remaining Life is commanded and monitored by Platform. This message (RPT) is used for display purposes. The platform may send a LOAD message with a data value of 100% and the Q-bit = 1 to command the PCM to reset the Fluid

Remaining Life. Upon detection of any reset of Fluid Remaining Life, the PCM will queue a RPT message with a data value of 100% with the Q-bit = 1.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	Not Reset	Yes
1	Reset	Yes

Engine Oil Remaining Life - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	%	To Engineering Units	N/2.55
Resolution	100/255	To Computer Units	E*2.55
Absolute Range	0-100		

Valid Message Sequences:

REQ → RPT
LOAD → RPT
RPT

5.1.8.53 Engine System Other-Engine Run Flag ($52/$04)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RACK	PF	PT		0.0		0.0	RPT		0.0	A9 52 SS 44
REQ	PF	PT	RPT	0.0	Off Awake-2 Accessory-2 Run-2 RAP-2	0.0			0.0	C9 52 SS 04
RPT No/False Yes/True	PT	PF	RACK	0.0	Off Awake-1 Accessory-1 Run-1 RAP-1	0.0	REQ	Any	0.0	 88 53 10 04 88 53 10 84

Change Trigger Definition:
The PT shall transmit the RPT when the Q Bit changes state.

Enabled Modes for Message Trigger:
(PF) RPT: Off Awake, Accessory, Run, Crank, RAP
(PT) REQ: Off Awake, Accessory, Run, RAP

Enabled Modes for Change Trigger:
(PT) RPT: Off Awake, Accessory, Run, Crank, RAP

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RACK	PT	PF	N/A		No	N/A	halt retry of RPT	X9 52 XX 44
REQ	PT	PF	N/A	RPT	No	N/A		X9 52 XX 04
RPT No/False Yes/True	PF	PT	(Platform specific)	RACK	Yes	(Platform specific)		 X8 53 XX 04 X8 53 XX 84

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) RACK: Run
(PT) REQ: Off Awake, Accessory, Run, Crank, RAP
(PF) RPT: Off Awake, Accessory, Run, Crank, RAP

Powertrain Interface Definition:

Engine System Other - Engine Run Flag is owned by Powertrain. It is an indication of whether the PCM has determined that the engine is running. Typically, the transition from engine not running to engine running occurs when the engine speed has been greater than a calibratable threshold for a calibratable number of engine revolutions. The transition from engine running to engine not running occurs when the engine speed drops below a calibratable threshold to indicate that the engine is no longer rotating. This message is enabled in any power mode and is sent whenever the engine run flag changes state. However, the message can only be sent when the PCM is powered.

For vehicles with remote vehicle start, Engine System Other - Engine Run Flag shall be set to “False” while the engine is running in remote mode and the system power mode is not equal to RUN. This allows a common power moding algorithm for vehicles with and without remote vehicle start.

Application Loop Time: 100 ms.

Platform Interface Definition:

Engine System Other - Engine Run Flag is monitored by Platform.. This message is used by Class 2 power moding backup strategy. It is also used by the Platform electronics for miscellaneous body functions. At least one Platform controller must be awake to transmit the RACK in all power modes for which the powertrain controller is awake.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	No/False	Yes
1	Yes/True	Yes

Valid Message Sequences:

REQ → RPT → RACK
RPT → RACK

5.1.8.54 Engine System Other-Electrically Heated Catalyst Status ($52/$09)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RACK	PF	PT		0.0		0.0	RPT		0.0	E9 52 SS 49
REQ	PF	PT	RPT	0.0	Run-2	750.0			0.0	E9 52 SS 09
RPT Disable Enable	PT	PF	RACK	0.0	Run-1	0.0	REQ	Any	0.0	 A8 53 10 09 A8 53 10 89

Change Trigger Definition:
The PT shall transmit the RPT when the Q Bit changes state.

Enabled Modes for Message Trigger:
(PF) RPT: Run
(PT) REQ: Run

Enabled Modes for Change Trigger:
(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RACK	PT	PF	N/A		No	N/A	halt retry of RPT	X9 52 XX 49
REQ	PT	PF	N/A	RPT	No	N/A		X9 52 XX 09
RPT Disable Enable	PF	PT	(Platform specific)	RACK	Yes	(Platform specific)		 X8 53 XX 09 X8 53 XX 89

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) RACK: Run
(PT) REQ: Run
(PF) RPT: Run

Powertrain Interface Definition:

Engine System Other - Electrically Heated Catalyst Status is owned by Powertrain. It is the commanded state of the output driver for the electrically heated catalyst. The electrically heated catalyst is needed during certain engine operating conditions on some vehicle applications in order to decrease the hydrocarbons within the engine exhaust.

Application Loop Time: 100 ms.

Platform Interface Definition:

Engine System Other - Electrically Heated Catalyst Status is monitored by Platform. Platform uses the status along with the vehicle electrical loading to determine if load shedding is needed in order to maintain adequate system voltage.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	Disable	Yes
1	Enable	Yes

Valid Message Sequences:
REQ → RPT → RACK
RPT → RACK

5.1.8.55 Engine System Other-Remote Start Engine Run Flag ($52/$14)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RACK	PF	PT		0.0		0.0	RPT		0.0	C9 52 40 54
REQ	PF	PT	RPT	0.0	Off Awake-2 Accessory-2 Run-2 RAP-2	0.0			0.0	C9 52 40 14
RPT No/False Yes/True	PT	PF	RACK	0.0	Off Awake-2 Accessory-2 Run-2 RAP-2	0.0	REQ	Any	0.0	 A8 53 10 14 A8 53 10 94

Change Trigger Definition:
The PT shall transmit the RPT when the Q Bit changes state (Flag will be set to true when engine is running in remote mode. It will be set to false when vehicle goes into normal mode) .

Enabled Modes for Message Trigger:
(PF) RPT: Off Awake, Accessory, Run, RAP
(PT) REQ: Off Awake, Accessory, Run, RAP

Enabled Modes for Change Trigger:
(PT) RPT: Off Awake, Accessory, Run, RAP

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RACK	PT	PF	N/A		No	N/A	halt retry of RPT	X9 52 XX 54
REQ	PT	PF	N/A	RPT	No	N/A	Xmit RPT	X9 52 XX 14
RPT No/False Yes/True	PF	PT	No/False	RACK	Yes	No/False	Used for remote vehicle start	 X8 53 XX 14 X8 53 XX 94

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) RACK: Off Awake, Accessory, Run, RAP
(PT) REQ: Off Awake, Accessory, Run, RAP
(PF) RPT: Off Awake, Accessory, Run, RAP

Powertrain Interface Definition:

Engine System Other – Remote Start Engine Run Flag is transmitted by Powertrain. For vehicles with Remote Vehicle Start (RVS), it is an indication of the running status of the engine while in remote mode. The Q-bit of this message shall be set to 1 when the engine is started in remote mode. The Q-bit of this message shall be set to 0 when the system transitions into normal mode as defined in the RVS Monitor algorithm in Section 4.7, or when the engine is determined to be not running.

Data Delay: 125 ms

Platform Interface Definition:

Engine System Other – Remote Start Engine Run Flag is used by the RVS system.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	No/False	Yes
1	Yes/True	Yes

Valid Message Sequences:
REQ → RPT → RACK
RPT → RACK

5.1.8.56 Engine System Other-Immediate Engine Snapshot n ($52/$21)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PF	PT	RPT	0.0		0.0		Q=Pos,	0.0	 68 52 SS 21 68 52 SS A1
RPT Disable Enable	PT	PF		0.0		0.0	LOAD	Q=Any, Engine Sys Immediate Snapshot n=1	0.0	 88 53 10 21 88 53 10 A1

Change Trigger Definition:

The PF shall transmit the LOAD when the Q Bit changes state, (Sent with Q=0 and data =01 to get snapshot.) .
The PT shall transmit the RPT when the Q Bit changes state, when the Engine Sys Immediate Snapshot n parameter changes by 1 (Q=0 and data =01) .

Enabled Modes for Message Trigger:

(PT) LOAD: Run

Enabled Modes for Change Trigger:

(PF) LOAD: Run
(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PT	PF		RPT	No	N/A		 X8 52 XX 21 X8 52 XX A1
RPT Disable Enable	PF	PT			No	N/A		 X8 53 XX 21 X8 53 XX A1

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PT) LOAD: Run
(PF) RPT: Run

Powertrain Interface Definition:

Engine System Other - Immediate Engine Snapshot n is owned by Powertrain. Powertrain will take a snapshot of predefined engine parameters and store them in battery backed memory or EEPROM equivalent memory upon receipt of the LOAD command from platform. Powertrain will transmit a RPT message upon receipt of the LOAD command with the data byte set equal to the data byte received in the LOAD message.

Platform Interface Definition:

Engine System Other - Immediate Engine Snapshot n is commanded by Platform. Platform commands powertrain to take a snapshot of predefined engine parameters for service troubleshooting by the customer or service. The LOAD message contains a data value of $01 with the Q-bit = 0 to command the PCM to take a snapshot.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	Disable	Yes
1	Enable	Yes

Engine Sys Immediate Snapshot n - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units		To Engineering Units	N
Resolution	1	To Computer Units	E
Absolute Range	0-255		

Valid Message Sequences:

LOAD → RPT
RPT

5.1.8.57 Engine System Other-Engine Type ($52/$22)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT	0.0	Run-4	750.0			0.0	E9 52 SS 22
RPT	PT	PF		0.0	Run-3	0.0	REQ		0.0	C8 53 10 22

Change Trigger Definition:
None

Enabled Modes for Message Trigger:
(PT) REQ: Run

Enabled Modes for Change Trigger:
None

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	N/A	RPT	No	N/A		X9 52 XX 22
RPT	PF	PT	(Platform specific)		No	N/A		X8 53 XX 22

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) REQ: Run
(PF) RPT: Run

Powertrain Interface Definition:
Engine Type is owned by Powertrain. It is a state encoded specific engine identifier parameter.

Platform Interface Definition:
Engine type is monitored by the Platform for use in determining the fuel gauge display. It is also used for ETS and TCS as described below.

ETS Interface Definition:
Engine Type is monitored by the ETS. It is used to change torque reduction gains as a function of engine performance (torque levels vary due to design and displacement).

TCS Interface Definition:
Engine Type is monitored by the TCS. It is used to determine initial torque selection depending on whether the engine is supercharged or not.

General Requirements

Data Definition (Reports and Loads only)

Engine Type - State Encoded (8 bits)		
State	Support	State Description
00	Yes	2.2L OHV
01	Yes	2.4L DOHC
02	Yes	2.2L DOHC L850
03	Yes	1.9L SOHC
04	Yes	1.9L DOHC
05	Yes	2.4L DOHC Enhanced Torque
06	Yes	2.5L Diesel Turbo
08	Yes	2.8L DOHC L4
21	Yes	3.5L DOHC L5
41	Yes	3.1L OHV
42	Yes	3.4L OHV
43	Yes	3.4L DOHC
44	Yes	3800 OHV
45	Yes	3800 OHV Supercharged
46	Yes	3.5L DOHC Premium V6

Engine Type - State Encoded (8 bits)		
State	Support	State Description
47	Yes	4.3L OHV
48	Yes	3.0L DOHC V6
49	Yes	4.0L L6
4A	Yes	4.2L L6
4B	Yes	2.6L DOHC V6
4C	Yes	3.2L DOHC V6
4D	Yes	7.2L Diesel Turbo
4E	Yes	7.8L Diesel Turbo
51	Yes	3.6L HFV6
52	Yes	3.2L HFV6
53	Yes	2.8L HFV6 Turbo
54	Yes	2.8L HFV6
80	Yes	4.0L DOHC
81	Yes	4.6L DOHC
82	Yes	5.3L Gen III
83	Yes	5.7L Gen III
84	Yes	4.8L Gen III
85	Yes	6.0L Gen III
86	Yes	6.5L Diesel OHV Non Turbo, reg duty
87	Yes	6.5L Diesel OHV Turbo, regular duty
88	Yes	6.5L Diesel OHV Non Turbo, hev duty
89	Yes	6.5L Diesel OHV Turbo, heavy duty
8A	Yes	7.4L OHV
8B	Yes	6.6L Diesel Turbo
8C	Yes	5.0L OHV
8D	Yes	8.1L OHV
8E	Yes	5.7L OHV High output
8F	Yes	6.4L OHV
90	Yes	5.3L Gen IV
91	Yes	5.7L Gen IV
92	Yes	4.8L Gen IV
93	Yes	6.0L Gen IV

Valid Message Sequences:

REQ → RPT
RPT

5.1.8.58 Engine System Other-Calculated RDM Clutch Temperature ($52/$26)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RPT	PT	PF	RPT	>1000.0	Run-1	750.0	REQ	1 Celsius	0.0	68 53 18 26
RPT(F)	PT	PF						Failure Condition		68 53 18 66

RPTF Transmit Value:

68 53 18 66

Change Trigger Definition:

The TCM shall transmit the RPT when the Calculated RDM Clutch Temperature parameter changes by 1 Celsius (Failure Condition) and no more than once every 1000.0 ms.

Enabled Modes for Message Trigger:

(PT) REQ: Run

Enabled Modes for Change Trigger:

(PT) RPT: Run

Received Message Requirements

Operation	Source	Dest	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PF	PT	N/A	RPT(F)	No	N/A		X9 52 XX 26

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

REQ: Run

Powertrain Interface Definition

The Engine System Other-Calculated RDM Clutch Temperature is monitored and transmitted by Powertrain. It is an estimation built on the momentary calculated heat loss in the AWD clutch package, and when present on the vehicle, with a feedback from the temperature sensor used for the All Wheel Drive Oil Temperature signal. This is used to determine if the AWD is close to a temperature protection opening of the All Wheel Drive clutch.

Powertrain shall send the report failsoft message shall be sent for faults in AWD system which would cause the data for Calculated RDM Clutch Temperature to be incorrect (e.g., output out of range).

Platform Interface Definition

The Engine System Other-Calculated RDM Clutch Temperature is received by Platform. The Engine System Other-Calculated RDM Clutch Temperature is used by VSES to determine if the AWD is close to a temperature protection opening of the All Wheel Drive clutch. This to not perform an action request to the AWD that causes extra heat loss. A temperature protection opening will occur if the All Wheel Drive Clutch Package Temperature exceeds a maximum temperature. After a temperature protection opening, normal operation of the AWD will be regained when All Wheel Drive Clutch Temperature becomes lower.

General Requirements

Data Definition (Reports and Loads only)

Calculated RDM Clutch Temperature - Unsigned Numeric (8 bits)

EncodingTransfer Functions

UnitsCelsiusTo Engineering UnitsE=N-40

Resolution1To Computer Units N=E+40

Supported Range-40-+215 Power Up

Absolute Range-40-+215 Default: N/A

Valid Message Sequences:

(R) REQ (T) RPT(F)

(T) RPT(F)

5.1.8.59 Engine System Other – Displacement on Demand Status ($52/$30)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT	0.0	Run-4	750.0			0.0	E9 52 SS 30
RPT	PT	PF		0.0	Run-3	0.0	REQ		0.0	C8 53 10 30

Change Trigger Definition:
The PT shall transmit the RPT every 500.0 ms.

Enabled Modes for Message Trigger:
(PT) REQ: Run

Enabled Modes for Change Trigger:
None

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	N/A	RPT	No	N/A		X9 52 XX 30
RPT	PF	PT	(Platform specific)		No	N/A		X8 53 XX 30

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) REQ: Run
(PF) RPT: Run

Powertrain Interface Definition:
Engine System Other -Displacement on Demand Status is owned by Powertrain. This message shall provide the status of the engine displacement on demand (DoD) function.

The message state definitions are defined as follows:

$00 = All Cylinders Active:
This mode implies that all of the cylinders in the engine are active. This is the default mode for a vehicle that does not have cylinder deactivation.

$01 = Deactivation In Progress:
This mode is set at the start of the cylinder deactivation process, before any cylinders have been turned off. While this mode is in effect, the cylinders will be deactivated. Once all of the desired cylinders have been deactivated, this signal shall transition to the next mode.

$02 = Half of Total Cylinders Active:
This mode indicates that the engine is operating in cylinder deactivation and that half of the cylinders are currently active.

$03 = Reactivation In Progress:
This mode indicates that the engine is reactivating the cylinders that were turned off. This mode shall be entered at the start of the reactivation process before any cylinders have been turned back on. When the reactivation is complete, this signal shall transition to the $00 mode.

If the engine is not running Powertrain shall transmit this signal with a value of $00 (“All Cylinders Active”).

Application Loop Time: 500 ms.

Platform Interface Definition:
Engine System Other Displacement on Demand Status is monitored by Platform. This message is used for display to the vehicle operator the number of engines cylinders active (all engine cylinder are active or half of all cylinders).

General Requirements (example)

Data Definition (Reports and Loads only)

State	Name	Support
$00	All cylinder Active	Yes
$01	Deactivation In Progress	Yes
$02	Half of Total Cylinders Active	Yes
$03	Reactivation In Progress	Yes

Valid Message Sequences:

REQ → RPT
RPT

5.1.8.60 Suspension-Failure Status ($58/$0B)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RACK	PT	PF		0.0		0.0	RPT		0.0	E9 58 10 4B
REQ	PT	PF	RPT	0.0	Run-2	750.0			0.0	C9 58 10 0B
RPT	PF	PT	RACK	0.0	Run-1	0.0	REQ		0.0	A8 59 SS 0B

Change Trigger Definition:

None

Enabled Modes for Message Trigger:

(PT) RPT: Run
(PF) REQ: Run

Enabled Modes for Change Trigger:

None

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RACK	PF	PT	N/A		No	N/A	halt retry of RPT	X9 58 XX 4B
REQ	PF	PT	N/A	RPT	No	N/A		X9 58 XX 0B
RPT	PT	PF	(N/A)	RACK	Yes	(Limit Vehicle Speed)		X8 59 XX 0B

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) RACK: Run
(PF) REQ: Run
(PT) RPT: Run

Powertrain Interface Definition:

Suspension - Failure Status is monitored by Powertrain. Powertrain will limit the vehicle speed to a calibratable value when bit 4 of the RPT message(Dampers Failed to Full Soft) is set. No powertrain action is taken based on the other bits in the RPT message.

Platform Interface Definition:

Suspension - Failure Status is owned by Platform.

General Requirements

Data Definition (Reports and Loads only)

Failure Status - Bit Mapped without Mask (8 bits)					
Byte	Bit	Support	Description	Meaning of 0	Meaning of 1
1	7	Yes	Not Used (Reserved)		
	6	Yes	Not Used (Reserved)		
	5	Yes	Not Used (Reserved)		
	4	Yes	Dampers Failed to Full Soft	False	True
	3	Yes	Normal Force Invalid	False	True
	2	Yes	Controller Fault	False	True
	1	Yes	Steering Sensor Power Spply Failure	False	True
	0	Yes	Steering Sensor Data Failure	False	True

Valid Message Sequences:

REQ → RPT → RACK
RPT → RACK

5.1.8.61 Suspension-Suspension Options ($58/$3C)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PT	PF	RPT	0.0	Run-2	750.0			0.0	C9 58 10 3C
RPT	PF	PT		0.0	Run-1	0.0	REQ		0.0	88 59 SS 3C

Change Trigger Definition:
None

Enabled Modes for Message Trigger:
(PF) REQ: Run

Enabled Modes for Change Trigger:
None

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PF	PT	N/A	RPT	No	N/A		X9 58 XX 3C
RPT	PT	PF	$00		No	N/A		X8 59 XX 3C

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) REQ: Run
(PT) RPT: Run

Powertrain Interface Definition:
Suspension - Suspension Options is monitored by Powertrain. Powertrain uses this information to determine if the diagnostic test for the lift/dive line should be run. This message must be sent by some other module besides CVRTD in order to indicate whether CVRTD is present or not.

Platform Interface Definition:
Suspension - Suspension Options is owned by Platform.

General Requirements

Data Definition (Reports and Loads only)

Suspension Options - Bit Mapped without Mask (8 bits)					
Byte	Bit	Support	Description	Meaning of 0	Meaning of 1
1	7	Yes	Not Used (Reserved)		
	6	Yes	Not Used (Reserved)		
	5	Yes	Not Used (Reserved)		
	4	Yes	Not Used (Reserved)		
	3	Yes	Not Used (Reserved)		
	2	Yes	Not Used (Reserved)		
	1	Yes	Not Used (Reserved)		
	0	Yes	CVRTD Present	Not Present	Present

Valid Message Sequences:
REQ → RPT
RPT

5.1.8.62 Vehicle Speed Control-Set Speed - Low Res Metric ($62/$02)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RACK	PF	PT		0.0		0.0	RPT		0.0	C9 62 SS 42
REQ	PF	PT	RPT	0.0	Run-2	750.0			0.0	A9 62 SS 02
RPT Disable Enable	PT	PF	RACK	>300.0	Run-1	0.0	REQ	Q=Any, Vehicle Speed Setting - Lo Res Metr=1 kph	0.0	 88 63 10 02 88 63 10 82

Change Trigger Definition:
The PT shall transmit the RPT when the Q Bit changes state, when the Vehicle Speed Setting - Lo Res Metr parameter changes by 1 kph and no more than once every 300.0 ms.

Enabled Modes for Message Trigger:
(PF) RPT: Run
(PT) REQ: Run

Enabled Modes for Change Trigger:
(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RACK	PT	PF	N/A		No	N/A	halt retry of RPT	X9 62 XX 42
REQ	PT	PF	N/A	RPT	No	N/A		X9 62 XX 02
RPT Disable Enable	PF	PT	(Platform specific)	RACK	No	N/A		 X8 63 XX 02 X8 63 XX 82

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) RACK: Run
(PT) REQ: Run
(PF) RPT: Run

Powertrain Interface Definition:
Vehicle Speed Control - Set Speed, Low Res Metric is owned by Powertrain. Powertrain reports the cruise control active state and the cruise control set speed. Application Loop Time: 25 ms.
Platform Interface Definition:
Vehicle Speed Control - Set Speed, Low Res Metric is monitored by Platform. Platform uses this message for display purposes.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	Disable	Yes
1	Enable	Yes

Vehicle Speed Setting - Lo Res Metr - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	kph	To Engineering Units	N
Resolution	1	To Computer Units	E
Absolute Range	0-255		

Valid Message Sequences:
REQ → RPT → RACK
RPT → RACK

5.1.8.63 Vehicle Speed Control-Cruise Cancel ($62/$07)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD No/False Yes/True	PF	PT	RPT	0.0	Run-1	0.0	RQCV	Any	0.0	 88 62 SS 07 88 62 SS 87
RPT No/False Yes/True	PT	PF		0.0		0.0	LOAD		0.0	 88 63 10 07 88 63 10 87
RQCV	PT	PF	LOAD	0.0	Run-2	750.0			0.0	89 63 10 07

Change Trigger Definition:

The PF shall transmit the LOAD when the Q Bit changes state.

Enabled Modes for Message Trigger:

(PF) RQCV: Run
(PT) LOAD: Run

Enabled Modes for Change Trigger:

(PF) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD No/False Yes/True	PT	PF	No/False	RPT	Yes	Yes/True		 X8 62 XX 07 X8 62 XX 87
RPT No/False Yes/True	PF	PT			No	N/A		 X8 63 XX 07 X8 63 XX 87
RQCV	PF	PT	N/A	LOAD	No	N/A		X9 63 XX 07

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PT) LOAD: Run
(PF) RPT: Run
(PF) RQCV: Run

Powertrain Interface Definition:

Vehicle Speed Control - Cruise Cancel is owned by Powertrain. Powertrain will cancel cruise control if a "LOAD" message is received with the Q-bit = 1. When a "LOAD" message is then received with the Q-bit = 0, cruise control will resume control to the previous set speed once the "resume" switch is pressed. Powertrain sends a "RPT" message in response to the "LOAD" message to indicate Powertrain's latest received cruise cancel state.

Platform Interface Definition:

Vehicle Speed Control - Cruise Cancel is commanded by Platform. The message could be sent with the Q-bit = 1 to inform powertrain to cancel cruise due to one of the following reasons:

1. Cruise cancel switch is pressed ; 2. Parking brake is set; 3. A problem with the brake system is detected

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	No/False	Yes
1	Yes/True	Yes

Valid Message Sequences:

RQCV → LOAD → RPT
LOAD → RPT

5.1.8.64 Vehicle Speed Control-Speed Limit Value ($62/$10)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT	0.0	Run-2	750.0			0.0	C9 62 SS 10
RPT	PT	PF		0.0	Run-1	0.0	REQ		0.0	88 63 10 10

Change Trigger Definition:
None

Enabled Modes for Message Trigger:
(PT) REQ: Run

Enabled Modes for Change Trigger:
None

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	N/A	RPT	No	N/A		X9 62 XX 10
RPT	PF	PT	(Platform specific)		Yes	(Platform specific)		X8 63 XX 10

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) REQ: Run
(PF) RPT: Run

Powertrain Interface Definition:
Vehicle Speed Control - Speed Limit Value is owned by Powertrain. Once at initialization, powertrain reports the speed value at which the vehicle will be limited to in the event of a CVRTD failure.

Platform Interface Definition:
Vehicle Speed Control - Speed Limit Value is monitored by Platform. Platform uses this message for display purposes. This is the speed that the vehicle will be limited to if powertrain reports a CVRTD failure via a EA-20-D5 message to inform the driver that the vehicle speed will be limited.

General Requirements

Data Definition (Reports and Loads only)

Vehicle Speed Limit Value - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	kph	To Engineering Units	N
Resolution	1	To Computer Units	E
Absolute Range	0-255		

Valid Message Sequences:
REQ → RPT
RPT

5.1.8.65 Charging System-Field Duty Cycle ($72/$20)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT	0.0	Run-2	750.0			0.0	C9 72 SS 20
RPT	PT	PF		>100.0	Run-1	0.0	REQ	Field Duty Cycle=Any, Field Duty Cycle=5 %, Data = 0% or 100% Generator L Term Message=Any	0.0	88 73 10 20
RPT(F)	PT	PF						DTC P0622 Failure Condition		88 73 10 60

RPTF Transmit Value:
Data in RPTF is ignored

Change Trigger Definition:
The PT shall transmit the RPT when the Field Duty Cycle parameter changes state, when the Field Duty Cycle parameter changes by 5 % and the data = 0 % or 100 %, when the Generator L Term Message parameter changes state, when DTC P0622 failure condition occurs and no more than once every 100.0 ms.

Enabled Modes for Message Trigger:
(PT) REQ: Run

Enabled Modes for Change Trigger:
(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	N/A	RPT	No	N/A		X9 72 XX 20
RPT	PF	PT	(Platform specific)		Yes	(Platform specific)		X8 73 XX 20
RPT(F)	PT	PF					(Platform specific)	X8 73 XX 60

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) REQ: Run
(PF) RPT: Run
(PF) RPT(F): Run

Powertrain Interface Definition:
Charging System - Field Duty Cycle is owned by Powertrain. The generator F-terminal is read by the PCM. F-terminal duty cycle is used by the PCM as an indication of generator load.

Platform Interface Definition:
Charging System - Field Duty Cycle is monitored by Platform. Platform uses this message for electric power management.

General Requirements

Data Definition (Reports and Loads only)
Packet Byte 1

Field Duty Cycle - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	%	To Engineering Units	N/2.55
Resolution	100/255	To Computer Units	E*2.55
Absolute Range	0-100		

Packet Byte 2

Generator L Term Message - State Encoded (8 bits)		
State	Support	State Description

Generator L Term Message - State Encoded (8 bits)		
State	Support	State Description
00	Yes	Generator Enabled
01	Yes	Generator Disabled

Valid Message Sequences:

REQ → RPT(F)
RPT(F)

5.1.8.66 Charging System-L-Terminal Duty Cycle ($72/$24)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD	PF	PT	RPT	1000.0	Run-1	0.0	RQCV	L-Terminal Duty Cycle=0.5 %, Data = 0% or 100%	0.0	88 72 SS 24
RPT	PT	PF		0.0		0.0	LOAD		0.0	A8 73 10 24
RQCV	PT	PF	LOAD	0.0	Run-2	0.0			0.0	C9 73 SS 24

Change Trigger Definition:

The PF shall transmit the LOAD when the L-Terminal Duty Cycle parameter changes by 0.5% and the data = 0 % or 100 % and no more than once every 1000.0 ms.

Enabled Modes for Message Trigger:

(PT) LOAD: Run
(PF) RQCV: Run

Enabled Modes for Change Trigger:

(PF) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD	PT	PF	100% Duty Cycle	RPT	Yes	100% Duty Cycle		X8 72 XX 24
RPT	PF	PT			No	N/A		X8 73 XX 24
RQCV	PF	PT	N/A	LOAD	No	N/A		X9 73 XX 24

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PT) LOAD: Run
(PF) RPT: Run
(PF) RQCV: Run

Powertrain Interface Definition:

Charging System - L-Terminal Duty Cycle command is received by Powertrain. While the engine is running, Powertrain controls the generator L-terminal duty cycle equal to the commanded value in this message. Powertrain also reports back the L-Terminal Duty Cycle that was commanded in a RPT message to Platform as the acknowledgement that the message was received.

Platform Interface Definition:

Charging System - L-Terminal Duty Cycle is commanded by Platform to control the battery voltage as a function of its temperature and state of charge. This is done by adjusting the generator voltage setpoint using the Charging System - L-Terminal Duty Cycle command.

General Requirements

Data Definition (Reports and Loads only)

L-Terminal Duty Cycle - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	%	To Engineering Units	N/2.55
Resolution	100/255	To Computer Units	E*2.55
Absolute Range	0-100		

Valid Message Sequences:

RQCV → LOAD → RPT
LOAD → RPT

5.1.8.67 Electrical Energy Management-Requested Minimum Idle Boost Level ($74/$26)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RACK	PT	PF		0.0		0.0	RPT		0.0	C9 74 10 66
RPT	PF	PT	RACK	0.0		0.0		Any	0.0	88 75 SS 26

Change Trigger Definition:
The PF shall transmit the RPT when the Requested Minimum Idle Boost Level parameter changes state.

Enabled Modes for Message Trigger:
(PT) RPT: Run

Enabled Modes for Change Trigger:
(PF) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RACK	PF	PT	N/A		No	N/A	halt retry of RPT	X9 74 XX 66
RPT	PT	PF	$00	RACK	No	N/A		X8 75 XX 26

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) RACK: Run
(PT) RPT: Run

Powertrain Interface Definition:
Electrical Energy Management - Requested Minimum Idle Boost Level is monitored by Powertrain. Upon receipt of a RPT command from the platform requesting an idle boost level, powertrain will transmit a RACK message as feedback to platform. Each idle boost level will correspond to two minimum calibratable idle speed thresholds (one for in-gear and one for not-in-gear) which the PCM must maintain the engine speed above. The determination of the calibratable idle speed thresholds is a coordinated effort between Powertrain and Platform. Powertrain may support up to three separate idle boost levels depending on the vehicle:

Platform Interface Definition:
Electrical Energy Management - Requested Minimum Idle Boost Level is owned by Platform. This message is used to request powertrain to boost the idle speed due to excessive electrical loading on the vehicle.

Application Loop Time: N/A

General Requirements

Data Definition (Reports and Loads only)

Requested Minimum Idle Boost Level - State Encoded (8 bits)		
State	Support	State Description
00	Yes	No Boost
01	Yes	Boost Level 1
02	Yes	Boost Level 2
03	Yes	Boost Level 3

Valid Message Sequences:
RPT → RACK

5.1.8.68 Odometer-Vehicle, Metric ($7A/$01)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PT	PF	RPT	0.0	Run-2	750.0			0.0	E9 7A 10 01
RPT	PF	PT		>1000.0	Run-1	0.0	REQ	0.04 km	0.0	C8 7B SS 01

Change Trigger Definition:
The PF shall transmit the RPT when the Odometer Vehicle Metric parameter changes by 0.04 km (.04 km if used for display, 2km otherwise) and no more than once every 1000.0 ms.

Enabled Modes for Message Trigger:
(PF) REQ: Run

Enabled Modes for Change Trigger:
(PF) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PF	PT	N/A	RPT	No	N/A		X9 7A XX 01
RPT	PT	PF	(Use last known from KAM)		Yes	(Use last rec'vd odo value)		X8 7B XX 01

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) REQ: Run
(PT) RPT: Run

Powertrain Interface Definition:
Odometer - Vehicle, Metric is monitored by Powertrain. It will be used by the oil life algorithm, as well as by other algorithms which estimate engine friction, combustion chamber deposits, piston ring sealing, etc. based on engine revolutions. Engine revolutions will be estimated based on vehicle odometer when a PCM is replaced. Vehicle odometer may be required for future OBD2 diagnostics.

Platform Interface Definition:
Odometer - Vehicle, Metric is owned by Platform. Platform owns and maintains vehicle odometer and reports the value of vehicle odometer for powertrain usage.

General Requirements

Data Definition (Reports and Loads only)

Odometer Vehicle Metric - Unsigned Numeric (32 bits)			
Encoding		Transfer Functions	
Units	km	To Engineering Units	N/64
Resolution	1/64	To Computer Units	E * 64
Absolute Range	0-67108862.5		

Valid Message Sequences:
REQ → RPT
RPT

5.1.8.69 Odometer-Rolling Count ($7A/$06)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT(F)	0.0	Run-2	750.0			0.0	A9 7A SS 06
RPT No RC Reset RC Reset Occurd	PT	PF		>1000.0	Run-1	0.0	REQ	Q=Any, Cumulative Distance Traveled=100 Pulses	0.0	 88 7B 10 06 88 7B 10 86
RPT(F) No RC Reset RC Reset Occurd	PT	PF						Failure Condition		 88 7B 10 46 88 7B 10 C6

RPTF Transmit Value:
Data in RPTF is ignored

Change Trigger Definition:
The PT shall transmit the RPT when the Q Bit changes state, when the Cumulative Distance Traveled parameter changes by 100 Pulses (40 pulse delta=100 ms Min Rep, 100 pulse delta=1 sec Min Rep) and no more than once every 1000.0 ms.

Enabled Modes for Message Trigger:
(PT) REQ: Run

Enabled Modes for Change Trigger:
(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	N/A	RPT(F)	No	N/A		X9 7A XX 06
RPT No RC Reset RC Reset Occurd	PF	PT	(Use last value in KAM)		Yes	(Platform specific)		 X8 7B XX 06 X8 7B XX 86
RPT(F) No RC Reset RC Reset Occurd	PF	PT					Use last value in KAM	 X8 7B XX 46 X8 7B XX C6

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) REQ: Run
(PF) RPT: Run
(PF) RPT(F): Run

Powertrain Interface Definition:
Powertrain shall read the VSS sensor and perform a calculation to convert the sensor information into odometer pulses (each represents 1/4000 miles). Powertrain shall allow the counter of odometer pulses to roll over (start over). Powertrain shall inhibit sending the initialization message until odometer pulses are determined. Powertrain and Platform must maintain the odometer rolling count in some type of battery backed keep alive memory to retain the latest value of odometer rolling count over ignition cycles. To avoid loss of data or inaccurate data used by Platform, Powertrain will send a message with the Q-bit set to 1 whenever the Powertrain memory that maintains odometer rolling count is reset to 0 due to a memory failure, loss of battery power, PCM box swap detection, etc.

Platform Interface Definition:
Platform shall read the Odometer Rolling Count Class 2 message and use it to increment the odometer display. Platform shall keep track of counter rollovers. Powertrain and Platform must maintain the odometer rolling count in some type of battery backed keep alive memory to retain the latest value of odometer rolling count over ignition cycles. When a message is received with the Q-bit set to 1 (which indicates that the PCM memory has been reset), the platform module should reset its odometer rolling count to the data value within the message. Other Platform strategies for detecting invalid data from Powertrain may also be implemented.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	No RC Reset	Yes
1	RC Reset Occurd	Yes

Cumulative Distance Traveled - Unsigned Numeric (16 bits)			
Encoding		Transfer Functions	
Units	Pulses	To Engineering Units	N
Resolution	1	To Computer Units	E
Absolute Range	0-65535		

Valid Message Sequences:

REQ → RPT(F)
RPT(F)

5.1.8.70 Fuel System-Cumulative Fuel ($82/$0A)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT	0.0	Run-2	750.0			0.0	A9 82 SS 0A
RPT Not Reset Reset	PT	PF		500.0	Run-1	0.0	REQ	Periodic	0.0	 88 83 10 0A 88 83 10 8A

Change Trigger Definition:
The PT shall transmit the RPT every 500.0 ms.

Enabled Modes for Message Trigger:
(PT) REQ: Run

Enabled Modes for Change Trigger:
None

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	N/A	RPT	No	N/A		X9 82 XX 0A
RPT Not Reset Reset	PF	PT	(Use last value from KAM)		Yes	(Platform specific)		 X8 83 XX 0A X8 83 XX 8A

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) REQ: Run
(PF) RPT: Run

Powertrain Interface Definition:
Fuel System - Cumulative Fuel is owned by Powertrain. It is the accumulated fuel amount which is delivered to the engine. Accuracy of cumulative fuel is ± 20% due to large errors from fuel system hardware variation. Powertrain allows the counter to roll over (start over). The platform module must keep track of roll-overs. Powertrain and platform must maintain cumulative fuel in some type of battery backed keep alive memory to retain the latest value of cumulative fuel over ignition cycles. To avoid loss of data or inaccurate data used by Platform, Powertrain will send a message with the Q-bit set to 1 whenever the Powertrain memory which maintains cumulative fuel is reset to 0 due to a memory failure, loss of battery power, PCM box swap detection, etc.

Application Loop Time: 500 ms.

Platform Interface Definition:
Fuel System - Cumulative Fuel is monitored by Platform. This message is used to determine fuel used, instantaneous fuel economy, etc. Powertrain allows the counter to roll over (start over). The platform module must keep track of roll overs. Powertrain and platform must maintain cumulative fuel in some type of battery backed keep alive memory to retain the latest value of cumulative fuel over ignition cycles. When a message is received with the Q-bit set to 1 (which indicates that the PCM memory has been reset), the platform module should reset its cumulative fuel memory to 0 Litres. If Platform detects a restoration of Class 2 communications from Powertrain after a loss of communications with Powertrain (indicated by a state of health failure), Platform should reset its cumulative fuel memory to the value received in the next Cumulative Fuel message from Powertrain.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	Not Reset	Yes
1	Reset	Yes

Cumulative Fuel - Unsigned Numeric (16 bits)	
Encoding	Transfer Functions

Cumulative Fuel - Unsigned Numeric (16 bits)			
Encoding		Transfer Functions	
Units	liters	To Engineering Units	N/20000
Resolution	1/20000	To Computer Units	E * 20000
Absolute Range	0-3.27675		

Valid Message Sequences:

REQ → RPT
RPT

5.1.8.71 Fuel System-Fuel Level-Percent (Filtered) ($82/$12)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT(F)	0.0	Run-2	750.0			0.0	C9 82 SS 12
RPT	PT	PF		>500.0	Run-1	0.0	REQ	1 %, Data = 0% or 100%	0.0	A8 83 10 12
RPT(F)	PT	PF						Failure Condition		A8 83 10 52

RPTF Transmit Value:
Data in RPTF is ignored

Change Trigger Definition:
The PT shall transmit the RPT when the Fuel Level Percent Filtered parameter changes by 1 % and the data = 0 % or 100 % and no more than once every 500.0 ms.

Enabled Modes for Message Trigger:
(PT) REQ: Run

Enabled Modes for Change Trigger:
(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	N/A	RPT(F)	No	N/A		X9 82 XX 12
RPT	PF	PT	(Platform specific)		Yes	(Platform specific)		X8 83 XX 12
RPT(F)	PF	PT					Platform specific	X8 83 XX 52

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) REQ: Run
(PF) RPT: Run
(PF) RPT(F): Run

Powertrain Interface Definition:
Fuel System - Fuel Level-Percent (Filtered) is owned by Powertrain. It is the filtered fuel level in percent of advertised fuel tank capacity. There are two calibratable filter coefficients which are available to allow for quicker filtering during a fuel fill operation. The slow filter will be used during normal operation. The fast filter will be used if the engine run time is less than a calibration, the fuel volume is less than a threshold or the transmission is in park or neutral. The calibratable engine run time period allows for the gauge to ramp to the fuel level quickly on each startup if desired.

Application Loop Time: 500 ms.

Platform Interface Definition:
Fuel System - Fuel Level-Percent (Filtered) is monitored by Platform. This message is used to display the fuel level to the driver and for trip computer functions.

General Requirements

Data Definition (Reports and Loads only)

Fuel Level Percent Filtered - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	%	To Engineering Units	N/2.55
Resolution	100/255	To Computer Units	E*2.55
Absolute Range	0-100		

Valid Message Sequences:
REQ → RPT(F)
RPT(F)

5.1.8.72 Fuel System-Fuel Capacity, Metric ($82/$16)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT	0.0	Run-2	750.0			0.0	E9 82 SS 16
RPT	PT	PF		0.0	Run-1	0.0	REQ		0.0	C8 83 10 16

Change Trigger Definition:
None

Enabled Modes for Message Trigger:
(PT) REQ: Run

Enabled Modes for Change Trigger:
None

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	N/A	RPT	No	N/A		X9 82 XX 16
RPT	PF	PT	(KAM value or calibration)		No	N/A		X8 83 XX 16

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) REQ: Run
(PF) RPT: Run

Powertrain Interface Definition:

Fuel System - Fuel Capacity, Metric is owned by Powertrain. It is the advertised fuel tank capacity in litres. This message is only sent during initialization.

Platform Interface Definition:

Fuel System - Fuel Capacity, Metric is monitored by Platform. Platform may use this data in conjunction with message 82-12 (Fuel Level - Percent Filtered) to determine Fuel Volume for trip computer functions.

General Requirements

Data Definition (Reports and Loads only)

Fuel Capacity - Unsigned Numeric (16 bits)			
Encoding		Transfer Functions	
Units	liters	To Engineering Units	N/100
Resolution	1/100	To Computer Units	E*100
Absolute Range	0-655.35		

Valid Message Sequences:
REQ → RPT
RPT

5.1.8.73 Vehicle Motion-Actual Lateral Acceleration ($84/$03)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PT	PF	RPT(F)	0.0	Run-2	750.0			0.0	A9 84 10 03
RPT	PF	PT		>100.0	Run-1	0.0	REQ	0.05 g's	0.0	68 85 SS 03
RPT(F)	PF	PT						Failure Condition		68 85 SS 43

RPTF Transmit Value:
Data in RPTF is ignored

Change Trigger Definition:
The PF shall transmit the RPT when the Actual Lateral Acceleration parameter changes by 0.05 g's and no more than once every 100.0 ms.

Enabled Modes for Message Trigger:
(PF) REQ: Run

Enabled Modes for Change Trigger:
(PF) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PF	PT	N/A	RPT(F)	No	N/A		X9 84 XX 03
RPT	PT	PF	0 g's		Yes	(High Perf Shift disabled)		X8 85 XX 03
RPT(F)	PT	PF					Use Default-0 g's	X8 85 XX 43

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) REQ: Run
(PT) RPT: Run
(PT) RPT(F): Run

Powertrain Interface Definition:

Vehicle Motion - Actual Lateral Acceleration is monitored by Powertrain. Powertrain uses this data as an input to the high performance shift control algorithm to determine whether or not it should be enabled.

Platform Interface Definition:

Vehicle Motion - Actual Lateral Acceleration is owned by Platform. This message represents the lateral acceleration of the vehicle as measured.

General Requirements

Data Definition (Reports and Loads only)

Actual Lateral Acceleration - Signed Numeric (Two's Complement) (8 bits)			
Encoding		Transfer Functions	
Units	g's	To Engineering Units	N/100
Resolution	.01	To Computer Units	E*100
Absolute Range	-1.28-1.27		

Valid Message Sequences:
REQ → RPT(F)
RPT(F)

5.1.8.74 Ignition Switch/Starter-Crank Aborted ($86/$15)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RACK	PF	PT		0.0		0.0	RPT		0.0	A9 86 XX 55
RPT No/False Yes/True	PT	PF	RACK	0.0		0.0		Any	0.0	 88 87 XX 15 88 87 XX 95

Change Trigger Definition:
The PT shall transmit the RPT when the Q Bit changes state.

Enabled Modes for Message Trigger:
(PF) RPT: Off Awake, Crank

Enabled Modes for Change Trigger:
(PT) RPT: Off Awake, Crank

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RACK	PT	PF	N/A		No	N/A	halt retry of RPT	X9 86 XX 55
RPT No/False Yes/True	PF	PT	No/False	RACK	No	N/A		 X8 87 XX 15 X8 87 XX 95

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) RACK: Off Awake, Crank
(PF) RPT: Off Awake, Crank

Powertrain Interface Definition:
Ignition Switch/Starter - Crank Aborted is owned by Powertrain. For definition, refer to Section 4.1.7 of the Starter Control Algorithm.

Platform Interface Definition:
Ignition Switch/Starter - Crank Aborted is monitored by Platform. This message is used for Easy Key and Remote Vehicle Start (RVS) systems to determine which power mode the vehicle should transition to after an aborted engine start. It is also used by the RVS system to limit the number of start attempts.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	No/False	Yes
1	Yes/True	Yes

Valid Message Sequences:
RPT → RACK

5.1.8.75 Ignition Switch/Starter-Remote Start Crank ($86/$16)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RACK	PT	PF		0.0		0.0	RPT		0.0	C9 86 10 56
REQ	PT	PF	RPT	0.0	Off Awake-2 Run-2 RAP-2	0.0			0.0	C9 86 10 16

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RPT No/False Yes/True	PF	PT	RACK	0.0	Off Awake-1 Run-1 RAP-1	850.0	REQ	Any	0.0	 A8 87 40 16 A8 87 40 96

Change Trigger Definition:
The PF shall transmit the RPT when the Q Bit changes state (Used to initiate remote vehicle start. When not needed, RPT will be sent with Qbit=false.) .

Enabled Modes for Message Trigger:
(PT) RPT: Off Awake, Run, RAP
(PF) REQ: Off Awake, Run, RAP

Enabled Modes for Change Trigger:
(PF) RPT: Off Awake, Run, RAP

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RACK	PF	PT	N/A		No	N/A	halt retry of RPT	X9 86 XX 56
REQ	PF	PT	N/A	RPT	No	N/A	Xmit RPT	X9 86 XX 16
RPT No/False Yes/True	PT	PF	No/False	RACK	Yes	No/False	Used to initiate remote vehicle start	 X8 87 XX 16 X8 87 XX 96

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) RACK: Off Awake, Run, RAP
(PF) REQ: Off Awake, Run, RAP
(PT) RPT: Off Awake, Run, RAP

Powertrain Interface Definition:
Ignition Switch/Starter – Remote Start Crank is received by Powertrain on vehicles with Remote Vehicle Start (RVS). When the Q-bit is set to 1, this message serves as a request to crank (see starter control algorithm in section 4.1) and criteria for keeping the engine running in remote mode (see RVS Monitor algorithm in section 4.7).

Output Actuation Delay: 150 ms.

Platform Interface Definition:
Ignition Switch/Starter – Remote Start Crank is transmitted by Platform from the RVS system. The Q-bit of this message is set to 1 when the RVS system is requesting remote start to be active. If remote start and run are not desired for any reason by the RVS system, the Q-bit of this message shall be set to 0.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	No/False	Yes
1	Yes/True	Yes

Valid Message Sequences:
REQ → RPT → RACK
RPT → RACK

5.1.8.76 Ignition Switch/Starter-Remote Start Aborted ($86/$18)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RACK	PF	PT		0.0		0.0	RPT		0.0	C9 86 40 58
REQ	PF	PT	RPT	0.0	Off Awake-2	950.0			0.0	C9 86 40 18

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RPT No/False Yes/True	PT	PF	RACK	0.0	Off Awake-1	0.0	REQ	Any	0.0	 A8 87 10 18 A8 87 10 98

Change Trigger Definition:

The PT shall transmit the RPT when the Q Bit changes state (Powertrain disables fuel for engine protect. reasons or gear not equal to Park) .

Enabled Modes for Message Trigger:

(PF) RPT: Off Awake
(PT) REQ: Off Awake

Enabled Modes for Change Trigger:

(PT) RPT: Off Awake

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RACK	PT	PF	N/A		No	N/A	halt retry of RPT	X9 86 XX 58
REQ	PT	PF	N/A	RPT	No	N/A	Xmit RPT	X9 86 XX 18
RPT No/False Yes/True	PF	PT	No/False	RACK	Yes	No/False	Used to exit remote vehicle start	 X8 87 XX 18 X8 87 XX 98

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PT) RACK: Off Awake
(PT) REQ: Off Awake
(PF) RPT: Off Awake

Powertrain Interface Definition:

Ignition Switch/Starter - Remote Start Aborted is owned by Powertrain. The Q-bit of this message is set to 1 when the PCM has disabled fuel during remote engine running operation and the fuel disable is for conditions that do not allow a re-start. Refer to Section 4.7.4.1 of the RVS Monitor Algorithm.

Data Delay: 1 second

Platform Interface Definition:

Ignition Switch/Starter - Remote Start Aborted is monitored by Platform. This message is used for Remote Vehicle Start (RVS) to take appropriate action, including denying any further remote start attempts until the ignition switch is cycled.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	No/False	Yes
1	Yes/True	Yes

Valid Message Sequences:

REQ → RPT → RACK
RPT → RACK

5.1.8.77 Vehicle Security-Password ($92/$01)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PT	PF	RPT	0.0	Accessory-2 Run-2 Crank-2	750.0			0.0	49 92 10 01
RPT	PF	PT	RPT[1]	50.0	Accessory-1 Run-1 Crank-1	0.0	REQ	PerEnabled,	0.0	28 93 SS 01

Change Trigger Definition:
The PF shall transmit the RPT (Sent periodically until Fuel Continue bit (bit 0) in $92/$02 set.) and once every 50.0 ms when enabled.

Enabled Modes for Message Trigger:
(PF) REQ: Accessory, Run, Crank

Enabled Modes for Change Trigger:
(PF) RPT: Accessory, Run, Crank

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PF	PT	N/A	RPT	No	N/A		X9 92 XX 01
RPT	PT	PF	(Assume Password Unmatched)		Yes	(Enter fail-enable mode)		X8 93 XX 01

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) REQ: Accessory, Run, Crank
(PT) RPT: Accessory, Run, Crank

Powertrain Interface Definition:
Vehicle Security - Password is monitored by Powertrain. Powertrain compares the password transmitted in the RPT message with its internally learned password to determine if fuel should be enabled to allow engine run. Powertrain reports the security status by transmitting a 92-02 RPT message whenever the status changes or in response to a 92-01 RPT. Powertrain shall allow engine run regardless of correct password if state of health failure occurs while engine is running.

Platform Interface Definition:
Vehicle Security - Password is owned by Platform. Platform periodically transmits the until Powertrain indicates that it has received the correct password and is enabling fuel to allow engine run. Powertrain indicates the security status through the 92-02 message. To avoid setting codes and taking failsoft action, it is important that the Platform controller be awake during the power modes that the Powertrain controller is awake.

Application Loop Time: 50 ms.

General Requirements

Data Definition (Reports and Loads only)

Vehicle Security Fuel Enable - Unsigned Numeric (16 bits)			
Encoding		Transfer Functions	
Units		To Engineering Units	N/A
Resolution	1	To Computer Units	N/A
Absolute Range	0000-FFFF		

Valid Message Sequences:
REQ → RPT
RPT

5.1.8.78 Vehicle Security-Powertrain Status ($92/$02)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RACK	PF	PT		0.0		0.0	RPT		0.0	49 92 SS 42
RPT	PT	PF	RACK	0.0	Accessory-1 Run-1 Crank-1	0.0	RPT[1]	Any	0.0	28 93 10 02

Change Trigger Definition:

The PT shall transmit the RPT when the Vehicle Security Fuel Enable parameter changes state.

Enabled Modes for Message Trigger:

(PF) RPT: Accessory, Run, Crank
(PT) 92 01 NA RPT: Accessory, Run, Crank

Enabled Modes for Change Trigger:

(PT) RPT: Accessory, Run, Crank

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RACK	PT	PF	N/A		No	N/A	halt retry of RPT	X9 92 XX 42
RPT	PF	PT	(Xmit 92-01 til 92-02 rcv)	RACK	Yes	(Platform specific)		X8 93 XX 02

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PT) RACK: Run, Crank
(PF) RPT: Accessory, Run, Crank

Powertrain Interface Definition:

Vehicle Security - Powertrain Status is owned by Powertrain. Powertrain reports the security status by transmitting a 92-02 RPT message whenever the status changes or in response to a 92-01 RPT. Application Loop Time: 50 ms.

Platform Interface Definition:

Vehicle Security - Powertrain Status is monitored by Platform. Platform monitors the RPT from Powertrain to determine the theft status within the PCM. Platform periodically transmits the 92-01 password until Powertrain indicates that it has received the correct password. This is indicated by bit 0 being set to 1 in the status byte. If a state of health failure occurs, Platform will typically set a communications diagnostic code and illuminate a telltale. To avoid setting codes and taking failsoft action, it is important that the Platform controller be awake during the Power Modes that the Powertrain controller is awake.

General Requirements

Data Definition (Reports and Loads only)

Vehicle Security Fuel Enable - Bit Mapped without Mask (8 bits)					
Byte	Bit	Support	Description	Meaning of 0	Meaning of 1
1	7	No	Not Used (Reserved)		
	6	No	Not Used (Reserved)		
	5	Yes	Password Learning Enabled	No	Yes
	4	Yes	VTD Fail-Enable Active	No	Yes
	3	Yes	Auto Learn Timer Active	No	Yes
	2	Yes	Fuel Disable Until Ign Off State	No	Yes
	1	Yes	Fuel Disable Timeout State	No	Yes
	0	Yes	Fuel Continue State	No	Yes

Valid Message Sequences:

RPT → RACK

5.1.8.79 Climate Control (HVAC)-Fluid Pressure, High Side ($B2/$11)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT(F)	0.0	Run-2	750.0			0.0	C9 B2 SS 11
RPT	PT	PF		>300.0	Run-1	0.0	REQ	28 kPaG	0.0	A8 B3 10 11
RPT(F)	PT	PF						Failure Condition		A8 B3 10 51

RPTF Transmit Value:
Data in RPTF is ignored

Change Trigger Definition:
The PT shall transmit the RPT when the HVAC High Side Fluid Pressure parameter changes by 28 kPaG and no more than once every 300.0 ms.

Enabled Modes for Message Trigger:
(PT) REQ: Run

Enabled Modes for Change Trigger:
(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	N/A	RPT(F)	No	N/A		X9 B2 XX 11
RPT	PF	PT	(Platform specific)		Yes	(Platform specific)		X8 B3 XX 11
RPT(F)	PF	PT					Platform specific	X8 B3 XX 51

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) REQ: Run
(PF) RPT: Run
(PF) RPT(F): Run

Powertrain Interface Definition:
Climate Control (HVAC) - Fluid Pressure, High Side is owned by Powertrain. It is the filtered fluid pressure read from the high pressure side of the refrigerant system.

Application Loop Time: 25 ms.

Platform Interface Definition:
Climate Control (HVAC) - Fluid Pressure, High Side is monitored by Platform. It is used for compressor protections.

General Requirements

Data Definition (Reports and Loads only)

HVAC High Side Fluid Pressure - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	kPaG	To Engineering Units	N*14
Resolution	14	To Computer Units	E / 14
Absolute Range	0-3570		

Valid Message Sequences:
REQ → RPT(F)
RPT(F)

5.1.8.80 Climate Control (HVAC)-Low Side Fluid Temp ($B2/$20)

This message is optional (only used with applications that contain a Low Side Fluid Temperature Sensor)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PT	PF	RPT(F)	0.0	Run-2	750.0			0.0	C9 B2 10 20
RPT	PF	PT		>300.0	Run-1	0.0	REQ	1 øC	0.0	A8 B3 SS 20
RPT(F)	PF	PT						Failure Condition		A8 B3 SS 60

RPTF Transmit Value:
Data in RPTF is ignored

Change Trigger Definition:
The PF shall transmit the RPT when the HVAC Low Side Fluid Temperature parameter changes by 1 øC and no more than once every 300.0 ms.

Enabled Modes for Message Trigger:
(PF) REQ: Run

Enabled Modes for Change Trigger:
(PF) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PF	PT	N/A	RPT(F)	No	N/A		X9 B2 XX 20
RPT	PT	PF	(Calibratable Value)		Yes	(Calibratable Value)		X8 B3 XX 20
RPT(F)	PT	PF					Calibratable Value	X8 B3 XX 60

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) REQ: Run
(PT) RPT: Run

Powertrain Interface Definition:
Climate Control (HVAC) - Low Side Fluid Temp is monitored by Powertrain. Powertrain uses Climate Control (HVAC) - Low Side Fluid Temp in the A/C Compressor torque model calculations.

Platform Interface Definition:
Climate Control (HVAC) - Low Side Fluid Temp is owned by Platform. It is the fluid temperature read from the low pressure side of the refrigerant system.

Application Loop Time: 100 ms.

General Requirements

Data Definition (Reports and Loads only)

HVAC Low Side Fluid Temperature - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	øC	To Engineering Units	N-40
Resolution	1	To Computer Units	E+40
Absolute Range	-40-+215		

Valid Message Sequences:
REQ → RPT(F)
RPT(F)

5.1.8.81 Climate Control (HVAC)-Options ($B2/$3C)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PT	PF	RPT	0.0	Run-4	0.0			0.0	C9 B2 10 3C
RPT	PF	PT		0.0	Run-3	0.0	REQ		0.0	A8 B3 SS 3C

Change Trigger Definition:
None

Enabled Modes for Message Trigger:
(PF) REQ: Run

Enabled Modes for Change Trigger:
None

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PF	PT	N/A	RPT	No	N/A		X9 B2 XX 3C
RPT	PT	PF	(Use value in NVM)		No	N/A		X8 B3 XX 3C

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) REQ: Run
(PT) RPT: Run

Powertrain Interface Definition:
Climate Control (HVAC) - Options is monitored by Powertrain. It is used on vehicles with optional A/C to determine whether A/C is present on the vehicle so that A/C Compressor diagnostics can be enabled if A/C is present. Only Byte #2, Bit #7 is used to determine whether A/C is present on the vehicle. The A/C Compressor present information is stored in non-volatile memory in the PCM so that it can be used if serial data communications is ever lost with the Platform module that transmits this message.

Platform Interface Definition:
Climate Control (HVAC) - Options is owned by the Platform. The Platform indicates HVAC option content in the following way:

General Requirements

Data Definition (Reports and Loads only)

HVAC System Options - Bit Mapped without Mask (24 bits)					
Byte	Bit	Support	Description	Meaning of 0	Meaning of 1
1	7	No	After Blow Option	No	Yes
	6	No	After Boil Option	No	Yes
	5	No	Heated Windshield	Not Present	Present
	4	No	Timed Recirc Option	Not Present	Present
	3	No	Dual Zone System	No	Yes
	2	No	Climate Control Panel Present	No	Yes
	1	No	Manual	No	Yes
	0	No	Automatic	No	Yes
2	7	Yes	A/C Compressor	Not Present	Present
	6	No	Rear Defog	Not Present	Present
	5	No	Not Used (Reserved)		
	4	No	Not Used (Reserved)		
	3	No	Not Used (Reserved)		
	2	No	Not Used (Reserved)		
	1	No	Not Used (Reserved)		
	0	No	Not Used (Reserved)		
3	7	No	Not Used (Reserved)		
	6	No	Not Used (Reserved)		
	5	No	Not Used (Reserved)		
	4	No	Not Used (Reserved)		
	3	No	Not Used (Reserved)		
	2	No	Not Used (Reserved)		

HVAC System Options - Bit Mapped without Mask (24 bits)					
Byte	Bit	Support	Description	Meaning of 0	Meaning of 1
	1	No	Not Used (Reserved)		
	0	No	Not Used (Reserved)		

Valid Message Sequences:

REQ → RPT
RPT

5.1.8.82 Restraints-Airbags Deployed ($D2/$07)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RACK	PT	PF		0.0		0.0	RPT		0.0	A9 D2 10 47
RPT	PF	PT	RACK	300.0	Run-1	0.0	REQ	Any	0.0	88 D3 SS 07

Change Trigger Definition:

The PF shall transmit the RPT when the Q Bit changes state and once every 300.0 ms when enabled.

Enabled Modes for Message Trigger:

None

Enabled Modes for Change Trigger:

(PF) RPT: Run, Crank

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RACK	PF	PT	N/A		No	N/A	halt retry of RPT	X9 D2 XX 47
RPT	PT	PF	No/False	RACK	No	N/A		X8 D3 XX 07

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) RACK: Run, Crank
(PT) RPT: Run, Crank

Powertrain Interface Definition:

Airbags Deployed ($D2/$07) is monitored by Powertrain. Powertrain uses the reported airbag state to trigger the ETC flight recorder. It may also be used to disengage cruise control.

Platform Interface Definition:

Airbags Deployed ($D2/$07) is owned by Platform. Platform reports to Powertrain the state of the first Airbag Deployment.

5.1.8.83 Tires-Spare Status ($E4/$18)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PT	PF	RPT	0.0	Run-4	0.0			0.0	C9 E4 10 18
RPT	PF	PT		0.0	Run-3	1000.0	REQ	Any	0.0	88 E5 SS 18

Change Trigger Definition:

The PF shall transmit the RPT when the Tires-Spare Status changes state.

Enabled Modes for Message Trigger:

(PF) REQ: Run

Enabled Modes for Change Trigger:

(PF) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PF	PT	N/A	RPT	No	N/A		X9 E4 XX 18
RPT	PT	PF	Use last known value in NVM		Yes	Disable all wheel drive		X8 E5 XX 18

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) REQ: Run
(PT) RPT: Run

Powertrain Interface Definition:
Tires - Spare Status is monitored by Powertrain. Powertrain shall disable the All Wheel Drive system and potentially disable the differential score algorithm if the status of the message is “Spare Detected”. Powertrain shall utilize the previous known state of this message if the state of the message is “Undetermined”. This previous state shall be stored in non-volatile memory for retention between key cycles. In the event of a failure of non-volatile memory and the status of the message is “No Spare Detected”, Powertrain shall default the All Wheel Drive system to Active.

Platform Interface Definition:
Tires - Spare Status is owned by Platform. It is an indication of whether a mini-spare tire is present on the vehicle. The “Undetermined” state shall be sent by Platform when it is not possible to determine whether a mini-spare is on the vehicle. This will generally occur at initial start up of the vehicle, when vehicle speed is zero.

General Requirements

Data Definition (Reports and Loads only)

Tires-Spare Status - State Encoded (8 bits) (*=Power up default)		
State	Support	State Description
00*	Yes	Undetermined
01	Yes	No Spare Detected
02	Yes	Spare Detected

Valid Message Sequences:
REQ → RPT
RPT

5.1.8.84 Displays-PRNDL ($EA/$0A)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD	PT	PF	RPT	>100.0	Accessory-1 Run-1	0.0	RQCV	Any	0.0	68 EA 10 0A
RPT	PF	PT		0.0		0.0	LOAD		0.0	88 EB SS 0A
RQCV	PF	PT	LOAD	0.0	Accessory-2 Run-2	0.0			0.0	A9 EB SS 0A

Change Trigger Definition:

The PT shall transmit the LOAD when the Displays PRNDL parameter changes state and no more than once every 100.0 ms.

Enabled Modes for Message Trigger:

(PT) RQCV: Accessory, Run
(PF) LOAD: Accessory, Run

Enabled Modes for Change Trigger:

(PT) LOAD: Accessory, Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD	PF	PT	$00	RPT	Yes	$00		X8 EA XX 0A
RPT	PT	PF			No	N/A		X8 EB XX 0A
RQCV	PT	PF	N/A	LOAD	No	N/A		X9 EB XX 0A

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) LOAD: Accessory, Run
(PT) RPT: Accessory, Run
(PT) RQCV: Accessory, Run

* The message will be enabled in these modes only if the PCM is powered. For the five position ignition switch, the PCM may not be powered in the ACCESSORY power mode.

Powertrain Interface Definition:

Displays - PRNDL is commanded by Powertrain. Powertrain commands the state of PRNDL based on the unfiltered value of the four Mode Indication switch inputs to the PCM (PRNDL A, PRNDL B, PRNDL C, and PRNDL P) on electronically-controlled automatic transmissions. The Mode Indication switch inputs are read and processed every 12.5 ms. If the Mode Indication switch is failed, the transmission pressure switch (PSM) is used if available to determine PRNDL when in D1, D2, D3, D4, or R when the engine is running. The PSM is read and processed every 25 ms. The PSM information is invalid when the engine is not running or in P/N. Therefore, an invalid PRNDL state will be commanded when a valid PRNDL state can not be determined due to a failure which does not allow a valid state to be determined or if the PRNDL position is actually between valid positions. Powertrain will requeue the Displays - PRNDL message if the PRNDL state in the RPT message received from Platform is not equal to the last commanded PRNDL state.

Platform Interface Definition:

Displays - PRNDL is owned by Platform. This message is primarily intended for display purposes however it may be monitored by other Platform devices. Upon receipt of the LOAD message, the Platform display module must provide closed loop feedback to the PCM by sending a RPT message with the value of the PRNDL state which was received in the LOAD message. A Platform non-display device that requires PRNDL information will monitor the LOAD message from the PCM however it shall not respond with a RPT message. The brake apply sensing system uses this in its algorithm for determining brake lamp operation in the event of a brake apply sensor failure.

General Requirements

Data Definition (Reports and Loads only)

Displays PRNDL - State Encoded (8 bits)		
State	Support	State Description

Displays PRNDL - State Encoded (8 bits)		
State	Support	State Description
00	Yes	Invalid PRNDL State
01	Yes	Park (P)
02	Yes	Reverse (R)
03	Yes	Neutral (N)
04	No	Overdrive (OD)
05	No	Drive (D)
06	Yes	D1
07	Yes	D2
08	Yes	D3
09	Yes	D4
0A	Yes	D5
0B	Yes	D6

Valid Message Sequences:
RQCV → LOAD → RPT
LOAD → RPT

5.1.8.85 Displays-Driver Notification- Transmission Shifts Delayed ($EA/$20/$76)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	0.0	RQCV	Any	0.0	 8A EA 10 20 76 8A EA 10 A0 76
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	
RQCV	PF	PT	LOAD	0.0	Run-2	0.0			0.0	

Change Trigger Definition:
The PT shall transmit the LOAD when the Q Bit changes state when enabled.

Enabled Modes for Message Trigger:
(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:
(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	Disable + $00	RPT	No	N/A		
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 76 XA EB XX A0 76
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 76

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition:
Displays – Transmission Shifts Delayed is commanded by Powertrain. Powertrain commands the state of Transmission Shift Delayed when a transmission shifts has been delayed by the powertrain controller because the transmission logic has entered the Heater Performance Mode. Following cold starts, this mode improves heater

performance by maintaining the engine at higher RPMs for a greater period of time to allow for quicker engine warm-up. Under delayed shift conditions, the powertrain controller will command a LOAD message with the Q-bit set to 1 to command a “shift delayed message”. The PKT data will always be $00 since the PCM does not control the period, duty cycle, or criticality of the displays.

Platform Interface Definition:
Displays –Transmission Shifts Delayed is owned by Platform. The message indicates to the vehicle operator that the transmission shifts have been delayed due to enabling of the Heater Performance Mode. This message is used for display purposes only. Upon receipt of the LOAD message, the Platform module provides closed loop feedback to Powertrain by sending a RPT message. Typically, the RPT message in response to a LOAD should reflect the action that was taken as opposed to simply acknowledging the receipt of the LOAD message, however in this case, Powertrain is only concerned that the Platform module received the latest message.

5.1.8.86 Displays-Driver Notification- Engine Overspeed Warning ($EA/$20/$77)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	0.0	RQCV	Any	0.0	 8A EA 10 20 77 8A EA 10 A0 77
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	
RQCV	PF	PT	LOAD	0.0	Run-2	0.0			0.0	

Change Trigger Definition:
The PT shall transmit the LOAD when the Q Bit changes state when enabled.

Enabled Modes for Message Trigger:
(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:
(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	Disable + $00	RPT	No	N/A		
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 77 XA EB XX A0 77
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 77

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition:
Displays – Engine Overspeed Warning is commanded by Powertrain. Powertrain commands the state of Engine Overspeed Warning when an engine overspeed condition has occurred. The engine overspeed information represents the Tachometer “Red Line” point. When engine overspeed has occurred, the powertrain controller will command a LOAD message with the Q-bit set to 1 to command an “engine overspeed display message”. The PKT data will always be $00 since the PCM does not control the period, duty cycle, or criticality of the displays.

Platform Interface Definition:
Displays – Engine Overspeed Warning is owned by Platform. This message is used for display purposes only on vehicles with multiple engine types having different maximum engine speed limits. A warning lamp is used in place of engine red-line graphics on the tachometer display. The message reduces proliferation of Display Cluster parts based on engine type.

Upon receipt of the LOAD message, the Platform module provides closed loop feedback to Powertrain by sending a RPT message. Typically, the RPT message in response to a LOAD should reflect the action that was taken as opposed to simply acknowledging the receipt of the LOAD message, however in this case, Powertrain is only concerned that the Platform module received the latest message.

5.1.8.87 Displays-Driver Notification-Engine Oil Change Soon ($EA/$20/$81)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	0.0	RQCV	Q=Any, Driver Notification= Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	 8A EA 10 20 81 8A EA 10 A0 81
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	 AA EB SS 20 81 AA EB SS A0 81
RQCV	PF	PT	LOAD	0.0	Run-2	0.0			0.0	CB EB SS 20 81

Change Trigger Definition:
The PT shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:
(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:
(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	Disable+$00	RPT	Yes	(Platform specific)		 XA EA XX 20 81 XA EA XX A0 81
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 81 XA EB XX A0 81
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 81

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition:
Displays - Engine Oil Change Soon is commanded by Powertrain. Powertrain commands the state of Engine Oil Change Soon based on the engine oil life determination algorithm which resides in the PCM. The algorithm is based on the principle that engine operation will decrease oil life especially at non-optimal oil temperatures. Once the oil life is reduced to a specific calibratable

level, the PCM will command a LOAD message with the Q-bit set to 1 to command the Engine Oil Change Soon display. The PKT data will always be $00 since the PCM does not control the period, duty cycle, or criticality of the displays.

Application Loop Time: 1000 ms.

Platform Interface Definition:

Displays - Engine Oil Change Soon is owned by Platform. This message is used for display purposes. Upon receipt of the LOAD message, the Platform module provides closed loop feedback to the PCM by sending a RPT message. Typically, the RPT message in response to a LOAD should reflect the action which was taken as opposed to simply acknowledging the receipt of the LOAD message, however in this case, the PCM is only concerned that the Platform module received the latest message.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	Disable	Yes
1	Enable	Yes

Packet Byte 1, Bits 7-5

Period - State Encoded (3 bits)		
State	Support	State Description
00	Yes	Dont Care
01	No	.5 Seconds
02	No	1 Second
03	No	1.5 Seconds
04	No	2.0 Seconds
05	No	2.5 Seconds
06	No	3.0 Seconds
07	No	3.5 Seconds

Packet Byte 1, Bits 4-3

Duty Cycle - State Encoded (2 bits)		
State	Support	State Description
00	Yes	Dont Care
01	No	25 %
02	No	50 %
03	No	75 %

Packet Byte 1, Bits 2-0

Criticality - State Encoded (3 bits)		
State	Support	State Description
00	Yes	Dont Care
01	No	Most Critical (1)
02	No	Critical (2)
03	No	Critical (3)
04	No	Critical (4)
05	No	Critical (5)
06	No	Critical (6)
07	No	Least Critical (7)

Valid Message Sequences:

RQCV → LOAD → RPT
LOAD → RPT

5.1.8.88 Displays-Driver Notification-Engine Oil Change Now ($EA/$20/$82)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	0.0	RQCV	Q=Any, Driver Notification= Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	 8A EA 10 20 82 8A EA 10 A0 82
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	 AA EB SS 20 82 AA EB SS A0 82
RQCV	PF	PT	LOAD	0.0	Run-2	0.0			0.0	CB EB SS 20 82

Change Trigger Definition:

The PT shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:

(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:

(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	Disable+$00	RPT	Yes	(Platform specific)		 XA EA XX 20 82 XA EA XX A0 82
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 82 XA EB XX A0 82
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 82

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition: Displays - Engine Oil Change Now is commanded by Powertrain. Powertrain commands the state of Engine Oil Change Now based on the engine oil life determination algorithm which resides in the PCM. The algorithm is based on the principle that engine operation will decrease oil life especially at non-optimal oil temperatures. Once the oil life is reduced to a specific calibratable level, the PCM will command a LOAD message with the Q-bit set to 1 to command the Engine Oil Change Now display. The PKT data will always be $00 since the PCM does not control the period, duty cycle, or criticality of the displays. Application Loop Time: 1000 ms.

Platform Interface Definition:

Displays - Engine Oil Change Now is owned by Platform. This message is used for display purposes. Upon receipt of the LOAD message, the Platform module provides closed loop feedback to the PCM by sending a RPT message. Typically, the RPT message in response to a LOAD should reflect the action which was taken as opposed to simply acknowledging the receipt of the LOAD message, however in this case, the PCM is only concerned that the Platform module received the latest message.

Valid Message Sequences:

RQCV → LOAD → RPT
LOAD → RPT

5.1.8.89 Displays-Driver Notification-Engine Oil Low Pressure ($EA/$20/$83)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	0.0	RQCV	Q=Any, Driver Notification= Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	 8A EA 10 20 83 8A EA 10 A0 83
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	 AA EB SS 20 83 AA EB SS A0 83
RQCV	PF	PT	LOAD	0.0	Run-2	0.0			0.0	CB EB SS 20 83

Change Trigger Definition:

The PT shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:

(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:

(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	Disable+$00	RPT	Yes	(Platform specific)		 XA EA XX 20 83 XA EA XX A0 83
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 83 XA EB XX A0 83
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 83

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition: Displays - Engine Oil Low Pressure is commanded by Powertrain. Powertrain commands the state of Engine Oil Low Pressure based on the value of the Oil Pressure sensor or the state of the Oil Pressure switch. In order to avoid transmitting false indications of low oil pressure, powertrain will not indicate a low oil pressure condition unless the engine is running, no failure has been detected with the Oil Pressure sensor or switch, and the oil pressure has been low for a calibratable continuous period of time. The PKT data will always be $00 since the PCM does not control the period, duty cycle, or criticality of the displays. Application Loop Time: 1000 ms.

Platform Interface Definition:

Displays - Engine Oil Low Pressure is owned by Platform. This message is used for display purposes. Upon receipt of the LOAD message, the Platform module provides closed loop feedback to the PCM by sending a RPT message. Typically, the RPT message in response to a LOAD should reflect the action which was taken as opposed to simply acknowledging the receipt of the LOAD message, however in this case, the PCM is only concerned that the Platform module received the latest message.

Valid Message Sequences:

RQCV → LOAD → RPT
LOAD → RPT

5.1.8.90 Displays-Driver Notification-Engine Oil Low Level ($EA/$20/$84)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	0.0	RQCV	Q=Any, Driver Notification=Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	 8A EA 10 20 84 8A EA 10 A0 84
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	 AA EB SS 20 84 AA EB SS A0 84
RQCV	PF	PT	LOAD	0.0	Run-2	0.0			0.0	CB EB SS 20 84

Change Trigger Definition:

The PT shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:

(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:

(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	Disable+$00	RPT	Yes	(Platform specific)		 XA EA XX 20 84 XA EA XX A0 84
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 84 XA EB XX A0 84
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 84

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition:

Displays - Engine Oil Low Level is commanded by Powertrain. Powertrain commands the state of Engine Oil Low Level based on the engine oil level determination algorithm which resides in the PCM. Basically, the algorithm determines the oil level is low if the engine had been shut down long enough for the oil to drain back to the oil pan, the engine is not rotating, and the oil level switch indicates that the oil level is low. Once the engine has started cranking (rotating) the oil level switch will not provide a valid indication of oil level, therefore the algorithm will be disabled until the next power-up. When the algorithm determines that the oil level is low, the PCM will command a LOAD message with the Q-bit set to 1 to command the Engine Oil Low Level display. The PKT data will always be $00 since the PCM does not control the period, duty cycle, or criticality of the displays.

Application Loop Time: 1000 ms.

Platform Interface Definition:

Displays - Engine Oil Low Level is owned by Platform. This message is used for display purposes. Upon receipt of the LOAD message, the Platform module provides closed loop feedback to the PCM by sending a RPT message. Typically, the RPT message in response to a LOAD should reflect the action which was taken as opposed to simply acknowledging the receipt of the LOAD message, however in this case, the PCM is only concerned that the Platform module received the latest message.

Valid Message Sequences:

RQCV → LOAD → RPT
LOAD → RPT

5.1.8.91 Displays-Driver Notification-Engine Hot / Stop Engine ($EA/$20/$85)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	0.0	RQCV	Q=Any, Driver Notification= Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	 8A EA 10 20 85 8A EA 10 A0 85
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	 AA EB SS 20 85 AA EB SS A0 85
RQCV	PF	PT	LOAD	0.0	Run-2	0.0			0.0	CB EB SS 20 85

Change Trigger Definition:

The PT shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:

(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:

(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	(Platform specific)	RPT	Yes	(Platform specific)		 XA EA XX 20 85 XA EA XX A0 85
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 85 XA EB XX A0 85
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 85

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition: Displays - Engine Hot / Stop Engine is commanded by Powertrain. Powertrain commands the state of Engine Hot / Stop Engine when the coolant temperature is greater than a calibratable temperature threshold. When the algorithm determines an extreme engine hot condition is present, the PCM will command a LOAD message with the Q-bit set to 1 to command the Engine Hot / Stop Engine display. The PKT data will always be $00 since the PCM does not control the period, duty cycle, or criticality of the displays. Application Loop Time: 1000 ms.

Platform Interface Definition:

Displays - Engine Hot / Stop Engine is owned by Platform. This message is used for display purposes. Upon receipt of the LOAD message, the Platform module provides closed loop feedback to the PCM by sending a RPT message. Typically, the RPT message in response to a LOAD should reflect the action which was taken as opposed to simply acknowledging the receipt of the LOAD message, however in this case, the PCM is only concerned that the Platform module received the latest message.

Valid Message Sequences:

RQCV → LOAD → RPT
LOAD → RPT

5.1.8.92 Displays-Driver Notification-Transmission Skip Shift ($EA/$20/$88)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	0.0	RQCV	Q=Any, Driver Notification=Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	 8A EA 10 20 88 8A EA 10 A0 88
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	 AA EB SS 20 88 AA EB SS A0 88
RQCV	PF	PT	LOAD	0.0	Run-2	0.0			0.0	CB EB SS 20 88

Change Trigger Definition:

The PT shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:

(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:

(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	Disable+$00	RPT	Yes	(Platform specific)		 XA EA XX 20 88 XA EA XX A0 88
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 88 XA EB XX A0 88
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 88

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition:

Displays - Transmission Skip Shift is commanded by Powertrain. On manual transmission applications, there are certain operating conditions in which upshifting to the next transmission gear is inhibited. The PCM will indicate this condition by transmitting the Transmission Skip Shift message. The driver is required to upshift to the next available transmission gear. As an example, if presently in first gear and skip shift is indicated, the driver will be allowed to shift into any other gear except for second gear. When the PCM determines that conditions for transmission skip shift are present, the PCM will command a LOAD message with the Q-bit set to 1 to command the Transmission Skip Shift display. The PKT data will always be $00 since the PCM does not control the period, duty cycle, or criticality of the displays.

Application Loop Time: 1000 ms.

Platform Interface Definition:

Displays - Transmission Skip Shift is owned by Platform. This message is used for display purposes. Upon receipt of the LOAD message, the Platform module provides closed loop feedback to the PCM by sending a RPT message. Typically, the RPT message in response to a LOAD should reflect the action which was taken as opposed to simply acknowledging the receipt of the LOAD message, however in this case, the PCM is only concerned that the Platform module received the latest message.

Valid Message Sequences:

RQCV → LOAD → RPT

LOAD → RPT

5.1.8.93 Displays-Driver Notification-Transmission Upshift ($EA/$20/$89)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	0.0	RQCV	Q=Any, Driver Notification= Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	 8A EA 10 20 89 8A EA 10 A0 89
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	 AA EB SS 20 89 AA EB SS A0 89
RQCV	PF	PT	LOAD	0.0	Run-2	0.0			0.0	CB EB SS 20 89

Change Trigger Definition:

The PT shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:

(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:

(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	Disable+$00	RPT	Yes	(Platform specific)		 XA EA XX 20 89 XA EA XX A0 89
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 89 XA EB XX A0 89
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 89

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition:

Displays - Transmission Upshift is commanded by Powertrain. On manual transmission applications, the PCM determines when the transmission should be upshifted for improved fuel economy by continuously comparing output speed to input speed of the transmission. When the PCM determines that an upshift is desired, the PCM will command a LOAD message with the Q-bit set to 1 to command the Transmission Upshift display. The PKT data will always be $00 since the PCM does not control the period, duty cycle, or criticality of the displays. Application Loop Time: 100 ms.

Platform Interface Definition:

Displays - Transmission Upshift is owned by Platform. This message is used for display purposes. Upon receipt of the LOAD message, the Platform module provides closed loop feedback to the PCM by sending a RPT message. Typically, the RPT message in response to a LOAD should reflect the action which was taken as opposed to simply acknowledging the receipt of the LOAD message, however in this case, the PCM is only concerned that the Platform module received the latest message.

Valid Message Sequences:

RQCV → LOAD → RPT
LOAD → RPT

5.1.8.94 Displays-Driver Notification-Vehicle Speed Control Active ($EA/$20/$8C)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	0.0	RQCV	Q=Any, Driver Notification= Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	 8A EA 10 20 8C 8A EA 10 A0 8C
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	 AA EB SS 20 8C AA EB SS A0 8C
RQCV	PF	PT	LOAD	0.0	Run-2	0.0			0.0	CB EB SS 20 8C

Change Trigger Definition:

The PT shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:

(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:

(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	(Platform specific)	RPT	Yes	(Platform specific)		 XA EA XX 20 8C XA EA XX A0 8C
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 8C XA EB XX A0 8C
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 8C

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition:

Displays - Vehicle Speed Control Active is commanded by Powertrain. This message is sent whenever the vehicle enters or exits an active cruise control mode, where the vehicle's speed is being controlled by the PCM. When the PCM detects an entry into an active cruise control mode, the PCM will command a LOAD message with the Q-bit set to 1 to indicate to the display that cruise control mode is active. The PKT data will always be $00 since the PCM does not control the period, duty cycle, or criticality of the displays. Application Loop Time: 100 ms.

Platform Interface Definition:

Displays - Vehicle Speed Control Active is owned by Platform. This message is used for display purposes. Upon receipt of the LOAD message, the Platform module provides closed loop feedback to the PCM by sending a RPT message. Typically, the RPT message in response to a LOAD should reflect the action which was taken as opposed to simply acknowledging the receipt of the LOAD message, however in this case, the PCM is only concerned that the Platform module received the latest message.

Valid Message Sequences:

RQCV → LOAD → RPT
LOAD → RPT

5.1.8.95 Displays-Driver Notification-Charging System/Generator Fault ($EA/$20/$8E)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	0.0	RQCV	Q=Any, Driver Notification=Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	 8A EA 10 20 8E 8A EA 10 A0 8E
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	 AA EB SS 20 8E AA EB SS A0 8E
RQCV	PF	PT	LOAD	0.0	Run-2	0.0			0.0	CB EB SS 20 8E

Change Trigger Definition:

The PT shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:

(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:

(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	Disable+$00	RPT	Yes	(Platform specific)		 XA EA XX 20 8E XA EA XX A0 8E
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 8E XA EB XX A0 8E
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 8E

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition:

Displays - Charging System / Generator Fault is commanded by Powertrain. Powertrain commands the state of Charging System / Generator Fault based on the whether a fault has been detected with the L-Terminal or F-Terminal circuits of the Generator. Refer to Section 4.4.3.6 of the Generator Status algorithm for details on fault determination. When a fault is detected, the PCM will command a LOAD message with the Q-bit set to 1 to command the Charging System / Generator Fault display. The PKT data will always be $00 since the PCM does not control the period, duty cycle, or criticality of the displays. Application Loop Time: 1000 ms.

Platform Interface Definition:

Displays - Charging System / Generator Fault is owned by Platform. This message is used for display purposes. Upon receipt of the LOAD message, the Platform module provides closed loop feedback to the PCM by sending a RPT message. Typically, the RPT message in response to a LOAD should reflect the action which was taken as opposed to simply acknowledging the receipt of the LOAD message, however in this case, the PCM is only concerned that the Platform module received the latest message.

Valid Message Sequences:

RQCV → LOAD → RPT
LOAD → RPT

5.1.8.96 Displays-Driver Notification-Service Vehicle Soon ($EA/$20/$8F)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	0.0	RQCV	Q=Any, Driver Notification= Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	 8A EA 10 20 8F 8A EA 10 A0 8F
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	 AA EB SS 20 8F AA EB SS A0 8F
RQCV	PF	PT	LOAD	0.0	Run-2	0.0			0.0	CB EB SS 20 8F

Change Trigger Definition:

The PT shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:

(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:

(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	Disable+$00	RPT	Yes	(Platform specific)		 XA EA XX 20 8F XA EA XX A0 8F
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 8F XA EB XX A0 8F
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 8F

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition:

Displays - Service Vehicle Soon is commanded by Powertrain. This message is sent when failures are detected by the PCM which require the service vehicle soon indication. The failures which cause this message to be sent need to be identified by Powertrain and Platform. When the PCM detects such a failure, the PCM will command a LOAD message with the Q-bit set to 1 to command the Service Vehicle Soon display. The PKT data will always be $00 since the PCM does not control the period, duty cycle, or criticality of the displays. Application Loop Time: 1000 ms.

Platform Interface Definition:

Displays - Service Vehicle Soon is owned by Platform. This message is used for display purposes. Upon receipt of the LOAD message, the Platform module provides closed loop feedback to the PCM by sending a RPT message. Typically, the RPT message in response to a LOAD should reflect the action which was taken as opposed to simply acknowledging the receipt of the LOAD message, however in this case, the PCM is only concerned that the Platform module received the latest message.

Valid Message Sequences:

RQCV → LOAD → RPT
LOAD → RPT

5.1.8.97 Displays-Driver Notification-Traction Control System Off ($EA/$20/$9B)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PF	PT		0.0	Run-1	0.0	RQCV	Q=Any, Driver Notification= Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	 8A EA SS 20 9B 8A EA SS A0 9B
RQCV	PT	PF	LOAD	0.0	Run-2	750.0			0.0	CB EB 10 20 9B

Change Trigger Definition:

The PF shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:

(PF) RQCV: Run

Enabled Modes for Change Trigger:

(PF) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PT	PF	Disable+$00 (Allow Brake Torque Mgt)		Yes	Disable+$00 (Allow Brake Torque Mgt)		 XA EA XX 20 9B XA EA XX A0 9B
RQCV	PF	PT	N/A	LOAD	No	N/A		XB EB XX 20 9B

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PT) LOAD: Run
(PF) RQCV: Run

Powertrain Interface Definition:

Displays - Traction Control System Off is monitored by Powertrain. This signal is used by the traction control algorithm in the powertrain controller. Powertrain may also disable brake torque management when the traction control system has been turned off by a driver selected on/off switch. The PCM will not send a RPT message upon receipt of the LOAD message.

Platform Interface Definition:

Displays - Traction Control System Off is commanded by Platform. Platform will transmit a LOAD message with the Q-bit set to 1 to command the Traction Control System Off display when the system is turned off via the driver selected on/off switch. This message is primarily used for display purposes, however Powertrain also needs to monitor this message to know when the traction control system has been turned off.

Valid Message Sequences:

RQCV → LOAD
LOAD

5.1.8.98 Displays-Driver Notification-Engine Coolant Hot ($EA/$20/$9D)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	0.0	RQCV	Q=Any, Driver Notification=Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	 8A EA 10 20 9D 8A EA 10 A0 9D
RPT Disable Enable	PF	PT		0.0	Run-1	0.0	LOAD		0.0	 AA EB SS 20 9D AA EB SS A0 9D
RQCV	PF	PT	LOAD	0.0	Run-2	0.0			0.0	CB EB SS 20 9D

Change Trigger Definition:

The PT shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:

(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:

(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	(Platform specific)	RPT	No	N/A		 XA EA XX 20 9D XA EA XX A0 9D
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 9D XA EB XX A0 9D
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 9D

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition:

Displays - Engine Coolant Hot is commanded by Powertrain. Powertrain commands the state of Engine Coolant Hot based on whether coolant temperature has exceeded a calibratable temperature threshold value. When the temperature exceeds this value, Powertrain will transmit a LOAD message with the Q-bit set to 1 to command the Hot Coolant display. The PKT data will always be $00 since Powertrain does not control the period, duty cycle or criticality of the displays.

Platform Interface Definition:

Displays - Engine Coolant Hot is owned by Platform. This message is used for display purposes. Upon receipt of the LOAD message, the Platform module provides closed loop feedback to Powertrain by sending the RPT message. Typically, the RPT message in response to a LOAD should reflect the action that was taken as opposed to simply acknowledging the receipt of the LOAD message. However, in this case, Powertrain is only concerned that the Platform module received the latest message.

Valid Message Sequences:

RQCV → LOAD → RPT
LOAD → RPT
RPT

5.1.8.99 Displays-Driver Notification-Change Transmission Oil Now ($EA/$20/$AA)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	0.0	RQCV	Q=Any, Driver Notification= Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	 8A EA 10 20 AA 8A EA 10 A0 AA
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	 AA EB SS 20 AA AA EB SS A0 AA
RQCV	PF	PT	LOAD	0.0	Run-2	0.0			0.0	CB EB SS 20 AA

Change Trigger Definition:

The PT shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:

(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:

(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	Disable+$00	RPT	Yes	(Platform specific)		 XA EA XX 20 AA XA EA XX A0 AA
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 AA XA EB XX A0 AA
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 AA

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition:

Displays - Change Transmission Oil Now is commanded by Powertrain. Powertrain commands the state of Change Transmission Oil Now based on the transmission oil life determination algorithm which resides in the PCM. The algorithm is based on the principle that transmission operation will decrease oil life especially at non-optimal oil temperatures. Once the oil life is reduced to a specific calibratable level, the PCM will command a LOAD message with the Q-bit set to 1 to command the Change Transmission Oil display. The PKT data will always be $00 since the PCM does not control the period, duty cycle, or criticality of the displays.
Application Loop Time: 1000 ms.

Platform Interface Definition:

Displays - Change Transmission Oil Now is owned by Platform. This message is used for display purposes. Upon receipt of the LOAD message, the Platform module provides closed loop feedback to the PCM by sending a RPT message. Typically, the RPT message in response to a LOAD should reflect the action which was taken as opposed to simply acknowledging the receipt of the LOAD message, however in this case, the PCM is only concerned that the Platform module received the latest message.

Valid Message Sequences:

RQCV → LOAD → RPT

LOAD → RPT

5.1.8.100 Displays-Driver Notification-A/C Off For Engine Protection ($EA/$20/$B4)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	0.0	RQCV	Q=Any, Driver Notification= Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	 8A EA 10 20 B4 8A EA 10 A0 B4
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	 AA EB SS 20 B4 AA EB SS A0 B4
RQCV	PF	PT		0.0	Run-2	0.0			0.0	CB EB SS 20 B4

Change Trigger Definition:

The PT shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:

(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:

(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT		RPT	No	N/A		 XA EA XX 20 B4 XA EA XX A0 B4
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 B4 XA EB XX A0 B4
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 B4

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition:

Air Conditioning Off Indication On is transmitted by Powertrain. The data value of this signal is set to “True” if the Compressor Control Algorithm is commanding the compressor off (i.e., Air Condition Compressor Command equal to “Off”) due to high coolant temperature or for compressor protection, such as, ignition voltage, engine speed or A/C pressure out of normal operating range. Refer to Section 4.2.4.4 of the Cooling Fan Control Algorithm. For Electronically Controlled Variable Displacement (ECVD) systems, the Air Conditioning Compressor Command equal “Off” and Air Conditioning Off Indication On equal to “True” indicates the Powertrain controller is requesting that the HVAC Platform controller disable the compressor (see Algorithm Requirements, section 4.03). Refer to Section 4.2.4.4 of the Cooling Fan Control Algorithm.

Platform Interface Definition:

Air Conditioning Off Indication On is used for display purposes for display purposes to indicate when Air Conditioning has been turned off for compressor protection or high engine coolant temperature.

Valid Message Sequences:

RQCV → LOAD → RPT
LOAD → RPT

5.1.8.101 Displays-Driver Notification-Reduced Engine Power ($EA/$20/$B7)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	0.0	RQCV	Q=Any, Driver Notification=Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	 8A EA 10 20 B7 8A EA 10 A0 B7
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	 AA EB SS 20 B7 AA EB SS A0 B7
RQCV	PF	PT	LOAD	0.0	Run-2	0.0			0.0	CB EB SS 20 B7

Change Trigger Definition:

The PT shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:

(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:

(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	Disable+$00	RPT	Yes	(Platform specific)		 XA EA XX 20 B7 XA EA XX A0 B7
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 B7 XA EB XX A0 B7
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 B7

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition:

Displays - Reduced Engine Power is commanded by Powertrain. This message is sent due to a failure detected with Electronic Throttle Control or other Powertrain systems such that the engine power will be limited. When the PCM detects a failure which causes the powertrain to be in a reduced power mode, the PCM will command a LOAD message with the Q-bit set to 1. The PKT data will always be $00 since the PCM does not control the period, duty cycle, or criticality of the displays.
Application Loop Time: 1000 ms.

Platform Interface Definition:

Displays - Reduced Engine Power is owned by Platform. This message is used for display purposes. Upon receipt of the LOAD message, the Platform module provides closed loop feedback to the PCM by sending a RPT message. Typically, the RPT message in response to a LOAD should reflect the action which was taken as opposed to simply acknowledging the receipt of the LOAD message, however in this case, the PCM is only concerned that the Platform module received the latest message.

Valid Message Sequences:

RQCV → LOAD → RPT
LOAD → RPT

5.1.8.102 Displays-Driver Notification-Top Speed Fuel Cut Off ($EA/$20/$C3)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	0.0	RQCV	Q=Any, Driver Notification= Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	 8A EA 10 20 C3 8A EA 10 A0 C3
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	 AA EB SS 20 C3 AA EB SS A0 C3
RQCV	PF	PT	LOAD	0.0	Run-2	0.0			0.0	CB EB SS 20 C3

Change Trigger Definition:

The PT shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:

(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:

(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	Disable+$00	RPT	Yes	(Platform specific)		 XA EA XX 20 C3 XA EA XX A0 C3
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 C3 XA EB XX A0 C3
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 C3

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition:

Displays - Top Speed Fuel Cut Off is commanded by Powertrain. This message is sent when the fuel is shut off due to the vehicle speed exceeding a limit. When the PCM detects a top speed fuel cut off condition, the PCM will command a LOAD message with the Q-bit set to 1. The PKT data will always be $00 since the PCM does not control the period, duty cycle, or criticality of the displays. Application Loop Time: 1000 ms.

Platform Interface Definition:

Displays - Top Speed Fuel Cut Off is owned by Platform. This message is used for display purposes. Upon receipt of the LOAD message, the Platform module provides closed loop feedback to the PCM by sending a RPT message. Typically, the RPT message in response to a LOAD should reflect the action which was taken as opposed to simply acknowledging the receipt of the LOAD message, however in this case, the PCM is only concerned that the Platform module received the latest message.

Valid Message Sequences:

RQCV → LOAD → RPT
LOAD → RPT

5.1.8.103 Displays-Driver Notification-Transmission Hot ($EA/$20/$CB)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	0.0	RQCV	Q=Any, Driver Notification= Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	 8A EA 10 20 CB 8A EA 10 A0 CB
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	 AA EB SS 20 CB AA EB SS A0 CB
RQCV	PF	PT	LOAD	0.0	Run-2	0.0			0.0	CB EB SS 20 CB

Change Trigger Definition:

The PT shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:

(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:

(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	Disable+$00	RPT	Yes	(Platform specific)		 XA EA XX 20 CB XA EA XX A0 CB
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 CB XA EB XX A0 CB
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 CB

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition:

Displays - Transmission Hot is commanded by Powertrain. When the Transmission Overtemp DTC P0218 is set, the PCM will command a LOAD message with the Q-bit set to 1. The PKT data will always be $00 since the PCM does not control the period, duty cycle, or criticality of the displays.

Application Loop Time: 1000 ms.

Platform Interface Definition:

Displays - Transmission Hot is owned by Platform. This message is used for display purposes. Upon receipt of the LOAD message, the Platform module provides closed loop feedback to the PCM by sending a RPT message. Typically, the RPT message in response to a LOAD should reflect the action which was taken as opposed to simply acknowledging the receipt of the LOAD message, however in this case, the PCM is only concerned that the Platform module received the latest message.

Valid Message Sequences:

RQCV → LOAD → RPT
LOAD → RPT

5.1.8.104 Displays-Driver Notification-Check Gas Cap ($EA/$20/$CC)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	0.0	RQCV	Q=Any, Driver Notification=Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	 8A EA 10 20 CC 8A EA 10 A0 CC
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	 AA EB SS 20 CC AA EB SS A0 CC
RQCV	PF	PT	LOAD	0.0	Run-2	0.0			0.0	CB EB SS 20 CC

Change Trigger Definition:

The PT shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:

(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:

(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	Disable+$00	RPT	Yes	(Platform specific)		 XA EA XX 20 CC XA EA XX A0 CC
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 CC XA EB XX A0 CC
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 CC

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition:

Displays - Check Gas Cap is commanded by Powertrain. This message is sent if the Evaporative Emissions Diagnostic has determined that the gas cap may not be installed completely due to a leak detected within the EVAP system. When the PCM detects that the gas cap may not be installed completely, the PCM will command a LOAD message with the Q-bit set to 1. The PKT data will always be $00 since the PCM does not control the period, duty cycle, or criticality of the displays.
Application Loop Time: 1000 ms.

Platform Interface Definition:

Displays - Check Gas Cap is owned by Platform. This message is used for display purposes. Upon receipt of the LOAD message, the Platform module provides closed loop feedback to the PCM by sending a RPT message. Typically, the RPT message in response to a LOAD should reflect the action which was taken as opposed to simply acknowledging the receipt of the LOAD message, however in this case, the PCM is only concerned that the Platform module received the latest message.

Valid Message Sequences:

RQCV → LOAD → RPT
LOAD → RPT

5.1.8.105 Displays-Driver Notification-Reduce Top Speed ($EA/$20/$D5)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	0.0	RQCV	Q=Any, Driver Notification= Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	 8A EA 10 20 D5 8A EA 10 A0 D5
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	 AA EB SS 20 D5 AA EB SS A0 D5
RQCV	PF	PT	LOAD	0.0	Run-2	0.0			0.0	CB EB SS 20 D5

Change Trigger Definition:

The PT shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:

(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:

(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	Disable+$00	RPT	Yes	(Platform specific)		 XA EA XX 20 D5 XA EA XX A0 D5
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 D5 XA EB XX A0 D5
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 D5

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition:

Displays - Reduce Top Speed is commanded by Powertrain. Powertrain commands the state of Reduce Top Speed based on whether or not powertrain will limit vehicle speed due to a suspension failure which is present. The PKT data will always be $00 since the PCM does not control the period, duty cycle, or criticality of the displays.
Application Loop Time: 1000 ms.

Platform Interface Definition:

Displays - Reduce Top Speed is owned by Platform. This message is used for display purposes. Upon receipt of the LOAD message, the Platform module provides closed loop feedback to the PCM by sending a RPT message. Typically, the RPT message in response to a LOAD should reflect the action which was taken as opposed to simply acknowledging the receipt of the LOAD message, however in this case, the PCM is only concerned that the Platform module received the latest message.
Valid Message Sequences:

RQCV → LOAD → RPT
LOAD → RPT

5.1.8.106 Displays-Driver Notification-Service Transmission ($EA/$20/$D6)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	0.0	RQCV	Q=Any, Driver Notification=Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	 8A EA 10 20 D6 8A EA 10 A0 D6
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	 AA EB SS 20 D6 AA EB SS A0 D6
RQCV	PF	PT	LOAD	0.0	Run-2	0.0			0.0	CB EB SS 20 D6

Change Trigger Definition:

The PT shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:

(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:

(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	Disable+$00	RPT	Yes	(Platform specific)		 XA EA XX 20 D6 XA EA XX A0 D6
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 D6 XA EB XX A0 D6
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 D6

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition:

Displays - Service Transmission is commanded by Powertrain. This message is sent if certain transmission diagnostic failures are detected. When the PCM detects a failure with the transmission, the PCM will command a LOAD message with the Q-bit set to 1. The PKT data will always be $00 since the PCM does not control the period, duty cycle, or criticality of the displays.
Application Loop Time: 1000 ms.

Platform Interface Definition:

Displays - Service Transmission is owned by Platform. This message is used for display purposes. Upon receipt of the LOAD message, the Platform module provides closed loop feedback to the PCM by sending a RPT message. Typically, the RPT message in response to a LOAD should reflect the action which was taken as opposed to simply acknowledging the receipt of the LOAD message, however in this case, the PCM is only concerned that the Platform module received the latest message.
Valid Message Sequences:

RQCV → LOAD → RPT
LOAD → RPT

5.1.8.107 Displays-Driver Notification-Water In Fuel ($EA/$20/$D9)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	0.0	RQCV	Q=Any, Driver Notification= Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	 8A EA 10 20 D9 8A EA 10 A0 D9
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	 AA EB SS 20 D9 AA EB SS A0 D9
RQCV	PF	PT	LOAD	0.0	Run-2	0.0			0.0	CB EB SS 20 D9

Change Trigger Definition:

The PT shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:

(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:

(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	Disable+$00	RPT	Yes	(Platform specific)		 XA EA XX 20 D9 XA EA XX A0 D9
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 D9 XA EB XX A0 D9
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 D9

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition:

Displays - Water In Fuel is commanded by Powertrain. This message is supported for Diesel applications. This message is sent if the fuel sensor detects water in the diesel fuel. When the PCM detects water in the fuel, the PCM will command a LOAD message with the Q-bit set to 1. The PKT data will always be $00 since the PCM does not control the period, duty cycle, or criticality of the displays. Application Loop Time: 1000 ms.

Platform Interface Definition:

Displays - Water In Fuel is owned by Platform. This message is used for display purposes. Upon receipt of the LOAD message, the Platform module provides closed loop feedback to the PCM by sending a RPT message. Typically, the RPT message in response to a LOAD should reflect the action which was taken as opposed to simply acknowledging the receipt of the LOAD message, however in this case, the PCM is only concerned that the Platform module received the latest message.

Valid Message Sequences:

RQCV → LOAD → RPT
LOAD → RPT

5.1.8.108 Displays-Driver Notification-Generator Indicator ($EA/$20/$E2)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	0.0	RQCV	Q=Any, Driver Notification= Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	 8A EA 10 20 E2 8A EA 10 A0 E2
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	 AA EB SS 20 E2 AA EB SS A0 E2
RQCV	PF	PT	LOAD	0.0	Run-2	0.0			0.0	CB EB SS 20 E2

Change Trigger Definition:

The PT shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:

(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:

(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	Disable+$00	RPT	Yes	(Platform specific)		 XA EA XX 20 E2 XA EA XX A0 E2
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 E2 XA EB XX A0 E2
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 E2

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition:

Displays - Generator Indicator is commanded by Powertrain. Powertrain commands the state of Generator Indicator to ENABLE if there is a fault detected with the L-Terminal or F-Terminal Circuit of the generator, or system power mode is currently RUN and the engine is not running. Refer to Section 4.4.3.5 of the Generator Status algorithm for details on fault determination. When any failure is detected, or system power mode is currently RUN and the engine is not running, the PCM will command a LOAD message with the Q-bit set to 1 to command the Generator Indicator display. The PKT data will always be $00 since the PCM does not control the period, duty cycle, or criticality of the displays.

Application Loop Time: 1000 ms.

Platform Interface Definition:

Displays - Generator Indicator is owned by Platform. This message is used to simulate the Generator Lamp functionality when the L-Terminal was directly driving the lamp. Upon receipt of the LOAD message, the Platform module provides closed loop feedback to the PCM by sending a RPT message. Typically, the RPT message in response to a LOAD should reflect the action which was taken as opposed to simply acknowledging the receipt of the LOAD message, however in this case, the PCM is only concerned that the Platform module received the latest message.

Valid Message Sequences:

RQCV → LOAD → RPT
LOAD → RPT

5.1.8.109 Displays-Driver Notification-Four Wheel Drive ($EA/$20/$E4)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	0.0	RQCV	Q=Any, Driver Notification= Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	 8A EA 10 20 E4 8A EA 10 A0 E4
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	 AA EB SS 20 E4 AA EB SS A0 E4
RQCV	PF	PT		0.0	Run-2	0.0			0.0	CB EB SS 20 E4

Change Trigger Definition:

The PT shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:

(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:

(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	Disable+$00	RPT	Yes	(Platform specific)		 XA EA XX 20 E4 XA EA XX A0 E4
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 E4 XA EB XX A0 E4
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 E4

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition:

Displays - Four Wheel Drive is commanded by Powertrain. Powertrain commands the state of Four Wheel Drive whenever four wheel drive is engaged or disengaged. When Powertrain detects that four wheel drive is engaged, the powertrain controller will command a LOAD message with the Q-bit set to 1 to command the four wheel drive display. The PKT data will always be $00 since the PCM does not control the period, duty cycle, or criticality of the displays.

Platform Interface Definition:

Displays - Four Wheel Drive is owned by Platform. This message is used for display purposes for four wheel drive with manual transfer case applications. Upon receipt of the LOAD message, the Platform module provides closed loop feedback to Powertrain by sending a RPT message. Typically, the RPT message in response to a LOAD should reflect the action that was taken as opposed to simply acknowledging the receipt of the LOAD message, however in this case, Powertrain is only concerned that the Platform module received the latest message.

Valid Message Sequences:

RQCV → LOAD → RPT
LOAD → RPT

5.1.8.110 Displays-Driver Notification-Start Disabled Elect Throttle Cntrl ($EA/$20/$E7)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	0.0	RQCV	Q=Any, Driver Notification=Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	 8A EA 10 20 E7 8A EA 10 A0 E7
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	 AA EB SS 20 E7 AA EB SS A0 E7
RQCV	PF	PT	LOAD	0.0	Run-2	0.0			0.0	CB EB SS 20 E7

Change Trigger Definition:

The PT shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:

(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:

(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	Disable+$00	RPT	Yes	(Platform specific)		 XA EA XX 20 E7 XA EA XX A0 E7
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 E7 XA EB XX A0 E7
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 E7

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition:

Displays - Starting Disabled - ETC is commanded by Powertrain. This message is sent when engine starting is disabled by the PCM due to failure detected with the Electronic Throttle Control system. When the PCM disables starting due to ETC, the PCM will command a LOAD message with the Q-bit set to 1. The PKT data will always be $00 since the PCM does not control the period, duty cycle, or criticality of the displays. Application Loop Time: 1000 ms.

Platform Interface Definition:

Displays - Starting Disabled - ETC is owned by Platform. This message is used for display purposes. Upon receipt of the LOAD message, the Platform module provides closed loop feedback to the PCM by sending a RPT message. Typically, the RPT message in response to a LOAD should reflect the action which was taken as opposed to simply acknowledging the receipt of the LOAD message, however in this case, the PCM is only concerned that the Platform module received the latest message.

Valid Message Sequences:

RQCV → LOAD → RPT
LOAD → RPT

5.1.8.111 Displays-Driver Notification-Tap Up / Tap Down Mode ($EA/$20/$F7)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	0.0	RQCV	Q=Any, Driver Notification= Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	 8A EA 10 20 F7 8A EA 10 A0 F7
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	 AA EB SS 20 F7 AA EB SS A0 F7
RQCV	PF	PT	LOAD	0.0	Run-2	0.0			0.0	CB EB SS 20 F7

Change Trigger Definition:

The PT shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:

(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:

(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	Disable+$00	RPT	Yes	(Platform specific)		 XA EA XX 20 F7 XA EA XX A0 F7
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 F7 XA EB XX A0 F7
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 F7

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition:

Displays - Tap Up/Tap Down Mode is commanded by Powertrain. This message is sent when the Tap Up/ Tap Down Mode is active , Tap Up/Tap Down mode active is defined as when the following are all true :

- The value of the Transmission/Transaxle/PRNDL - Tap Up/Tap Down Mode Status message received from Platform is set to "Enable".
- Other criteria for Powertrain to activate Tap Up/Tap Down Mode is met (e.g. no active TUTD diagnostic faults, etc.).

When the Tap Up/Tap Down Mode is activated, the PCM will command a LOAD message with the Q-bit set to 1. The PKT data will always be $00 since the PCM does not control the period, duty cycle, or criticality of the displays. Application Loop Time: 100 ms

Platform Interface Definition:

Displays - Tap Up/Tap Down Mode is owned by Platform. This message is used for display purposes. Typically when the data value of this message is set to "Enable", Platform will display actual vehicle gear to the driver in place of or in addition to the gear selector position (PRNDL) display. Upon receipt of the LOAD message, the Platform module provides closed loop feedback to the PCM by sending a RPT message. Typically, the RPT message in response to a LOAD should reflect the action which was taken as opposed to simply acknowledging the receipt of the LOAD message, however in this case, the PCM is only concerned that the Platform module received the latest message.

Valid Message Sequences:

RQCV → LOAD → RPT
LOAD → RPT

5.1.8.112 Displays-Driver Notification- All Wheel Drive Disabled ($EA/$20/$FE)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-1	850.0	RQCV	Q=Any, Driver Notification=Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	 8A EA 10 20 FE 8A EA 10 A0 FE
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	 AA EB SS 20 FE AA EB SS A0 FE
RQCV	PF	PT	LOAD	0.0	Run-2	0.0			0.0	CB EB SS 20 FE

Change Trigger Definition:

The PT shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:

(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:

(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	Disable+$00	RPT	Yes	(Platform specific)		 XA EA XX 20 FE XA EA XX A0 FE
RPT Disable Enable	PT	PF			No	N/A		 XA EB XX 20 FE XA EB XX A0 FE
RQCV	PT	PF	N/A	LOAD	No	N/A		XB EB XX 20 FE

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition:

Displays – All Wheel Drive Disabled is commanded by Powertrain. Powertrain commands a LOAD message with the Q-bit set to 1 to command the All Wheel Drive Disabled display whenever the All Wheel Drive system is disabled. The PKT data will always be $00 since the PCM does not control the period, duty cycle, or criticality of the displays.
Application Loop Time: 1000 ms.

Platform Interface Definition:

Displays – All Wheel Drive Disabled is owned by Platform. This message is used for display purposes. Upon receipt of the LOAD message, the Platform module provides closed loop feedback to the PCM by sending a RPT message. Typically, the RPT message in response to a LOAD should reflect the action which was taken as opposed to simply acknowledging the receipt of the LOAD message, however in this case, the PCM is only concerned that the Platform module received the latest message.

Valid Message Sequences:

RQCV → LOAD → RPT
LOAD → RPT

5.1.8.113 Displays-Driver Notification-Tap Up/Tap Down Request Denied ($EA/22/A4)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
LOAD Disable Enable	PT	PF	RPT	0.0	Run-3	1800.0	RQCV	Q=Any, Driver Notification= Any, Period=Any, Duty Cycle=Any, Criticality=Any	0.0	8A EA 10 22 A4 8A EA 10 A2 A4
RPT Disable Enable	PF	PT		0.0		0.0	LOAD		0.0	 AA EB XX 22 A4 AA EB XX A2 A4
RQCV	PF	PT	LOAD	0.0	Run-4	0.0			0.0	CB EB XX 22 A4

Change Trigger Definition:

The PT shall transmit the LOAD when the Q Bit changes state, when the Driver Notification parameter changes state, when the Period parameter changes state, when the Duty Cycle parameter changes state, when the Criticality parameter changes state.

Enabled Modes for Message Trigger:

(PT) RQCV: Run
(PF) LOAD: Run

Enabled Modes for Change Trigger:

(PT) LOAD: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
LOAD Disable Enable	PF	PT	Disable + $00	RPT	No	N/A		 XA EA XX 22 A4 XA EA XX A2 A4
RPT Disable Enable	PT	PF			No	N/A	Halt retries of LOAD	 XA EB XX 22 A4 XA EB XX A2 A4
RQCV	PT	PF	N/A	LOAD	No	N/A	Xmit LOAD	XB EB XX 22 A4

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PF) LOAD: Run
(PT) RPT: Run
(PT) RQCV: Run

Powertrain Interface Definition:

Displays-Driver Notification-Tap Up/ Tap Down Request Denied is commanded by Powertrain. On Tap-Up/Tap-Down transmission applications, when a new Tap-Up/Tap-Down hardwire signal transition occurs, Powertrain shall determine if the requested gear is allowed given current operating conditions. If the requested gear is not allowed the PCM will command a LOAD message with the Q-bit set to 1 to command the Tap Up/Tap Down Request Denied display. The PKT data will always be $00 since the PCM does not control the period, duty cycle, or criticality of the displays.

Platform Interface Definition:

Displays-Driver Notification-Tap Up/ Tap Down Request Denied is owned by Platform. This message is used for display and/or for a chime activation. The message indicates that the Powertrain has rejected the driver’s Tap Up or Tap Down gear request. Upon receipt of the LOAD message, the Platform module provides closed loop feedback to the PCM by sending a RPT message. Typically, the RPT message in response to a LOAD should reflect the action that was taken as opposed to simply acknowledging the receipt of the LOAD message, however in this case, Powertrain is only concerned that the Platform module received the latest message.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	Disable	Both
1	Enable	Both

Packet Byte 1, Bits 7-5

Period - State Encoded (3 bits) (*=Power up default)		
State	Support	State Description
00	Both	Dont Care
01	N/A	.5 Seconds
02	N/A	1 Second
03	N/A	1.5 Seconds
04	N/A	2.0 Seconds
05	N/A	2.5 Seconds
06	N/A	3.0 Seconds
07	N/A	3.5 Seconds

Packet Byte 1, Bits 4-3

Duty Cycle - State Encoded (2 bits) (*=Power up default)		
State	Support	State Description
00	Both	Dont Care
01	N/A	25 %
02	N/A	50 %
03	N/A	75 %

Packet Byte 1, Bits 2-0

Criticality - State Encoded (3 bits) (*=Power up default)		
State	Support	State Description
00	Both	Dont Care
01	N/A	Most Critical (1)
02	N/A	Critical (2)
03	N/A	Critical (3)
04	N/A	Critical (4)
05	N/A	Critical (5)
06	N/A	Critical (6)
07	N/A	Least Critical (7)

Valid Message Sequences:

RQCV → LOAD → RPT
LOAD → RPT

5.1.8.114 Engine System Other - Estimated Outside Air Temperature ($F2/$08)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT(F)	0.0	Run-2	750.0			0.0	C9 F2 SS 08
RPT Unusable Data Usable Data	PT	PF		>1000.0	Run-1	0.0	REQ	1 ° C	0.0	A8 F3 10 08 A8 F3 10 88
RPT(F)	PT	PF						Failure Condition		A8 F3 10 08 A8 F3 10 88

RPT(F)Transmit Value: Data in RPT(F) is ignored

Change Trigger Definition:

The PT shall transmit the RPT when the Estimated Outside Air Temperature parameter changes by 1° C and no more than once every 1000.0 ms.

Enabled Modes for Message Trigger:
(PT) REQ: Run

Enabled Modes for Change Trigger:
(PT) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	N/A	RPT(F)	No	N/A		X9 F2 XX 08
RPT Unusable Data Usable Data	PF	PT	(Platform specific)		No	N/A	Platform specific	X8 F3 XX 08 X8 F3 XX 88
RPT(F)	PF	PT					Platform specific	X8 F3 XX 48

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) REQ: Run
(PF) RPT: Run
(PF) RPT(F): Run

Powertrain Interface Definition:

Estimated Outside Air Temperature is owned by Powertrain. This message represents the estimated ambient air temperature that is based on engine inlet air temperature, mass air flow and vehicle speed information. Estimated Outside Air Temperature shall be transmitted within 7 seconds after the engine run flag has been set to “True”.

Failure Report Definition:
Failure report occurs when Estimated Outside Air Temperature cannot be calculated due to a sensor failure. Powertrain shall transmit a failure report message identified with the C-bit set to “1”, a corresponding DTC shall be set and the Q-bit shall be set to “0”. If a failure report is received, the platform receiving module shall ignore the data. The Q-bit set to “0” indicates Powertrain has determined that the data is not usable due to limitations of the temperature algorithm but not a sensor failure.

Platform Interface Definition:

Estimated Outside Air Temperature is monitored by the Platform. This signal information is used by the Regulated voltage Control (RVC) subsystem to determine when to activate Fuel Economy Mode operation and voltage boost determination to improve HVAC blower performance. In addition, this signal information is also available to the ABS for TCS Brake Thermal Modeling or HVAC fan “afterblow” determination. The Data in Estimated Outside Air Temperature shall not be used to provide a customer display of outside air temperature.

General Requirements

Data Definition (Reports and Loads only)

Q Bit		
State	Name	Support
0	Unusable Data	Yes
1	Usable Data	Yes

Data Definition (Reports and Loads only)

Estimated Outside Air Temperature - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	øC	To Engineering Units	(N*0.5) - 40
Resolution	0.5	To Computer Units	2*E+80
Absolute Range	-40 to +87.5		

Estimated Outside Air Temperature Requirements

Data Range	Accuracy
-40 to <+5 °C	+/-5 °C
+5 to 30 °C	+/-4 °C
>30 to +86 °C	+/-5 °C

Valid Message Sequences:
REQ → RPT(F)
RPT(F)

5.1.8.115 Exterior Environment-Outside Air Temperature ($F2/$10)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PT	PF	RPT(F)	0.0	Run-2	750.0			0.0	C9 F2 10 10
RPT	PF	PT		0.0	Run-1	0.0	REQ	1 øC	0.0	A8 F3 SS 10
RPT(F)	PF	PT						Failure Condition		A8 F3 SS 50

RPTF Transmit Value:
Data in RPTF is ignored

Change Trigger Definition:
The PF shall transmit the RPT when the Outside Air Temperature parameter changes by 1 øC.

Enabled Modes for Message Trigger:
(PF) REQ: Run

Enabled Modes for Change Trigger:
(PF) RPT: Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PF	PT	N/A	RPT(F)	No	N/A		X9 F2 XX 10
RPT	PT	PF	(Calibratable Value)		Yes	(Calibratable Value)		X8 F3 XX 10
RPT(F)	PT	PF					Calibratable Value	X8 F3 XX 50

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) REQ: Run
(PT) RPT: Run
(PT) RPT(F): Run

Powertrain Interface Definition:

Exterior Environment - Outside Air Temperature is monitored by Powertrain. It is used for idle speed load modeling, to default induction air temperature, and for the induction air temperature sensor diagnostic.

Platform Interface Definition:

Exterior Environment - Outside Air Temperature is owned by Platform. It represents the temperature processed from the ambient air temperature sensor and the coolant temperature. Coolant temperature is received on initialization from powertrain prior to initializing outside air temperature.

General Requirements

Data Definition (Reports and Loads only)

Outside Air Temperature - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	øC	To Engineering Units	(N/2)-40
Resolution	1/2	To Computer Units	(E + 40) * 2
Absolute Range	-40-87.5		

Valid Message Sequences:
REQ → RPT(F)
RPT(F)

5.1.8.116 Exterior Environment-Barometric Pressure (Absolute) ($F2/$11)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PF	PT	RPT(F)	0.0	Run-2	750.0			0.0	C9 F2 SS 11
RPT	PT	PF		0.0	Run-1	0.0	REQ		0.0	A8 F3 10 11
RPT(F)	PT	PF						Failure Condition		A8 F3 10 51

RPTF Transmit Value:
Data in RPTF is ignored

Change Trigger Definition:
None

Enabled Modes for Message Trigger:
(PT) REQ: Run

Enabled Modes for Change Trigger:
None

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PT	PF	N/A	RPT(F)	No	N/A		X9 F2 XX 11
RPT	PF	PT	(Platform specific)		Yes	(Platform specific)		X8 F3 XX 11
RPT(F)	PF	PT					Platform specific	X8 F3 XX 51

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PT) REQ: Run
(PF) RPT: Run
(PF) RPT(F): Run

Powertrain Interface Definition:

Exterior Environment - Barometric Pressure (Absolute) is owned by Powertrain. Powertrain determines barometric pressure by using the manifold absolute pressure sensor prior to the engine cranking. Prior to engine rotation, the pressure within the manifold is equal to the barometric pressure. Powertrain transmits the barometric pressure only on initialization of the RUN power mode.

Platform Interface Definition:

Exterior Environment - Barometric Pressure (Absolute) is monitored by Platform for use in the Tire Pressure Monitor system.

General Requirements

Data Definition (Reports and Loads only)

Exterior Barometric Pressure - Unsigned Numeric (8 bits)			
Encoding		Transfer Functions	
Units	kPaA	To Engineering Units	N*4
Resolution	4	To Computer Units	E/4
Absolute Range	0-1020		

Valid Message Sequences:
REQ → RPT(F)
RPT(F)

5.1.8.117 Vehicle Id (VIN)-VIN Packet 3 (digits 6 - 9) ($FA/$03)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PT	PF	RPT	0.0	Run-4	750.0			0.0	C9 FA 10 03
RPT	PF	PT		0.0	Run-3	0.0	REQ		0.0	A8 FB SS 03

Change Trigger Definition:
None

Enabled Modes for Message Trigger:
(PF) REQ: Run

Enabled Modes for Change Trigger:
None

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PF	PT	N/A	RPT	No	N/A		X9 FA XX 03
RPT	PT	PF	(VIN from prev power up)		No	N/A		X8 FB XX 03

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) REQ: Run
(PT) RPT: Run

Powertrain Interface Definition:

Vehicle Id (VIN) - 03 VIN Packet 3 (digits 6-9) is monitored by Powertrain. Powertrain uses VIN to determine when a PCM has been transferred from one vehicle to another. If this condition has been detected, the powertrain adaptive parameters which are stored in EEPROM equivalent memory will be re-initialized. It is critical that certain OBD-II diagnostic parameters also get re-initialized to avoid indicating a false diagnostic status.

Platform Interface Definition:

Vehicle Id (VIN) - 03 VIN Packet 3 (digits 6-9) is owned by Platform. The VIN is programmed at the vehicle assembly plant. This message is sent once at initialization and reports digits 6-9 of the VIN. The data consists of bytes 1 through 4 equal to digits 6 through 9 of the VIN encoded in ASCII. The Platform shall transmit this message with all ASCII null characters ($00) in the data field when the VIN has not been programmed in the Platform module.

General Requirements

Data Definition (Reports and Loads only)

VIN Packet 3 - ASCII Encoded (32 bits)
Description
Four ASCII Characters

Valid Message Sequences:
REQ → RPT
RPT

5.1.8.118 Vehicle Id (VIN)-VIN Packet 4 (digits 10 - 13) ($FA/$04)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PT	PF	RPT	0.0	Run-4	750.0			0.0	C9 FA 10 04
RPT	PF	PT		0.0	Run-3	0.0	REQ		0.0	A8 FB SS 04

Change Trigger Definition:
None

Enabled Modes for Message Trigger:
(PF) REQ: Run

Enabled Modes for Change Trigger:
None

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PF	PT	N/A	RPT	No	N/A		X9 FA XX 04
RPT	PT	PF	(VIN from prev power up)		No	N/A		X8 FB XX 04

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) REQ: Run
(PT) RPT: Run

Powertrain Interface Definition:

Vehicle Id (VIN) - 04 VIN Packet 4 (digits 10-13) is monitored by Powertrain. Powertrain uses VIN to determine when a PCM has been transferred from one vehicle to another. If this condition has been detected, the powertrain adaptive parameters which are stored in EEPROM equivalent memory will be re-initialized. It is critical that certain OBD-II diagnostic parameters also get re-initialized to avoid indicating a false diagnostic status.

Platform Interface Definition:

Vehicle Id (VIN) - 04 VIN Packet 4 (digits 10-13) is owned by Platform. The VIN is programmed at the vehicle assembly plant. This message is sent once at initialization and reports digits 10-13 of the VIN. The data consists of bytes 1 through 4 equal to digits 10 through 13 of the VIN encoded in ASCII. The Platform shall transmit this message with all ASCII null characters ($00) in the data field when the VIN has not been programmed in the Platform module.

General Requirements

Data Definition (Reports and Loads only)

VIN Packet 4 - ASCII Encoded (32 bits)
Description
Four ASCII Characters

Valid Message Sequences:
REQ → RPT
RPT

5.1.8.119 Vehicle Id (VIN)-VIN Packet 5 (digits 14 - 17) ($FA/$05)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PT	PF	RPT	0.0	Run-4	750.0			0.0	C9 FA 10 05
RPT	PF	PT		0.0	Run-3	0.0	REQ		0.0	A8 FB SS 05

Change Trigger Definition:
None

Enabled Modes for Message Trigger:
(PF) REQ: Run

Enabled Modes for Change Trigger:
None

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PF	PT	N/A	RPT	No	N/A		X9 FA XX 05
RPT	PT	PF	(VIN from prev power up)		No	N/A		X8 FB XX 05

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) REQ: Run
(PT) RPT: Run

Powertrain Interface Definition:

Vehicle Id (VIN) - 05 VIN Packet 5 (digits 14-17) is monitored by Powertrain. Powertrain uses VIN to determine when a PCM has been transferred from one vehicle to another. If this condition has been detected, the powertrain adaptive parameters which are stored in EEPROM equivalent memory will be re-initialized. It is critical that certain OBD-II diagnostic parameters also get re-initialized to avoid indicating a false diagnostic status.

Platform Interface Definition:

Vehicle Id (VIN) - 05 VIN Packet 5 (digits 14-17) is owned by Platform. The VIN is programmed at the vehicle assembly plant. This message is sent once at initialization and reports digits 14-17 of the VIN. The data consists of bytes 1 through 4 equal to digits 14 through 17 of the VIN encoded in ASCII. The Platform shall transmit this message with all ASCII null characters ($00) in the data field when the VIN has not been programmed in the Platform module.

General Requirements

Data Definition (Reports and Loads only)

VIN Packet 5 - ASCII Encoded (32 bits)
Description
Four ASCII Characters

Valid Message Sequences:
REQ → RPT
RPT

5.1.8.120 Network Control-Node Alive ($FE/$03)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
RPT	PF	<ALL>		2000.0	Accessory-1 Run-1 Crank-1	0.0		Periodic	0.0	08 FF SS 03
RPT	PT	<ALL>		2000.0	Accessory-1 Run-1 Crank-1	0.0		Periodic	0.0	08 FF 10 03

Change Trigger Definition:

The PF shall transmit the RPT every 2000.0 ms.
The PT shall transmit the RPT every 2000.0 ms.

Enabled Modes for Message Trigger:

None

Enabled Modes for Change Trigger:

(PF) RPT: Accessory, Run
(PT) RPT: Accessory, Run

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
RPT	PT	PF PT			No	N/A		X8 FF XX 03
RPT	PF	PF PT			No	N/A		X8 FF XX 03

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:

(PT) RPT: Accessory, Run, Crank
(PF) RPT: Accessory, Run, Crank

Powertrain Interface Definition:

Network Control - Node Alive is reported by all devices on the class 2 link that transmit class 2 messages. All devices transmit a node alive message once every 2 seconds in all system power modes where the device is powered and performing functions that require detection of a communications fault. This message is primarily used by the other devices on the link to determine when communication has been lost with a device so that a diagnostic trouble code can be set and default action can be taken on the data normally received from the device, which has failed.

General Requirements

None.

Valid Message Sequences:

RPT

5.1.8.121 Network Control-System Power Modes ($FE/$06)

Transmitted Message Requirements

Operation	Source	Dest	Exp Resp	Repetition Interval	Mode Trigger	Latency - Mode Init	Msg Trigger	Change Trigger	Latency - Norm Op	Message Header
REQ	PT	PF	RPT		Off Awake-2 Accessory-2 Run-2 Crank-2 RAP-2	0.0			0.0	49 FE 10 06
RPT	PF	PT		>100.0	Off Awake-1 Accessory-1 Run-1 Crank-1 RAP-1	0.0	REQ	System Power Modes=Any, Power Modes=Any, Ignition Switch Signal at PMM=Any	0.0	28 FF SS 06

Change Trigger Definition:

The PF shall transmit the RPT when the System Power Modes parameter changes state, when the Power Modes parameter changes state, when the Ignition Switch Signal at PMM parameter changes state and no more than once every 100.0 ms.

Enabled Modes for Message Trigger:
(PF) REQ: Off Awake, Accessory, Run, Crank, RAP

Enabled Modes for Change Trigger:
(PF) RPT: Off Awake, Accessory, Run, Crank, RAP

Received Message Requirements

Operation	Dest	Source	Power Up Default	Req'd Resp	Learn Source	SOH Failure Value	Receive Action	Message Header*
REQ	PF	PT	N/A	RPT	No	N/A		X9 FE XX 06
RPT	PT	PF			Yes	(Use backup strategy)		X8 FF XX 06

*The device shall only accept messages with an EVEN value in the most significant 4 bits of the message header

Rx action enabled in:
(PF) REQ: Off Awake, Accessory, Run, Crank, RAP
(PT) RPT: Off Awake, Accessory, Run, Crank, RAP

Powertrain Interface Definition:

Network Control - System Power Modes is monitored by Powertrain. The BMM bytes may be used by Powertrain for diagnostic purposes.. Powertrain uses Network Control - System Power Modes to synchronize itself with all the other Class 2 nodes on the vehicle, such that Class 2 normal communications can begin and remain in phase. Powertrain needs the system power mode to determine which Class 2 messages should be supported since not all messages are supported in all system power modes. Also, a transition into a new system power mode will cause each device to perform a Class 2 message initialization. The System Power Modes which Powertrain may be awake to receive (depending on the type of ignition switch) are:

$03 - OFF AWAKE (prior to PCM shutdown)
$06 - ACCESSORY
$07 - RUN
$08 - CRANK
$09 - RAP (prior to PCM shutdown)

Powertrain implements the following algorithm for determination of System Power Mode:

1. Initially default to (Power-Up Reset) system power mode
2. Wait a calibratable time delay (typically 200 ms.) for the system power mode report
3. If system power mode report is not received, then transmit a request
4. If report is not received within 50 ms. then determine power mode based on hard wired ignition switch inputs.

Platform Interface Definition:

Network Control - System Power Modes is owned by Platform. Platform determines the System Power Modes based on ignition switch inputs.

General Requirements

Data Definition (Reports and Loads only)

Packet Byte 1

Power Modes - State Encoded (8 bits)		
State	Support	State Description
00	Yes	Reserved
01	Yes	Off Battery Save
02	Yes	Off Asleep
03	Yes	Off Awake
04	Yes	Unlock
05	Yes	Retained Accessory Power Unlock
06	Yes	Accessory
07	Yes	Run
08	Yes	Crank
09	Yes	Retained Accessory Power (RAP)

Packet Bytes 2-3

Ignition Switch Signal at PMM - Bit Mapped with Mask (16 bits)						
Byte	Bit	Support	Mask	Description	Meaning of 0	Meaning of 1
1	7	Yes	Yes	Unused and Reserved		
	6	Yes	Yes	Unused and Reserved		
	5	Yes	Yes	Unused and Reserved		
	4	Yes	Yes	Unused and Reserved		
	3	Yes	Yes	Accessory	Inactive	Active
	2	Yes	Yes	Run	Inactive	Active
	1	Yes	Yes	Run/Crank	Inactive	Active
	0	Yes	Yes	Unlock	Inactive	Active
2	Mask for Bit Mapped with Mask byte 1					

Valid Message Sequences:

REQ → RPT

RPT

5.1.9 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/ AUTHORIZATION
5.1.8	Added mode triggers (Off Awake, Accessory and RAP) to the following Class-2 Messages (A/C Clutch Enable ($14/$01) and A/C Clutch-Clutch Permission ($14/$10)) and Added statement, "This message may also be used for HVAC Control in RVS vehicles" for clarity to ($14/$01) and ($14/$10). Added mode triggers (Off Awake, Accessory and Rap) Engine System Other-Engine Run Flag ($52/$04) Added Rap mode trigger to Ignition Switch/Starter-Remote Start Crank ($86/$16)	ICR 321
5.1.7 5.1.8	Added Class 2 message - Displays-Driver Notification-Tap Up/ Tap Down Request Denied ($EA/$22/$A4).	ICR 2052
5.1.7 5.1.8	Added Class 2 message – Engine System Other – Calculated RDM Clutch ($52-26)	ICR 2058
5.1.7 5.1.8	Added "Section 2.16" for signal usage for Engine Coolant – Fan (All) Speed ($48/$01) message. Revised message Engine Coolant – Fan (All) Speed ($48/$01) Platform Interface description to add usage for "RVC calculations".	ICR 2073
5.1.7 5.1.8	Added Class 2 Message Transmission/Transaxle/PRNDL-Transmission Gear Ratio ($3A/$38).	ICR 2103
5.1.75.1.8	Added new Class 2 message Engine System Other – Displacement on Demand Status ($52/$30).	ICR 2106
5.1.7 5.1.8	Added Class 2 message "Engine Oil-Fluid Temperature ($4A/$10).	ICR 2110
5.1.7 5.1.8	Added Class 2 message Engine System Other – Estimated Outside Air Temperature ($F2/$08).	ICR 2111
5.1.8	Added Powertrain and Platform Interface Definitions for $EA/$20/$B4 A/C Off for Engine Protection Class 2 Message.	ICR 2119

5.1.8	Added 6 Speed Transmission Variants with their corresponding state bit-6L45E, 6L50E, 6L80E, 6L90E, HM6T65E, HM6T80E.	ICR 2130

5.2 GMLAN

5.2.1 Definition of Terms

Periodic Interval:
The maximum fixed periodic (plus allowable tolerance) interval at which a frame is transmitted (in the absence of event triggers). The frames may be transmitted faster than the periodic interval if the time base supported by the application does not allow for transmission at the exact documented interval.

Update Time:
Minimum interval between successive transmissions of a frame. Update time holds for both periodic and event-triggered transmissions of a particular frame.

Supervision Timeout:
A communication failure is detected when a periodic frame has not been received within this interval, which must be more than twice its Periodic Interval.

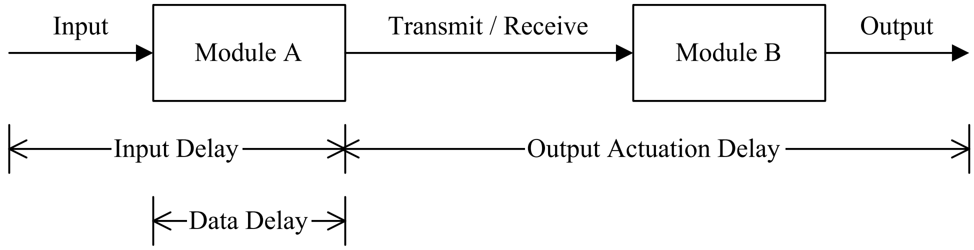
Accuracy Requirement:
The Accuracy Requirement is a requirement for a signal that is imposed upon the transmitter of the signal by the receiver of the signal. It is the maximum allowable difference between the true value of a quantity and the value transmitted for the quantity in its associated serial data signal. Accuracy requirements generally only apply to numerical signals, and may not apply to all numeric signals.

Power-Up Default:
The Power-up Default is the value to be used for the signal prior to its initial receipt. In general, this value cannot be specified, as different receivers (or even different information consumers within a single receiver) may have different requirements for Power-Up Defaults. In certain situations, however, proper operation of a function may require that some or all receivers use a specific Power-up Default value. In these limited situations, the transmitter of a signal is placing behavioral requirements on the receiver.

Communication Failure Value:
The Communication Failure Value is the value to be used for the signal upon detection of a communication failure (see definition of Supervision Timeout above). In general, this value cannot be specified, as different receivers (or even different information consumers within a single receiver) may have different requirements for Communication Failure Value. In certain situations, however, proper operation of a function may require that some or all receivers use a specific Communication Failure value. In these limited situations, the transmitter of a signal is placing behavioral requirements on the receiver.

Timing Parameters

The following parameters may not be specified for every GMLAN signal.



Input Delay:
The Input Delay is a latency requirement for a signal that is imposed upon the transmitter of the signal by the receiver of the signal. It is the maximum time delay from the change of state of a switch or sensor at the input of the controller to the completion of transmission of the serial data signal. This delay includes debounce time (if applicable), application loop time, serial data handler loop time, and serial data arbitration time. It does not include any timing associated with the reception of a signal, or any times associated with the transference of a signal through a gateway.

This requirement influences the selection of the periodic interval at which the input is sampled and processed, the Periodic Interval for the frame containing the signal, the possible use of an event trigger and the associated Update Time for the frame containing the signal, and the periodic interval at which the transmit processing of the GMLAN handler is scheduled.

Data Delay:
The Data Delay is a latency requirement for a signal that is imposed upon the transmitter of the signal by the receiver of the signal. It is the maximum time delay from an input that causes an algorithm decision to change the state of a variable to the transmission of the serial data signal. This delay includes the application and serial data handler loop times as well as the serial data arbitration time.

This requirement influences the selection of the periodic interval at which the algorithm is scheduled, the Periodic Interval for the frame containing the signal, the possible use of an event trigger and the associated Update Time for the frame containing the signal, and the periodic interval at which the transmit processing of the GMLAN handler is scheduled.

Output Actuation Delay:
The Output Actuation Delay is a latency requirement for a signal that is imposed upon the receiver of the signal by the transmitter of the signal and is typically applied to control requests and displays. It is the time delay from the completion of the transmission of a serial data message by the original transmitter to the change of state at the output of the controller. This delay includes the receiver serial data handler loop time, application loop time, and output driver actuation time, and any time associated with the transference of information across one or more gateways.

This requirement influences the selection of the periodic interval at which the receive processing of the GMLAN handler is scheduled and the periodic interval at which the algorithm which asserts the output is scheduled. It also affects the use and/or design of serial data gateways that lie between the original transmitter and the device that ultimately controls an output.

The GMLAN signals that are in this document are included for the purpose of identifying the required signals for the standard interface between Platform and Powertrain. It is not intended that every signal be used in every application.

5.2.2 References

GMW3104 - GMLAN Strategy Specification
GMW3110 - GMLAN Diagnostic Test Mode Specification
GMW3122 - GMLAN High Speed CAN Physical Layer Specification

5.2.3 GMLAN Signals Summary

Description	Trans-mitter	PPEI Section Number	Notes
Accelerator Kick Down Detected	PT	2.11	TCS
Accelerator Actual Position	PT	2.2, 2.7, 2.11, 2.17	Required for ATC with active push button control and Truck AWD Required with ETC for SDM. Required with BASS.
Accelerator Actual Position Validity	PT	2.2, 2.7,2.11, 2.17	Required for ATC with active push button control and Truck AWD Required with ETC for SDM. Required with BASS.
Accelerator Effective Position	PT	2.7, 2.11	ETS, TCS
Accelerator Effective Position Validity	PT	2.7, 2.11	ETS, TCS
Air Conditioning Compressor Clutch Engaged	PT	2.9	Optional for A/C
Air Conditioning Compressor Clutch Request	PF	2.8, 2.9	Required for cooling fan control when A/C pressure sensor not present. Required for clutched compressors
Air Conditioning Compressor Normalized Load	PF	2.9	Required with Electronically Controlled Variable Displacement, GME only.
Air Conditioning Compressor Normalized Load Validity	PF	2.9	Required with Electronically Controlled Variable Displacement, GME only.
Air Conditioning Compressor Stroke Request	PT	2.9	Required with Clutchless AC, GME only.
Air Conditioning Compressor Present	PF	2.9	Required for vehicles that have optional A/C
Air Conditioning Off Indication On	PT	2.3, 2.8	Optional
Air Conditioning Refrigerant High Side Fluid Pressure	PT	2.9	Optional
Air Conditioning Refrigerant High Side Fluid Pressure Validity	PT	2.9	Optional
Air Conditioning Refrigerant Low Side Fluid Temperature	PF	2.9	Optional
Air Conditioning Refrigerant Low Side Fluid Temperature Validity	PF	2.9	Optional
Airbag Deployed	PF	2.7, 2.17	Powertrain-Optional with ETC
Airbag System Virtual Device Availability	PF	2.10	Required when Airbag Deployed signal is gated to Powertrain
All Wheel Drive Clutch Completely Open	PT	2.2	Required with Electronically Controlled Active Transfer Case
All Wheel Drive Clutch Temperature	PT	2.2	Required with Electronically Controlled Active Transfer Case

Description	Trans-mitter	PPEI Section Number	Notes
All Wheel Drive Clutch Temperature Validity	PT	2.2	Required with Electronically Controlled Active Transfer Case
All Wheel Drive Mode Active	PT	2.2, 2.3	Required for Truck four wheel drive with manual transfer case
All Wheel Drive Oil Temperature	PT	2.2	Required with Electronically Controlled Active Transfer Case
All Wheel Drive Oil Temperature Validity	PT	2.2	Required with Electronically Controlled Active Transfer Case
All Wheel Drive Overheated Indication On	PT	2.2	Required with Electronically Controlled Active Transfer Case
All Wheel Drive System Failure Status	PT	2.2	Required with Electronically Controlled Active Transfer Case
All Wheel Drive Torque Request Achievable	PT	2.2	Required with Electronically Controlled Active Transfer Case
All Wheel Drive Transferred Torque	PT	2.2	Required with Electronically Controlled Active Transfer Case
All Wheel Drive Transferred Torque Status	PT	2.2	Required with Electronically Controlled Active Transfer Case
All Wheel Drive Transferred Torque Validity	PT	2.2	Required with Electronically Controlled Active Transfer Case
Anticipated Electrical Load Estimation	PF	2.4	Optional
Antilock Brake System Active	PF	2.2, 2.11, 2.15	ABS Required for GMNA Required with Electronically Controlled Active Transfer Case
Antilock Brake System Failed	PF	2.7, 2.11	ABS Required for GMNA Required with cruise control
Antilock Brake System Present	PF	2.11, 2.15	ABS Optional for transmission control
Apply Brake Pedal Indication On	PT	2.3, 2.7	Platform-Optional with Cruise Control
Backup Power Mode Master Virtual Device Availability	PF	2.1. 2.5	Required GMNA
Barometric Pressure Absolute	PT	2.10	Optional
Barometric Pressure Absolute Validity	PT	2.10	Optional
Body Virtual Device Availability	PF	2.2	Required with Electronically Controlled Active Transfer Case
Brake Extended Travel Switch Active	PT	2.11	VSES for vehicles without BASS
Brake Extended Travel Switch Active Validity	PT	2.11	VSES for vehicles without BASS
Brake Pedal Driver Applied Pressure	PF	2.2	Required with Electronically Controlled Active Transfer Case
Brake Pedal Driver Applied Pressure Validity	PF	2.2	Required with Electronically Controlled Active Transfer Case
Brake Pedal Initial Travel Achieved	PF	2.7, 2.15	Vehicles with BASS
Brake Pedal Initial Travel Achieved Protection	PF	2.7	Vehicles with BASS
Brake Pedal Moderate Travel Achieved	PF	2.4	Vehicles with BASS and brake torque management
Brake Pedal Position Failure	PF	2.4, 2.7, 2.15	Vehicles with BASS
Brake Pedal Position Rolling Count	PF	2.7	Vehicles with BASS
Brake Pedal Switch Active	PT	2.11, 2.15, 21.7	For vehicles without BASS ABS, SDM Optional for BTSI control
Brake Pedal Switch Active Validity	PT	2.11,	For vehicles without BASS

Description	Trans-mitter	PPEI Section Number	Notes
		2.15, 2.17	ABS, SDM Optional for BTSI control
Check Fuel Filler Cap Indication On	PT	2.3, 2.12	Optional
Climate Control Virtual Device Availability	PT	2.10	Required when either Air Conditioning Compressor Clutch Request or Air Conditioning Refrigerant Low Side Fluid Temperature signal is gated to Powertrain
Clutch Start Switch Active	PT	2.2	Required for ATC with active push button control and Truck AWD
Clutch Start Switch Active Validity	PT	2.2	Required for ATC with active push button control and Truck AWD
Continuous Variable Transmission Present	PT	2.15	Required for CVT
Cruise Control Active	PT	2.3, 2.7	Required with cruise control & PTO
Cruise Control Alive Rolling Count	PF	2.7	Required with cruise control
Cruise Control Cancel Request	PF	2.7	Optional with cruise control
Cruise Control Clutch Switch Active	PT	2.11	ETS, TCS
Cruise Control Clutch Switch Active Validity	PT	2.11	ETS, TCS
Cruise Control Driver Selected Speed	PT	2.7,2.3	Required with conventional cruise control.
Cruise Control Driver Selected Speed Active	PT	2.7, 2.3	Required with conventional cruise control.
Cruise Control Enabled	PT	2.7	Required with cruise control
Cruise Control On Switch Active	PF	2.7	Optional with cruise control
Cruise Control Resume Switch Active	PF	2.7	Optional with cruise control
Cruise Control Set Switch Active	PF	2.7	Optional with cruise control
Cruise Control Switch Failed	PF	2.7	Optional with cruise control
Cruise Control Switch Protection Value	PF	2.7	Required with cruise control
Diesel Glow Plug Indication On	PT	2.3	Optional with diesel
Distance Rolling Count Driven Wheel	PT	2.3, 2.19	Required – See Section 2.19
Distance Rolling Count Driven Wheel Reset Occurred	PT	2.3, 2.19	Required – See Section 2.19
Distance Rolling Count Driven Wheel Validity	PT	2.3, 2.19	Required – See Section 2.19
Distance Rolling Count Left Non Driven Wheel	PT	2.3, 2.19	Required – See Section 2.19
Distance Rolling Count Left Non Driven Wheel Reset Occurred	PT	2.3, 2.19	Required – See Section 2.19
Distance Rolling Count Left Non Driven Wheel Validity	PT	2.3, 2.19	Required – See Section 2.19
Distance Rolling Count Non Driven Wheel	PT	2.3, 2.19	Required – See Section 2.19
Distance Rolling Count Non Driven Wheel Reset Occurred	PT	2.3, 2.19	Required – See Section 2.19
Distance Rolling Count Non Driven Wheel Validity	PT	2.3, 2.19	Required – See Section 2.19
Distance Rolling Count Right Non Driven Wheel	PT	2.3, 2.19	Required – See Section 2.19
Distance Rolling Count Right Non Driven Wheel Reset Occurred	PT	2.3, 2.19	Required – See Section 2.19
Distance Rolling Count Right Non Driven Wheel Validity	PT	2.3, 2.19	Required – See Section 2.19
Driver Shift Control Request Denied Indication On	PT	2.15	Optional for Tap Up/Tap Down
Energy Management Minimum Idle Boost Level Request	PF	2.4	Optional
Engine Boost Pressure Indication	PT	2.3	Optional on turbo vehicles
Engine Boost Pressure Indication Validity	PT	2.3	Optional on turbo vehicles
Engine Calculated Actual Gear	PT	2.11,2.15 ,2.17	Required by SDM on vehicles with manual transmission and ECM, TCS
Engine Calculated Actual Gear Validity	PT	2.11, 2.15,2.17	Required for SDM on vehicles with manual transmission and ECM, TCS
Engine Coast Fuel Cutoff Active	PT	2.3	Optional

Description	Trans-mitter	PPEI Section Number	Notes
Engine Coolant Hot Indication On	PT	2.3, 2.8	Required
Engine Coolant Level Low	PF	2.4	Required with premium V6
Engine Coolant Level Switch Virtual Device Availability	PF	2.10	Required when Engine Coolant Level Low signal is gated to Powertrain
Engine Coolant Temperature	PT	2.3, 2.11	Required TCS
Engine Coolant Temperature Validity	PT	2.3, 2.11	Required TCS
Engine Cooling Fan Speed	PT	2.8, 2.16	Required with RVC
Engine Cooling Fan Speed Adjustment	PF	2.8	Optional
Engine Cylinder Deactivation Mode	PT	2.3	Required with DoD control
Engine Emissions Related Malfunction Active	PT	2.17	Required
Engine Emissions Related Malfunction Indication Request	PT	2.03	Required
Engine Hot / Stop Engine Indication On	PT	2.3	Powertrain Optional
Engine Intake Air Temperature	PT	2.10, 2.11, 2.14, 2.16	Required with suspension control TCS Required for ATC with Active Push Button Control Optional for HVAC fan afterblow Required with RVC
Engine Intake Air Temperature Validity	PT	2.10, 2.11, 2.14, 2.16	Required with suspension control TCS Required for ATC with Active Push Button Control Optional for HVAC fan afterblow Required with RVC
Engine Limp Home Mode Active	PT	2.3, 2.7, 2.17	Required with ETC
Engine Off Time	PF	2.2	Required with Electronically Controlled Active Transfer Case
Engine Off Time Validity	PF	2.2	Required with Electronically Controlled Active Transfer Case
Engine Oil Change Now Indication On	PT	2.3	Optional
Engine Oil Change Soon Indication On	PT	2.3	Optional
Engine Oil Level Low Indication On	PT	2.3	Optional
Engine Oil Life Reset Performed	PT	2.3	Optional
Engine Oil Life Reset Request	PF	2.3	Optional
Engine Oil Pressure	PT	2.3	Optional
Engine Oil Pressure Low Indication On	PT	2.3	Required
Engine Oil Pressure Validity	PT	2.3	Optional
Engine Oil Remaining Distance	PT	2.3	Optional
Engine Oil Remaining Life	PT	2.3	Optional
Engine Oil Starvation Indication On	PT	2.3	Optional
Engine Oil Temperature	PT	2.3	Optional
Engine Oil Temperature Validity	PT	2.3	Optional
Engine Recommended Shift Indication	PT	2.3, 2.15	Optional
Engine Running Status	PT	2.2, 2.3, 2.10, 2.11	Required
Engine Speed	PT	2.3, 2.11, 2.17	Required
Engine Speed Validity	PT	2.3, 2.11,	Required

Description	Trans-mitter	PPEI Section Number	Notes
		2.17	
Engine System Regular Production Option Identifier	PF	2.10	Optional use for GME Only (vehicles sold in non-North American markets)
Engine Torque Actual	PT	2.11	Required for ATC with active push button control and Truck AWD ETS, TCS
Engine Torque Actual Validity	PT	2.11	Required for ATC with active push button control and Truck AWD ETS, TCS
Engine Torque Driver Requested	PT	2.11	ETS, TCS
Engine Torque Driver Requested Validity	PT	2.11	ETS, TCS
Engine Torque Maximum	PT	2.11	ETS, TCS
Engine Torque Maximum Validity	PT	2.11	ETS, TCS
Engine Torque Minimum	PT	2.11	ETS, TCS
Engine Torque Minimum Validity	PT	2.11	ETS, TCS
Engine Torque Reduction Failed	PT	2.11	ETS, TCS
Engine Torque Reduction Failure Status	PT	2.11	ETS, TCS
Engine Torque Traction Control Request Failed	PT	2.11	ETS, TCS
Engine Water In Fuel Indication On	PT	2.3	Optional with diesel
Fuel Capacity	PT	2.3, 2.12	Required
Fuel Injected Rolling Count	PT	2.3	Optional
Fuel Injected Rolling Count Reset Occurred	PT	2.3	Optional
Fuel Level Percent	PT	2.3, 2.12	Required
Fuel Level Percent Validity	PT	2.3, 2.12	Required
Generator Enabled	PT	2.16	Optional
Generator Failed	PT	2.3, 2.16	Required
Generator Field Duty Cycle	PT	2.16	Required with RVC
Generator Field Duty Cycle Validity	PT	2.16	Required with RVC
Generator Regulator Setpoint Duty Cycle Request	PF	2.16	Required with RVC
Immobilizer Information (see specification)	PF/PT	2.6	Required for Immobilizer
Instantaneous Fuel Consumption Rate	PT	2.3	Optional
Manual Transmission Reverse Gear Active	PF	2.15	Optional
Manual Transmission Reverse Gear Active Validity	PF	2.15	Optional
Manual Transmission Reverse Gear Switch Virtual Device Availability	PF	2.10	Required when Manual Transmission Reverse Gear Active signal is gated to Powertrain
Outside Air Temperature Corrected Value	PF	2.4	Optional
Outside Air Temperature Corrected Value Validity	PF	2.4	Optional
Outside Air Temperature Powertrain Estimated	PT	2.16	Required with RVC
Outside Air Temperature Powertrain Estimated Validity	PT	2.16	Required with RVC
Outside Air Temperature Powertrain Estimated Mask	PT	2.16	Required with RVC
Outside Air Temperature Virtual Device Availability	PF	2.10	Required when Outside Air Temperature Corrected Value signal is gated to Powertrain
Park Brake Switch Active	PF	2,.2, 2.7, 2.15	Required with Auto Trailering Mode, Required with Electronically Controlled Active Transfer Case
Park Brake Virtual Device Availability	PF		Required with Auto Trailering Mode, Required with Electronically Controlled Active Transfer Case
Power Mode Master Accessory Terminal Status	PF	2.1	Powertrain Optional
Power Mode Master Run Crank Terminal Status	PF	2.1	Powertrain Optional

Description	Trans-mitter	PPEI Section Number	Notes
Powertrain Brake Pedal Discrete Input Status	PT	2.7, 2.11,2.15	Optional use for GME only
Powertrain Brake Pedal Discrete Input Status Validity	PT	2.7, 2.11,2.15	Optional use for GME only
Powertrain Brake Pedal Secondary Discrete Input Status	PT	2.7, 2.11,2.15	Optional use for GME only
Powertrain Brake Pedal Secondary Discrete Input Status Validity	PT	2.7, 2.11,2.15	Optional use for GME only
Powertrain Crank Aborted	PT	2.5	Required with Easy Key and Remote Start
Powertrain Customer Snapshot Request	PF	2.10	Optional
Powertrain Exhaust Particle Filter Warning Indication On	PT	2.3, 2.4, 2.13	Optional withDiesel
Powertrain High Electrical Load Requested	PT	2.3, 2.4, 2.13	Optional with Diesel
Powertrain Run Aborted	PT	2.5	Required with Easy Key and Remote Start
Real Time Damping System Present	PF	2.14	Optional with suspension control
Remote Vehicle Start Engine Running	PT	2.4, 2.5	Required with Easy Key and Remote Start
Remote Vehicle Start Request	PF	2.4, 2.5	Required with Easy Key and Remote Start
Service Engine System Non Emission Related Indication Request	PT	2.3, 2.17	Platform-Optional
Service Transmission System Indication On	PT	2.3	Optional
Spare Tire Status	PF	2.2, 2.11	Optional for Non-Truck all wheel drive
Starting Disabled Indication On	PT	2.3, 2.5	Platform optional
Steering Wheel Angle	PF	2.2	Required with Electronically Controlled Active Transfer Case
Steering Wheel Angle Validity	PF	2.2	Required with Electronically Controlled Active Transfer Case
Suspension System Dampers Failed Full Soft	PF	2.14	Required with suspension control
System Backup Power Mode	PF	2.1, 2.5	Required GMNA
System Backup Power Mode Enabled	PF	2.1, 2.5	Required GMNA
System Power Mode	PF	2.1, 2.5, 2.10	Required
Throttle Position	PT	2.17	Required for GMNA
Throttle Position Validity	PT	2.17	Required for GMNA
Throttle Progression Request	PF	2.03	
Throttle Progression Status	PT	2.03	
Traction Control Alive Rolling Count	PF	2.11	ETS, TCS
Traction Control System Active	PF	2.2, 2.11	ETS, TCS, Required with Electronically Controlled Active Transfer Case
Traction Control System Enabled	PF	2.4, 2.11	ETS, TCS
Traction Control System Failed	PF	2.11	ETS, TCS
Traction Control System Present	PF	2.11	ETS, TCS
Traction Control Torque Request	PF	2.11	ETS, TCS
Traction Control Torque Request Protection	PF	2.11	ETS, TCS
Traction Control Torque Request Validity	PF	2.11	ETS, TCS
Traction Torque Decay Control	PF	2.11	TCS
Traction Torque Decay Control Active	PF	2.11	Required for ETC

Description	Trans-mitter	PPEI Section Number	Notes
Transfer Case Non Emissions Related Malfunction Active	PT	2.2	Required with Electronically Controlled Active Transfer Case
Transmission Actual Gear	PT	2.2, 2.11, 2.15, 2.17	Required Required for ATC with active push button control and Truck AWD ETS & TCS
Transmission Actual Gear Validity	PT	2.2, 2.11, 2.15, 2.17	Required Required for ATC with active push button control and Truck AWD ETS & TCS
Transmission Change Oil Now Indication On	PT	2.3	Optional
Transmission Electronic Range Select Mode Request	PF	2.15	Optional
Transmission Gear Indication	PT	2.3, 2.15	Optional
Transmission Gear Indication Validity	PT	2.3, 2.15	Optional
Transmission Gear Ratio	PT	2.11,2.15	Required for traction control with CVT transmission
Transmission Gear Ratio Validity	PT	2.11,2.15	Required for traction control with CVT transmission
Transmission Gear Selector Position	PT	2.3, 2.11, 2.15	Required BASS, ETS, TCS
Transmission Gear Selector Position Validity	PT	2.3, 2.11, 2.15	Required BASS, ETS, TCS
Transmission Gear Shift Direction	PT	2.11	ETS, TCS
Transmission Hot Indication On	PT	2.3	Optional
Transmission Limp Home Mode Active	PT	2.3	Optional
Transmission Load Management Shift Pattern Request	PF	2.15	Optional
Transmission Load Management Shift Pattern Status	PT	2.3, 2.15	Optional
Transmission Oil Life Reset Request	PF	2.3	Optional
Transmission Oil Remaining Life	PT	2.3	Optional
Transmission Oil Temperature	PT	2.3	Optional
Transmission Oil Temperature Validity	PT	2.3	Optional
Transmission Performance Algorithm Shift Mode Active	PT	2.3, 2.15	Optional
Transmission Shift Lever Lock Requested	PT	2.15	Required with CVT
Transmission Skip Shift Indication On	PT	2.3, 2.15	Optional
Transmission Sport Shift Pattern Request	PF	2.15	Optional
Transmission Sport Shift Pattern Status	PT	2.3, 2.15	Optional
Transmission Tap Up/Tap Down Mode Indication On	PT	2.3, 2.15	Required with Tap Up/Tap Down
Transmission Tap Up/Tap Down Mode Request	PF	2.15	Required with Tap Up/Tap Down
Transmission Tap Up/Tap Down Request,	PF	2.15	Optional
Transmission Tap Up/Tap Down Request Validity	PF	2.15	Optional
Transmission Trailering Shift Pattern Request	PF	2.15	Optional
Transmission Trailering Shift Pattern Status	PT	2.3, 2.15	Optional
Transmission Winter Mode Request	PF	2.15	Optional
Transmission Winter Mode Status	PT	2.3, 2.15	Optional
Vehicle Dynamics Alive Rolling Count	PF	2.2	Required with Electronically Controled Active Transfer Case
Vehicle Dynamics Control Active	PF	2.2, 2.11	VSES, Required with Electronically Controlled Active Transfer Case
Vehicle Dynamics Control Enabled	PF	2.2	Required with Electronically Controlled Active Transfer Case
Vehicle Dynamics Control Failed	PF	2.2	Required with Electronically Controlled Active Transfer Case

Description	Trans-mitter	PPEI Section Number	Notes
Vehicle Dynamics Declutch Request	PF	2.2	Required with Electronically Controlled Active Transfer Case
Vehicle Dynamics Declutch Request Validity	PF	2.2	Required with Electronically Controlled Active Transfer Case
Vehicle Dynamics Lateral Acceleration	PF	2.11	VSES
Vehicle Dynamics Lateral Acceleration Validity	PF	2.11	VSES
Vehicle Dynamics Over Under Steer	PF	2.2	Required with Electronically Controlled Active Transfer Case
Vehicle Dynamics Over Under Steer Validity	PF	2.2	Required with Electronically Controlled Active Transfer Case
Vehicle Dynamics Torque Transfer Request	PF	2.2	Required with Electronically Controlled Active Transfer Case
Vehicle Dynamics Torque Transfer Request Protection	PF	2.2	Required with Electronically Controlled Active Transfer Case
Vehicle Dynamics Torque Transfer Request Validity	PF	2.2	Required with Electronically Controlled Active Transfer Case
Vehicle Dynamics Yaw Rate	PF	2.2	Required with Electronically Controlled Active Transfer Case
Vehicle Dynamics Yaw Rate Validity	PF	2.2	Required with Electronically Controlled Active Transfer Case
Vehicle Identification Number Digits 10-17	PF	2.10	Optional
Vehicle Lift/Dive Status	PT	2.14	Optional
Vehicle Lift/Dive Status Validity	PT	2.14	Optional
Vehicle Odometer	PF	2.3	Optional
Vehicle Odometer Validity	PF	2.3	Optional
Vehicle Security Non Immobilizer Password	PF	2.5, 2.6	Required with Non-Immobilizer VTD
Vehicle Security Non Immobilizer Password Status	PF	2.5, 2.6	Required with Non-Immobilizer VTD
Vehicle Security Non Immobilizer Powertrain Status	PT	2.5, 2.6	Required with Non-Immobilizer VTD
Vehicle Speed	PT	2.2, 2.3, 2.8, 2.14, 2.17, 2.19	Required
Vehicle Speed Validity	PT	2.2, 2.3, 2.8, 2.14 2.17, 2.19	Required
Vehicle Theft Deterrent Non Immobilizer Virtual Device Availability	PF	2.10	Required when Vehicle Security Non Immobilizer Password Status signal is gated to Powertrain
Vehicle Top Speed Limit Value	PT	2.3, 2.14	Optional with suspension control
Vehicle Top Speed Limitation Indication On	PT	2.3, 2.14	Required with suspension control
Wheel Angular Velocity Front Left	PF	2.7, 2.11, 2.19	ABS
Wheel Angular Velocity Front Left Validity	PF	2.7, 2.11, 2.19	ABS
Wheel Angular Velocity Front Right	PF	2.7, 2.11, 2.19	ABS
Wheel Angular Velocity Front Right Validity	PF	2.7, 2.11, 2.19	ABS
Wheel Angular Velocity Rear Left	PF	2.7, 2.11, 2.19	ABS
Wheel Angular Velocity Rear Left Validity	PF	2.7, 2.11, 2.19	ABS

Description	Trans-mitter	PPEI Section Number	Notes
Wheel Angular Velocity Rear Right	PF	2.7, 2.11, 2.19	ABS
Wheel Angular Velocity Rear Right Validity	PF	2.7, 2.11, 2.19	ABS
Wheel Angular Velocity High Resolution Front Left	PF	2.2	Required with Electronically Controlled Active Transfer Case
Wheel Angular Velocity High Resolution Front Left Validity	PF	2.2	Required with Electronically Controlled Active Transfer Case
Wheel Angular Velocity High Resolution Front Right	PF	2.2	Required with Electronically Controlled Active Transfer Case
Wheel Angular Velocity High Resolution Front Right Validity	PF	2.2	Required with Electronically Controlled Active Transfer Case
Wheel Angular Velocity High Resolution Rear Left	PF	2.2	Required with Electronically Controlled Active Transfer Case
Wheel Angular Velocity High Resolution Rear Left Validity	PF	2.2	Required with Electronically Controlled Active Transfer Case
Wheel Angular Velocity High Resolution Rear Right	PF	2.2	Required with Electronically Controlled Active Transfer Case
Wheel Angular Velocity High Resolution Rear Right Validity	PF	2.2	Required with Electronically Controlled Active Transfer Case
Wheel Average Peak to Peak Acceleration	PF	2.11, 2.19	Required for GMNA vehicles that require rough road detection
Wheel Average Peak to Peak Acceleration Validity	PF	2.11, 2.19	Required for GMNA vehicles that require rough road detection
Wheel Rotations Left Driven Rolling Count	PF	2.19	Required with ABS for GME
Wheel Rotations Left Driven Rolling Count Reset Occurred	PF	2.19	Required with ABS for GME
Wheel Rotations Left Driven Rolling Count Validity	PF	2.19	Required with ABS for GME
Wheel Rotations Left Non Driven Rolling Count	PF	2.19	Required with ABS for GME
Wheel Rotations Left Non Driven Rolling Count Reset Occurred	PF	2.19	Required with ABS for GME
Wheel Rotations Left Non Driven Rolling Count Validity	PF	2.19	Required with ABS for GME
Wheel Rotations Right Driven Rolling Count	PF	2.19	Required with ABS for GME
Wheel Rotations Right Driven Rolling Count Reset Occurred	PF	2.19	Required with ABS for GME
Wheel Rotations Right Driven Rolling Count Validity	PF	2.19	Required with ABS for GME
Wheel Rotations Right Non Driven Rolling Count	PF	2.19	Required with ABS for GME
Wheel Rotations Right Non Driven Rolling Count Reset Occurred	PF	2.19	Required with ABS for GME
Wheel Rotations Right Non Driven Rolling Count Validity	PF	2.19	Required with ABS for GME
Wheel Speed Sensing Diagnostic Completed	PF	2.11	ABS

5.2.4 GMLAN Signal Definitions

5.2.4.1 Accelerator Kick Down Detected

Signal	Length	Data Type	Range	Conversion
Accelerator Kick Down Active	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Accelerator Kick Down Detected is transmitted by the ECM, for automatic transmissions vehicles equipped with ETC and European style Detent Feel Pedal Assemblies only. It shall be transmitted as always False or not transmitted on all other vehicle configurations. The signal is set to "True" when the ECM determines the Accelerator Position to be in the Pedal Position kick down feel range (greater than approximately 110% Rotation via PPS1 only). Cruise Control operation shall not cause this request. A transition from “False” to “True” indicates a driver request for a kick down downshift to obtain elevated vehicle acceleration operation.

Accelerator Kick Down Detected shall be disabled (no request) by the ECM whenever the signal used to generate the request is unreliable for more than approximately 200 ms to prevent unwanted downshifts. In addition, Accelerator Kick Down Detected shall be disabled by the ECM when the ETC failure mode system will not allow the full engine power expected when the Accelerator Pedal is at the kick down detent position.

Data Delay: TBD

Platform Interface Definition:
Accelerator Kick Down Detected is used by Traction Control. It is used to trigger a TCS performance mode, simultaneously with any kick down shift (if it occurs), to allow more wheel slip than normal and may otherwise change the traction control system performance to accommodate the driver’s request/expectation for different traction control performance.

The TCS will disallow this action for TCS system failures, as appropriate.

Note: If needed on manual transmission, non-ETC, or Non-European Kick down Detent Pedal vehicles, Platform shall obtain this information by evaluating the Accelerator Actual Position, Effective Accelerator Position, or other parameters.

Power-Up Default: “False”
Communication Failure: “False”
Sensor Failure: “False”

5.2.4.2 Accelerator Actual Position, Accelerator Actual Position Validity

Signal	Length	Data Type	Range	Conversion
Accelerator Actual Position	8	UNM	0 - 100 % Rotation	E = N * 0.392157
Accelerator Actual Position Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Accelerator Actual Position is transmitted by Powertrain. It represents the driver intended request for power or acceleration.

It is the accelerator pedal position sensor interpretation and does not include cruise control effects on vehicles equipped with Electronic Throttle Control (ETC).

It is the throttle position sensor interpretation and does include cruise control effects on vehicles not equipped with Electronic Throttle Control (ETC).

In all cases, it is not an indication of actual power or acceleration. In all cases, the effects of other engine or throttle control functions such as idle control, traction control, torque management, drag control, vehicle speed governing/limiting, and engine speed governing/limiting are not reflected in this parameter.

Data Delay: TBD

Platform Interface Definition:
Accelerator Actual Position is used by the SDM for crash recording. It may also be used by the traction control algorithms. The data in Accelerator Actual Position shall be ignored when Accelerator Actual Position Validity is set to “Invalid”.

5.2.4.3 Accelerator Effective Position , Accelerator Effective Position Validity

Signal	Length	Data Type	Range	Conversion
Accelerator Effective Position	8	UNM	0 - 100 %	E = N * 0.392157
Accelerator Effective Position Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Accelerator Effective Position is transmitted by Powertrain. It is calculated from the driver depressing the accelerator pedal or cruise control opening the throttle, whichever is requesting a higher engine response.

On ETC vehicles, it represents a normalized 0 to 100% “engine response” resulting from an interpretation of the driver accelerator pedal position sensor request (pedal position, mode switches, and other parameters) or cruise request. “Engine response” can be based on air mass, throttle effective area, torque, etc., depending on the Powertrain application. On non-ETC vehicles, it represents the “linearized” throttle position sensor reading.

In all cases, the effects of other engine or throttle control functions such as idle control, traction control, torque management, drag control, vehicle speed governing/limiting, and engine speed governing/limiting are not reflected in this parameter. The automatic transmission uses this parameter in determining when to perform most up/down shifts.

Data Delay: TBD

Platform Interface Definition:
Accelerator Effective Position is received by Platform. It is used by traction control algorithms
.

ETS Interface Definition:
ETS uses this variable for exit, upshift, and control logic and possibly altitude compensation.

TCS Interface Definition:
TCS uses this variable for torque management, to determine TCS entrance and exit decisions, and as a baseline for subsequent torque reduction decisions

The data in Accelerator Effective Position shall be ignored when Accelerator Effective Position Validity is set to “Invalid”.

5.2.4.4 Air Conditioning Compressor Clutch Engaged

Signal	Length	Data Type	Range	Conversion
Air Conditioning Compressor Clutch Engaged	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Air Conditioning Compressor Clutch Engaged is transmitted by Powertrain. Powertrain reports to Platform the final commanded state of the A/C Clutch output driver. The A/C Clutch may be engaged by Powertrain during A/C Slugging prevention which can enable the A/C Clutch during crank. The A/C Clutch may be disengaged by Powertrain to protect the A/C Compressor at high engine speed, low or high A/C pressures and low or high voltages. The A/C Clutch may be disengaged by Powertrain due to high coolant temperature to improve cooling system performance.

Data Delay: TBD

Platform Interface Definition:
Air Conditioning Compressor Clutch Engaged is used as feedback to indicate differences between the desired and actual state of the A/C Clutch. Knowing the actual state of the A/C Clutch will avoid any potential out of synchronization conditions (e.g., Platform thinks the A/C Clutch is disengaged when it is actually engaged).

5.2.4.5 Air Conditioning Compressor Clutch Request

Signal	Length	Data Type	Range	Conversion
Air Conditioning Compressor Clutch Request	2	ENM	N/A	$0=No Action $1=Engage $2=Disengage $3=Disengage Immediately

Powertrain Interface Definition:
Powertrain uses the request from the Platform along with its own A/C Clutch control logic to ultimately determine the final commanded state of the A/C Clutch output driver. Also, Powertrain will use this information for cooling fan control when an A/C pressure sensor is not present.

The source of this signal shall be monitored by the Climate Control Virtual Device Availability signal.

Output Actuation Delay: Refer to Compressor Control Algorithm Description in Section 4.3

Platform Interface Definition:
Air Conditioning Compressor Clutch Request is transmitted by Platform. Platform reports to Powertrain a request to engage the A/C Clutch by using the state encoded data byte values below. If air conditioning is not present on the vehicle, the data value of the Air Conditioning Compressor Clutch Request shall always be set to “Disengage”.

$0 - No Action
$1 - Engage
    This state indicates that Platform has determined that A/C Clutch operation is allowed. This request is determined from: 1) Occupant request, 2) Climate control (when present), and, 3) Platform-executed compressor protections (Platform-optional).
$2 - Disengage
    This state indicates that Platform has determined the compressor should be disengaged due to: 1) Occupant request or 2) Climate control (when present).
    Powertrain may delay compressor disengage during transmission shifts for no longer than 2.5 seconds.
$3 - Disengage Immediately
    This state indicates the A/C Clutch must be disengaged due to compressor protections (Platform-optional).
    Powertrain may not delay this disengage for more than 300 ms after receipt of this message.

Power-Up Default: “Disengage”
Communication Failure Value: “Disengage”

5.2.4.6 Air Conditioning Compressor Normalized Load, Air Conditioning Compressor Normalized Load Validity

Signal	Length	Data Type	Range	Conversion
Air Conditioning Compressor Normalized Load	8	UNM	0 – 25.5 l/min	E = N * 0.1
Air Conditioning Compressor Normalized Load Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Air Conditioning Compressor Normalized Load is received by Powertrain. Air Conditioning Compressor Normalized Load is used along with data from the signal Air Conditioning Compressor Anticipated Torque as an input to the idle and engine speed control system in order to calculate total engine output torque requirements.

The engine torque which is currently consumed by the AC compressor shall be calculated by Powertrain by the following multiplication:

AC_Torque_Actual = AC_Load_Transmitted * AC_High_Side_Pressure / Engine_Speed_Actual

In case of Air Conditioning Compressor Normalized Load Validity equals to “Invalid”, Powertrain shall transmit Air Conditioning Compressor Torque Control Request equal to “Torque Gradient Limitation” until the validity bit recovers to “Valid”.

Platform Interface Definition:
Air Conditioning Compressor Normalized Load is transmitted by the HVAC module when the HVAC module is present, and is not transmitted when the HVAC module is not present. It is the calculated component of engine torque output (crankshaft) resulting from the A/C compressor.

Air Conditioning Compressor Normalized load Validity shall be set to “Invalid” if a needed signal for torque calculation is missing and subsequently the expected torque estimation does not meet the accuracy requirement stated below.

For details of the operation of this signal refer to PPEI section 4.3.

5.2.4.7 Air Conditioning Compressor Stroke Request

Signal	Length	Data Type	Range	Conversion
Air Conditioning Compressor Stroke Request	2	ENM	N/A	$0=No Action $1=Engage $2=Minimum Stroke $3=Security Shutdown

Powertrain Interface Definition:
Air Conditioning Compressor Stroke Request is transmitted by Powertrain. This signal is transmitted with a default value of “0” on applications without air conditioning or with conventional (clutch) air conditioning.

Input Delay: 40 ms

Platform Interface Definition:
Air Conditioning Compressor Stroke Request is received by Platform. For clutchless AC applications, the Air Conditioning Stroke Request is used along with the Air Conditioning Compressor Clutch Request within a handshake procedure to switch AC on. The Platform activates AC when the stroke request is received from the Powertrain, indicating that ECM actions are finished.

This signal is applicable on GME, clutchless AC applications, only.

5.2.4.8 Air Conditioning Compressor Present

Signal	Length	Data Type	Range	Conversion
Air Conditioning Compressor Present	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Air Conditioning Compressor Present is received by Powertrain. It is used on vehicles with optional A/C to determine whether A/C is present on the vehicle so that A/C compressor diagnostics can be enabled if A/C is present.

Latency Requirement: TBD

Platform Interface Definition:
Air Conditioning Compressor Present is transmitted by the Platform.

5.2.4.9 Air Conditioning Off Indication On

Signal	Length	Data Type	Range	Conversion
Air Conditioning Off Indication On	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Air Conditioning Off Indication On is transmitted by Powertrain. The data value of this signal is set to “True” if the Compressor Control Algorithm is commanding the compressor off (i.e., Air Condition Compressor Command equal to “Off”) due to high coolant temperature or for compressor protection, such as, ignition voltage, engine speed or A/C pressure out of normal operating range. Refer to Section 4.2.4.4 of the Cooling Fan Control Algorithm. For Electronically Controlled Variable Displacement (ECVD) systems, the Air Conditioning Compressor Command equal “Off” and Air Conditioning Off Indication On equal to “True” indicates the Powertrain controller is requesting that the HVAC Platform controller disable the compressor (see Algorithm Requirements, section 4.03). Refer to Section 4.2.4.4 of the Cooling Fan Control Algorithm.

Data Delay: 1 sec

Platform Interface Definition:
Air Conditioning Off Indication On is used for display purposes to indicate when Air Conditioning has been turned off for compressor protection or high engine coolant temperature.

5.2.4.10 Air Conditioning Refrigerant High Side Fluid Pressure, Air Conditioning Refrigerant High Side Fluid Pressure Validity

Signal	Length	Data Type	Range	Conversion
Air Conditioning Refrigerant High Side Fluid Pressure	8	UNM	0 - 3570 kPaG	E = N * 14
Air Conditioning Refrigerant High Side Fluid Pressure Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Air Conditioning Refrigerant High Side Fluid Pressure is transmitted by Powertrain. It is the filtered fluid pressure read from the high pressure side of the refrigerant system. Air Conditioning Refrigerant High Side Fluid Pressure shall be set to “Invalid” if the sensor providing the data has failed and a backup value cannot be determined.
Input Delay: 40 ms

Accuracy Requirement: Reference PPEI Section 2.9.5.3.

Platform Interface Definition:
Air Conditioning Refrigerant High Side Fluid Pressure is used optionally for compressor protections.

The data in Air Conditioning Refrigerant High Side Fluid Pressure shall be ignored if Air Conditioning Refrigerant High Side Fluid Pressure Validity is set to "Invalid".

The source of this signal shall be monitored by the Climate Control Virtual Device Availability signal.

Power-Up Default: "Invalid"
Communication Failure Value: "Invalid"

5.2.4.11 Air Conditioning Refrigerant Low Side Fluid Temperature, Air Conditioning Refrigerant Low Side Fluid Temperature Validity

Signal	Length	Data Type	Range	Conversion
Air Conditioning Refrigerant Low Side Fluid Temperature	8	UNM	-10 to 41 deg C	E = N * 0.2 - 10
Air Conditioning Refrigerant Low Side Fluid Temperature Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Air Conditioning Refrigerant Low Side Fluid Temperature is used in the A/C Compressor torque model calculations.

The data in Air Conditioning Refrigerant Low Side Fluid Temperature shall be ignored if Air Conditioning Refrigerant Low Side Fluid Temperature Validity is set to "Invalid".

Platform Interface Definition:
Air Conditioning Refrigerant Low Side Fluid Temperature is transmitted by Platform. It is the fluid temperature read from the low pressure side of the refrigerant system. Air Conditioning Refrigerant Low Side Fluid Temperature Validity shall be set to "Invalid" if the sensor providing the data has failed and a backup value cannot be determined.
Input Delay: 125 ms

Accuracy Requirement: TBD

5.2.4.12 Airbag Deployed

Signal	Length	Data Type	Range	Conversion
Airbag Deployed	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Airbag Deployed is received by Powertrain. Powertrain uses the reported airbag state to trigger the ETC flight recorder. It may also be used to disengage cruise control.

The source of this signal shall be monitored by the Airbag System Virtual Device Availability signal.

Power-Up Default: "False"
Communication Failure Value: "False"

Platform Interface Definition:
Airbag Deployed is transmitted by Platform. Platform reports to Powertrain the state of the first airbag deployment.

Data Delay: TBD

5.2.4.13 Airbag System Virtual Device Availability

Signal	Length	Data Type	Range	Conversion
Airbag System Virtual Device Availability	1	ENM	N/A	$0=Virtual Device Unavailable $1=Virtual Device Available

Powertrain Interface Definition:
Airbag System Virtual Device Availability is received by Powertrain (ECM, PCM). If the value of this signal is "$0", then the Airbag Deployed signal shall be defaulted to "False" within the powertrain controller.

Power-Up Default: "$1"
Communication Failure Value: "$0"

Platform Interface Definition:
Airbag System Virtual Device Availability is transmitted by Platform. If the Airbag Deployed signal is transmitted to Powertrain through a gateway, then the Airbag System Virtual Device Availability signal indicates the availability of the source of the Airbag Deployed signal.

Data Delay: TBD

5.2.4.14 All Wheel Drive Clutch Completely Open

Signal	Length	Data Type	Range	Conversion
All Wheel Drive Clutch Completely Open	1	BLN	N/A	$0 = False $1 = True

Powertrain Interface Definition

All Wheel Drive Clutch Completely Open is transmitted by AWD if AWD is present and not sent if AWD is not present.

All Wheel Drive Clutch Completely Open will be set to "True" when the All Wheel Drive unit´s throttle valve is as open as it can be, e.i. power to the valve is cut. The torque transfer of the All Wheel Drive unit is as low as it can be during the circumstances. All Wheel Drive Clutch Completely Open will be set to "False" as long as there is any current through the throttle valve coil.

Input Delay: 40 ms

Platform Interface Definition

All Wheel Drive Clutch Completely Open is received by Platform. It is used by VSES to perform various vehicle stability enhancement operations.

5.2.4.15 All Wheel Drive Clutch Temperature, All Wheel Drive Clutch Temperature Validity.

Signal	Length	Data Type	Range	Conversion
All Wheel Drive Clutch Temperature	8	UNM	-40–215 degC	E = N * 1 - 40
All Wheel Drive Clutch Temperature Validity	1	ENM	N/A	$0 = Valid $1 = Invalid

Powertrain Interface Definition:
All Wheel Drive Clutch Temperature and All Wheel Drive Clutch Temperature Validity are transmitted by the All Wheel Drive (AWD) module if the AWD module is present, sent by the TCM for VersaTrak applications, and not sent otherwise.
All Wheel Drive Clutch Temperature represents the temperature of the AWD clutch package. The signal is an estimation built on the momentary calculated heat loss in the AWD clutch package , and, when present on the vehicle, with a feedback from the

temperature sensor used for the All Wheel Drive Oil Temperature signal. In the case of an invalid signal, default values will be sent for the All Wheel Drive Clutch Temperature.

All Wheel Drive Clutch Temperature Validity will be set to "invalid" if the All Wheel Drive Oil Temperature sensor is present on the vehicle, has failed, and a corresponding DTC has been set. The All Wheel Drive Clutch Temperature Validity will also be set to "invalid" if the All Wheel Drive Oil Temperature exceeds measurable range of the sensor, when the sensor is present on the vehicle. When the AWD oil temperature sensor is not present on the vehicle, the All Wheel Drive Clutch Temperature Validity signal will be set to “valid”.

Data Delay: 40 ms

Accuracy Requirement: 1 degC

Platform Interface Definition:
All Wheel Drive Clutch Temperature and All Wheel Drive Clutch Temperature Validity are received by Platform. They are used by VSES to determine if the AWD is close to a temperature protection opening of the All Wheel Drive clutch. This is not to perform an action request to the AWD that causes extra heat loss. A temperature protection opening will occur if the All Wheel Drive Clutch Package Temperature exceeds a maximum temperature. After a temperature protection opening, normal operation of the AWD will be regained when All Wheel Drive Clutch Temperature becomes lower.

5.2.4.16 All Wheel Drive Mode Active

Signal	Length	Data Type	Range	Conversion
All Wheel Drive Mode Active	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
All Wheel Drive Mode Active is transmitted by Powertrain. When Powertrain detects that all wheel drive is engaged, the powertrain controller will set the data value of this signal to “True” to command the all wheel drive display.

Data Delay: TBD

Platform Interface Definition:
All Wheel Drive Mode Active is used for display purposes.

5.2.4.17 All Wheel Drive Oil Temperature, All Wheel Drive Oil Temperature Validity

Signal	Length	Data Type	Range	Conversion
All Wheel Drive Oil Temperature	8	UNM	-40–215 degC	E = N * 1 – 40
All Wheel Drive Oil Temperature Validity	1	ENM	N/A	$0 = Valid $1 = Invalid

Powertrain Interface Definition

All Wheel Drive Oil Temperature and All Wheel Drive Oil Temperature Validity are transmitted by the AWD if the AWD is present and not sent if AWD is not present.

All Wheel Drive Oil Temperature signal represent the temperature of the oil flowing through the All Wheel Drive throttle valve. The temperature is measured by a temperature sensor in contact with the oil in the differential speed pump. The sensor is located close to the throttle valve. The All Wheel Drive Oil Temperature does also to some extent give information about the AWD ECU temperature since the throttle valve and the ECU are located close together. The measurable range of the temperature sensor is –40 to 120 degC.The default value, in case of an invalid signal, is 215 degC.

All Wheel Drive Oil Temperature Validity will be set to "invalid" if the temperature sensor is broken and a corresponding DTC has been set.
All Wheel Drive Oil Temperature Validity will also be set to "invalid" if the temperature exceeds the measurable range of the sensor.

Data Delay: 40 ms

Accuracy Requirement: 1 degC

Platform Interface Definition

All Wheel Drive Oil Temperature and All Wheel Drive Oil Temperature Validity are received by Platform. It is used by VSES to determine if the AWD is close to a temperature protection opening of the All Wheel Drive clutch. This to not perform an action request to the AWD that causes extra heat loss. A temperature protection opening will occur if the All Wheel Drive Oil Temperature exceeds 100 degC. After a temperature protection opening, normal operation of the AWD will be regained when All Wheel Drive Oil Temperature becomes lower than 90degC.

5.2.4.18 All Wheel Drive Overheated Indication On

Signal	Length	Data Type	Range	Conversion

All Wheel Drive Overheated Indication On	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:

All Wheel Drive Overheated Indication On is transmitted by the TCCM. The state of All Wheel Drive Overheated is based on the algorithm that resides in the Powertrain electronics.
When the system is overheated, the All Wheel Drive System may lose its capability to transfer torque to the secondary axle.

Data Delay: 1025 ms

Platform Interface Definition:

All Wheel Drive Overheated Indication On is received by Platform It is used by the cluster or DIC to indicate, through a telltale or message, when the data value is “True”, that the All Wheel Drive System is Overheated and may have lost its capability to transfer torque to the secondary axle. When implemented as a telltale, platform shall provide a "bulb check" of the telltale. A chime can accompany the visual indication at Platform's discretion.

5.2.4.19 All Wheel Drive System Failure Status

Signal	Length	Data Type	Range	Conversion
All Wheel Drive System Failure Status	3	ENM	N/A	$0=System OK $1=Temporarily Disabled $2=Permanently Failed $3=Temporarily Limited $4 - $7 = Not used and reserved

Powertrain Interface Definition:

All Wheel Drive System Failure Status is transmitted by the Transfer Case Control Module (TCCM) when the TCCM is present. If the TCCM is not present, and the application has the VersaTrak system, this signal will be transmitted by the TCM. If the TCCM is not present and the application has a manual transfer case, this signal will be transmitted by the ECM. On all other systems this signal will not be transmitted.

The states of this signal have the following meanings:

System OK – The system is operating as intended. The system has the capability to deliver torque to the secondary axle.

Temporarily Disabled – An operating condition has been detected that prevents delivery of torque to the secondary axle. Torque delivery may resume once the condition has cleared.

Permanently Failed – A system failure has occurred that prevents delivery of torque to the secondary axle. Torque delivery will remain disabled for the remainder of the ignition cycle.

Temporarily Limited – An operating condition has been detected that limits the control strategy for the secondary axle (e.g. temporarily invalid Vehicle Dynamics Yaw Rate). Torque delivery may resume once the condition has cleared.

This signal is only meaningful on VersaTrak systems or systems that have a TCCM. All other applications should always transmit this signal with a data value of “System OK”.

Data Delay: 125 ms

Platform Interface Definition:

All Wheel Drive System Failure Status is received by platform. The signal is used for display and ABS control purposes however it may be monitored by other Platform devices for miscellaneous body functions.

5.2.4.20 All Wheel Drive Torque Request Achievable

Signal	Length	Data Type	Range	Conversion
All Wheel Drive Torque Request Achievable	1	BLN	N/A	$0 = False $1 = True

Powertrain Interface Definition

All Wheel Drive Torque Request Achievable is transmitted by AWD if AWD is present and not sent if AWD is not present.

The status of the signal is based on differential speed over the All Wheel Drive unit, the amount of torque demanded and if the situation is appreciable for an external torque demand.
All Wheel Drive Torque Request Achievable will be set to “False” if the AWD does not allow an external torque demand.

Input Delay: 40ms

Platform Interface Definition

All Wheel Drive Torque Request Achievable is received by Platform. It is to be received by VSES as an answer from AWD if the demanded torque in the signal Vehicle Dynamics Torque Transfer Request is achievable or suitable at the current drive condition.

5.2.4.21 All Wheel Drive Transferred Torque, All Wheel Drive Transferred Torque Status, All Wheel Drive Transferred Torque Validity

Signal	Length	Data Type	Range	Conversion
All Wheel Drive Transferred Torque	11	UNM	0 – 4094Nm	E=N*2
All Wheel Drive Transferred Torque Status	1	ENM	N/A	$0 = Normal $1 = Estimated
All Wheel Drive Transferred Torque Validity	1	ENM	N/A	$0 = Valid $1 = Invalid

Powertrain Interface Definition

All Wheel Drive Transferred Torque, All Wheel Drive Transferred Torque Status and All Wheel Drive Transferred Torque Validity are Transmitted by AWD if AWD is present and not sent if AWD is not present.

All Wheel Drive Transferred Torque represent the absolute value of the friction torque level of the All Wheel Drive clutch package e.i the momentary absolute value of torque transfer ability of the All Wheel Drive clutch package. The All Wheel Drive Transferred Torque is limited by the All Wheel Drive safety check valve. It is mainly derived from the AWD internal pressure sensor and a friction factor of the All Wheel Drive wet-clutch lamella package. When the All Wheel Drive internal pressure exceeds measurable range of the internal pressure sensor, the signal is estimated from the following three components: [1] Calculated flow through the All Wheel Drive Throttle valve; [2] The All Wheel Drive throttle valve position; [3] The friction factor of the All Wheel Drive wet-clutch lamella package.

All Wheel Drive Transferred Torque Status represent the quality of the All Wheel Transferred Torque signal information. In the measurable range of the internal pressure sensor, 0-620 Nm, the signal will be set to Normal, and above that range the signal will be set to "Estimated". The guarantied accuracy of All Wheel Drive Transferred Torque is:
For All Wheel Drive Tranferred Torque Status “Normal”
Torque Range: 0 to 630Nm, Temperature: 10 to 100°C Accuracy: 15 Nm
Torque Range: 0 to 630Nm, Temperature: 100 to 150°C Accuracy: 16,5 Nm
For All Wheel Drive Tranferred Torque Status “Estimated”:
Torque Range: >630Nm, Accuracy: 195 Nm

All Wheel Drive Transferred Torque Validity will be set to “Invalid” if the AWD internal pressure sensor has failed and a corresponding DTC has been set.

Input Delay: 40 ms

Platform Interface Definition

All Wheel Transferred Torque, All Wheel Drive Transferred Torque Status and All Wheel Drive Transferred Torque Validity are received by Platform. They are used by VSES to perform various vehicle stability enhancement operations.

5.2.4.22 Anticipated Electrical Load Estimation

Signal	Length	Data Type	Range	Conversion
Anticipated Electrical Load Estimation	4	UNM	0 - 150 A	E = N * 10

Powertrain Interface Definition:
Anticipated Electrical Load Estimation is used by Powertrain to compensate the engine power for a step change in electrical load, to avoid engine flare or engine "droop" when the load is applied by Platform. A predefined time delay between the signal change and the change in electrical load makes it possible for Powertrain to synchronize the engine response with the step load change.

Platform Interface Definition:
Anticipated Electrical Load Estimation is transmitted by Platform. The signal value is the sum of the platform controlled electrical step loads (loads that are either fully on or fully off) with a current consumption above 10A. If groups of smaller loads are always controlled simultaneously and the sum of these currents is above 10A, these loads shall be included in the signal.

There is a predefined delay time between a change in the signal and the controlling of the electrical load. The delay time is defined to be 120 ms.

Accuracy Requirement: TBD

Timing Requirement: electrical load control and delay time shall be synchronized with an error less than 20 ms.

5.2.4.23 Antilock Brake System Active

Signal	Length	Data Type	Range	Conversion
Antilock Brake System Active	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Antilock Brake System Active is received by Powertrain. Powertrain resets some brake switch diagnostic tests if the vehicle is equipped with antilock brakes and antilock braking is active. The brake switch diagnostics measure deceleration rates that may be inconsistent if antilock braking is active

Platform Interface Definition:

Platform transmits Antilock Brake System Active to indicate whether antilock braking is active.

Data Delay: 25 ms

5.2.4.24 Antilock Brake System Failed

Signal	Length	Data Type	Range	Conversion
Antilock Brake System Failed	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Antilock Brake System Failed is received by Powertrain. Powertrain disables some brake switch diagnostics if the vehicle is equipped with antilock brakes and antilock braking is not functional because of a failure with the ABS system. The brake switch diagnostics measure deceleration rates that may be inconsistent if antilock braking is not functional.

Platform Interface Definition:

Platform transmits Antilock Brake System Failed to indicate whether there is a failure in the ABS system that prevents antilock braking from functioning.

Data Delay: 25 ms

5.2.4.25 Antilock Brake System Present

Signal	Length	Data Type	Range	Conversion
Antilock Brake System Present	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Powertrain monitors this signal to determine if ABS is present in order to enable the diagnostics that rely on ABS information. The ABS present status is stored in non-volatile memory in the Powertrain electronics in case communications is lost with the platform controller sending this signal.

Power-Up Default: Use last known value stored in non-volatile memory
Communication Failure Value: Use last known value stored in non-volatile memory

Platform Interface Definition:
Antilock Brake System Present is transmitted by Platform. A Platform module other than the ABS controller is required to transmit this signal if ABS is optional on the vehicle.

If there is a communication failure with the source of this information, the module on the high speed data link shall continue to transmit the last known value and store this value in non-volatile memory at power-down.

Data Delay: 1 sec

5.2.4.26 Apply Brake Pedal Indication On

Signal	Length	Data Type	Range	Conversion
Apply Brake Pedal Indication On	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Apply Brake Pedal Indication On is transmitted by Powertrain. It is used to trigger a one-shot display message to instruct the driver to press the brakes before cruise control can be engaged. At system startup the signal shall be initialized to "False".

The signal shall transition to "True" when all of the following conditions are fulfilled:
- Both brake inputs have been detected as inactive at least once since system startup (to protect from the display message being shown due to a permanent failure on either of the brake inputs).
- All the conditions for allowing cruise to be engaged, except Brake-Before-Cruise, are present (speed range, brakes, clutch, etc.)
- The Brake-Before-Cruise test has not passed during the current drive cycle.
- The signal Cruise Control On Switch Active received from Platform is "True".

Once the signal has been set to "True" the signal shall transition to "False" if at least one of the following conditions are fulfilled:
- The Brake-Before-Cruise test has passed.
- The Accessory input transitions from "Active" to "Inactive".

Platform Interface Definition:
Apply Brake Pedal Indication On is used for display purposes. The display message shall be shown as long as the signal is "True", and a calibratable timeout has not expired. The timer starts when Apply Brake Pedal Indication On transitions to "True".

Output Actuation Delay: 200 ms maximum

5.2.4.27 Backup Power Mode Master Virtual Device Availability

Signal	Length	Data Type	Range	Conversion
Backup Power Mode Master Virtual Device Availability	1	ENM	N/A	$0=Virtual Device Unavailable $1=Virtual Device Available

Powertrain Interface Definition:
Backup Power Mode Master Virtual Device Availability (VDA) is received by Powertrain. Powertrain uses this data as part of the Backup Power Moding strategy for starter control. Refer to the starter control algorithm (Section 4.1) for details.

Platform Interface Definition:
Backup Power Mode Master Virtual Device Availability is transmitted by the Gateway Module. The Gateway module determines the availability of the Backup Power Mode Master based on signal supervision. If the platform does not use a Backup Power Mode Master, this signal shall always be set to “Virtual Device Unavailable”. Refer to PPEI section 2.10 for additional information on Virtual Device Availability signals.

Data Delay: TBD ms

5.2.4.28 Barometric Pressure Absolute, Barometric Pressure Absolute Validity

Signal	Length	Data Type	Range	Conversion
Barometric Pressure Absolute	8	UNM	0 - 127.5 kPa	E = N * 0.5
Barometric Pressure Absolute Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Barometric Pressure Absolute is transmitted by Powertrain. Powertrain determines barometric pressure by using the manifold absolute pressure sensor prior to the engine cranking. Prior to engine rotation, the pressure within the manifold is equal to the barometric pressure. Barometric Pressure Absolute Validity shall be set to "Invalid" if the sensor providing the data has failed and a backup value cannot be determined.

Input Delay: TBD
Accuracy Requirement: TBD

Platform Interface Definition:
Barometric Pressure Absolute is used for the Tire Pressure Monitor system.

The data in Barometric Pressure Absolute shall be ignored if Barometric Pressure Absolute Validity is set to "Invalid".

5.2.4.29 Body Virtual Device Availability

Signal	Length	Data Type	Range	Conversion
Body Virtual Device Availability	1	ENM	N/A	$0=Virtual Device Unavailable $1=Virtual Device Available

Powertrain Interface Definition:

Body Virtual Device Availability is received by Powertrain. Powertrain uses this signal to determine proper operation of the various users of Park Brake and Engine Off Time information in the event of a failure with the original source.

Platform Interface Definition:

Body Virtual Device Availability is transmitted by the Gateway. This signal represents the availability of the original source of Park Brake and Engine Off Time information.

Data Delay: 125 ms

5.2.4.30 Brake Extended Travel Switch Active, Brake Extended Travel Switch Active Validity

Signal	Length	Data Type	Range	Conversion
Brake Extended Travel Switch Active	1	BLN	N/A	$1=True; $0=False
Brake Extended Travel Switch Active Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:

Brake Extended Travel Switch Active is transmitted by Powertrain. Powertrain reports the state of the Brake Extended Travel Switch. Brake Extended Travel Switch Active Validity shall be set to “Invalid” if the sensor providing the data has failed and a backup value cannot be determined.
Input Delay: 20 ms

Platform Interface Definition:

The Integrated Chassis Control System uses this information as a confirmation that the brake pedal is applied. A failure of the yaw rate sensor or the yaw rate signal wiring could activate the pressure build mode (VSES mode) of the Integrated Chassis Control System. If the faulty yaw rate signal lies within the normal operating range, the diagnostics may not immediately detect the failure and disable the system activation. Extended travel brake switch information would indicate that the brake pedal is indeed applied and consequently, the Integrated Chassis Control System would promptly switch from the VSES mode to the Braking or ABS mode.

The data in Brake Extended Travel Switch Active shall be ignored if Brake Extended Travel Switch Active Validity is set to “Invalid”.

5.2.4.31 Brake Pedal Driver Applied Pressure, Brake Pedal Driver Applied Pressure Validity

Signal	Length	Data Type	Range	Conversion
Brake Pedal Driver Applied Pressure	8	UNM	0-19125 kPa	E=N*75
Brake Pedal Driver Applied Pressure Validity	1	ENM	N/A	$0=Valid $1=Invalid

Powertrain Interface Definition

Brake Pedal Driver Applied Pressure and Brake Pedal Driver Applied Pressure Validity signals are received by Powertrain.

The Brake Pedal Driver Applied Pressure signal is used by AWD as a redundancy check for vehicle braking. If the vehicle is braking the AWD changes it control strategy to not interfere with brake stability. AWD consider the vehicle braking if Brake Pedal Switch Active equals "True" and Accelerator Effective Position is below a certain limit. The AWD uses the Brake Pedal Driver Applied Pressure Validity to determine if the Brake Pedal Driver Applied Pressure signal is correct.

Platform Interface Definition

Brake Pedal Driver Applied Pressure and Brake Pedal Driver Applied Pressure Validity signals are transmitted by Platform. Brake Pedal Driver Applied Pressure represents the primary circuit pressure in the brake system and is based on a pressure sensor.

Brake Pedal Driver Applied Pressure Validity shall be set to “Invalid” if the data has failed and a corresponding DTC has been set.

Input delay: 10 ms

5.2.4.32 Brake Pedal Initial Travel Achieved

Signal	Length	Data Type	Range	Conversion
Brake Pedal Initial Travel Achieved	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Brake Pedal Initial Travel Achieved is received by Powertrain. The signal is used by Powertrain for all functions requiring an initial indication of the application of brakes (e.g., cruise control and torque converter clutch release).

Platform Interface Definition:
Brake Pedal Initial Travel Achieved is transmitted by Platform. It is set equal to true when the Brake Pedal Position as sensed by the Brake Apply Sensing System (BASS) has passed a threshold (calibratable) for release of cruise control and stop lamp activation.

A module on the high speed serial data link shall read the Brake Apply Sensor and transmit this signal.

Data Delay: 10 ms

5.2.4.33 Brake Pedal Initial Travel Achieved Protection

Signal	Length	Data Type	Range	Conversion
Brake Pedal Initial Travel Achieved Protection	2	UNM	0 - 3	E = N * 1

Powertrain Interface Definition:
Brake Pedal Initial Travel Achieved Protection is received by Powertrain. The signal is a protection value for Brake Pedal Initial Travel Achieved. A reference protection value shall be calculated by Powertrain as the 2's complement of (Brake Pedal Initial Travel Achieved + Brake Pedal Position Rolling Count) and then compared with the protection value received from Platform.

Appropriate action shall be taken by Powertrain if the calculated protection value does not match the protection value received from Platform.

When the Brake Pedal Position Failure signal is “Invalid” (signifying that Brake Pedal Initial Travel Achieved status is not known), the protection value shall be the 2's complement of the Brake Pedal Position Rolling Count (decimal: 0, 1, 2, 3, 0, …) for debugging purposes.

Platform Interface Definition:
Brake Pedal Initial Travel Achieved Protection is transmitted by Platform. The signal is a protection value for Brake Pedal Initial Travel Achieved. The protection value shall be calculated as the 2’s complement of (Brake Pedal Initial Travel Achieved + Brake Pedal Position Rolling Count) in each frame sent.

When the Brake Pedal Position Failure signal is “Invalid” (signifying that Brake Pedal Initial Travel Achieved status is not known), the protection value shall be the 2’s complement of the Brake Pedal Position Rolling Count signal (decimal: 0, 1, 2, 3, 0, …) for debugging purposes. See the Brake Apply Sensing System Level Specification for more details.
A module on the high speed serial data link shall read the Brake Apply Sensor and transmit this signal.

Data Delay: 10 ms

5.2.4.34 Brake Pedal Moderate Travel Achieved

Signal	Length	Data Type	Range	Conversion
Brake Pedal Moderate Travel Achieved	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Brake Pedal Moderate Travel Achieved is received by Powertrain. The signal is used by Powertrain for optional Brake Torque Management.

Platform Interface Definition:
Brake Pedal Moderate Travel Achieved is transmitted by Platform. It is set to true when the Brake Pedal Position as sensed by the BASS has passed a threshold (calibratable) for brake torque management and some 2-channel Vehicle Stability Enhancement Systems.

A module on the high speed serial data link shall read the Brake Apply Sensor and transmit this signal.

Data Delay: TBD ms

5.2.4.35 Brake Pedal Position Failure

Signal	Length	Data Type	Range	Conversion
Brake Pedal Position Failure	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Brake Pedal Position Failure is received by Powertrain. This signal is used by Powertrain to take appropriate action due to unknown brake pedal position. Since Platform may implement a failsoft action in the control of its BLS hardwire output, Powertrain shall disable/inhibit cruise control when the Brake Pedal Position Failure signal is set to “Invalid”.

Platform Interface Definition:
Brake Pedal Position Failure is transmitted by Platform. This signal is set to “Invalid” for all faults in the Brake Apply Sensing System which would cause the data for the Brake Initial Travel Achieved or Brake Pedal Position to be incorrect (e.g., output out of range). Platform shall set this signal to “Invalid” even if a failsoft action is taken with the control of its BLS output in an attempt to maintain brake lamps operation.

A module on the high speed serial data link shall read the Brake Apply Sensor and transmit this signal.

Data Delay: 200 ms

5.2.4.36 Brake Pedal Position Rolling Count

Signal	Length	Data Type	Range	Conversion
Brake Pedal Position Rolling Count	2	UNM	0 – 3 N/A	E = N * 1

Powertrain Interface Definition:
Brake Pedal Position Rolling Count is received by Powertrain. This signal is used by Powertrain for updating a watchdog timer. The Rolling Counter shall be an incremented value in the following decimal order: 0, 1, 2, 3, 0,.. Powertrain shall monitor the sequence of data values and provide a calibratable timeout for fault recognition.

If the current and previous BASS data frames contain the same Rolling Counter Value, or if the counter is not the next expected sequential value, then Powertrain shall indicate an invalid frame has occurred and take appropriate action.

Powertrain shall allow any value of the Rolling Counter as the sequence starter following a period of one or more missing or invalid frames. A timeout error exists when no valid frame has been received for a calibratable time (typically 200 msec).

Platform Interface Definition:
Brake Pedal Position Rolling Count is transmitted by Platform. . This signal indicates that the Brake Apply Sensing System processing software module is alive. This signal is incremented in the following decimal order 0, 1, 2, 3, 0, …. The rolling count shall be incremented each time the frame containing BASS signals is sent The Rolling Counter incrementation must not be done in the transport software layer. Platform shall connect the updating of the rolling count to the internal CPU core monitoring. The part of the CPU core monitoring that is selected as the update source shall have a timeout associated with it, and the monitor loop must finish with at least the same periodic rate as the rolling count update.

The minimum requirement is to use the data flow monitoring as the source for updating the rolling count. See the Brake Apply Sensing System Level Specification for more details.

A module on the high speed serial data link shall read the Brake Apply Sensor and transmit this signal.

Data Delay: 10 ms

5.2.4.37 Brake Pedal Switch Active, Brake Pedal Switch Active Validity

Signal	Length	Data Type	Range	Conversion
Brake Pedal Switch Active	1	BLN	N/A	$1=True; $0=False
Brake Pedal Switch Active Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Brake Pedal Switch Active is transmitted by Powertrain. It represents the status of either the brake lamp switch or the cruise/ETC/TCC brake switch. Powertrain will report the status as being “True” if either of these switches becomes active. When both switches are available, Powertrain will report the status as being “True” as long as one of the switches are functioning properly. If both of the switches are determined to be failed, then Powertrain will report the signal as being “Invalid” via the validity bit. A cruise/ETC/TCC brake switch failure can be relatively slow to detect because the diagnostic operates during specific driving conditions. For those vehicles that do not have the cruise/ETC/TCC brake switch, the brake lamp switch will be the only source for the signal information.

Input Delay: 20 ms

Platform Interface Definition:
Brake Pedal Switch Active is received by Platform. This signal is used by ABS, traction control and VSES as an indication of the driver’s intent to apply the brakes. It may also be used for dynamic rear proportioning braking control. The Brake Pedal Switch Active signal may also be used by the SDM for crash recording and by another Platform module for use in BTSI control.

The data in Brake Pedal Switch Active shall be ignored if Brake Pedal Switch Active Validity is set to “Invalid”.

5.2.4.38 Check Fuel Filler Cap Indication On

Signal	Length	Data Type	Range	Conversion
Check Fuel Filler Cap Indication On	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Check Fuel Filler Cap Indication On is transmitted by Powertrain. The data value of this signal is set to "True" if the Evaporative Emissions Diagnostic has determined that the gas cap may not be installed completely due to a leak detected within the EVAP system.

Data Delay: 1000 ms.

Platform Interface Definition:
Check Fuel Filler Cap Indication On is used for display purposes.

5.2.4.39 Climate Control Virtual Device Availability

Signal	Length	Data Type	Range	Conversion
Climate Control Virtual Device Availability	1	ENM	N/A	$0=Virtual Device Unavailable $1=Virtual Device Available

Powertrain Interface Definition:
Climate Control Virtual Device Availability is received by Powertrain (ECM, PCM). If the value of this signal is "$0", then the Air Conditioning Compressor Clutch Request signal shall be defaulted to "Disengage", the Air Conditioning Refrigerant Low Side Fluid Temperature signal shall be defaulted , the Air Conditioning Refrigerant Low Side Fluid Temperature Validity shall be defaulted to "Invalid", the Air Conditioning Compressor Torque Actual signal shall be defaulted, and the Air Conditioning Compressor Torque Actual Validity shall be defaulted to "Invalid" within the powertrain controller.

Power-Up Default: "$1"
Communication Failure Value: "$0"

Platform Interface Definition:
Climate Control Virtual Device Availability is transmitted by Platform. If the Air Conditioning Compressor Clutch Request, Air Conditioning Refrigerant Low Side Fluid Temperature, and the Air Conditioning Refrigerant Low Side Fluid Temperature Validity signals are transmitted to Powertrain through a gateway, then the Climate Control Virtual Device Availability signal indicates the availability of the source of the Air Conditioning Compressor Clutch Request, Air Conditioning Refrigerant Low Side Fluid Temperature, and the Air Conditioning Refrigerant Low Side Fluid Temperature Validity signals.

Data Delay: TBD

5.2.4.40 Clutch Start Switch Active, Clutch Start Switch Active Validity

Signal	Length	Data Type	Range	Conversion
Clutch Start Switch Active	1	BLN	N/A	$1=True; $0=False
Clutch Start Switch Active Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Clutch Start Switch Active is transmitted by Powertrain. The data value is set to "True" when the clutch start switch (bottom of travel) is depressed on a manual transmission. Clutch Start Switch Active Validity shall be set to "Invalid" if the sensor providing the data has failed and a backup value cannot be determined.
Input Delay: TBD

Platform Interface Definition:
Clutch Start Switch Active is used by the active transfer case with active push button control for slip wheel control.

The data in Clutch Start Switch Active shall be ignored if Clutch Start Switch Active Validity is set to “Invalid”.

5.2.4.41 Continuous Variable Transmission Present

Signal	Length	Data Type	Range	Conversion
Continuous Variable Transmission Present	1	BLN	N/A	$0 = False $1 = True

Powertrain Interface Definition:
Continuous Variable Transmission Present is transmitted by Powertrain. The signal shall be set to “True” if a CVT (Continuous Variable Transmission) is present.

Data Delay: 1025 ms
Power-Up Default: False

Platform Interface Definition:
Continuous Variable Transmission Present is received by Platform. It is used to switch between Automatic Transmission and CVT mode for display purposes.

5.2.4.42 Cruise Control Active

Signal	Length	Data Type	Range	Conversion
Cruise Control Active	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Cruise Control Active is transmitted by Powertrain. The data value of the signal is set based on when the vehicle enters or exits an active cruise control mode, where the vehicle’s speed is being controlled by Powertrain.

Data Delay: 25 ms

Platform Interface Definition:
Cruise Control Active is used for display purposes. This signal is also used by the SDM for crash recording.

5.2.4.43 Cruise Control Alive Rolling Count

Signal	Length	Data Type	Range	Conversion
Cruise Control Alive Rolling Count	2	UNM	0-3	E = N * 1

Powertrain Interface Definition:
Cruise Control Alive Rolling Count is received by Powertrain. To detect repetition of old messages (e.g., SET or RESUME signal), the transmitter must confirm that it still is alive by permanently updating a 2-bit rolling counter value. Powertrain shall continuously supervise the current counter value. Any cruise control switch message containing a wrong counter value shall be ignored. Any mode switch OFF command will be accepted, even if incorporated in a message with a wrong alive rolling counter value. N counter update errors (n=3 is a typical value) in m consecutive frames (m=10 is a typical value) will lead to an irreversible disengagement of cruise control until the end of the respective driving cycle.

Platform Interface Definition:
Cruise Control Alive Rolling Count is transmitted by Platform. The signal indicates that the sender’s processing software module still is alive. The rolling counter value shall be incremented in every transmitted message in the order 0, 1, 2, 3, 0. The counter

value also shall be increased if no other bit within the respective frame changes. Incrementing shall be performed within the software application layer and not within the transport layer.

5.2.4.44 Cruise Control Cancel Request

Signal	Length	Data Type	Range	Conversion
Cruise Control Cancel Request	1	ENM	N/A	$0=Do Not Cancel $1=Cancel

Powertrain Interface Definition:
Powertrain will cancel cruise control when the signal is received with a value of "Cancel".

Power-Up Default: "Cancel"
Communication Failure Value: "Cancel"

Platform Interface Definition:
Cruise Control Cancel Request is transmitted by Platform. The signal could be sent with a value of "Cancel" to inform Powertrain to cancel cruise due to one of the following reasons:

1. Cruise cancel switch is pressed
2. Parking brake is set
3. A problem with the brake system is detected

Data Delay: Reference PPEI Section 2.7.2.

5.2.4.45 Cruise Control Clutch Switch Active, Cruise Control Clutch Switch Active Validity

Signal	Length	Data Type	Range	Conversion
Cruise Control Clutch Switch Active	1	BLN	N/A	$1=True; $0=False
Cruise Control Clutch Switch Active Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Cruise Control Clutch Switch Active is transmitted by Powertrain. This signal indicates whether the manual transmission cruise control clutch switch is active. Cruise Control Clutch Switch Active Validity shall be set to "Invalid" if the sensor providing the data has failed and a backup value cannot be determined.

Input Delay: TBD

Platform Interface Definition:
The data in Cruise Control Clutch Switch Active shall be ignored if Cruise Control Clutch Switch Active Validity is set to "Invalid".
TBD

5.2.4.46 Cruise Control Driver Selected Speed

Signal	Length	Data Type	Range	Conversion
Cruise Control Driver Selected Speed	12	UNM	0 – 255.9375 km / h	E = N * 1 / 16

Powertrain Interface Definition:
Cruise Control Driver Selected Speed is transmitted by the ECM to report the conventional cruise control driver-selected speed data value stored in the ECM's memory. The fractional part of the signal avoids display discrepancies in North American applications when displaying in units of mph while employing tap-up or tap-down commands that are in increments of whole units of mph.

This value will be reset to a data value of zero when the cruise control system has been shut off or when the ECM experiences a power up reset or when the vehicle is not equipped with conventional cruise control.

The signal Cruise Control Cancel Request has no impact on the driver selected speed value stored in the ECM, and will therefore have no impact on the data value contained in this message.

Data Delay: 113 ms

<u>Platform Interface Definition:</u>

Cruise Control Driver Selected Speed is received by Platform and is used for display purposes. This signal does not affect the operation of Adaptive Cruise Control systems.

5.2.4.47 Cruise Control Driver Selected Speed Active

Signal	Length	Data Type	Range	Conversion
Cruise Control Driver Selected Speed Active	1	BLN	N/A	$1=True; $0=False

<u>Powertrain Interface Definition:</u>
Cruise Control Driver Selected Speed Active is transmitted by Powertrain. This signal determines when the driver selected speed has been set (TRUE), thus communicating to platform that the new Cruise Control Driver Selected Speed should be used immediately.

Data Delay: 113 ms

Platform Interface Definition:
Cruise Control Driver Selected Speed Active is received by Platform. When this signal transitions from “False” to “True” (inactive to active), the platform shall immediately use the new Cruise Control Driver Selected Speed value. The use of Cruise Control Driver Selected Speed Active in conjunction with Cruise Control Driver Selected Speed avoids potential display flicker.

5.2.4.48 Cruise Control Enabled

Signal	Length	Data Type	Range	Conversion
Cruise Control Enabled	1	BLN	N/A	$1=True; $0=False

<u>Powertrain Interface Definition</u>:
Cruise Control Enabled is transmitted by Powertrain. The data value of this signal shall be set according to the following criteria.

<u>Cruise Control Enabled signal not currently active:</u>
The data value of this signal shall be set to “True” when all the conditions for allowing cruise are present (no inhibit conditions exist that would prevent cruise engagement) and the Cruise Control On Switch Active signal is “True”.

<u>Cruise Control Enabled signal currently active:</u>
The data value of this signal shall be set to “False” when either of the following conditions is fulfilled:

- The signal Cruise Control On Switch Active from Platform transitions from “True” to “False”.
- The Accessory input to Powertrain transitions from “Active” to “Inactive”.

This is to avoid a flashing cruise enabled indication when any temporary cruise inhibit conditions occur. Permanent failures that would cause cruise to be inhibited will cause the Cruise Control Enabled signal to be set to “False” once the cruise has been switched off again (by driver action or at next drive cycle).

Platform Interface Definition:
Cruise Control Enabled is used for display purposes. Once enabled, platform can then latch the state of the display, if desired. This signal is an indication to the driver that all cruise control enabled conditions have been satisfied. This signal is not used for cruise control active indication.

Output Actuation Delay: 200 ms maximum

5.2.4.49 Cruise Control On Switch Active

Signal	Length	Data Type	Range	Conversion
Cruise Control On Switch Active	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Powertrain uses Cruise Control On Switch Active in the cruise control algorithm.

Platform Interface Definition:
Cruise Control On Switch Active is transmitted by Platform. For a latched switch this signal represents the status of the Cruise Control On switch.

For a momentary On/Off Switch the signal should be sent as a request to Powertrain. The signal shall be set to “True” when the Cruise Control On switch transitions from inactive to active and the current state of the signal is “False”.

When the Platform uses the Cruise Control Enabled Signal, Cruise Control On Switch Active shall then remain “True” for a calibratable time. When the timer expires, the state of Cruise Control On Switch Active shall be set equal to the state of Cruise Control Enabled, i.e. platform shall use this signal as a feedback from Powertrain.

Once the signal has been set to "True" it shall stay in that state until at least one of the following conditions is fulfilled:
- The On/Off Switch input to platform transitions from "Inactive" to "Active" (i.e., driver requests "Off")
- A Power Mode equal to "Off" is received (i.e., the drive cycle is finished)
- An internal ECU fault has been detected in the platform module reading the switch.
- The On/Off switch is diagnosed as failed.

Latency Requirement: Reference PPEI Section 2.7.2.

5.2.4.50 Cruise Control Resume Switch Active

Signal	Length	Data Type	Range	Conversion
Cruise Control Resume Switch Active	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Powertrain uses Cruise Control Resume Switch Active in the cruise control algorithm.

Power-Up Default: "False"
Communication Failure Value: "False"

Platform Interface Definition:
Cruise Control Resume Switch Active is transmitted by Platform. This signal represents the status of the Cruise Control Resume switch. A module on the high speed serial data link shall read the cruise control resume switch and transmit this signal.

Input Delay: Reference PPEI Section 2.7.2.

5.2.4.51 Cruise Control Set Switch Active

Signal	Length	Data Type	Range	Conversion
Cruise Control Set Switch Active	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Powertrain uses Cruise Control Set Switch Active in the cruise control algorithm.

Power-Up Default: "False" Communication Failure Value: "False"

Platform Interface Definition:
Cruise Control Set Switch Active is transmitted by Platform. This signal represents the status of the Cruise Control Set switch. A module on the high speed serial data link shall read the cruise control set switch and transmit this signal.

Input Delay: Reference PPEI Section 2.7.2.

5.2.4.52 Cruise Control Switch Failed

Signal	Length	Data Type	Range	Conversion
Cruise Control Switch Failed	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Powertrain uses Cruise Control Switch Failed in the cruise control algorithm. Powertrain shall disengage cruise control is there is a cruise control switch failure.

Power-Up Default: "False"
Communication Failure Value: "False"

Platform Interface Definition:
Cruise Control Switch Failed is transmitted by Platform. This signal indicates if a failure of the cruise control switch has been detected.
A module on the high speed serial data link shall read the cruise control switches and transmit this signal.

Input Delay: Reference PPEI Section 2.7.2.

5.2.4.53 Cruise Control Switch Protection Value

Signal	Length	Data Type	Range	Conversion
Cruise Control Switch Protection Value	4	UNM	N/A	E = N * 1

Powertrain Interface Definition:
Cruise Control Switch Protection Value is received by Powertrain. To assure that the transmitter still is working properly, the sender must be able to calculate a mode switch signal protection. A reference protection value shall be calculated by Powertrain as the 2's complement of (received Cruise Control Alive Rolling Count value + received Cruise Control Switch Status) and then compared with the protection value received from Platform. Any cruise control switch message containing a wrong protection value shall be ignored. Any mode switch OFF command will be accepted, even if it is incorporated in a message with a wrong protection value. N protection calculation errors (n=3 is a typical value) in m consecutive frames (m=10 is a typical value) will lead to an irreversible disengagement of cruise control until the end of the respective driving cycle.

Cruise Control Switch Protection Value and Cruise Control Alive Rolling Count supervision can be handled in one diagnostic software module with one common error threshold (n errors in m consecutive frames). Every detected fault will increase the malfunction counter.

Platform Interface Definition:
Cruise Control Switch Protection Value is transmitted by Platform. The signal indicates that the sender's processing software module still is working properly. The protection value shall be calculated as the 2's complement of (Cruise Control Alive Rolling Count value + Cruise Control Switch Status) in each frame transmitted. All calculations shall be done without carryover evaluation (i.e., a 4-bit truncation shall be performed in case of carryover).

The following binary values shall be used to indicate Cruise Control Switch Status:

Bit 3: Cruise Control Set Switch Active
Bit 2: Cruise Control Resume Switch Active
Bit 1: Cruise Control Cancel Request
Bit 0: Cruise Control On Switch Active

These four status bits reflect the values of the Cruise Control Set Switch Active, Cruise Control Resume Switch Active, Cruise Control Cancel Request, and Cruise Control On Switch Active signals at the time of frame transmission. ***For correct calculation of the Cruise Control Switch Protection Value, these four cruise mode signals must be packed and ordered within the same frame as noted above.***

Example: Transmitted counter value = 11, Set Switch = 1, Resume Switch = 0, Cancel Request = 0, On Switch = 0.

Calculation of the binary sum: 1000 + 11 = 1011 bin = B hex.
2's complement of 1011 = 0100 + 1 = 0101 bin = 5 hex.

The transmitted Cruise Control Switch Protection Value should be $5 in the above example.

5.2.4.54 Diesel Glow Plug Indication On

Signal	Length	Data Type	Range	Conversion
Diesel Glow Plug Indication On	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Diesel Glow Plug Indication On is transmitted by Powertrain. It is set to “True” at glowing before engine start.

Data Delay: 500 ms

Platform Interface Definition:

Diesel Glow Plug Indication On is used for display purposes.

5.2.4.55 Distance Rolling Count Driven Wheel, Distance Rolling Count Driven Wheel Reset Occurred, Distance Rolling Count Driven Wheel Validity, Distance Rolling Count Non Driven Wheel, Distance Rolling Count Non Driven Wheel Reset Occurred, Distance Rolling Count Non Driven Wheel Validity, Distance Rolling Count Left Non Driven Wheel, Distance Rolling Count Left Non Driven Wheel Reset Occurred, Distance Rolling Count Left Non Driven Wheel Validity, Distance Rolling Count Right Non Driven Wheel, Distance Rolling Count Right Non Driven Wheel Reset Occurred, Distance Rolling Count Right Non Driven Wheel Validity

Signal	Length	Data Type	Range	Conversion
Distance Rolling Count (Driven or Non Driven)	16	UNM	0 - 1023.98 m	E = N * 0.015625
Distance Rolling Count (Driven or Non Driven) Reset Occurred	1	BLN	N/A	$1=True; $0=False
Distance Rolling Count (Driven or Non Driven) Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Powertrain transmits the Distance Rolling Count signals.

Using wheel speed sensor data as input, these signals represent a rolling counter of the distance traveled by the vehicle in meters for both the driven and non-driven wheels independently. Powertrain shall allow the counters to roll over (start over) when the signal exceeds its maximum defined value of 1023.98 meters. For example, 1022 meters in current counter + 6 meters additionally traveled since last computation = 4.02 meters in current counter.

The Powertrain algorithm which creates distance rolling count information is set up to create a maximum of two independent rolling counters from 7 different data sources. The source used shall be calibratable and must be specified by the platform from the available sources for that application. Not all applications will have 7 possible sources for the input data.

The 7 possible sources are:

1) Wheel Rotations Left Driven Rolling Count data from ABS
2) Wheel Rotations Right Driven Rolling Count data from ABS
3) Wheel Rotations Left Non Driven Rolling Count data from ABS
4) Wheel Rotations Right Non Driven Rolling Count data from ABS
5) Hardwired Wheel Speed Sensor input to powertrain controller
6) Hardwired Transmission Output Speed input to powertrain controller
7) Transmission Output Speed data from TCM to ECM

Up to two of the above input sources shall be calibratably mapped into only one of the following two distance rolling count output pairs:

Output Pair #1:
Distance Rolling Count Driven Wheel
Distance Rolling Count Non Driven Wheel

Output Pair #2:
Distance Rolling Count Left Non Driven Wheel
Distance Rolling Count Right Non Driven Wheel

The output pairs used must be determined at build time by the platform.

The validity bit shall be set to "Invalid if a failure is detected with the source of the information (serial data or hard-wired sensor) used for calculating distance rolling count. Powertrain and Platform must maintain the distance rolling count in some type of battery backed keep alive memory to retain the latest value of distance rolling count over ignition cycles. To avoid loss of data or inaccurate data used by Platform, Powertrain will send the Distance Rolling Count Reset Occurred signal with a value of "True" whenever the Powertrain memory that maintains distance rolling count is reset due to a memory failure that causes a reset of the memory that contains the distance rolling count information.

Refer to Section 2.19 for further detail on GMNA and GME mechanizations.

Input Delay (Distance Rolling Count): TBD
Data Delay (Distance Rolling Count Reset Occurred): TBD
Accuracy Requirement: See PPEI subsection 2.19: *Vehicle Speed and Rough Road Sensing*

Examples:

GME OPEL

The following two cases show how one software/calibration can be setup to realize sufficient functionality for both non ABS and ABS equipped systems where wheel speed sensors will be the primary signal source for distance rolling data.. The algorithm may be setup to use the GMLAN signal "Antilock Brake System Present" to automatically configure the distance rolling counter computation for either the ABS or the non-ABS configurations. Therefore the "Antilock Brake System Present" signal may be required for proper powertrain functionality.

GME 2002 Epsilon Opel equipped with ABS and Navigation	Blanks in this column indicate that the input data is not used	
Input	**Output**	**Functional or Invalid?**
Wheel Rotations Left Driven Rolling Count data from ABS		
Wheel Rotations Right Driven Rolling Count data from ABS		
Wheel Rotations Left Non Driven Rolling Count data from ABS	Distance Rolling Count Left Non Driven Wheel	Functional
Wheel Rotations Right Non Driven Rolling Count data from ABS	Distance Rolling Count Right Non Driven Wheel	Functional
Hardwired Wheel Speed Sensor		

GME 2002 Epsilon Opel not equipped with ABS	Blanks in this column indicate that the input data is not used	
Input	**Output**	**Functional or Invalid?**
Wheel Rotations Left Driven Rolling Count data from ABS		
Wheel Rotations Right Driven Rolling Count data from ABS		
Wheel Rotations Left Non Driven Rolling Count data from ABS		
Wheel Rotations Right Non Driven Rolling Count data from ABS		
Hardwired Wheel Speed Sensor	Distance Rolling Count Left Non Driven Wheel	Functional
	Distance Rolling Count Right Non Driven Wheel	Invalid

GME SAAB

The following case shows how one software/calibration can be setup to realize sufficient functionality for the 2003 SAAB where all systems are equipped with ABS and ABS wheel speed sensors will be the primary signal source for distance rolling data..

GME SAAB, all equipped with ABS	Blanks in this column indicate that the input data is not used	
Input	**Output**	**Functional or Invalid?**
Wheel Rotations Left Driven Rolling Count data from ABS		
Wheel Rotations Right Driven Rolling Count data from ABS		
Wheel Rotations Left Non Driven Rolling Count data from ABS	Distance Rolling Count Left Non Driven Wheel	Functional
Wheel Rotations Right Non Driven Rolling Count data from ABS	Distance Rolling Count Right Non Driven Wheel	Functional

GMNA

The following case shows how one software/calibration can be setup to realize sufficient functionality for the GMNA type applications where all systems will use a transmission output speed sensor as the primary signal source for distance rolling data..

GMNA PCM (single engine/transmission controller)	Blanks in this column indicate that the input data is not used	
Input	**Output**	**Functional or Invalid?**
Wheel Rotations Left Driven Rolling Count data from ABS		
Wheel Rotations Right Driven Rolling Count data from ABS		
Wheel Rotations Left Non Driven Rolling Count data from ABS		
Wheel Rotations Right Non Driven Rolling Count data from ABS		
Hardwired Transmission Output Speed	Distance Rolling Count Driven Wheel	Functional
Transmission Output Speed data from TCM to ECM		
	Distance Rolling Count Non Driven Wheel	Invalid

GMNA ECM with separate TCM (automatics only)	Blanks in this column indicate that the input data is not used	
Input	**Output**	**Functional or Invalid?**
Wheel Rotations Left Driven Rolling Count data from ABS		
Wheel Rotations Right Driven Rolling Count data from ABS		
Wheel Rotations Left Non Driven Rolling Count data from ABS		
Wheel Rotations Right Non Driven Rolling Count data from ABS		
Hardwired Transmission Output Speed		
Transmission Output Speed data from TCM to ECM	Distance Rolling Count Driven Wheel	Functional
	Distance Rolling Count Non Driven Wheel	Invalid

GMNA ECM without TCM (manuals only)	Blanks in this column indicate that the input data is not used	
Input	**Output**	**Functional or Invalid?**
Wheel Rotations Left Driven Rolling Count data from ABS		
Wheel Rotations Right Driven Rolling Count data from ABS		
Wheel Rotations Left Non Driven Rolling Count data from ABS		
Wheel Rotations Right Non Driven Rolling Count data from ABS		
Hardwired Transmission Output Speed	Distance Rolling Count Driven Wheel	Functional
Transmission Output Speed data from TCM to ECM		
	Distance Rolling Count Non Driven Wheel	Invalid

GMNA, equipped with ABS and Navigation	Blanks in this column indicate that the input data is not used	
Input	**Output**	**Functional or Invalid?**
Wheel Rotations Left Driven Rolling Count data from ABS		
Wheel Rotations Right Driven Rolling Count data from ABS		
Wheel Rotations Left Non Driven Rolling Count data from ABS	Distance Rolling Count Left Non Driven Wheel	Functional
Wheel Rotations Right Non Driven Rolling Count data from ABS	Distance Rolling Count Right Non Driven Wheel	Functional
Hardwired Transmission Output Speed	Distance Rolling Count Driven Wheel	Invalid
Transmission Output Speed data from TCM to ECM		
	Distance Rolling Count Non Driven Wheel	Invalid

Platform Interface Definition:
Platform uses the Distance Rolling Count signal to increment the odometer display. Platform shall keep track of counter rollovers. Powertrain and Platform must maintain the distance rolling count in some type of battery backed keep alive memory to retain the latest value of distance rolling count over ignition cycles. When the Distance Rolling Count Reset Occurred signal is received with a value of “True” (which indicates that the Powertrain electronics memory has been reset), the platform module should reset its distance rolling count to the data value within the Distance Rolling Count signal. Other Platform strategies for detecting invalid data from Powertrain may also be implemented.

The data in Distance Rolling Count shall be ignored if Distance Rolling Count Validity is set to “Invalid”.

Power-Up Default: Use last known value stored in non-volatile memory
Data Failure Action: Use last known value stored in non-volatile memory

5.2.4.56 Driver Shift Control Request Denied Indication On

Signal	Length	Data Type	Range	Conversion
Driver Shift Control Request Denied Indication On	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Driver Shift Control Request Denied Indication On is transmitted by the TCM if the vehicle has a TCM, otherwise it is not transmitted.
The data value of this signal shall be set to “True” when a Transmission Tap Up/Tap Down Request or Tap-Up/Tap-Down hardwire signal transition occurs requesting a target gear that cannot be allowed in the current operating conditions.

When a new Transmission Tap Up/Tap Down Request or Tap-Up/Tap-Down hardwire signal transition occurs, Powertrain shall determine if the requested gear is allowed given current operating conditions. If the Transmission Tap Up/Tap Down Request or Tap-Up/Tap-Down hardwire signal transition occurs indicating a “tap-down”, and the transmission is in 1st gear, the Driver Shift Control Request Denied Indication On parameter shall be set to “False”. If the Transmission Tap Up/Tap Down Request or Tap-Up/Tap-Down hardwire signal transition occurs indicating a “tap-up”, and the transmission is in the highest gear, the Driver Shift Control Request Denied Indication On parameter shall be set to “False”. If the requested gear is NOT allowed the Driver Shift Control Request Denied Indication On parameter shall be set to “True”. Scenarios that may result in a denied request include but are not limited to:

- Selecting too low of a gear that would result in engine overspeed.
- Selecting too high of a gear that would result in engine lugging.
- Selecting a gear that would result in detrimental Powertrain cooling performance.

- Selecting a gear that would result in degraded Powertrain lubrication.

Once “True”, this parameter shall remain “True” until <u>any</u> of the following occurs:
A subsequent Transmission Tap Up/Tap Down Request or Tap-Up/Tap-Down hardwire signal transition is received that results in an allowed change to the Driver Shift Control Target Gear parameter.

- A subsequent Transmission Tap Up/Tap Down Request or Tap-Up/Tap-Down hardwire signal transition is received that results in an allowed change to the Driver Shift Control Target Gear parameter.
- The Transmission Tap Up/Tap Down Mode Indication On parameter becomes False.
- More than 500 ms has elapsed since the Transmission Tap Up/Tap Down Request or Tap-Up/Tap-Down hardwire signal transition occurred which resulted in the most recent denied request.

Note: this signal shall only provide feedback in response to driver-initiated gear change requests. It shall not indicate automatic shifts or limited operation necessary to protect the powertrain.

Applications that do not support Tap-Up/Tap-Down shall always send this signal with a data value of “False”.

Data Delay: 50 ms

<u>Platform Interface Definition:</u>
Driver Shift Control Request Denied Indication On is received by Platform. It is the intended signal to be used as a mechanism to provide visual and/or audible feedback to the driver that a Tap-Up/Tap-Down request will not be executed. The value of this parameter should be ignored by Platform when the Driver Shift Control Active signal is “False”.

Output Actuation Delay: 250 ms

5.2.4.57 Energy Management Minimum Idle Boost Level Request

Signal	Length	Data Type	Range	Conversion
Energy Management Minimum Idle Boost Level Request	3	ENM	N/A	$0=No Boost Requested $1=Boost Level 1 $2=Boost Level 2 $3=Boost Level 3

<u>Powertrain Interface Definition:</u>
Energy Management Minimum Idle Boost Level Request is received by Powertrain. Each idle boost level will correspond to two minimum calibratable idle speed thresholds (one for in-gear and one for not-in-gear) above which the Powertrain electronics must maintain the engine speed. The determination of the calibratable idle speed thresholds is a coordinated effort between Powertrain and Platform. Powertrain may support up to three separate idle boost levels depending on the vehicle.

Power-Up Default: “No Boost Requested”
Communication Failure Value: “No Boost Requested”

<u>Platform Interface Definition</u>:
Energy Management Minimum Idle Boost Level Request is transmitted by Platform. This signal is used to request the Powertrain boost the idle speed due to excessive electrical loading on the vehicle.

5.2.4.58 Engine Boost Pressure Indication, Engine Boost Pressure Indication Validity

Signal	Length	Data Type	Range	Conversion
Engine Boost Pressure Indication	8	UNM	0 - 100 %	E = N * 0.392157
Engine Boost Pressure Indication Validity	1	ENM	N/A	$0=Valid; $1=Invalid

<u>Powertrain Interface Definition:</u>
Engine Boost Pressure Indication is transmitted by Powertrain. It represents the boost pressure on turbo-charged engine applications. Engine Boost Pressure Indication Validity shall be set to "Invalid" if the sensor providing the data has failed and a backup value cannot be determined.
Input Delay: 125 ms

Accuracy Requirement: TBD

<u>Platform Interface Definition:</u>
Engine Boost Pressure Indication is used for display purposes.

The data in Engine Boost Pressure Indication shall be ignored if Engine Boost Pressure Indication Validity is set to "Invalid".

5.2.4.59 Engine Calculated Actual Gear, Engine Calculated Actual Gear Validity

Signal	Length	Data Type	Range	Conversion
Engine Calculated Actual Gear	4	ENM	N/A	$0=Shift in Process $1=First Gear $2=Second Gear $3=Third Gear $4=Fourth Gear $5=Fifth Gear $6=Sixth Gear $7=Seventh Gear $8=Reverse $9=Neutral
Engine Calculated Actual Gear Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Engine Calculated Actual Gear is transmitted by Powertrain on manual transmission vehicles with an ECM. The forward drive gear states are determined based on comparing a calculated engine speed to vehicle speed (N/V) ratio to a calibrated range of ratios for the forward gears. The Neutral gear state will be indicated if the calculated speed ratio is not within one of the calibrated range of ratios for the forward gears, or if it can be determined that the clutch pedal is depressed. Reverse and Shift in Process are not supported for manual transmissions.
Engine Calculated Actual Gear Validity shall be set to “Invalid” if the sensor providing the data has failed and a backup value cannot be determined.

Data Delay: TBD

Platform Interface Definition:
Engine Calculated Actual Gear is used for miscellaneous body functions and Traction Control. ETS uses it for exit criteria, gear shifting functions and wheel torque calculations. TCS uses it to select the appropriate TCS ramp rate. This signal is also used by the SDM for crash recording

The data in Engine Calculated Actual Gear shall be ignored if Engine Calculated Actual Gear Validity is set to “Invalid”.

5.2.4.60 Engine Coast Fuel Cut Off Active

Signal	Length	Data Type	Range	Conversion
Engine Coast Fuel Cut Off Active	1	BLN	N/A	$1=True, $0=False

Powertrain Interface Definition:

Engine Coast Fuel Cut Off is transmitted by Powertrain. It shall be set to "True" if the engine controller cuts off fuel during a coast condition.

Data Delay: 20ms maximum

Platform Interface Definition:

The signal is received by Platform. Platform uses this signal for fuel consumption display purposes.

5.2.4.61 Engine Coolant Hot Indication On

Signal	Length	Data Type	Range	Conversion
Engine Coolant Hot Indication On	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Engine Coolant Hot Indication On is transmitted by Powertrain. When the coolant temperature exceeds a calibratable temperature threshold value, Powertrain shall set the data value of the signal to “True” to command the Hot Coolant display.

Data Delay: 500 ms

Platform Interface Definition:
Engine Coolant Hot Indication On is used for display purposes.

5.2.4.62 Engine Coolant Level Low

Signal	Length	Data Type	Range	Conversion
Engine Coolant Level Low	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Engine Coolant Level Low is used for engine protection due to low coolant on certain engines.

The source of this signal shall be monitored by the Engine Coolant Level Switch Virtual Device Availability signal.

Power-Up Default: “False”
Communication Failure Value: “False”

Platform Interface Definition:
Engine Coolant Level Low is transmitted by Platform. Platform reports to Powertrain the state of the low coolant level sensor.

Latency Requirement: TBD

5.2.4.63 Engine Coolant Level Switch Virtual Device Availability

Signal	Length	Data Type	Range	Conversion
Engine Coolant Level Switch Virtual Device Availability	1	ENM	N/A	$0=Virtual Device Unavailable $1=Virtual Device Available

Powertrain Interface Definition:
Engine Coolant Level Switch Virtual Device Availability is received by Powertrain (ECM, PCM). If the value of this signal is “$0”, then the Engine Coolant Level Low signal shall be defaulted to “False” within the powertrain controller.

Power-Up Default: “$1”
Communication Failure Value: “$0”

Platform Interface Definition:
Engine Coolant Level Switch Virtual Device Availability is transmitted by Platform. If Engine Coolant Level Low signal is transmitted to Powertrain through a gateway, then the Engine Coolant Level Switch Virtual Device Availability signal indicates the availability of the source of the Engine Coolant Level Low signal.

Data Delay: TBD

5.2.4.64 Engine Coolant Temperature, Engine Coolant Temperature Validity

Signal	Length	Data Type	Range	Conversion
Engine Coolant Temperature	8	UNM	-40 - 215 deg C	E = N * 1 - 40
Engine Coolant Temperature Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Engine Coolant Temperature is transmitted by Powertrain. It represents the temperature of the engine coolant. This signal must have a high internal Powertrain electronics scheduling priority because the Platform requires this data prior to calculating and displaying Outside Air Temperature. Engine Coolant Temperature Validity shall be set to “Invalid” if the sensor providing the data has failed and a backup value cannot be determined. It shall also be set to “Invalid” until Engine Coolant Fluid Temperature is determined.

Input Delay: 1025 ms

Accuracy Requirement: TBD

Platform Interface Definition:
Engine Coolant Temperature is used for the calculation and display of Outside Air Temperature and display of coolant temperature.

The data in Engine Coolant Temperature shall be ignored if Engine Coolant Temperature Validity is set to “Invalid”.

5.2.4.65 Engine Cooling Fan Speed

Signal	Length	Data Type	Range	Conversion
Engine Cooling Fan Speed	8	UNM	0 - 100 %	E = N * 0.392157

Powertrain Interface Definition:
Engine Cooling Fan Speed is transmitted by Powertrain. Powertrain reports the percentage of fan power commanded. This command is based on parameters such as coolant temperature, transmission temperature, engine oil temperature and A/C pressure. On discrete fan systems, this percentage is represents a discrete fan speed based on the calibrations in the cooling fan control algorithm. On PWM fan systems this percentage represents the PWM duty cycle commanded.

Data Delay: TBD

Accuracy Requirement: TBD

Platform Interface Definition:
Engine Cooling Fan Speed is used by Platform in electrical load management for RVC calculations and other algorithms to determine if a reduction in fan speed should be requested.

Power-Up Default: 0%

5.2.4.66 Engine Cooling Fan Speed Adjustment

Signal	Length	Data Type	Range	Conversion
Engine Cooling Fan Speed Adjustment	8	SNM	-100 - 99.2188 %	E = N * 0.78125

Powertrain Interface Definition:
Engine Cooling Fan Speed Adjustment is received by Powertrain. The cooling fan control algorithm uses this information to adjust the fan speed as defined in Section 4.2.4.8.2.2 Cooling Fan Control Algorithm.

PowerUp Default: 0%
Communication Failure Value: 0%
Output Actuation Delay: TBD

Platform Interface Definition:
Engine Cooling Fan Speed Adjustment is transmitted by Platform. This signal is used to request Powertrain to modify the cooling fan speed. The fan speed may be requested to be lowered for electrical energy management purposes. If the cooling fan is not already running, the fan speed may be requested to be increased during extended engine idle periods in order to ventilate the engine compartment.

Accuracy Requirement: TBD

5.2.4.67 Engine Cylinder Deactivation Mode

Signal	Length	Data Type	Range	Conversion
Engine Cylinder Deactivation Mode	2	ENM	N/A	$0=All Cylinders Active $1=Deactivation In Progress $2=Half of Total Cylinders Active $3=Reactivation In Progress

Powertrain Interface Definition:
Engine Cylinder Deactivation Mode is transmitted by the ECM. This signal shall provide the status of the engine displacement on demand (DoD) function.

The enumeration definitions are as follows:

All Cylinders Active:
This mode implies that all of the cylinders in the engine are active. This is the default mode for a vehicle that does not have cylinder deactivation.

Deactivation In Progress:
This mode is set at the start of the cylinder deactivation process, before any cylinders have been turned off. While this mode is in effect, the cylinders will be deactivated. Once all of the desired cylinders have been deactivated, this signal shall transition to the next mode.

Half of Total Cylinders Active:
This mode indicates that the engine is operating in cylinder deactivation and that half of the cylinders are currently active.

Reactivation In Progress:
This mode indicates that the engine is reactivating the cylinders that were turned off. This mode shall be entered at the start of the reactivation process before any cylinders have been turned back on. When the reactivation is complete, this signal shall transition to the $0 mode.

If the engine is not running Powertrain shall transmit this signal with a value of "All Cylinders Active".

Data Delay: 125 ms

Platform Interface Definition:
Engine Cylinder Deactivation Mode is received by Platform. This signal is used to display to the vehicle operator when the engine control system (if equipped with the DoD function) is operating with all cylinders active or with half of all cylinders active.

5.2.4.68 Engine Emissions Related Malfunction Active

Signal	Length	Data Type	Range	Conversion
Engine Emissions Related Malfunction Active	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Engine Emissions Related Malfunction Active is transmitted by Powertrain. The data value of the signal will be set to "True" when the Malfunction Indicator Lamp (MIL) is illuminated, or flashing, due to a fault.

Data Delay: 250 msec

Platform Interface Definition:
Engine Emissions Related Malfunction Active is used by the SDM for crash recording. It shall not be used for display purposes.

Power-up Default: False
Communication Failure Value: False

5.2.4.69 Engine Emissions Related Malfunction Indication Request

Signal	Length	Data Type	Range	Conversion
Engine Emissions Related Malfunction Indication Request	3	ENM	N/A	$0= Continuous Indication $1= No Indication $2= Flashing 1 Hertz Indication $3= Flashing 2 Hertz Indication $4=Flashing 0.5 Hertz Indication

Powertrain Interface Definition:
Engine Emissions Related Malfunction Indication Request is transmitted by Powertrain to control the service engine soon (Malfunction Indication Lamp) indication.. It will be transmitted only by the ECM. This signal is sent with a data value of "Continuous Indication" for bulb check, service device control, or when failures are detected by Powertrain that require a MIL indication. This signal is sent with a data value of "Flashing 1 Hertz Indication" when catalyst damage is detected or OBD readiness status is incomplete. This signal is sent with a data value of "Flashing 1/2 Hertz Indication" in the vehicle assembly plant during fuel pump prime. Additional flashing rates are reserved for future OBD II regulations. When the signal is used for service device control, only the "Continuous Indication" and "No Indication " states are used. The Powertrain controller will control the bulb check time as a calibration in the Powertrain controller.

Data Delay: TBD ms max.

Platform Interface Definition:
Engine Emissions Related Malfunction Indication Request is used only to control the service engine soon (Malfunction Indication Lamp) indication. This signal does not always indicate that an emission related fault is present (e.g. bulb check and service device control) and therefore cannot be used for fault status. This signal is used to control an OBD II regulated display and should only be used on the GMLAN high-speed communication link in OBD II markets. Any other communication link and any additional gateways using this signal to control the MIL display would be subject to OBD II regulations including all controllers on that link.

The Platform display system shall always power-up in a default state that commands the "Continuous Indication" state until a valid signal is received commanding a different state. When a valid "Flashing x Hertz Indication" state is received, the indication flash rate duty cycle shall be 50%.

The Platform display system shall default to the "Continuous Indication" state when communications between the Platform high-speed receiver and the Powertrain is interrupted (i.e. continuous loss of frame containing this signal) for more than 5 seconds. The Platform high-speed controller shall resume normal display control within 5 seconds of resuming valid serial data messages. Although the Platform display system may store diagnostic trouble codes upon detecting loss of serial communications, those communication trouble codes are not required by OBD regulations and shall not directly invoke illumination of the MIL.

The Platform display system must not take hardware or software action to prevent MIL illumination when the vehicle battery voltage is below 18 volts.

During crank the Platform display system shall attempt to follow the Powertrain controlled state. With any reset or loss of communication during crank, the Platform display system shall recover into a default state that commands the "Continuous Indication" state until a valid signal is received commanding a different state. This is based on the Powertrain bulb check logic that commands the MIL on during crank until engine running occurs.

Power-Up Default: "Continuous Indication"
Communication Failure Value: "Continuous Indication"

5.2.4.70 Engine Hot / Stop Engine Indication On

Signal	Length	Data Type	Range	Conversion
Engine Hot / Stop Engine Indication On	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Engine Hot / Stop Engine Indication On is transmitted by Powertrain. When Powertrain determines that an extreme engine hot condition is present based on coolant temperature being greater than a calibratable temperature threshold, the Powertrain electronics will set the data value of the signal to “True” to command the Engine Hot / Stop Engine display.

Data Delay: 1025 ms

Platform Interface Definition:
Engine Hot / Stop Engine Indication On is used for display purposes.

5.2.4.71 Engine Intake Air Temperature, Engine Intake Air Temperature Validity

Signal	Length	Data Type	Range	Conversion
Engine Intake Air Temperature	8	UNM	-40 - 215 deg C	E = N * 1 - 40
Engine Intake Air Temperature Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Engine Intake Air Temperature is transmitted by Powertrain upon detection of either RUN or ACCESSORY power mode. It represents the air temperature in the fresh air inlet, either between the air cleaner and throttle body, or in the intake manifold. The placement of the temperature sensor, referred to as the MAT (Manifold Air Temperature) sensor is application dependent and could result in significant variation in temperature readings between applications. The temperature reading could be extremely high after extended idles and hot soaks. Engine Intake Air Temperature Validity shall be set to “Invalid” if the sensor providing the data has failed and a backup value cannot be determined.

Input Delay: TBD

Accuracy Requirement: TBD

Platform Interface Definition:
Engine Intake Air Temperature is received by Platform. The TCS Brake Thermal Model uses the intake air temperature as an estimate for ambient temperature. Platform may also use this for HVAC fan afterblow (running the HVAC blower motor after the engine is turned off) in the Low Coolant Algorithm and battery state of charge estimate.

The data in Engine Intake Air Temperature shall be ignored if Engine Intake Air Temperature Validity is set to “Invalid”.

5.2.4.72 Engine Limp Home Mode Active

Signal	Length	Data Type	Range	Conversion
Engine Limp Home Mode Active	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Engine Limp Home Mode Active is transmitted by Powertrain. The data value of this signal will be set to “True” if a failure is detected with Electronic Throttle Control or other Powertrain systems such that the engine power will be limited.

Data Delay: 1025 ms

Platform Interface Definition:
Engine Limp Home Mode Active is used for display purposes. This signal is also used by the SDM for crash recording.

5.2.4.73 Engine Off Time, Engine Off Time Validity

Signal	Length	Data Type	Range	Conversion
Engine Off Time	8	UNM	0 - 510 min	E = N * 2
Engine Off Time Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:

Engine Off Time is received by Powertrain. The Engine Off Time is used at Ignition on to calculate the heat decreased in the AWD lamella package during ignition off.

The data in EngineOffTime shall be ignored if Engine Off Time Validity is set to "Invalid".

Platform Interface Definition:

Engine Off Time is transmitted by the Gateway. The signal represents the time from Ignition off to Ignition on.

Engine Off Time Validity shall be set to "Invalid" if the calculation has failed.

Data Delay: 125 ms

5.2.4.74 Engine Oil Change Now Indication On

Signal	Length	Data Type	Range	Conversion
Engine Oil Change Now Indication On	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Engine Oil Change Now Indication On is transmitted by Powertrain. The state of Engine Oil Change Now is based on the engine oil life determination algorithm that resides in the Powertrain electronics. The algorithm is based on the principle that engine operation will decrease oil life especially at non-optimal oil temperatures. Once the oil life is reduced to a specific calibratable level, Powertrain will set the data value of the signal to "True" to command the Engine Oil Change Now display.

Data Delay: 1025 ms
Platform Interface Definition:
Engine Oil Change Now Indication On is used for display purposes.

5.2.4.75 Engine Oil Change Soon Indication On

Signal	Length	Data Type	Range	Conversion
Engine Oil Change Soon Indication On	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Engine Oil Change Soon Indication On is transmitted by Powertrain. The state of Engine Oil Change Soon is based on the engine oil life determination algorithm that resides in the Powertrain electronics. The algorithm is based on the principle that engine operation will decrease oil life especially at non-optimal oil temperatures. Once the oil life is reduced to a specific calibratable level, Powertrain will set the data value of the signal to “True” to command the Engine Oil Change Soon display.

Data Delay: 1025 ms

Platform Interface Definition:
Engine Oil Change Soon Indication On is used for display purposes.

5.2.4.76 Engine Oil Level Low Indication On

Signal	Length	Data Type	Range	Conversion
Engine Oil Level Low Indication On	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Engine Oil Level Low Indication On is transmitted by Powertrain. The state of Engine Oil Low Level is based on the engine oil level determination algorithm that resides in the Powertrain electronics. Basically, the algorithm determines the oil level is low if the engine had been shut down long enough for the oil to drain back to the oil pan, the engine is not rotating, and the oil level switch indicates that the oil level is low. Once the engine has started cranking (rotating) the oil level switch will not provide a valid indication of oil level, therefore the algorithm will be disabled until the next power-up. When the algorithm determines that the oil level is low, Powertrain will set the data value of the signal to “True” to command the Engine Oil Low Level display.

Data Delay: 1025 ms

Platform Interface Definition:
Engine Oil Level Low Indication On is used for display purposes.

5.2.4.77 Engine Oil Pressure, Engine Oil Pressure Validity

Signal	Length	Data Type	Range	Conversion
Engine Oil Pressure	8	UNM	0 - 1020 kPaG	E = N * 4
Engine Oil Pressure Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Engine Oil Pressure is transmitted by Powertrain. It is the filtered fluid pressure read from the oil pressure sensor or is calculated fluid pressure determined by an algorithm in the Powertrain electronics. Engine Oil Pressure Validity shall be set to "Invalid" if the sensor providing the data has failed and a backup value cannot be determined. It shall also be set to "Invalid" until Fluid Pressure is determined. The validity bit will not be set to "Invalid" when fluid pressure is determined by an algorithm.

Input Delay: 525 ms

Accuracy Requirement: TBD

Platform Interface Definition:
Engine Oil Pressure is used for display purposes.

The data in Engine Oil Pressure shall be ignored if Engine Oil Pressure Validity is set to "Invalid".

5.2.4.78 Engine Oil Pressure Low Indication On

Signal	Length	Data Type	Range	Conversion
Engine Oil Pressure Low Indication On	1	BLN	N/A	$1=True; $0=Invalid

Powertrain Interface Definition:
Engine Oil Pressure Low Indication On is transmitted by Powertrain. The state of Engine Oil Low Pressure is based on the value of the oil pressure sensor or the state of the oil pressure switch. In order to avoid transmitting false indications of low oil pressure, Powertrain will not indicate a low oil pressure condition unless the engine is running, no failure has been detected with the oil pressure sensor or switch, and the oil pressure has been low for a calibratable continuous period of time.

Data Delay: 1025 ms

Platform Interface Definition:
Engine Oil Pressure Low Indication On is used for display purposes.

5.2.4.79 Engine Oil Life Reset Performed

Signal	Length	Data Type	Range	Conversion
Engine Oil Life Reset Performed	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Engine Oil Life Reset Performed is transmitted by the ECM. Platform will indicate a reset to Powertrain via the Engine Oil Life Reset Request signal or by the throttle pedal stomp maneuver. The data value of this signal will be set to “True” when Powertrain has reset the engine oil remaining life.

The data value of this signal will be set to “False” after a calibratable time, K_OilLifeResetOccurredTime.

When an engine oil condition sensor is present, the signal Engine Oil Life Reset Performed shall always be set to “False”.

Output Actuation Delay: 300ms (with respect to updating the information in the Engine Oil Remaining Life Signal).

Platform Interface Definition:
Engine Oil Life Reset Performed is received by Platform, and is used for display purposes. When implemented as a telltale, platform shall provide a "bulb check" of the telltale. A chime can accompany the visual indication at Platform's discretion.

Data Delay: 125 ms

5.2.4.80 Engine Oil Remaining Distance

Signal	Length	Data Type	Range	Conversion
Engine Oil Remaining Distance	10	UNM	0 – 102300 km	E = N * 100 km

Powertrain Interface Definition:
Engine Oil Remaining Distance is transmitted by Powertrain. Powertrain determines Engine Oil Remaing Distance based on the engine oil life determination algorithm that resides in the Powertrain electronics. The algorithm is based on the principle that engine operation will decrease oil life especially at non-optimal oil temperatures.

Data Delay (Engine Oil Remaining Distance): 1 second
Output Actuation Delay (Engine Oil Remaining Life Reset Request): 1 second

Platform Interface Definition:
Engine Oil Remaining Distance is used for display purposes. Platform may set the data value of the Engine Oil Life Reset Request signal to “True” to command Powertrain to reset the Remaining Distance.

5.2.4.81 Engine Oil Life Reset Request, Engine Oil Remaining Life

Signal	Length	Data Type	Range	Conversion
Engine Oil Life Reset Request	1	BLN	N/A	$1=True; $0=False
Engine Oil Remaining Life	8	UNM	0 - 100 %	E = N * 0.392157

Powertrain Interface Definition:
Engine Oil Remaining Life is transmitted by Powertrain. Powertrain determines Engine Oil Remaining Life based on the engine oil life determination algorithm that resides in the Powertrain electronics. The algorithm is based on the principle that engine operation will decrease oil life especially at non-optimal oil temperatures. The Oil Remaining Life may be reset by either utilizing

the throttle pedal stomp procedure or a platform-optional reset switch. For the platform-optional reset switch, the Platform will indicate a reset via the Engine Oil Life Reset Request signal to Powertrain. Upon detection of any reset of Fluid Remaining Life, Powertrain will set the data value of the Engine Oil Remaining Life signal to 100%. Even if the platform module does not use Fluid Remaining Life data, a reset notification will be communicated with this signal.

Data Delay (Engine Oil Remaining Life): 1 second
Output Actuation Delay (Engine Oil Remaining Life Reset Request): 1 second

Platform Interface Definition:
Engine Oil - Fluid Remaining Life is used for display purposes. Platform may set the data value of the Engine Oil Life Reset Request signal to "True" to command Powertrain to reset the Fluid Remaining Life. Upon detection of any reset of Fluid Remaining Life, Powertrain will set data value of the Engine Oil Remaining Life signal to 100%.

5.2.4.82 Engine Oil Starvation Indication On

Signal	Length	Data Type	Range	Conversion
Engine Oil Starvation Indication On	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Engine Oil Starvation Indication On is transmitted by the ECM. The data value of this signal will be set to "True" if the Powertrain is currently operating in Oil Starvation Protection mode. The data value of this signal will be set to "False" in all other circumstances.

Applications that do not support an Oil Starvation Protection mode shall always transmit this signal with a data value of "False".

Data Delay: 275 ms

Platform Interface Definition:
Engine Oil Starvation Indication On is received by Platform, and is used for display purposes. When implemented as a telltale, platform shall provide a "bulb check" of the telltale. A chime can accompany the visual indication at Platform's discretion.

5.2.4.83 Engine Oil Temperature, Engine Oil Temperature Validity

Signal	Length	Data Type	Range	Conversion
Engine Oil Temperature	8	UNM	-40 - 215 deg C	E = N * 1 - 40
Engine Oil Temperature Validity	1	ENM	N/A	$0=Valid $1=Invalid

Powertrain Interface Definition:
Engine Oil Temperature and Engine Oil Temperature Validity are transmitted by the ECM. This signal represents the oil temperature read from an engine oil temperature sensor – it shall not be based on modeled oil temperature.

Engine Oil Temperature Validity shall be set to "Invalid" if the sensor providing the data has failed and a corresponding DTC has been set.

Applications with no engine oil temperature sensor shall transmit Engine Oil Temperature with a value of -40 deg C and Engine Oil Temperature Validity with a value of "Valid".

Input Delay: 1025 ms
Accuracy Requirement: TBD

Platform Interface Definition:

Engine Oil Temperature is received by Platform: It is used for display purposes. The data in Engine Oil Temperature shall be ignored if Engine Oil Temperature Validity is set to “Invalid”.

5.2.4.84 Engine Recommended Shift Indication

Signal	Length	Data Type	Range	Conversion
Engine Recommended Shift Indication	2	ENM	N/A	$0=None $1=Shift Up $2=Shift Down $3=Neutral

Powertrain Interface Definition:
Engine Recommended Shift Indication is transmitted by Powertrain. This signal indicates the Powertrain recommendation that the driver should change the gear. Powertrain sets the value of the signal to “Shift Up” when the Shift-Up algorithm desires this state to improve fuel consumption.

Platform Interface Definition:
Engine Recommended Shift Indication is used for display purposes.

Output Actuation Delay: 250 ms

5.2.4.85 Engine Running Status

Signal	Length	Data Type	Range	Conversion
Engine Running Status	2	ENM	N/A	$0=Not Running $1=Running and Idling $2=Running and Not Idling

Powertrain Interface Definition:
Engine Running Status is transmitted by Powertrain. It is an indication of the running status of the engine. Typically, the transition from engine not running to engine running occurs when the engine speed has been greater than a calibratable threshold for a calibratable number of engine revolutions. The determination of the "Running and Idling" and the "Running and Not Idling" states shall be based on air idle. The transition from engine running to engine not running occurs when the engine speed drops below a calibratable threshold to indicate that the engine is no longer rotating. This signal is enabled in any power mode and is sent whenever the engine run flag changes state. However, the signal can only be sent when the Powertrain electronics is powered.
For vehicles with remote vehicle start, Engine Running Status shall be set to "Not Running" while the engine is running in remote mode and the system power mode is not equal to RUN. This allows a common power moding algorithm for vehicles with and without remote vehicle start.

Data Delay: 125 ms

Platform Interface Definition:
Engine Running Status is used by the power moding backup strategy. It may be used for the tachometer display that would need to have a higher damping rate in idle. It may also be used for other miscellaneous functions.

5.2.4.86 Engine Speed, Engine Speed Validity

Signal	Length	Data Type	Range	Conversion
Engine Speed	16	UNM	0 - 16383.8 rpm	E = N * 0.25
Engine Speed Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Engine Speed is transmitted by Powertrain. It represents the unfiltered high resolution engine speed in revolutions per minute determined from the engine speed sensors available for the engine. Engine Speed Validity shall be set to "Invalid" if the sensor providing the data has failed and a backup value cannot be determined.
Input Delay: TBD

Accuracy Requirement: ± 50 rpm

Platform Interface Definition:
Engine Speed is used for tachometer display and for miscellaneous body functions. ETS uses Engine Speed as an override for upshift command in torque management. ETS also requires Engine Speed on manual transmission applications. TCS use Engine Speed to detect that the engine is being started and that the TCS diagnostic initialization can be performed. Diagnostics are performed during crank on some systems such that the noise from exercising the hydraulic modulator can be masked by the engine noise for customer satisfaction. TCS also requires Engine Speed on manual transmission applications.

The data in Engine Speed shall be ignored if Engine Speed Validity is set to "Invalid".

5.2.4.87 Engine System Regular Production Option Identifier

Signal	Length	Data Type	Range	Conversion
Engine System Regular Production Option Identifier	8	ENM	N/A	$00=Unknown $01=L61 2.2L L4 MFI $02=L81 3.0L V6 MFI $03=LA1 3.4L V6 MFI $04=LV3 3.0L V6 SFI $05=LV4 3.4L V6 SFI $06=LY9 2.6L V6 $07=L850 1.8L R4 Turbo $08=L850 2.0L R4 Turbo $09=LH2 4.6L V8 $0A=L68 6.0L V8 $0B=LS7 6.4L V8 $0C=LR2 3.4L V6 SFI $0D=LD1 2.0L L4 Diesel $0E=LL9 2.2L L4 Diesel $0F=L50 2.2L L4 Diesel $10=LX9 3.5L V6 SFI $11=LN5 3.2L V6 DOHC $12=LY7 3.6L V6 HF $13=LU1 3.2L V6 HF $14=LP9 2.8L V6 HF Turbo $15=LP1 2.8L V6 HF $16=LJ4 1.0L MFI (Z10XEP) $17=LN9 1.3L L4 DI (Z13DT) $18=L4I 1.3L L4 DI TURBO-HIGH (Z13DTR) $19=LJ2 1.4L MFI (Z14XEP) $1A=L91 1.6L MFI (Z16XE) $1B=LJ7 1.6L MFI PDA (Z16XEP) $1C=LM2 1.6L, DI (Z16YG) $1D=LK8 1.7L L4 DI TURBO-LOW (Y17DT) $1E=LRB 1.7L L4 CRI TURBO (Z17DT) $1F=2H9 1.8L MFI (Z18XE) $20=LK2 1.8L DI (Z18YG) $21=L61 2.2L MFI (Z22SE) $22=LA7 2.2L MFI DI (Z22YG) $23=LY7 3.6L HFV6 $24=LE0 3.6L HFV6 (minus Cam Phasers) $25=LH6 5.3L Gen4 $26=L76 6.0L Gen4 $27=LNJ 3.4L V6 MFI $28=LJK 3.5L V6 MFI DOHC $29=LJ2 1.4L L4 MFI PDA $2A=LJ7 1.6L L4 MFI PDA $2B=2H9 1.8L L4 MFI $2C=LCF 2.0L L4 Turbo $2D=LU2 2.0L L4 Turbo $2E=L41 1.3L L4 Diesel $2F=LRB 1.7 L4 Diesel $30=LPL 1.7 L4 Diesel $31=LPZ 1.7L L4 Diesel $32=LRD 1.9L L4 Diesel 4V $33=LW2 3.6L Base HFV6 LPG $34=LZ3 3.5L V6 $35=LZ5 3.5L V6 DoD $36=LZ8 3.9L V6 DoD $37=LE5 2.4L HO L4 $38=LSJ 2.0L L4 MFI $39=LS2 6.0L Gen4 $3A=LPM 1.9L L4 Diesel 2V $3B=LZ4 3.5L V6 Non-DoD $3C=LZ9 3.9L V6 Non-DoD $3D=LNG 1.6L L4 Turbo (Z16LEL)

				$3E=LLV 1.6L L4 Turbo (Z16LET) $3F=LKA 1.4L L4 MFI PDA (Z14XEL) $40=2H0 1.8L L4 MFI (Z18XER)

Powertrain Interface Definition:
Engine System Regular Production Option Identifier is received by Powertrain. It is used for ECM upgrade protection purposes.

Platform Interface Definition:
Engine System Regular Production Option Identifier is transmitted by Platform. It is a state encoded specific engine identifier parameter (RPO).

Data Delay: 1 second.

5.2.4.88 Engine Torque Actual, Engine Torque Actual Validity

Signal	Length	Data Type	Range	Conversion
Engine Torque Actual	12	UNM	-200 - 823.75 Nm	E = N * 0.25 - 200
Engine Torque Actual Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Engine Torque Actual is transmitted by Powertrain. It is the calculated torque at the engine output (crankshaft) considering internal friction of the engine and all external connected systems such as generator or the air conditioning system. Engine Torque Actual Validity shall be set to “Invalid” if the primary inputs for determining the data value have failed or are unavailable and a backup value cannot be determined.
Data Delay: 25 ms

Accuracy Requirement:
Actual Engine Torque > 50 Nm: required accuracy ± 10 %
Actual Engine Torque ≤ 50 Nm: required accuracy ± 5 Nm

Platform Interface Definition:
Engine Torque Actual is received by Platform. This signal is used as an input to the traction control system in order to calculate the required torque for traction control. The data in Engine Torque Actual shall be ignored if Engine Torque Actual Validity is set to “Invalid”.

5.2.4.89 Engine Torque Driver Requested, Engine Torque Driver Requested Validity

Signal	Length	Data Type	Range	Conversion
Engine Torque Driver Requested	12	UNM	-200 - 823.75 Nm	E = N * 0.25 - 200
Engine Torque Driver Requested Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Engine Torque Driver Requested is transmitted by Powertrain. This signal is the unfiltered calculated driver demanded torque commanded via accelerator position or by cruise control. This torque represents the engine torque level that would be present if torque management were not active. Engine Torque Driver Requested Validity shall be set to “Invalid” if the primary inputs for determining the data value have failed or are unavailable and a backup value cannot be determined.

Data Delay: 100 ms

Accuracy Requirement:
Engine Torque Driver Requested > 50 Nm: required accuracy ± 10 %

Engine Torque Driver Requested ≤ 50 Nm: required accuracy ± 5 Nm

Platform Interface Definition:
Engine Torque Driver Requested is received by Platform. This signal is used as an input to the traction control system in order to calculate the required torque for traction control.

The data in Engine Torque Driver Requested shall be ignored if Engine Torque Driver Requested Validity is set to "Invalid".

5.2.4.90 Engine Torque Maximum, Engine Torque Maximum Validity

Signal	Length	Data Type	Range	Conversion
Engine Torque Maximum	12	UNM	-200 - 823.75 Nm	E = N * 0.25 - 200
Engine Torque Maximum Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Engine Torque Maximum is transmitted by Powertrain. This signal is the calculated maximum torque that the engine can provide under the current circumstances (altitude, temperature, etc.), based on wide open throttle conditions. Engine Torque Maximum Validity shall be set to "Invalid" if the primary inputs for determining the data value have failed or are unavailable and a backup value cannot be determined.

Data Delay: 100 ms

Accuracy Requirement: Engine Torque Maximum > 50 Nm: required accuracy ± 10 %
Engine Torque Maximum ≤ 50 Nm: required accuracy ± 5 Nm

Platform Interface Definition:
Engine Torque Maximum is received by Platform. This signal may be utilized by the traction control system to improve performance at high altitudes.

The data in Engine Torque Maximum shall be ignored if Engine Torque Maximum Validity is set to "Invalid".

5.2.4.91 Engine Torque Minimum, Engine Torque Minimum Validity

Signal	Length	Data Type	Range	Conversion
Engine Torque Minimum	12	UNM	-200 - 823.75 Nm	E = N * 0.25 - 200
Engine Torque Minimum Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Engine Torque Minimum is transmitted by Powertrain. This signal is the calculated minimum torque to which the engine torque can actually be reduced obtaining all powertrain imperatives such as driveability, emissions etc. It can be negative in drag mode. Engine Torque Minimum Validity shall be set to "Invalid" if the primary inputs for determining the data value have failed or are unavailable and a backup value cannot be determined.

Data Delay: 100 ms

Accuracy Requirement: Engine Torque Minimum > 50 Nm: required accuracy ± 10 %
Engine Torque Minimum ≤ 50 Nm: required accuracy ± 5 Nm

Platform Interface Definition:
Engine Torque Minimum is received by Platform. This signal is utilized by the traction control system to improve performance in very low coefficient of friction surfaces.

The data in Engine Torque Minimum shall be ignored if Engine Torque Minimum Validity is set to "Invalid".

5.2.4.92 Engine Torque Reduction Failed

Signal	Length	Data Type	Range	Conversion
Engine Torque Reduction Failed	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Engine Torque Reduction Failed is transmitted by Powertrain. This signal indicates that engine torque cannot be adjusted due to permanent (i.e. not reversible without service) failures in the engine system. It shall only be used to indicate severe failures. As a reaction, traction control may be switched off or the TCM may go to limp home mode. A diagnostic trouble code has to be stored in the powertrain controller if this bit is set.

Data Delay: 100 ms

Platform Interface Definition:
Engine Torque Reduction Failed is received by Platform. This signal is utilized by the traction control system to perform failsoft action.

5.2.4.93 Engine Torque Reduction Failure Status

Signal	Length	Data Type	Range	Conversion
Engine Torque Reduction Failure Status	3	ENM	N/A	$0=Torque Reduction OK $1=Torque Reduction Temporarily Failed $2=Torque Reduction Permanently Failed $3=Torque Reduction Limited

Powertrain Interface Definition:

Engine Torque Reduction Failure Status is transmitted by Powertrain. This signal is used on all traction (ETS or TCS) equipped vehicles to convey Powertrain's failure status in response to the Traction Control Torque Request signal from Platform.

Torque Reduction OK:

This state indicates that powertrain is performing torque reduction as requested by Platform.

Torque Reduction Temporarily Failed:

This state indicates that powertrain is temporarily unable to perform its powertrain torque reduction due to a temporary failure condition such as; coolant, catalyst, or transmission oil in an over-temperature condition that may ultimately result in damage and an OBD-2 diagnostic. It is considered temporary because the conditions, which have disabled torque reductions, may possibly recover within the ignition cycle. Powertrain only stops torque reduction when no reduction is present to avoid an abrupt change, or slowly reduces powertrain torque reduction. When this temporary situation is over, powertrain torque reduction is resumed. (compare to Class-2 message $2A0B bit 10)

Torque Reduction Permanently Failed:

This state indicates that Powertrain has diagnosed a permanent latched failure such as; ETC failed, backup fuel, or spark, such that Powertrain is unable to reduce torque. It is considered permanent because the conditions, which have disabled torque reductions, will not recover within the ignition cycle. (compare to Class-2 message $2A0B bit 9)

Torque Reduction Limited:

This indicates that Powertrain is temporarily unable to perform full authority torque reduction due to a condition such as; cold engine or transmission operation. Powertrain will attempt torque reduction during this condition but the Powertrain actual delivered torque may not match the Platform requested torque reduction. As the engine and transmission approach normal operating temperatures, torque reduction allowed is increased until normal operating temperatures are reached to allow full authority torque reduction. (compare to Class-2 message $2A0B bit 12)

Data Delay: TBD
Power Up Default: $0 – Torque Reduction OK

Platform Interface Definition:

Engine Torque Reduction Failure Status is received by Platform. This signal is used on all traction (ETS or TCS) equipped vehicles to understand Powertrain's failure status in response to the Traction Control Torque Request signal from Platform. This information will then be used by Platform in the following manner.

Torque Reduction OK:

This state indicates that Powertrain is providing what has been requested by the Platform (chassis).
Platform's: "Traction Control Torque Request – Torque Request Value" and Powertrain's: "Engine Torque Actual" value match to within TBD percent at steady state conditions.

Torque Reduction Temporarily Failed:

This state indicates that Powertrain has encountered a failure (or series of failures) that prevent them from providing ANY traction torque reduction for chassis use. Powertrain has determined that the factor(s) that caused this suspension MAY BE RECOVERABLE within the CURRENT ignition cycle. If the vehicle is not able (option contented) to allow "Reduced Functionality", the ABS/Traction module will set the Diagnostic Code: TBD-TempFail. If the vehicle is able to allow "Reduced Functionality", the Platform will decide upon the manner and extent to which it is implemented.

Torque Reduction Permanently Failed:

This state indicates that Powertrain has encountered a failure (or series of failures) that prevent them from providing ANY traction torque reduction for chassis use. Powertrain has determined that the factor(s) that caused this suspension IS NOT RECOVERABLE within the CURRENT ignition cycle. If the vehicle is not able (option contented) to allow "Reduced Functionality", the ABS/Traction module will set the Diagnostic Code: TBD-PermFail. If the vehicle is able to allow "Reduced Functionality", the Platform will decide upon the manner and extent to which it is implemented.

Torque Reduction Limited:

This state indicates that Powertrain has encountered a limitation (or series of limitations) that prevent them from matching Platform's: "Traction Control Torque Request – Torque Request Value" and Powertrain's: "Engine Torque Actual" value to within TBD- percent at steady state conditions. Powertrain will provide some amount of traction torque reduction, however less than what Platform requested. The vehicle, regardless of option content, will continue to perform traction control – it just may take longer to achieve the same end.

Power Up Default: $0 – Torque Reduction OK
Communication Failure Value: $1 – Torque Reduction Temporarily Failed & Loss of Comm fault code
Latency Requirement: 100 ms MAX

Platform – Important Notes:

Some Traction algorithms don't care whether the suspension is temporary (within the current ignition cycle) or permanent (beyond the current ignition cycle). The algorithm will react accordingly based upon; the type of traction system implemented (ETS versus TCS), the torque reduction value being provided (if any), and the manner in which the Platform prescribes "Reduced Functionality" (if applicable).

While the traction algorithm doesn't care whether the suspension is temporary or permanent, the diagnostic algorithms and reporting scheme on some applications do. A unique fault code and history is set on those applications, depending upon temporary versus permanent suspension (failures) of torque reduction requests.

An example of "Reduced Functionality" (referenced in the description of the state "Torque Reduction Temporarily Failed") would be if the vehicle was equipped with TCS (engine and brake intervention) and only engine intervention was lost due to a Powertrain failure. This vehicle may still be able to provide some limited or reduced traction capability by means of brake intervention alone.

5.2.4.94 Engine Torque Traction Control Request Failed

Signal	Length	Data Type	Range	Conversion
Engine Torque Traction Control Request Failed	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Engine Torque Traction Control Request Failed is transmitted by Powertrain. The signal indicates an error in Traction Control Alive Rolling Counter updating or in Traction Control Protection value calculation. If the bit is set, not further Traction Control torque requests will be executed by Powertrain. The bit remains set until the end of the respective driving cycle. The signal default value in the consecutive driving cycle is false until the test conditions are reached.

The bit is set after three Alive Rolling Counter update errors in ten consecutive frames. Alternatively the bit is set after ten wrong Traction Control Protection values in total in one driving cycle.

Platform Interface Definition:
Engine Torque Traction Control Request Failed is received by Platform. The signal indicates an error in Traction Control Alive Rolling Counter updating or in Traction Control Protection Value calculation. If the bit is set, not further Traction Control torque requests will be executed until the end of the respective driving cycle. The signal may be used for storage of an appropriate error code in Traction Control Unit.

5.2.4.95 Engine Water In Fuel Indication On

Signal	Length	Data Type	Range	Conversion
Engine Water In Fuel Indication On	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Engine Water In Fuel Indication On is transmitted by Powertrain. This signal is supported for diesel applications. The data value of this signal will be set to "True" if the fuel sensor detects water in the diesel fuel.

Data Delay: 1025 ms

Platform Interface Definition:
Engine Water In Fuel Indication On is used for display purposes.

5.2.4.96 Fuel Capacity

Signal	Length	Data Type	Range	Conversion
Fuel Capacity	12	UNM	0 - 255 liters	E = N * 0.06225586

Powertrain Interface Definition:
Fuel Capacity is transmitted by Powertrain. It is the advertised fuel tank capacity in liters.

Data Delay: TBD

Platform Interface Definition:
Fuel Capacity may be used in conjunction with the Fuel Level Percent signal to determine fuel volume for trip computer functions.

5.2.4.97 Fuel Injected Rolling Count, Fuel Injected Rolling Count Reset Occurred

Signal	Length	Data Type	Range	Conversion
Fuel Injected Rolling Count	16	UNM	0 - 1.99997 liters	E = N * 0.0000305175
Fuel Injected Rolling Count Reset Occurred	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Fuel Injected Rolling Count is transmitted by Powertrain. It is the accumulated fuel amount that is delivered to the engine. Accuracy of cumulative fuel is ± 20% due to large errors from fuel system hardware variation. Powertrain allows the counter to roll over (start over). The platform module must keep track of rollovers. Powertrain and Platform must maintain cumulative fuel in some type of battery backed keep alive memory to retain the latest value of cumulative fuel over ignition cycles. To avoid loss of data or inaccurate data used by Platform, Powertrain will set the data value of the Fuel Injected Rolling Count Reset Occurred signal to "True" whenever the Powertrain memory that maintains cumulative fuel is reset due to a failure that causes a reset of the memory that contains the rolling count information.

Data Delay (Fuel Injected Rolling Count): 525 ms

Data Delay (Fuel Injected Rolling Count Reset Occurred): 525 ms

Accuracy Requirement: TBD

Platform Interface Definition:
Fuel Injected Rolling Count is used to determine fuel used, instantaneous fuel economy, etc. Powertrain allows the counter to roll over (start over). The platform module must keep track of rollovers. Powertrain and Platform must maintain cumulative fuel in some type of battery backed keep alive memory to retain the latest value of cumulative fuel over ignition cycles. When the data value of the Fuel Injected Rolling Count Reset Occurred signal is "True" (that indicates that the Powertrain electronics memory has been reset), the Platform module should reset its cumulative fuel memory to the data value within the Fuel Injected Rolling Count signal. If Platform detects a restoration of serial data communications with Powertrain after a loss of communications with Powertrain, Platform should reset its cumulative fuel memory to the value received in the Fuel Injected Rolling Count signal from Powertrain.
Power-Up Default: Use last known value stored in non-volatile memory

5.2.4.98 Fuel Level Percent, Fuel Level Percent Validity

Signal	Length	Data Type	Range	Conversion
Fuel Level Percent	8	UNM	0 - 100 %	E = N * 0.392157
Fuel Level Percent Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Fuel Level Percent is transmitted by Powertrain. It is the filtered fuel level in percent of advertised fuel tank capacity. There are two calibratable filter coefficients that are available to allow for quicker filtering during a fuel fill operation. The slow filter will be used during normal operation. The fast filter will be used if the engine run time is less than a calibration, the fuel volume is less than a threshold or the transmission is in park or neutral. The calibratable engine run time period allows for the gauge to ramp to the fuel level quickly on each startup if desired. Fuel Level Percent Validity shall be set to "Invalid" if the sensor providing the data has failed and a backup value cannot be determined. It shall also be set to "Invalid" until Fuel Level is determined.
Input Delay: 525 ms
Accuracy Requirement: TBD

Platform Interface Definition:
Fuel Level Percent is used to display the fuel level to the driver and for trip computer functions.

The data in Fuel Level Percent shall be ignored if Fuel Level Percent Validity is set to "Invalid".

5.2.4.99 Generator Enabled

Signal	Length	Data Type	Range	Conversion
Generator Enabled	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Generator Enabled is transmitted by Powertrain. When the Generator L-Terminal is commanded "On" via normal control or device control, Powertrain will set the data value of the signal to "True".

Data Delay: 40 ms

Platform Interface Definition:
Generator Enabled is used for electrical load management.

5.2.4.100 Generator Failed

Signal	Length	Data Type	Range	Conversion
Generator Failed	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Generator Failed is transmitted by Powertrain. When a fault is detected with either the L - Terminal or F- Terminal circuits of the generator, Powertrain will set the data value of the signal to "True" to command the Charging System / Generator Fault display. Refer to Section 4.4.3.6 of the Generator Status Algorithm for details on fault determination.

Data Delay: 1025 ms

Platform Interface Definition:
Generator Failed is used for display purposes.

5.2.4.101 Generator Field Duty Cycle, Generator Field Duty Cycle Validity

Signal	Length	Data Type	Range	Conversion
Generator Field Duty Cycle	8	UNM	0 - 100 %	E = N * 0.392157
Generator Field Duty Cycle Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Generator Field Duty Cycle is transmitted by Powertrain. The generator F-terminal is read and filtered by the Powertrain electronics. F-terminal duty cycle is used by the Powertrain electronics as an indication of generator load. Generator Field Duty Cycle Validity shall be set to "Invalid" when a generator field duty cycle input fault occurs.

Input Delay: 275 ms

Accuracy Requirement: TBD

Platform Interface Definition:
Generator Field Duty Cycle is used for electric power management.

5.2.4.102 Generator Regulator Setpoint Duty Cycle Request

Signal	Length	Data Type	Range	Conversion
Generator Regulator Set Point Duty Cycle Request	8	UNM	0 - 100 %	E = N * 0.392157

Powertrain Interface Definition:
Generator Regulator Setpoint Duty Cycle Request is received by Powertrain. While the engine is running, Powertrain controls the generator L-terminal duty cycle equal to the value in this signal.

Output Actuation Delay: 75 ms

Platform Interface Definition:
Generator Regulator Setpoint Duty Cycle Request is transmitted by Platform to control the battery voltage as a function of its temperature and state of charge.

5.2.4.103 Immobilizer Information (see specification)

Signal	Length	Data Type	Range	Conversion
Immobilizer Information (see specification)				See Immobilizer Specification

Powertrain Interface Definition:
Immobilizer Information (see specification) is transmitted and received by Powertrain. For details see the Immobilizer Specification.

Platform Interface Definition:
Immobilizer Information is received and transmitted by Platform. For details see the Immobilizer Specification.

5.2.4.104 Instantaneous Fuel Consumption Rate

Signal	Length	Data Type	Range	Conversion
Instantaneous Fuel Consumption Rate	12	UNM	0 – 102.375 liters / hr	E = N * 0.025

Powertrain Interface Definition:
Instantaneous Fuel Consumption Rate is transmitted by Powertrain. This signal indicates the instantaneous fuel consumption rate of the engine in liters per hour.

Powertrain shall compute this parameter based on the average fuel consumption rate over the last sample period (e.g., 100 ms). No other filtering shall be applied.

If the engine is not running Powertrain shall transmit this signal with a value of 0.0 liters per hour. If the instantaneous fuel consumption rate exceeds the maximum encodable value (102.375 liters per hour) Powertrain shall transmit this signal with a value of 102.375 liters per hour.

Accuracy Requirement: +/- 5%
Input Delay: 125 ms

Platform Interface Definition:
Instantaneous Fuel Consumption Rate is received by Platform. It is used for trip computer and fuel consumption rate display functions.

5.2.4.105 Manual Transmission Reverse Gear Active

Signal	Length	Data Type	Range	Conversion
Manual Transmission Reverse Gear Active	1	BLN	N/A	$1=True; $0=False
Manual Transmission Reverse Gear Active Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Manual Transmission Reverse Gear Active is used by Powertrain to limit the engine torque in reverse gear on manual transmission vehicles. This is done to protect the gearbox from possible damage.
The data in Manual Transmission Reverse Gear Active shall be ignored if Manual Transmission Reverse Gear Active Validity is set to “Invalid”.

The source of this signal shall be monitored by the Manual Transmission Reverse Gear Switch Active Virtual Device Availability signal.

Power-Up Default: “False”
Communication Failure Value: “False”
Data Failure Action: “False”

Platform Interface Definition:
Manual Transmission Reverse Gear Active is transmitted by Platform. The signal is set to "True" when Platform detects reverse gear, e.g. by reading the reverse gear switch. Manual Transmission Reverse Gear Validity shall be set to “Invalid” if the sensor providing the data has failed and a backup value cannot be determined.

Input Delay: TBD

5.2.4.106 Manual Transmission Reverse Gear Switch Virtual Device Availability

Signal	Length	Data Type	Range	Conversion
Manual Transmission Reverse Gear Switch Virtual Device Availability	1	ENM	N/A	$0=Virtual Device Unavailable $1=Virtual Device Available

Powertrain Interface Definition:
Manual Transmission Reverse Gear Switch Virtual Device Availability is received by Powertrain (ECM, PCM). If the value of this signal is “$0”, then the Manual Transmission Reverse Gear Active signal shall be defaulted to “False” and the Manual Transmission Reverse Gear Active Validity signal shall be defaulted to “Invalid” within the powertrain controller.

Power-Up Default: “$1”
Communication Failure Value: “$0”

Platform Interface Definition:
Manual Transmission Reverse Gear Switch Virtual Device Availability is transmitted by Platform. If Manual Transmission Reverse Gear Active and Manual Transmission Reverse Gear Active Validity signals are transmitted to Powertrain through a gateway, then the Manual Transmission Reverse Gear Switch Virtual Device Availability signal indicates the availability of the source of Manual Transmission Reverse Gear Active and Manual Transmission Reverse Gear Active Validity signals.

Data Delay: TBD

5.2.4.107 Outside Air Temperature Corrected Value, Outside Air Temperature Corrected Value Validity

Signal	Length	Data Type	Range	Conversion
Outside Air Temperature Corrected Value	8	UNM	-40 - 87.5 deg C	E = N * 0.5 - 40
Outside Air Temperature Corrected Value Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Outside Air Temperature Corrected Value is used for idle speed load modeling, to default induction air temperature, and for the induction air temperature sensor diagnostic.

The data in Outside Air Temperature Corrected Value shall be ignored if Outside Air Temperature Corrected Value Validity is set to “Invalid”.

The source of this signal shall be monitored by the Outside Air Temperature Virtual Device Availability signal.

Power-Up Default: “Invalid”
Communication Failure Value: “Invalid”

Platform Interface Definition:
Outside Air Temperature Corrected Value is transmitted by Platform. It represents the temperature processed from the ambient air temperature sensor and the coolant temperature. Platform requires the data from the Engine Coolant Temperature Signal prior to calculating and displaying Outside Air Temperature. Outside Air Temperature Corrected Value Validity shall be set to “Invalid” if the sensor providing the data has failed and a backup value cannot be determined.

Input Delay: TBD

Accuracy Requirement: TBD

5.2.4.108 Outside Air Temperature Powertrain Estimated, Outside Air Temperature Powertrain Estimated Validity, Outside Air Temperature Powertrain Estimated Mask

Signal	Length	Data Type	Range	Conversion
Outside Air Temperature Powertrain Estimated	8	UNM	-40 to 87.5 ˚C	E = (N*0.5) - 40
Outside Air Temperature Powertrain Estimated Validity	1	ENM	N/A	$0=Valid $1=Invalid
Outside Air Temperature Powertrain Estimated Mask	1	ENM	N/A	$0=Don’t Use Data $1=Use Data

Powertrain Interface Definition:
Outside Air Temperature Powertrain Estimated is transmitted by the ECM. This signal represents an estimated value of outside air temperature based on the values of, Engine Inlet Air Temperature, Mass Air Flow, Vehicle Speed, and other parameters known to the engine controller, which are useful in refining this estimated value. Outside Air Temperature Powertrain Estimated Validity shall be set to “Invalid” if a sensor providing data has failed and a corresponding DTC has been set. Outside Air Temperature Powertrain Estimated Mask shall be set to “Unusable Data” if the required signal accuracy value cannot be met with respect to the associated temperature data range.

Data Delay: 525 ms
Outside Air Temperature Powertrain Estimated shall be transmitted within 7 seconds after the signal Engine Running Statustransitions from “Not Running” state to either the “Running and Idling” state or “Running and Not Idling.” state.

Accuracy Requirement: The accuracy of this signal with respect to actual air temperature shall meet the following requirement

Data Range	Accuracy
-40 to +5 °C	+/-5 °C
+5 to 30 °C	+/-4 °C
30 to +86 °C	+/-5 °C

Platform Interface Definition:
Outside Air Temperature Powertrain Estimated is received by Platform. This signal information is used by the Regulated voltage Control (RVC) subsystem to determine when to activate Fuel Economy Mode operation and voltage boost determination to improve HVAC blower performance. In addition, this signal information is also available to the ABS for TCS Brake Thermal Modeling or HVAC fan "after-blow" determination.

The Data in Outside Air Temperature Powertrain Estimated shall not be used to provide a customer display of outside air temperature.

The data in Outside Air Temperature Powertrain Estimated shall be ignored if Outside Air Temperature Powertrain Estimated Validity is set to "Invalid" or if Outside Air Temperature Powertrain Estimated Mask is set to "Unusable Data". During these periods it is the receivers responsibility to provide acceptable fail safe operation of the affected subsystems.

5.2.4.109 Outside Air Temperature Virtual Device Availability

Signal	Length	Data Type	Range	Conversion
Outside Air Temperature Virtual Device Availability	1	ENM	N/A	$0=Virtual Device Unavailable $1=Virtual Device Available

Powertrain Interface Definition:
Outside Air Temperature Virtual Device Availability is received by Powertrain (ECM, PCM). If the value of this signal is "$0", then the Outside Air Temperature Corrected Value signal shall be defaulted and Outside Air Temperature Corrected Value Validity signal shall be defaulted to "Invalid" within the powertrain controller.

Power-Up Default: "$1"
Communication Failure Value: "$0"

Platform Interface Definition:
Outside Air Temperature Virtual Device Availability is transmitted by Platform. If the Outside Air Temperature Corrected Value and Outside Air Temperature Corrected Value Validity signals are transmitted to Powertrain through a gateway, then the Outside Air Temperature Virtual Device Availability signal indicates the availability of the source of the Outside Air Temperature Corrected Value and Outside Air Temperature Corrected Value Validity signals.

Data Delay: TBD

5.2.4.110 Park Brake Switch Active

Signal	Length	Data Type	Range	Conversion
Park Brake Switch Active	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Park Brake Switch Active is received by the Powertrain. It is used by some Transfer Case applications to detect a park brake turn, when the Transfer Case system will reduce the drive torque on the rear wheels. It is also used to deactivate the Powertrain automatic trailer detection (vehicle mass estimation) feature when the park brake switch is active. When the park brake is not

active and the Powertrain detects additional vehicle mass (e.g. trailer load) then the accelerator pedal gain may be modified to accommodate the additional vehicle mass. Additionally, on some applications the ECM will disengage conventional cruise control when Park Brake Switch Active is set to “True”.

Platform Interface Definition:
Park Brake Switch Active is transmitted by the Gateway. This signal indicates whether or not the park brake is applied, and shall represent the correct status on both electrical and mechanical park brake systems.

Input Delay: 125 ms

5.2.4.111 Park Brake Virtual Device Availability

Signal	Length	Data Type	Range	Conversion
Park Brake Virtual Device Availability	1	ENM	N/A	$0=Virtual Device Unavailable $1=Virtual Device Available

Powertrain Interface Definition:

Park Brake Virtual Device Availability is received by Powertrain. Powertrain uses this signal to determine proper operation of the various users of Park Brake information in the event of a failure with the original source.

Platform Interface Definition:

Park Brake Virtual Device Availability is transmitted by the Gateway. This signal represents the availability of the original source of Park Brake information.

Data Delay: 125 ms

5.2.4.112 Power Mode Master Accessory Terminal Status

Signal	Length	Data Type	Range	Conversion
Power Mode Master Accessory Terminal Status	1	ENM	N/A	$0=Inactive $1=Active

Powertrain Interface Definition:
Power Mode Master Accessory Terminal Status is used by Powertrain for diagnostic purposes only.

Platform Interface Definition:
Power Mode Master Accessory Terminal Status is transmitted by Platform. It represents the state of the Accessory input signal to the Power Mode Master. On systems without an ignition switch (e.g. Easy Key), it represents the state of the output that generates the Accessory signal to the PCM/ECM.

Input Delay: 200 ms

5.2.4.113 Power Mode Master Run Crank Terminal Status

Signal	Length	Data Type	Range	Conversion
Power Mode Master Run Crank Terminal Status	1	ENM	N/A	$0=Inactive $1=Active

Powertrain Interface Definition:
Power Mode Master Run Crank Terminal Status is used by Powertrain for diagnostic purposes only.

Platform Interface Definition:
Power Mode Master Run Crank Terminal Status is transmitted by Platform. It represents the state of the Run/Crank input signal to the Power Mode Master. On systems without an ignition switch (e.g. Easy Key), it represents the state of the output that controls the Run/Crank relay.

Input Delay: 200 ms

5.2.4.114 Powertrain Brake Pedal Discrete Input Status, Powertrain Brake Pedal Discrete Input Status Validity

Signal	Length	Data Type	Range	Conversion
Powertrain Brake Pedal Discrete Input Status	1	ENM	N/A	$0=Brake Not Applied $1=Brake Applied
Powertrain Brake Pedal Discrete Input Status Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Powertrain Brake Pedal Discrete Input Status is transmitted by the ECM. The ECM shall report the status of its discrete Brake Lamp Switch input through this signal. This signal only indicates whether the brake pedal has been applied and is not necessarily indicative of the state of the stop lamps.

Powertrain shall send the signal Powertrain Brake Pedal Discrete Input Status Validity signal with a value of "Invalid" if it has diagnosed a failure in its brake pedal discrete input and the appropriate DTC has been set.

Note: This signal was added to PPEI 2.4 in order provide a dedicated status message for the Brake Lamp Switch input to the ECM for use in subsystems that require independent information on the status of this switch and the Cruise/ETC/TCC/Brake Switch for diagnostics purposes. This is currently a GME only signal and is not supported in other applications.
Input Delay: 60 ms

Platform Interface Definition:
Powertrain Brake Pedal Discrete Input Status is received by Platform. The ABS and MTA subsystems may use this as an additional source of brake apply information.

If the Brake Sensing Module is the source of the brake lamp switch discrete to the ECM on BAS applications, the Brake Sensing Module can use this signal as part of its diagnostics to verify the discrete input is being correctly recognized by the ECM.

5.2.4.115 Powertrain Brake Pedal Secondary Discrete Input Status, Powertrain Brake Pedal Discrete Input Status Validity

Signal	Length	Data Type	Range	Conversion
Powertrain Brake Pedal Secondary Discrete Input Status	1	ENM	N/A	$0=Brake Not Applied $1=Brake Applied

Powertrain Brake Pedal Secondary Discrete Input Status Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Powertrain Brake Pedal Secondary Discrete Input Status is transmitted by the ECM. The ECM shall report the status of its discrete Cruise/ETC/TCC/Brake input through this signal. This signal only indicates whether the brake pedal has been applied and is not necessarily indicative of the state of any other function except switch status.

Powertrain shall send the signal Powertrain Brake Pedal Secondary Discrete Input Status Validity signal with a value of "Invalid" if it has diagnosed a failure in its brake pedal discrete input and the appropriate DTC has been set.

Note: This signal was added to provide a dedicated status message for the Cruise/ETC/TCC/Brake switch input to the ECM for use in subsystems that require independent information on the status of this switch and the Brake Lamp Switch for diagnostics purposes. This is currently a GME only signal and is not supported in other applications.
Input Delay: 60 ms

Platform Interface Definition:
Powertrain Brake Pedal Secondary Discrete Input Status is received by Platform. The ACCA and PTO subsystems may use this as an additional source of brake apply information.

If the Brake Sensing Module is the source of the Cruise/ETC/TCC/Brake switch discrete to the ECM on BAS applications, the Brake Sensing Module can use this signal as part of its diagnostics to verify the discrete input is being correctly recognized by the ECM.

5.2.4.116 Powertrain Crank Aborted

Signal	Length	Data Type	Range	Conversion
Powertrain Crank Aborted	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Powertrain Crank Aborted is owned by Powertrain. For definition, refer to Section 4.1.7 of the Starter Control Algorithm.

Data Delay: 1 second

Platform Interface Definition:
Powertrain Crank Aborted is monitored by Platform. This signal is used for Easy Key and remote start systems to determine which power mode the vehicle should transition to after an aborted engine start. It is also used by the remote start system to limit the number of start attempts.

5.2.4.117 Powertrain Customer Snapshot Request

Signal	Length	Data Type	Range	Conversion
Powertrain Customer Snapshot Request	1	ENM	N/A	$0=No Action $1=Take Snapshot

Powertrain Interface Definition:
Powertrain Customer Snapshot Request is used to trigger Powertrain to take a snapshot of pre-defined engine or transmission parameters and store them in battery backed memory or EEPROM equivalent memory upon receipt of this signal with a data value set to "Take Snapshot". Within the powertrain controller a P1624 (Customer Snapshot Requested - Data Available) will be stored as a DTC that also causes a failure record of the conditions at that time to be captured. Unlike all other powertrain controller DTCs, the P1624 DTC is such that failure record conditions will be updated each time "Powertrain Customer Snapshot Request" is set to "Take Snapshot" regardless of how many times this may occur during an ignition cycle. Only one frame of conditions shall be stored within the powertrain controller. This frame will represent the engine conditions present at the time Powertrain Customer Snapshot Request was last set to "Take Snapshot". For a detailed algorithm description see Powertrain Algorithm Ring = CSS (Customer Snapshot).

Output Actuation Delay: 100 ms

Platform Interface Definition:
Powertrain Customer Snapshot Request is transmitted by Platform. Platform commands Powertrain to take a snapshot of pre-defined engine or transmission parameters for service troubleshooting by the customer or service.

If there is a communication failure with the source of this information, the module on the high speed data link shall transmit the signal with a value of "No Action".

5.2.4.118 Powertrain Exhaust Particle Filter Warning Indication On

Signal	Length	Data Type	Range	Conversion
Powertrain Exhaust Particle Filter Warning Indication On	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition
Powertrain Exhaust Particle Filter Warning Indication On is transmitted by Powertrain. The data value of this signal is set to "True" when Powertrain has determined that the diesel particle filter needs to be cleaned, and the engine load is not sufficient to complete the regeneration process even with the maximum electrical load being applied.

If the Diesel Particle Filter Sensor is not present on the vehicle, the data value of the Powertrain Exhaust Particle Filter Warning Indication On shall always be set to "False".

Data Delay: 525 ms

Platform Interface Definition
Powertrain Exhaust Particle Filter Warning Indication On is received by Platform. If the value of this signal is equal to "True", then a telltale or message will be displayed to inform the driver to start a specific driving condition to start the regeneration process. When implemented as a telltale, platform shall provide a "bulb-check" of the telltale.

5.2.4.119 Powertrain High Electrical Load Requested

Signal	Length	Data Type	Range	Conversion
Powertrain High Electrical Load Requested	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition

Powertrain High Electrical Load Requested is transmitted by Powertrain. The data value of this signal is set to “True” when the ECM determines that the regeneration process of the Diesel Particle Filter should start, and there is no excessive generator load. This is accomplished by the ECM evaluating the generator F-terminal to determine whether further activation of electrical loads can occur without draining the battery. The regeneration process requires a high exhaust temperature. This specific temperature may be achieved by turning on electrical consumers, resulting in higher engine loads necessary to start the regeneration process.

If the Diesel Particle Filter Sensor is not present on the vehicle, the data value of the Powertrain High Electrical Load Requested shall always be set to “False”.

Data Delay: 525 ms

Platform Interface Definition

Powertrain High Electrical Load Requested is received by Platform. If the value of this signal is equal to “True”, then one or more electrical consumers (e.g. rear window defogging) will turned on by Platform.

5.2.4.120 Powertrain Run Aborted

Signal	Length	Data Type	Range	Conversion
Powertrain Run Aborted	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:

Powertrain Run Aborted is owned by Powertrain. The data value of this signal is set to “True” when the PCM/ECM has disabled fuel during remote engine running operation and the fuel disable is for conditions that do not allow a re-start. Refer to Section 4.7.4.1 of the RVS Monitor Algorithm.

Data Delay: 1 second

Platform Interface Definition:

Powertrain Run Aborted is monitored by Platform. This signal is used for Remote Vehicle Start (RVS) to take appropriate action, including denying any further remote start attempts until the ignition switch is cycled.

5.2.4.121 Real Time Damping System Present

Signal	Length	Data Type	Range	Conversion
Real Time Damping System Present	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Real Time Damping System Present is used to determine if the diagnostic test for the lift/dive line should be run. This signal must be sent by some other module besides CVRTD in order to indicate whether CVRTD is present or not.

Power-Up Default: Use last known value stored in non-volatile memory
Communication Failure Value: Use last known value stored in non-volatile memory

Platform Interface Definition:
Real Time Damping System Present is transmitted by Platform. If there is a communication failure with the source of this information, the module on the high speed data link shall continue to transmit the last known value and store this value in non-volatile memory at power-down.

Data Delay: TBD

5.2.4.122 Remote Vehicle Start Engine Running

Signal	Length	Data Type	Range	Conversion
Remote Vehicle Start Engine Running	1	BLN	N/A	$0=False $1=True

Powertrain Interface Definition:
Remote Vehicle Start Engine Running is transmitted by Powertrain. For vehicles with Remote Vehicle Start (RVS), it is an indication of the running status of the engine while in remote mode. Remote Vehicle Start Engine Running shall be set equal to “True” when the engine is started in remote mode. Remote Vehicle Start Engine Running shall be set equal to “False”, when the system transitions into normal mode as defined in the RVS Monitor algorithm in Section 4.7, or when the engine is determined to be not running.

Data Delay: 125 ms

Platform Interface Definition:
Remote Vehicle Start Engine Running is used by the RVS system.

5.2.4.123 Remote Vehicle Start Request

Signal	Length	Data Type	Range	Conversion
Remote Vehicle Start Request	1	ENM	N/A	$0=Remote Start Not Requested $1=Remote Start Requested

Powertrain Interface Definition:
Remote Vehicle Start Request is received by Powertrain on vehicles with Remote Vehicle Start (RVS). When the data value received is “Remote Start Requested”, this signal serves as a request to crank (see starter control algorithm in section 4.1) and criteria for keeping the engine running in remote mode (see RVS Monitor algorithm in section 4.7).

Output Actuation Delay: 150 ms.

Platform Interface Definition:
Remote Vehicle Start Request is transmitted by Platform from the RVS system. Remote Vehicle Start Request is set equal to “Remote Start Requested” when the RVS system is requesting remote start to be active. If remote start and run is not desired for any reason by the RVS system, this signal shall be sent with a data value of “Remote Start Not Requested”.

5.2.4.124 Service Engine System Non Emission Related Indication Request

Signal	Length	Data Type	Range	Conversion
Service Engine System Non Emission Related Indication Request	2	ENM	N/A	$0=No Indication $1=Continuous Indication $2=Flashing Indication

Powertrain Interface Definition:
Service Engine System Non Emission Related Indication Request is transmitted by Powertrain. This signal is sent with a data value of “Continuous Indication” or “Flashing Indication” when failures are detected by Powertrain that requires the service vehicle soon indication. Powertrain and Platform need to identify these failures and the decision whether the indication should be continuous or flashing. For example, Powertrain will send the signal with a data value of “Flashing Indication” when an Immobilizer system fault is detected.

Data Delay: 1025 ms

Platform Interface Definition:
Service Engine System Non Emission Related Indication Request is used for display purposes. This signal is also used by the SDM for crash recording. The frequency and pulse width of the flash rate shall be determined by Platform.

5.2.4.125 Service Transmission System Indication On

Signal	Length	Data Type	Range	Conversion
Service Transmission System Indication On	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Service Transmission System Indication On is transmitted by Powertrain. The data value of this signal is set to “True” if certain transmission diagnostic failures are detected as determined by Powertrain. This indication is intended to inform the vehicle operator that anomalous conditions within the transmission have been detected and that the transmission may need to be serviced.

Data Delay: 1025 ms

Platform Interface Definition:
Service Transmission System Indication On is used for display purposes. This display indication is intended to inform the vehicle operator that anomalous conditions within the transmission have been detected and that the transmission may need to be serviced.

5.2.4.126 Spare Tire Status

Signal	Length	Data Type	Range	Conversion
Spare Tire Status	2	ENM	N/A	$0=Undetermined $1=No Spare Detected $2=Spare Detected

Powertrain Interface Definition:
Spare Tire Status is used to turn off all wheel drive if a mini spare tire is present.

Power-Up Default: Use last known value stored in non-volatile memory
Communication Failure Value: “Spare Detected”

Platform Interface Definition:
Spare Tire Status is transmitted by Platform. It is an indication of whether a mini spare tire is present on the vehicle. This tire has a smaller diameter than the original equipment tire for the vehicle.

Data Delay: TBD

5.2.4.127 Starting Disabled Indication On

Signal	Length	Data Type	Range	Conversion
Starting Disabled Indication On	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Starting Disabled Indication On is transmitted by Powertrain. The data value of this signal is set to “True” when engine starting is disabled by the Powertrain electronics due to failure detected with the Electronic Throttle Control system.

Data Delay: 1025 ms

Platform Interface Definition:
Starting Disabled Indication On is used for display purposes.

5.2.4.128 Steering Wheel Angle, Steering Wheel Angle Validity

Signal	Length	Data Type	Range	Conversion
Steering Wheel Angle	16	SNM	-2048 – 2047.94 deg	E = N * 0.0625
Steering Wheel Angle Validity	1	ENM	N/A	$0 = Valid $1 = Invalid

Powertrain Interface Definition:

Steering Wheel Angle and Steering Wheel Angle Validity signals are received by Powertrain.

The Steering Wheel Angle signal is used by AWD as an input to its "Yaw rate control" function where it is used as an input to the vehicle stability calculations. AWD consider the steering wheel angular sensor as correctly operating as long as the Steering Wheel Angle Validity equals "Valid".

Platform Interface Definition:

Steering Wheel Angle and Steering Wheel Angle Validity signals are transmitted by Platform.

The function of the steering wheel angle sensor is to provide a output signal which is proportional to the steering wheel angle of a vehicle. The sensor will have the capability of monitoring the integrity of it's internal components. The value of the Steering Wheel Angle is positive counterclockwise.

The validity bit indicates failures on the signal. The bit must not be set prior to failure debouncing, i.e., it shall only be set in case the steering wheel sensor error state equals "present". The signal shall be reset at once in case of healing (error 'not present' or 'history').

Data Delay: 20 ms

Accuracy Requirement: 0.1 deg

5.2.4.129 Suspension System Dampers Failed Full Soft

Signal	Length	Data Type	Range	Conversion
Suspension System Dampers Failed Full Soft	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Suspension System Dampers Failed Full Soft is used to limit the vehicle speed to a calibratable value when this signal is received with a data value of "True".

Power-Up Default: "False"
Communication Failure Value: "True"

Platform Interface Definition:
Suspension System Dampers Failed Full Soft is transmitted by Platform.

Data Delay: TBD

5.2.4.130 System Backup Power Mode

Signal	Length	Data Type	Range	Conversion
System Backup Power Mode	2	ENM	N/A	$0=Off $1=Accessory $2=Run $3=Crank Request

Powertrain Interface Definition:
System Backup Power Mode is received by Powertrain. Refer to the starter control algorithm (section 4.1) for details of how it is used for starter control. This data shall not be used unless the System Backup Power Mode Enabled signal is equal to “True” and the Backup Power Mode Master Virtual Device Availability signal is equal to “Available”.

A transition from Run to Off or Accessory of this signal shall not be used by powertrain to shut down the engine. Powertrain shall use the Run/Crank hardwire input for this purpose.

Platform Interface Definition:
System Backup Power Mode is transmitted by the Gateway Module. Platform determines the System Backup Power Mode based on ignition (or Easy Key) switch inputs. This signal is determined by a module other than the Power Mode Master Module. If the platform does not use a Backup Power Mode Master, this signal shall always be set to "Off".

Data Delay: TBD ms

5.2.4.131 System Backup Power Mode Enabled

Signal	Length	Data Type	Range	Conversion
System Backup Power Mode Enabled	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
System Backup Power Mode Enabled is received by Powertrain. When System Backup Power Mode Enabled is "True", the starter control algorithm shall use the System Backup Power Mode signal to determine system power mode.

Platform Interface Definition:
System Backup Power Mode Enabled is transmitted by the Gateway Module. This bit shall be set to "True" if the system is using a Backup Power Mode Master to determine system power mode. If the platform does not use a Backup Power Mode Master, this signal shall always be set to "False".

Data Delay: TBD ms

5.2.4.132 System Power Mode

Signal	Length	Data Type	Range	Conversion
System Power Mode	2	ENM	N/A	$0=Off $1=Accessory $2=Run $3=Crank Request

Powertrain Interface Definition:
System Power Mode is used as an input in determining whether to initiate cranking in the Starter Control algorithm. System Power Mode may also be used to determine which serial data signals should be supported since not all serial data signals may be

valid or supported by other devices in all system power modes that the Powertrain controller is awake. The System Power Modes that Powertrain may be awake to receive signals (depending on the type of ignition switch) are:

$0 - Off (prior to Powertrain electronics shutdown)
$1 - Accessory
$2 - Run
$3 - Crank Request

Communication Failure Value: Use power moding backup strategy

Platform Interface Definition:
System Power Mode is transmitted by Platform. Platform determines the System Power Modes based on ignition switch inputs.

Data Delay: TBD

5.2.4.133 Throttle Position, Throttle Position Validity

Signal	Length	Data Type	Range	Conversion
Throttle Position	8	UNM	0 - 100 %	E = N * 100/255
Throttle Position Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Throttle Position is transmitted by Powertrain. It represents throttle position as determined by Powertrain. Throttle Position Validity shall be set to “Invalid” if the sensor providing the data has failed and a backup value cannot be determined.

Data Delay: 250 msec

Platform Interface Definition:
Throttle Position is used by the SDM for crash recording. This signal is required for NAO applications in NAO markets.

The data in Throttle Position shall be ignored if Throttle Position Validity is set to “Invalid”.

Power Up Default: 0%
Communication Failure Value: 0%

5.2.4.134 Throttle Progression Request

Signal	Length	Data Type	Range	Conversion
Throttle Progression Request	2	ENM	N/A	$0 = Map A $1 = Map B $2 = Map C

Powertrain Interface Definition:
Throttle Progression Request is received by Powertrain. This signal is used to allow the Platform to select an alternate pedal-to-throttle gain profile. Powertrain shall enable the appropriate throttle progression table, if allowed, based on the data value of this signal. The powertrain control software is capable of supporting three unique throttle progression tables. Specific values of each throttle progression table define the throttle progression mode (e.g., sport mode, or valet mode) assigned to each table for a given application. It is the responsibility of the application to calibrate each of the discrete progression tables to meet platform requirements. Progression “Map A” shall be calibrated to offer the most desirable default progression if a communications failure occurs. For vehicles sold in OBD II markets, “Map A” shall be the emission certified normal progression.

Powertrain may override all above requests and operate with an ETC limp home limited authority progression when ETC detects certain failures.

It is an OBD II requirement that the powertrain controller must power-up into the emission certified normal throttle progression, "Map A", and remain in that state until the Throttle Progression Request signal is received and transitions from "Map A" to another state. The powertrain controller shall default to the "Map A" throttle progression if the GMLAN message is not received or stops being received.

Changes between throttle progressions shall only occur when the vehicle is at idle/coast or at wide open throttle so that the progression change can be made without an increase in power.

Power-Up Default: "Map A"
Communication Failure Value: "Map A"
Input Delay: ***TBD***

Platform Interface Definition:
Throttle Progression Request is transmitted by Platform. Platform sends this signal to reflect the driver-selected request. Platform is responsible for arbitrating between multiple switch inputs to determine the desired state of the Throttle Progression Request signal.

For OBD II applications, a momentary switch or selectable display or input device may be used provided that each ignition cycle the selectable throttle progression starts with the emission certified normal throttle progression "Map A" and requires a customer input for a change to anything other than "Map A".

If there is a communication failure with the source of this information, the Platform module on the high speed data link shall transmit this signal with a value of "Map A", and set the value of the signal to the power-up default value for the next ignition cycle (also "Map A").

The Platform shall communicate the throttle progression requirements via the Vehicle Technical Specification or other appropriate document. For vehicles sold in OBD II markets "Map A" shall be the emission certified normal progression.

5.2.4.135 Throttle Progression Status

Signal	Length	Data Type	Range	Conversion
Throttle Progression Request	2	ENM	N/A	$0 = Map A $1 = Map B $2 = Map C $3 = ECM Selected Progression

Powertrain Interface Definition:
Throttle Progression Status is transmitted by Powertrain. This signal is used to inform Platform of the currently active throttle progression map, and operates in conjunction with the Platform-transmitted Throttle Progression Request signal.

This signal reflects the status of the currently active throttle progression map, regardless of the status of any Platform request for a particular throttle progression. Following a request for a throttle progression change that is delayed while waiting for an idle/coast or wide open throttle condition, this signal will continue to indicate the current progression until the progression is actually changed. State $3, "ECM Selected Progression", is used to indicate a condition where a platform requested progression has been overridden by a Powertrain internal progression (for example, a Powertrain internal progression used in an ETC Limp Home failure condition).

The following examples illustrate the operation of this signal:

Example 1 – Platform is sending Throttle Progression Request with a value of "Map A", and Powertrain is currently using the Map A throttle progression. An ETC fault occurs, causing the Powertrain to change to an internally selected "limp home" progression. Platform continues to request Map A. Once the ECM has changed to the "limp home" progression, the ECM will transmit Throttle Progression Status with a value of "ECM Selected Progression" as long as the limp home mode progression is in use.

Example 2 – Platform is sending Throttle Progression Request with a value of "Map A", and Powertrain is currently using the Map A throttle progression. An ETC fault occurs, causing the Powertrain to change to an internally selected "limp home" progression. Platform begins to request Map B. Once the ECM has changed to the “limp home” progression, the ECM will transmit Throttle Progression Status with a value of “ECM Selected Progression” as long as the limp home mode progression is in use.

Example 3 – Platform is sending Throttle Progression Request with a value of “Map A”, and Powertrain is currently using the Map A throttle progression. Platform begins to request Map B. The Powertrain will ultimately accept the Map B request, but continues to use Map A until conditions are correct for a throttle progression change (i.e., idle/coast or wide open throttle). Powertrain will transmit Throttle Progression Status with a value of “Map A” until the throttle progression has actually been switched to Map B, at which point Powertrain will begin to transmit the signal with a value of “Map B”.

Example 4 – Platform is sending Throttle Progression Request with a value of “Map A”, but Powertrain has detected an ETC fault, and has been operating using an internally selected “limp home” throttle progression map. Powertrain is thus currently transmitting Throttle Progression Status with a value of “ECM Selected Progression”. After a period of time the ETC fault is corrected, and Powertrain will ultimately switch to the Platform requested throttle progression, but continues to use the “limp home” map until conditions are correct for a throttle progression change (i.e., idle/coast or wide open throttle). Powertrain will continue to transmit Throttle Progression Status with a value of “ECM Selected Progression” until the throttle progression has actually been switched to Map A, at which point Powertrain will begin to transmit the signal with a value of “Map A”. Note – Powertrain behavior may not allow a change back to a Platform requested throttle progression during the current ignition cycle. This example is for illustrative purposes only.

Data Delay: ***TBD***

Platform Interface Definition:
Throttle Progression Status is received by Platform, and is used to determine whether Powertrain has actually carried out a requested change to the throttle progression map. Platform may use this information to coordinate changes in throttle progression, shift patterns, etc.

5.2.4.136 Traction Control Alive Rolling Count

Signal	Length	Data Type	Range	Conversion
Traction Control Alive Rolling Count	2	UNM	0 - 3	E = N * 1

Powertrain Interface Definition:
Traction Control Alive Rolling Count is received by Powertrain. The Rolling Counter shall be an incremented value in the following decimal order: 0, 1, 2, 3, 0,... Three Rolling Counter update errors in a t.b.d. number (normally ten) of consecutive frames will lead to an irreversible rejection of all further torque requests by Powertrain until the end of the respective driving cycle.

Platform Interface Definition:
Traction Control Alive Rolling Count is transmitted by Platform. The Rolling Counter shall be incremented in the following decimal order: 0, 1, 2, 3, 0,... The Rolling Counter incrementation must not be done in the transport software layer. The Rolling counter shall be increased by one each time the frame with the Traction Control signals is sent. The counter shall be increased even if no other bit in the frame is changed. The signal indicates that the traction control processing software module is alive.
Data Delay: 25 ms

5.2.4.137 Traction Control System Active

Signal	Length	Data Type	Range	Conversion
Traction Control System Active	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Traction Control System Active is received by Powertrain. Powertrain will cancel cruise control when the data value of this signal is "True" for a calibratable time.

Platform Interface Definition:
Traction Control System Active is transmitted by Platform. This signal indicates whether or not the traction control system is active(i.e. trying to control wheel slip).

Data Delay: 125 ms

5.2.4.138 Traction Control System Enabled

Signal	Length	Data Type	Range	Conversion
Traction Control System Enabled	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Traction Control System Enabled is received by Powertrain. This signal is used by the traction control algorithm in the powertrain controller. Powertrain may also disable brake torque management when the traction control system has been turned off.

Platform Interface Definition:
Traction Control System Enabled is transmitted by Platform. This signal indicates whether the traction control system is enabled. The traction control system could be disabled by the driver (via a disable switch) or by a failure detected within the traction control system.

Data Delay: 125 ms

5.2.4.139 Traction Control System Failed

Signal	Length	Data Type	Range	Conversion
Traction Control System Failed	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Traction Control System Failed is received by Powertrain.

Platform Interface Definition:
Traction Control System Failed is transmitted by Platform. The data value of this signal is set to "True" if the traction control system has failed.

Data Delay: 125 ms

5.2.4.140 Traction Control System Present

Signal	Length	Data Type	Range	Conversion
Traction Control System Present	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Traction Control System Present is received by Powertrain. This signal is used to determine if the traction control system is present so that functions and diagnostics that may not apply may be turned off.

Power-Up Default: Use last known value stored in non-volatile memory
Communication Failure Value: Use last known value stored in non-volatile memory

Platform Interface Definition:
Traction Control System Present is transmitted by Platform. Platform indicates that the traction control system is present by setting the data value of the signal to "True". If there is a communication failure with the source of this information, the module on the high speed data link shall continue to transmit the last known value and store this value in non-volatile memory at power-down.

Data Delay: 125 ms

5.2.4.141 Traction Control Torque Request

Signal	Length	Data Type	Range	Conversion
Traction Control Torque Request	16	PKT	N/A	N/A
Traction Control Torque Intervention Type	2	ENM	N/A	$0=No Intervention $1=Reduce Torque $2=Increase Torque
Torque Reduction Realization Suggestion	2	ENM	N/A	$0=No Suggestion $1=No Throttle Usage $2=Throttle Only
Traction Control Torque Request Value	12	UNM	-200 - 823.75 Nm	E = N * 0.25 - 200
Traction Control Torque Request Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:

Traction Control Torque Request is received by Powertrain. Traction Control Torque Request Value shall be ignored if Traction Control Torque Intervention Type = "No Intervention". The powertrain electronics shall limit torque increases by value and/or time to insure that no undesired vehicle acceleration occurs. A torque reduction or increase is defined with respect to the calculated engine crankshaft torque. If the value of Traction Control Torque Intervention Type = "No Suggestion", the powertrain electronics is responsible for choosing the proper means for the torque adjustment. If the value of Torque Reduction Realization Suggestion = "No Throttle Usage", the powertrain electronics shall try to use only ignition retard or fuel cut-off and shall return to the original torque as fast as possible. The data in Traction Control Torque Request shall be ignored if Traction Control Torque Request Validity is set to "Invalid".

Power-Up Defaults:
    Traction Control Torque Intervention Type: "No Intervention"
    Traction Control Torque Reduction Realization Suggestion: "No Suggestion"

Platform Interface Definition:
Traction Control Torque Request is transmitted by Platform. The signal consists of the following:

Traction Control Torque Request Value:

This signal is the requested torque at the engine output. It can be smaller than Engine Torque Actual e.g. when wheels are spinning or during gearshifts. It can be greater than Engine Actual Torque e.g. for drag torque control. Intervention type (reduction/increase) has to be commanded by Traction Control Torque Intervention Type. Traction Control Torque Request Validity shall be set to “Invalid” if the primary inputs for determining the data value have failed or are unavailable and a backup value cannot be determined.

Torque Intervention Type:

This signal indicates the type of the requested torque intervention. A torque reduction or increase is defined with respect to the calculated engine crankshaft torque.

Traction Control Reduction Realization Suggestion:

A certain type of torque realization can be requested via the Traction Control Reduction Realization Suggestion signal. If a smooth intervention is required or engine torque shall be limited for longer terms, e.g., to avoid transmission damages, “Throttle Only” can be commanded to force use of throttle adjustment. If the torque intervention shall be only for short time, after which the engine shall return to the original torque as fast as possible, “No Throttle Usage” can be commanded via the Traction Control Torque Intervention Type signal and the Powertrain electronics shall try to use only ignition retard or fuel cut-off.

Data Delay: 25 ms

5.2.4.142 Traction Control Torque Request Protection

Signal	Length	Data Type	Range	Conversion
Traction Control Torque Request Protection	16	UNM	0 - 65535	E = N * 1

Powertrain Interface Definition:

Traction Control Torque Request Protection is received by Powertrain. The signal is a protection value for Traction Control torque requests. The protection value has to be calculated in Powertrain as the 2's complement of (Traction Control Torque Request + Traction Control Alive Rolling Count) of each request, independent of an active or no active torque request.

Protection value for torque safety reasons. The protection value has to be calculated as 2's complement of (16 bit torque request + transmitted alive rolling counter value) in each message.

The 16-bit torque request consists of 2 bits intervention type (most significant bits), 2 bits realization suggestion and the 12-bit torque value (lowest significant bits). The required sum of the transmitted rolling counter value and the 16-bit torque request shall be performed via binary addition. The addition result shall be limited to 16 bits (cut), i.e. evaluation of a possible overflow is prohibited. This counts also (16-bit cut, no overflow evaluation) for 2’s complement processing.

Example: Intervention type = $2, realization suggestion = $2, torque request value = $3DF, rolling counter = $3.

Addition = 1010 0011 1101 1111 + 11 = 1010 0011 1110 0010 = $A3E2

Protection = 0101 1100 0001 1101 + 1 = 0101 1100 0001 1110 = $5C1E

Any request with a wrong protection value will be ignored by ECM. Ten wrong protection values in driving cycle will lead to an irreversible rejection of all further torque requests by ECM until the end of the respective driving cycle.
Any request with a wrong protection value will not be executed by Powertrain. A t.b.d. number (normally ten) of wrong protection values in one driving cycle will lead to an irreversible rejection of all further torque requests by Powertrain until the end of the respective driving cycle.

Platform Interface Definition:

Traction Control Torque Request Protection is transmitted by Platform. The signal is a protection value for Traction Control torque requests. The protection value has to be calculated as the 2's complement of (Traction Control Torque Request + Traction Control Alive Rolling Count) in each request, independent of an active or no active torque request.

Data Delay: 25 ms

5.2.4.143 Traction Torque Decay Control

Signal	Length	Data Type	Range	Conversion
Traction Torque Decay Control	11	PKT	N/A	N/A
Traction Torque Decay Enable	1	BLN	N/A	$0= False; $1= True
Traction Torque Decay Gradient	10	UNM	0 - 1.5% per ms	E = (N * 1.5/1023) %/ms Throttle Effective Area, Throttle Rotation or Engine Torque where 100% Torque is defined as 1024 Nm

Powertrain Interface Definition:
The Traction Torque Decay Gradient is received by Powertrain. This signal is used to control the torque decay when the driver requests less torque in order to improve vehicle traction, when a platform requests it. Powertrain has several other features that use Torque Decay Control for vehicle stability, vehicle clunk, and emissions control. Powertrain will arbitrate by choosing the slowest decay requested by any source. Powertrain may provide a worst case (slowest) decay limit or decay time limit, which can not be exceeded in order to protect against undesirable sail-on. In addition, this decay may not be allowed during certain severe ETC or other system failures.

The torque decay feature may be implemented using % engine torque, % throttle effective area, % throttle position, or % of similar control parameter depending on powertrain application. It is expected that all applications will eventually migrate to torque, so the % torque signal is designed to control absolute (i.e., Nm) torque rates rather than % Max. torque at the current RPM, which the % Throttle signals control. This Traction Torque Decay Gradient will only be applied to the "driver request" component (cruise, pedal, idle). Other functions such as Traction/Drag Control and Torque management shall not be affected. Powertrain shall implement the requested torque decay rate at the fastest update rate at which the torque parameter is normally commanded to change in order to avoid any driveability impact.

On gasoline vehicles, only control of air (not fuel or spark at this time) shall be used to control torque. Actual torque rate of change will differ from commanded due to engine manifold filling effects.

This feature is only required on ETC gasoline vehicles, where this decay will be applied over the entire throttle range from 0-100% throttle. If specifically required by the platform on non-ETC gasoline vehicles, this decay will be applied over a very limited range not to exceed the maximum Idle Control Actuator authority. If applied to diesel vehicles, this decay will be applied over the entire torque range from 0-100% torque.

Traction Torque Decay Gradient and Traction Torque Decay Enable shall be included in the standard Torque Request Frame, but shall not be included in the security checksum. These parameters shall be considered corrupted when any other parameters in the frame are considered corrupted. Powertrain shall failsoft Traction Throttle Decay Enable = False when the these parameters are not updated for longer than approx. 200 to 500 ms due to any loss of serial data, roll count error, protection error or other cause.

Platform Interface Definition:
The Traction Torque Decay Control is transmitted by Platform. This signal is used to control the engine torque decay when the driver requests less torque in order to improve vehicle traction when a high lateral acceleration occurs by avoiding any abrupt torque changes and/or mass distribution changes that might cause the tires to break loose. Any requirement to change this parameter due to transmission gear (i.e. axle torque) will be the responsibility of the platform. Any other features that use this interface must be approved before implementation.

Traction Torque Decay Enabled:
Indicates to Powertrain that the transmitted Traction Torque Decay rate must be used when set to “True”. If this message indicates “False”, no limit will be imposed regardless of the value of “Traction Torque Decay Gradient”.

Traction Torque Decay Gradient:
Maximum percent of torque reduction rate per milliseconds.

Data Delay: 25 ms

5.2.4.144 Traction Torque Decay Control Active

Signal	Length	Data Type	Range	Conversion
Traction Torque Decay Control Active	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Traction Torque Decay Control Active is received by Powertrain. Powertrain will not perform Torque Decay Control (or will abort decay control if it is currently active) unless both this signal and the signal Traction Torque Decay Control: Traction Torque Decay Enabled have a data value of “True”. By using this message in addition to “Traction Torque Decay Control: Traction Torque Decay Enable”, a dual-path methodology is established to ensure Torque Decay Control is not performed when the system is inactive.

Platform Interface Definition:
Traction Torque Decay Control Active is transmitted by Platform. This signal indicates whether or not the Torque Decay Control System is active (i.e. desiring to limit throttle closure). As stated above, both this message and “Traction Torque Decay Control: Traction Torque Decay Enable” must be “TRUE” for Torque Decay Control to be enabled.

The “Traction Torque Decay Control Active” signal shall be in a separate frame from the “Traction Torque Decay Control” signal.

Data Delay: 25 ms

5.2.4.145 Transfer Case Non Emissions Related Malfunction Active

Signal	Length	Data Type	Range	Conversion
Transfer Case Non Emissions Related Malfunction Active	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:

Transfer Case Non Emissions Related Malfunction Active is transmitted the Transfer Case Control Module (TCCM) when the TCCM is present. If the TCCM is not present, and the application has the VersaTrak system, this signal will be transmitted by the TCM. If the TCCM is not present and the application has a manual transfer case, this signal will be transmitted by the ECM. On all other systems this signal will not be transmitted.

Powertrain shall determine the state of Transfer Case Non Emissions Related Malfunction Active based on the status of the TCCM diagnostic monitors for diagnostics that are **not** emission related. If no such TCCM Diagnostic Trouble Codes (DTCs) are active, then Transfer Case Non Emissions Related Malfunction Active will be set to “False”. If one or more of the non-emissions related DTCs in the TCCM are active, the TCCM shall set the value of Transfer Case Non Emissions Related Malfunction Active to “True”.

Applications that do not have a TCCM shall always transmit this signal with a data value of “False”

Data Delay: 1025 ms

Platform Interface Definition:

Transfer Case Non Emissions Related Malfunction Active is received by Platform and is used for display purposes. (Note that when this signal is set to True, the MIL will **not** become illuminated as a result of this signal).

This display indication is intended to inform the vehicle operator that non-emissions related anomalous conditions within the transfer case have been detected and that the transfer case may need to be serviced. The existence of a telltale is a Platform decision. Platform may also choose to combine this signal with Transfer Case Emissions Related Malfunction Active to provide a combined indication of any transfer case malfunction – emissions related or not.

5.2.4.146 Transmission Actual Gear, Transmission Actual Gear Validity

Signal	Length	Data Type	Range	Conversion
Transmission Actual Gear	4	ENM	N/A	$0=Shift in Process $1=First Gear $2=Second Gear $3=Third Gear $4=Fourth Gear $5=Fifth Gear $6=Sixth Gear $7=Seventh Gear $8=Reverse $9=Neutral $10=Park
Transmission Actual Gear Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:

Transmission Actual Gear is transmitted by the Powertrain for automatic transmission vehicles by the PCM or the TCM. It is the engaged gear that Powertrain determines from the best available inputs such as engine speed/vehicle speed ratio, turbine speed/output speed ratio, commanded gear, Drive/Reverse pressure discretes, PSM Transmission Gear Selector Position, PRNDL Transmission Gear Selector position, P/N switch discrete, clutch discrete, etc. - depending upon application.

The forward gear states are determined based on comparing the gear ratio across the input and output speed sensors to a calibrated range of ratios corresponding to each available forward gear. The Reverse and Neutral states are assigned just as the Transmission Gear Selector Position signal also referenced in this document.

Note: Forward drive gear states are not updated to the currently engaged gear until Powertrain has determined that a gear shift is complete and stabilized. However, transmission “engaged” state indications (Park, Reverse and Neutral) are updated based upon detection of the Transmission Gear Selector Position.

Transmission Actual Gear Validity shall be set to “Invalid” if the sensor providing the data has failed and a backup value cannot be accurately determined.

Data Delay: TBD

Platform Interface Definition:

Transmission Actual Gear is used for miscellaneous body functions and Traction Control. ETS uses it for exit criteria, gear shifting functions and wheel torque calculations. TCS uses it to select the appropriate TCS ramp rate.

The data in Transmission Actual Gear shall be ignored if Transmission Actual Gear Validity is set to “Invalid”.

5.2.4.147 Transmission Change Oil Now Indication On

Signal	Length	Data Type	Range	Conversion
Transmission Change Oil Now Indication On	1	BLN	N/A	$1=True; $1=False

Powertrain Interface Definition:
Transmission Change Oil Now Indication On is transmitted by Powertrain. The state of Change Transmission Oil Now is based on the transmission oil life determination algorithm that resides in the Powertrain electronics. The algorithm is based on the principle that transmission operation will decrease oil life especially at non-optimal oil temperatures. Once the oil life is reduced to a specific calibratable level, Powertrain will set the data value of this signal to “True” to command the Change Transmission Oil display.

Data Delay: 1025 ms

Platform Interface Definition:
Transmission Change Oil Now Indication On is used for display purposes.

5.2.4.148 Transmission Electronic Range Select Mode Request

Signal	Length	Data Type	Range	Conversion
Transmission Electronic Range Select Mode Request	1	ENM	N/A	$0=Disable Electronic Range Selection $1=Enable Electronic Range Selection

Powertrain Interface Definition:
Transmission Electronic Range Select Mode Request is used to enable or disable the Electronic Range Selection function based on the state of this signal as received from the Platform. This request is used to enter electronic range shift selection. Upon entering this mode, Powertrain shall monitor the Tap Up/Tap Down indications and electronically shift the range of the automatic transmission based upon which switch was depressed. For example, a tap down will result in the transmission downshifting from D3 to D2.
Output Actuation Delay: TBD
Power-Up Default: “Disable Electronic Range Select”
Communication Failure Value: “Disable Electronic Range Select”

Platform Interface Definition:
Transmission Electronic Range Select Mode Request is transmitted by Platform. Platform sets the data value of this signal based on the driver-selected Tap Up/Tap Down On/Off switch status.

If there is a communication failure with the source of this information, the module on the high speed data link shall continue to transmit the last known value and set the value of the signal to “Disable Electronic Range Select” for the next ignition cycle.

5.2.4.149 Transmission Gear Indication, Transmission Gear Indication Validity

Signal	Length	Data Type	Range	Conversion
Transmission Gear Indication	6	ENM	N/A	$00=Shift In Progress $01=First Gear $02=Second Gear

				$03=Third Gear $04=Fourth Gear $05=Fifth Gear $06=Sixth Gear $07=Seventh Gear $08=Reverse $09=Neutral $0A=Park $0B=Drive $0C=Overdrive $0D=Intermediate $0E=Low $0F=Manual $10=Simulated Automatic . $3F=Failure
Transmission Gear Indication Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:

Transmission Gear Indication is transmitted by Powertrain. For GMNA automatic transmissions, it is the current state of the shift solenoids. When Powertrain determines that a new gear is desired, the shift solenoid state will be updated to reflect the new intended gear and the shift process will begin.

For GMNA automatic transmissions with Tap Up/Tap Down Mode active, it is the target gear that has been selected via the tap up/tap down switches. For some driving conditions, the transmission will not immediately shift into the target gear or the target gear may not be allowed. (For example, a 1 to 4 shift is not allowed.) The target gear value reported will always reflect the allowed gear. Only First Gear through Sixth Gear are supported. For some driving conditions, the target gear reported may be the gear that the customer selected initially, but then would get updated if Powertrain determines that the target gear is no longer allowed because of new conditions encountered during the shift. In general, when the target gear is achieved, the target gear value that is reported shall remain the same until another tap up/tap down selection is received. However, if Powertrain determines that a shift is necessary to protect the transmission (i.e., upshift near fuel cutoff), the target gear will be updated to reflect this new shift and will no longer equal the original customer selection.

For GME automatic and automatic/manual transmissions in normal mode (P, R, N, D, L), the signal equals the position of the gear selector. In manual mode, the hydraulically active gear (1, 2, 3, 4, 5) is displayed. A tap up/ tap down forces the TCM to check if the requested gear change is allowed. A positive result will change the Transmission Gear Indication to the requested gear immediately. Fast double taps will be displayed sequentially. The states $00 (shift in progress) and $0F (Manual) shall never be used.

For CVT (Continuous Variable Transmission) systems in normal mode (P, R, N, D, I, L), the signal equals the position of the gear selector. In automatic emulation mode the state equals $10, Simulated Automatic. In this mode the CVT simulates an automatic transmission shifting. In manual mode, the active simulated gear (1, 2, 3, 4, 5, 6) is displayed. A tap up/tap down request causes the TCM to check if the requested gear change is allowed. A positive result will change the Transmission Gear Indication to the requested gear immediately. Fast double taps will be displayed sequentially.

The state $3F (Failure) indicates a internal failure which causes the system to store a DTC (required only Manual Transmission Automatically shifted (MTA) transmissions).

Transmission Gear Indication Validity shall be set to “Invalid” if the sensor providing the data has failed and a backup value cannot be determined. For GMNA transmissions with and without TUTD, the reported state for Transmission Gear Indication reflects the actual commanded state of the shift solenoids therefore, Transmission Gear Indication Validity will always be set “Valid”.
Data Delay: TBD

Platform Interface Definition:

Transmission Gear Indication is monitored by Platform. For GME applications it is always used for displaying gear information to the driver. For GMNA applications it is used for displaying gear position when in Tap Up/Tap Down mode or when in Performance Algorithm Shift mode. This information enables the customer to view the gear that has been selected via the tap up/tap down switches prior to the shift being completed. For example, a customer will be able to view that a tap up to third gear (a third gear start) has been selected when vehicle speed is zero.

State $3F is used for MTA to display a internal failure to the driver.

The data in Transmission Gear Indication shall be ignored if Transmission Gear Indication Validity is set to “Invalid”.

5.2.4.150 Transmission Gear Ratio, Transmission Gear Ratio Validity

Signal	Length	Data Type	Range	Conversion
Transmission Gear Ratio	8	UNM	0 - 7.96875	E = N * 1/32
Transmission Gear Ratio Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Transmission Gear Ratio is transmitted by Powertrain. This signal is generated if the vehicle is equipped with a CVT transmission. It is the calculated relation between CVT input speed and output speed (input speed/output speed). Transmission Gear Ratio Validity shall remain valid as long as actual gear information is available internally to the TCM.

Data Delay: 125ms

Platform Interface Definition:
Transmission Gear Ratio is received by Platform. It is used for ABS/TC to calculate the wheel torque.

5.2.4.151 Transmission Gear Selector Position, Transmission Gear Selector Position Validity

Signal	Length	Data Type	Range	Conversion
Transmission Gear Selector Position	6	ENM	N/A	$00=Shift In Progress $01=First Gear $02=Second Gear $03=Third Gear $04=Fourth Gear $05=Fifth Gear $06=Sixth Gear $07=Seventh Gear $08=Reverse $09=Neutral $0A=Park $0B=Drive $0C=Overdrive $0D=Intermediate $0E=Low $0F=Manual
Transmission Gear Selector Position Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Transmission Gear Selector Position is transmitted by Powertrain. It represents the driver-selected gear position. Powertrain commands the state of PRNDL based on the unfiltered value of the four Mode Indication switch inputs to the Powertrain electronics (PRNDL A, PRNDL B, PRNDL C, and PRNDL P) on electronically-controlled automatic transmissions. The Mode Indication switch inputs are read and processed every 12.5 ms. If the Mode Indication switch is failed, the transmission pressure switch (PSM) is used if available to determine PRNDL when in D1, D2, D3, D4, or R when the engine is running. The PSM is read and processed every 25 ms. The PSM information is invalid when the engine is not running or in Park or Neutral. Therefore, the validity bit shall be set to "Invalid" when a valid PRNDL state cannot be determined due to a failure that does not allow a valid state to be determined or if the PRNDL position is actually between valid positions. Transmission Gear Selector Position Validity shall be set to "Invalid" if the sensor providing the data has failed and a backup value cannot be determined.
Input Delay: TBD

Platform Interface Definition:

Transmission Gear Selector Position is typically used for display purposes however it may be monitored by other Platform devices for miscellaneous body functions. The Brake Apply Sensing System uses it in its algorithm for determining brake lamp operation in the event of a brake apply sensor failure.

The data in Transmission Gear Selector Position shall be ignored if Transmission Gear Selector Position Validity is set to "Invalid".

5.2.4.152 Transmission Gear Shift Direction

Signal	Length	Data Type	Range	Conversion
Transmission Gear Shift Direction	2	ENM	N/A	$0=No Shift in Progress $1=Upshift in Progress $2=Downshift in Progress

Powertrain Interface Definition:
Transmission Gear Shift Direction is transmitted by Powertrain. The shift in progress states are used to communicate that a shift is occurring for automatic transmissions. The signal is set to the appropriate state when the respective shift solenoid state changes. The signal remains set throughout the shift delay, the ratio change and the end timing of the shift. The "No Shift in Progress" signal state is assigned when no shifts are occurring (i.e. the transmission is in the steady state operating mode).

Data Delay: TBD

Platform Interface Definition:
Transmission Gear Shift Direction is used by Traction Control and ESP.

5.2.4.153 Transmission Hot Indication On

Signal	Length	Data Type	Range	Conversion
Transmission Hot Indication On	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Transmission Hot Indication On is transmitted by Powertrain. When the transmission overtemp diagnostic trouble code is set, the Powertrain electronics will set the data value of this signal to "True".

Data Delay: 1025 ms

Platform Interface Definition:
Transmission Hot Indication On is used for display purposes.

5.2.4.154 Transmission Limp Home Mode Active

Signal	Length	Data Type	Range	Conversion
Transmission Limp Home Mode Active	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Transmission Limp Home Mode Active is transmitted by Powertrain. The data value of this signal will be set to "True" if a severe failure is detected in the Transmission system. The Transmission performance will be limited.

Data Delay: TBD

Platform Interface Definition:
Transmission Limp Home Mode Active is used for display purposes.

5.2.4.155 Transmission Load Management Shift Pattern Request, Transmission Load Management Shift Pattern Status

Signal	Length	Data Type	Range	Conversion
Transmission Load Management Shift Pattern Request	1	ENM	N/A	$0=Deactivate Load Mgt Shift Pattern $1=Activate Load Mgt Shift Pattern
Transmission Load Management Shift Pattern Status	1	ENM	N/A	$0=Load Mgt Shift Pattern Inactive $1=Load Mgt Shift Pattern Active

Powertrain Interface Definition:
Transmission Load Management Shift Pattern Request is received by Powertrain. This request is used to schedule the automatic transmission load management shift pattern. Powertrain shall provide for at least one shift pattern to be selected by Platform. For some transmissions, the transmission control software is capable of supporting two or more unique shift patterns other than normal. Typically, one of the additional shift patterns is used for cruise control but since the Powertrain electronics monitors cruise engaged, a request signal is not required to select the cruise shift pattern. This results in at least one allowable unique shift pattern that the Platform may request.

Powertrain shall enable the load management shift pattern if allowed and the data value of this signal is set to “Activate Load Mgt Shift Pattern”. Powertrain shall send the Transmission Load Management Shift Pattern Status signal with a data value set to “Load Mgt Shift Pattern Active” when it enables the load management shift pattern.

Output Actuation Delay (Transmission Load Management Shift Pattern Request): 50 ms

Data Delay (Transmission Load Management Shift Pattern Status): 12.5 ms

Platform Interface Definition:
Transmission Load Management Shift Pattern Request is transmitted by Platform. Platform sends this signal based on a load management algorithm. If the load management shift pattern is desired, Platform shall send this signal with a value of “Activate Load Mgt Shift Pattern”. While this signal is set to this value, the value of the signal shall be set to “Deactivate Load Mgt Shift Pattern” when one of the following occurs:

- The load management algorithm determines that the load management shift pattern is no longer needed.
- The state of the Transmission Load Management Shift Pattern Status signal does not reflect the Transmission Load Management Shift Pattern Request signal state after a calibratable time. (Platform will have to request the shift pattern again.)

If there is a communication failure with the source of this information, the module on the high speed data link shall continue to transmit the last known value and set the value of the signal to the power-up default value for the next ignition cycle.

5.2.4.156 Transmission Oil Life Reset Request, Transmission Oil Remaining Life

Signal	Length	Data Type	Range	Conversion
Transmission Oil Life Reset Request	1	BLN	N/A	$1=True; $0=False
Transmission Oil Remaining Life	8	UNM	0 - 100 %	E = N * 0.392157

Powertrain Interface Definition:
Transmission Oil Remaining Life is transmitted by Powertrain. Powertrain determines Transmission Fluid Remaining Life based on the transmission oil life determination algorithm which resides in the Powertrain electronics. The algorithm is based on the principle that transmission operation will decrease oil life especially at non-optimal oil temperatures. The Fluid Remaining Life may be reset by a platform-optional reset switch. For the platform-optional reset switch, the platform will indicate a reset through the Transmission Oil Life Reset Request signal with a data value set to “True”.

Accuracy Requirement (Transmission Oil Remaining Life): TBD

Data Delay (Transmission Oil Remaining Life): 1025 ms

Platform Interface Definition:
Transmission Oil Remaining Life is used for display purposes. The Platform may set the data value of the Transmission Oil Life Reset Request signal to “True” to command the Powertrain electronics to reset the Fluid Remaining Life.

If there is a communication failure with the source of this information, the module on the high speed data link shall transmit the Transmission Oil Life Reset Request with a value of “False”.

5.2.4.157 Transmission Oil Temperature, Transmission Oil Temperature Validity

Signal	Length	Data Type	Range	Conversion
Transmission Oil Temperature	8	UNM	-40 - 215 deg C	E = N * 1 - 40
Transmission Oil Temperature Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Transmission Oil Temperature is transmitted by Powertrain. It represents the temperature of the transmission fluid. This only applies to automatic transmissions. Transmission Oil Temperature Validity shall be set to “Invalid” if the sensor providing the data has failed and a backup value cannot be determined.

Input Delay: 1025 ms
Accuracy Requirement: TBD

Platform Interface Definition:
Transmission Oil Temperature is used for display purposes.

The data in Transmission Oil Temperature shall be ignored if Transmission Oil Temperature Validity is set to "Invalid".

5.2.4.158 Transmission Performance Algorithm Shift Mode Active

Signal	Length	Data Type	Range	Conversion
Transmission Performance Algorithm Shift Mode Active	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:

Transmission Performance Algorithm Shift Mode Active is transmitted by Powertrain. The data value of this signal is set to "True" when the high performance shift algorithm is activated.

Data Delay: 125 ms

Platform Interface Definition:

Transmission Performance Algorithm Shift Mode Active is used for display purposes and may be used for other control functions. The performance shift mode is utilized when the vehicle is in a high lateral acceleration maneuver. During this maneuver, the transmission will downshift to give the driver more performance through the curve. When the transmission downshifts, the signal will be read by the cluster and the PRNDL display will be changed to reflect the downshift. This mode is not selectable by the driver.

5.2.4.159 Transmission Shift Lever Lock Requested

Signal	Length	Data Type	Range	Conversion
Transmission Shift Lever Lock Requested	1	BLN	N/A	$0 = False $1 = True

Powertrain Interface Definition:

Transmission Shift Lever Lock Requested is transmitted by Powertrain. Powertrain shall set this signal to "True" if the transmission is currently not working (e.g. low temperature for CVT transmission <-25°C).

Data Delay: 100 ms

Power-Up Default: True

Communication Failure Value: False

Platform Interface Definition:

Transmission Shift Lever Lock Requested is received by Platform. Platform shall lock the transmission gear shift lever in P or N position if the signal is set to "True".

5.2.4.160 Transmission Skip Shift Indication On

Signal	Length	Data Type	Range	Conversion
Transmission Skip Shift Indication On	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:

Transmission Skip Shift Indication is transmitted by Powertrain. On manual transmission applications, there are certain operating conditions in which upshifting to the next transmission gear is inhibited. The Powertrain electronics will indicate this via this signal. The driver is required to upshift to the next available transmission gear. As an example, if presently in first gear and skip shift is indicated, the driver will be allowed to shift into any other gear except for second gear. When the Powertrain electronics determines that conditions for transmission skip shift are present, the Powertrain electronics will set the data value of this signal appropriately to command the Transmission Skip Shift display

Data Delay: 1025 ms

Platform Interface Definition:

Transmission Skip Shift Indication is used for display purposes.

5.2.4.161 Transmission Sport Shift Pattern Request, Transmission Sport Shift Pattern Status

Signal	Length	Data Type	Range	Conversion
Transmission Sport Shift Pattern Request	1	ENM	N/A	$0=Deactivate Sport Shift Pattern $1=Activate Sport Shift Pattern
Transmission Sport Shift Pattern Status	1	ENM	N/A	$0=Sport Shift Pattern Inactive $1=Sport Shift Pattern Active

Powertrain Interface Definition:

Transmission Sport Shift Pattern Request is received by Powertrain. This request is used to schedule the automatic transmission sport shift pattern. Powertrain shall provide for at least one shift pattern to be selected by Platform. For some transmissions, the transmission control software is capable of supporting two or more unique shift patterns other than normal. Typically, one of the additional shift patterns is used for cruise control but since the Powertrain electronics monitors cruise engaged, a request signal is not required to select the cruise shift pattern. This results in at least one allowable unique shift pattern that the Platform may request Powertrain shall enable the sport shift pattern if allowed and the data value of this signal is set to “Activate Sport Shift Pattern”. Powertrain shall send the Transmission Sport Shift Pattern Status signal with a data value set to “Sport Shift Pattern Active” when it enables the sport shift pattern.

Output Actuation Delay (Transmission Sport Shift Pattern Request): 50 ms

Data Delay (Transmission Sport Shift Pattern Status): 12.5 ms

Platform Interface Definition:

Transmission Sport Shift Pattern Request is transmitted by Platform. Platform sends this signal to reflect the driver-selected request. For a latched switch this signal represents the status of the sport mode switch. For a momentary switch or a selectable display, this signal shall be determined as follows:

The signal shall be set to “Activate Sport Shift Pattern” when the sport mode switch transitions from “Inactive” to “Active”. While this signal is set to “Activate Sport Shift Pattern”, it shall be set to “Deactivate Sport Shift Pattern” when one of the following occurs:

- The sport mode switch input to Platform transitions from “Inactive” to “Active”.
- The state of the Transmission Sport Shift Pattern Status signal does not reflect the Transmission Sport Shift Pattern Request signal state after a calibratable time. (The customer will have to request the sport shift pattern again.)

If there is a communication failure with the source of this information, the module on the high speed data link shall continue to transmit the last known value and set the value of the signal to the power-up default value for the next ignition cycle.

5.2.4.162 Transmission Tap Up/Tap Down Mode Indication On

Signal	Length	Data Type	Range	Conversion
Transmission Tap Up/Tap Down Mode Indication On	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Transmission Tap Up/Tap Down Mode Indication On is transmitted by Powertrain. The data value of this signal is set to "True" when the Tap Up/ Tap Down Mode is active. Tap Up/Tap Down mode active is defined as when the following are all true :

- The value of the Transmission Tap Up/Tap Down Mode Request signal received from Platform is set to "Enable"
- Other criteria for Powertrain to activate Tap Up/Tap Down Mode is met (e.g. no active TUTD diagnostic faults, etc.)

Data Delay: 125 ms

Platform Interface Definition:
Displays - Tap Up/Tap Down Mode is used for display purposes. Typically when the data value of this signal is set to "True", Platform will display actual vehicle gear to the driver in place of or in addition to the gear selector position (PRNDL) display.

5.2.4.163 Transmission Tap Up/Tap Down Mode Request

Signal	Length	Data Type	Range	Conversion
Transmission Tap Up/Tap Down Mode Request	1	ENM	N/A	$0=Disable Tap Up/Tap Down $1=Enable Tap Up/Tap Down

Powertrain Interface Definition:
Transmission Tap Up/Tap Down Mode Request is used to enable or disable the Tap Up/Tap Down function based on the state of this signal as received from the Platform.
Output Actuation Delay: TBD
Power-Up Default: "Disable Tap Up/Tap Down"
Communication Failure Value: "Disable Tap Up/Tap Down"

Platform Interface Definition:
Transmission Tap Up/Tap Down Mode Request is transmitted by Platform. Platform sets the data value of this signal based on the driver-selected Tap Up/Tap Down On/Off switch status.

If there is a communication failure with the source of this information, the module on the high speed data link shall continue to transmit the last known value and set the value of the signal to "Disable Tap Up/Tap Down" for the next ignition cycle.

5.2.4.164 Transmission Tap Up/Tap Down Request, Transmission Tap Up/Tap Down Request Validity

Signal	Length	Data Type	Range	Conversion
Transmission Tap Up/Tap Down Request	2	ENM	N/A	$0 = No Shift $1 = Down Shift $2 = Up Shift
Transmission Tap up/ Tap Down Request Validity	1	ENM	N/A	$0 = Valid $1 = Invalid

Powertrain Interface Definition:
Transmission Tap Up/Tap Down Request is received by Powertrain. If the transmission Tap Up/Tap Down mode is enabled, the Transmission shall use this signal to determine the drivers wish for a gear change.

When the data value of Transmission Tap Up/Tap Down Request Validity equals "Invalid", the Transmission shall go to normal "Drive" mode and ignore any Tap Up/Tap Down.

Since GM Powertrain automatic transmissions require a hardwired analog TUTD signal, this GMLAN signal will not be used on North American vehicles.

Platform interface Definition:

Transmission Tap Up/Tap Down Request is transmitted by Platform. The signal reflects the state of the Tap Up/Tap Down switch. This signal shall be sent whenever the Tap Up/Tap Down switch has changed state. It shall also be sent in a periodic frame with a maximum period of 100 ms.

Transmission Tap Up/Tap Down Request Validity shall be set to "Invalid" if the sensor providing the data has failed and a backup value cannot be determined.

Input Delay: The maximum allowed delay, calculated from switch actuation until the Powertrain receives the information, including switch debounce, is 40 ms. Refer to Section 2.15.2.

5.2.4.165 Transmission Trailering Shift Pattern Request, Transmission Trailering Shift Pattern Status

Signal	Length	Data Type	Range	Conversion
Transmission Trailering Shift Pattern Request	1	ENM	N/A	$0=Deactivate Trailering Shift Pattern $1=Activate Trailering Shift Pattern
Transmission Trailering Shift Pattern Status	1	ENM	N/A	$0=Trailering Shift Pattern Inactive $1=Trailering Shift Pattern Active

Powertrain Interface Definition:

Transmission Trailering Shift Pattern Request is received by Powertrain. This request is used to schedule the automatic transmission trailering shift pattern. Powertrain shall provide for at least one shift pattern to be selected by Platform. For some transmissions, the transmission control software is capable of supporting two or more unique shift patterns other than normal. Typically, one of the additional shift patterns is used for cruise control but since the Powertrain electronics monitors cruise engaged, a request signal is not required to select the cruise shift pattern. This results in at least one allowable unique shift pattern that the Platform may request

Powertrain shall enable the trailering shift pattern if allowed and the data value of this signal is set to “Activate Trailering Shift Pattern”. Powertrain shall send the Transmission Trailering Shift Pattern Status signal with a data value set to “Trailering Shift Pattern Active” when it enables the trailering shift pattern.

Output Actuation Delay (Transmission Trailering Shift Pattern Request): 50 ms

Data Delay (Transmission Trailering Shift Pattern Status): 12.5 ms

Platform Interface Definition:

Transmission Trailering Shift Pattern Request is transmitted by Platform. Platform sends this signal to reflect the driver-selected request. For a latched switch this signal represents the status of the trailering mode switch. For a momentary switch or a selectable display, this signal shall be determined as follows:

The signal shall be set to “Activate Trailering Shift Pattern” when the trailering mode switch transitions from “Inactive” to “Active”. While this signal is set to “Activate Trailering Shift Pattern”, it shall be set to “Deactivate Trailering Shift Pattern” when one of the following occurs:

- The trailering mode switch input to Platform transitions from “Inactive” to “Active”.
- The state of the Transmission Trailering Shift Pattern Status signal does not reflect the Transmission Trailering Shift Pattern Request signal state after a calibratable time. (The customer will have to request the trailering shift pattern again.)

If there is a communication failure with the source of this information, the module on the high speed data link shall continue to transmit the last known value and set the value of the signal to the power-up default value for the next ignition cycle.

5.2.4.166 Transmission Winter Mode Request, Transmission Winter Mode Status

Signal	Length	Data Type	Range	Conversion
Transmission Winter Mode Request	1	ENM	N/A	$0=Deactivate Winter Mode $1=Activate Winter Mode
Transmission Winter Mode Status	1	ENM	N/A	$0=Winter Mode Inactive $1=Winter Mode Active

Powertrain Interface Definition:

Transmission Winter Mode Request is received by Powertrain. This request is used to enter the automatic transmission winter mode if allowed. The winter mode typically consists of enabling the high gear start function and scheduling the winter mode shift pattern if supported. The high gear start function typically consists of enabling 2nd or 3rd gear starts. Powertrain shall provide for at least one shift pattern to be selected by Platform. For some transmissions, the transmission control software is capable of supporting two or more unique shift patterns other than normal. Typically, one of the additional shift patterns is used for cruise control but since the Powertrain electronics monitors cruise engaged, a request signal is not required to select the cruise shift pattern. This results in at least one allowable unique shift pattern that the Platform may request.

Powertrain shall enable the Winter Mode if allowed and the data value of this signal is set to “Activate Winter Mode”. Powertrain shall send the Transmission Winter Mode Status signal with a data value set to “Winter Mode Active” when it enables the winter mode.

Output Actuation Delay (Transmission Winter Mode Request): 50 ms

Data Delay (Transmission Winter Mode Status): 12.5 ms

Platform Interface Definition:

Transmission Winter Mode Request is transmitted by Platform. Platform sends this signal to reflect the driver-selected request. For a latched switch this signal represents the status of the winter mode switch. For a momentary switch or a selectable display, this signal shall be determined as follows:

The signal shall be set to “Activate Winter Mode” when the winter mode switch transitions from “Inactive” to “Active”. While this signal is set to “Activate Winter Mode”, it shall be set to “Deactivate Winter Mode” when one of the following occurs:

- The winter mode switch input to Platform transitions from “Inactive” to “Active”.
- The state of the Transmission Winter Mode Status signal does not reflect the Transmission Winter Mode Request signal state after a calibratable time. (The customer will have to request the winter mode again.)

If there is a communication failure with the source of this information, the module on the high speed data link shall continue to transmit the last known value and set the value of the signal to the power-up default value for the next ignition cycle.

5.2.4.167 Vehicle Dynamics Alive Rolling Count

Signal	Length	Data Type	Range	Conversion
Vehicle Dynamics Alive Rolling Count	2	UNM	0 - 3	E = N * 1

Powertrain Interface Definition:

Vehicle Dynamics Alive Rolling Count is received by Powertrain. The Rolling Counter shall be an incremented value in the following decimal order: 0, 1, 2, 3, 0,... Three Rolling Counter update errors in a TBD number (normally ten) of consecutive frames will lead to an irreversible rejection of all further torque requests by Powertrain until the end of the respective driving cycle.

Platform Interface Definition:

Vehicle Dynamics Alive Rolling Count is transmitted by Platform. The signal is related to the Vehicle Dynamics Transferred Torque Request signal.

The Rolling Counter shall be incremented in the following decimal order: 0, 1, 2, 3, 0,... The Rolling Counter incrementation must not be done in the transport software layer. The Rolling Counter shall be increased by one each time the frame with the Vehicle Dynamics signals is sent. The counter shall be increased even if no other bit in the frame is changed. The signal indicates that the traction control processing software module is alive.

Data Delay: 30 ms

5.2.4.168 Vehicle Dynamics Control Active

Signal	Length	Data Type	Range	Conversion
Vehicle Dynamics Control Active	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Vehicle Dynamics Control Active is used to disable cruise control if the data value of this signal is set to “True”.

Platform Interface Definition:
Vehicle Dynamics Control Active is transmitted by Platform. Platform reports to Powertrain whether Yaw control is active or not via this signal.

Data Delay: TBD

5.2.4.169 Vehicle Dynamics Control Enabled

Signal	Length	Data Type	Range	Conversion
Vehicle Dynamics Control Enabled	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Vehicle Dynamics Control Enabled is received by Powertrain. This signal is used by the AWD algorithm in the powertrain controller.

Platform Interface Definition:

Vehicle Dynamics Control Enabled is transmitted by Platform. This signal indicates whether the vehicle dynamics system is enabled. The vehicle dynamics system could be disabled by the driver (via a disable switch) or by a failure detected within the system.

Data Delay: 125 ms

5.2.4.170 Vehicle Dynamics Control Failed

Signal	Length	Data Type	Range	Conversion
Vehicle Dynamics Control Failed	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Vehicle Dynamics Control Failed is received by Powertrain. This signal is used by the AWD algorithm in the powertrain controller.

Platform Interface Definition:
Vehicle Dynamics Control Failed is transmitted by Platform. The data value of this signal is set to “True” if the system has failed and a corresponding DTC has been set.

Data Delay: 125 ms

5.2.4.171 Vehicle Dynamics Declutch Request, Vehicle Dynamic Declutch Request Validity

Signal	Length	Data Type	Range	Conversion
Vehicle Dynamics Declutch Request	2	ENM	N/A	$0 = Normal Operation $1 = Fast Open $2 = Slow Open $3 = Not used and reserved.
Vehicle Dynamics Declutch Request Validityj	1	ENM	N/A	$0 = Valid $1 = Invalid

Powertrain Interface Definition

Vehicle Dynamics Declutch Request and Vehicle Dynamics Declutch Request Validity are received by Powertrain.

The AWD can open the AWD coupling either slowly (appr. 500 ms) or fast (appr. 60 ms). In case VSES needs to release the torque transfer to the rear axle the most appropriate way will be decided by VSES and executed through the Vehicle Dynamics Declutch Request. Normal Operation equals that the internal AWD declutch control is enabled (but not necessarily active).
If Vehicle Dynamics Declutch Request Validity equals “Invalid” the value of Vehicle Dynamics Declutch Request will be disregarded by AWD and normal operation will be maintained. In this situation the AWD will make a fast opening of the AWD clutch if Antilock Brake System Active or Vehicle Dynamics Control Active equals "True".

Output Actuation Delay: 20 ms

Platform Interface Definition

Vehicle Dynamics Declutch Request and Vehicle Dynamics Declutch Request Validity are transmitted by Platform.

Vehicle Dynamics Declutch Request enables VSES to request the AWD system to declutch
either "fast" (60ms) or "slow" (500ms) and provides a method for the VSES to control the clutch opening during VSES interventions.

Vehicle Dynamics Declutch Request Validity shall be set to “Invalid” if the data has failed and a backup value cannot be determined.

Data delay: 40 ms

5.2.4.172 Vehicle Dynamics Over Under Steer, Vehicle Dynamics Over Under Steer Validity

Signal	Length	Data Type	Range	Conversion
Vehicle Dynamics Over Under Steer	10	SNM	-256 - +255,5	E = N * 0.5
Vehicle Dynamics Over Under Steer Validity	1	ENM	N/A	$0 = Valid $1 = Invalid

Powertrain Interface Definition

Vehicle Dynamics Over Under Steer and Vehicle Dynamics Over Under Steer Validity are received by Powertrain.

Vehicle Dynamics Over Under Steer will be an input to the AWD “Yaw rate control” function. AWD will use the signal to compare and correct the AWD internal vehicle reference model with VSES reference model. AWD will consider the VSES model ruling in case of differences.
AWD will consider Vehicle Dynamics Over Under Steer correct and liable as long as Vehicle Dynamics Over Under Steer Validity equals "False".

Data delay: 40 ms

Platform Interface Definition

Vehicle Dynamics Over Under Steer and Vehicle Dynamics Over Under Steer Validity are transmitted by Platform.

Vehicle Dynamics Over Under Steer represents the error of measured vehicle yaw rate from the calculated yaw rate in the VSES vehicle model (Positive = oversteer, negative = understeer).
. The vehicle model takes into account the desired driver trajectory, indicated by the steering wheel, vehicle moment of inertia and road – tire friction coefficient. It is always referring to brake intervention threshold.
Engine intervention threshold is about 60% of brakes threshold but it has to be taken into account, that the engine intervention uses a slightly different reference yaw rate for activation. The VSES activation threshold is not always constant. This means that there is a second influence on the “Instability Variable”. So the afore mentioned signal represents the stability reserve, until VSES starts with a brake intervention. One influence which can corrupt this signal is driving in a banked bend, in which the VSES system is covered by other means.

The range is % of dynamic over-/ understeer detection threshold of VSC brake intervention. -256 - +255,5, e.g. -200 = 100% understeer threshold +200 = 100% oversteer threshold.

The over/understeer parameter refers to the intervention threshold - ie at what point brake intervention would happen. "100% oversteer" means that the ESP will be active with both brake and engine intervention. "70% oversteer" would mean that only engine intervention was used. "120%" means that the vehicle has exceed the ESP brake intervention limit by 20%.

These thresholds relate to the prevailing "slip" of the vehicle (tyres). For braking, acceleration and steering some slip is essential, ABS, TCS and ESP are systems designed to control the slip. When excessive slip is detected, the systems become active. The slip value where intervention becomes necessary is the slip threshold, and it is measured in % - ie the slip value where intervention is necessary is 100% of the slip threshold. For smoothness in ESP, engine interventions are made before the slip threshold is reached.

Vehicle Dynamics Over Under Steer Validity shall be set to “Invalid” if the data has failed and a corresponding DTC has been set.

5.2.4.173 Vehicle Dynamics Lateral Acceleration, Vehicle Dynamics Lateral Acceleration Validity

Signal	Length	Data Type	Range	Conversion
Vehicle Dynamics Lateral Acceleration	12	SNM	-32.0 – 31.9844 m/s^2	E = N * 0.015625
Vehicle Dynamics Lateral Acceleration Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Vehicle Dynamics Lateral Acceleration is used as an input to the high performance shift control algorithm to determine whether or not it should be enabled, and to what extent the automatic transmission shift schedule is modified.

The data in Vehicle Dynamics Lateral Acceleration shall be ignored if Vehicle Dynamics Lateral Acceleration Validity is set to "Invalid".

Platform Interface Definition:
Vehicle Dynamics Lateral Acceleration is transmitted by Platform. This signal represents the lateral acceleration of the vehicle as measured from an accelerometer. Vehicle Dynamics Lateral Acceleration Validity shall be set to "Invalid" if the sensor providing the data has failed and a backup value cannot be determined.

Input Delay: 25 ms

Accuracy Requirement: TBD

5.2.4.174 Vehicle Dynamics Torque Transfer Request, Vehicle Dynamics Torque Transfer Request Validity

Signal	Length	Data Type	Range	Conversion
Vehicle Dynamics Torque Transfer Request	13	PKT	N/A	N/A
Vehicle Dynamics Torque Transfer Request Value	11	UNM	0 - 4094 Nm	E = N * 2
Vehicle Dynamics Torque Transfer Request Intervention Type	2	ENM	0-3	$0 = No Intervention $1 = Reduce All Wheel Drive Torque $2 = Increase All Wheel Drive Torque $3 = Not used and reserved
Vehicle Dynamics Torque Transfer Request Validity	1	ENM	N/A	$0=Valid $1=Invalid

Powertrain Interface Definition:
Vehicle Dynamics Torque Transfer Request and Vehicle Dynamics Torque Transfer Request Validity are received by Powertrain.

Vehicle Dynamics Torque Transfer Request represents the VSES request for an absolute value of torque transferred to the rear axle input shaft by All Wheel Drive. If the All Wheel Drive system will not react on this request, the signal All Wheel Drive Torque Request Status will be set to "Request Not Achievable".

If the data value of the signal Vehicle Dynamics Torque Transfer Request Validity equals "Invalid" the All Wheel Drive system will ignore the request signal.

Output Actuation Delay: 60 ms

Platform Interface Definition:
Vehicle Dynamics Torque Transfer Request is transmitted by Platform. The signal is a packet that consists of the following subsignals:

Vehicle Dynamics Torque Transfer Request Value:
This subsignal is the requested torque at the rear axle input shaft. It can be smaller than All Wheel Drive Transferred Torque e.g. when wheels are spinning or during vehicle stability operation. It can be greater than All Wheel Drive Transferred Torque e.g. for drag torque control. The intervention type (reduction/increase) shall be commanded by the signal Vehicle Dynamics Torque Transfer Request Intervention Type.

Vehicle Dynamics Torque Transfer Request Intervention Type:
This subsignal indicates the type of the requested torque intervention. A torque reduction or increase is defined with respect to the signal All Wheel Drive Transferred Torque.

Applications which do not support Vehicle Stability Enhancement shall always send this signal with the Vehicle Dynamics Torque Transfer Request Intervention Type subsignal set to "No Intervention".

Vehicle Dynamics Torque Transfer Request Validity shall be set "Invalid" if the data has failed and a corresponding DTC has been set.

Data Delay: 30 ms

5.2.4.175 Vehicle Dynamics Torque Transfer Request Protection

Signal	Length	Data Type	Range	Conversion
Vehicle Dynamics Torque Transfer Request Protection	13	UNM	0 - 32767	E = N * 1

Powertrain Interface Definition:
Vehicle Dynamics Torque Transfer Request Protection is received by Powertrain. The signal is a safety protection value for Vehicle Dynamics torque requests. The protection value has to be calculated in Powertrain as the 2's complement of (Vehicle Dynamics Transferred Torque + Vehicle Dynamics Alive Rolling Count) of each request, independent of an active or no active torque request.

The protection value has to be calculated as 2's complement of (<u>13-bit</u> torque request + <u>transmitted</u> alive rolling counter value) in each message.

The 13-bit torque request consists of 2-bits intervention type (<u>most</u> significant bits) and the 11-bit torque value (<u>lowest</u> significant bits). The required sum of the transmitted rolling counter value and the 13-bit torque request shall be performed via binary addition. The addition result shall be limited to 13-bits (cut), i.e. evaluation of a possible overflow is prohibited. This counts also (13-bit cut, no overflow evaluation) for 2's complement processing.

Any request with a wrong protection value will not be executed by the AWD system. A calibratable number (normally ten) of wrong protection values in one driving cycle will lead to an irreversible rejection of all further torque requests by AWD until the end of the respective driving cycle.

Platform Interface Definition:

Vehicle Dynamics Torque Transfer Request Protection is transmitted by Platform. The signal is a protection value for Vehicle Dynamics torque requests. The protection value has to be calculated as the 2's complement of (Vehicle Dynamics Transferred Torque Request + Vehicle Dynamics Alive Rolling Count) in each request, independent of an active or no active torque request.

Data Delay: 30 ms

5.2.4.176 Vehicle Dynamics Yaw Rate, Vehicle Dynamics Yaw Rate Validity

Signal	Length	Data Type	Range	Conversion
Vehicle Dynamics Yaw Rate	12	SNM	-128 - 127. 938 deg/sec	E=N*1/16
Vehicle Dynamics Yaw Rate Validity	1	ENM	N/A	$0=Valid $1=Invalid

Powertrain Interface Definition

Vehicle Dynamics Yaw Rate and Vehicle Dynamics Yaw Rate Validity are received by Powertrain.

AWD will use Vehicle Dynamics Yaw Rate as an input to its “Yaw rate control” function where it is used as an input to the vehicle stability calculations. AWD will perform internal filtering and offset calibration on the Vehicle Dynamics Yaw Rate before use in internal calculations. AWD will consider the Vehicle Dynamics Yaw Rate operational when Vehicle Dynamics Yaw Rate Validity equals “Valid”.

Platform Interface Definition

Vehicle Dynamics Yaw Rate and Vehicle Dynamics Yaw Rate Validity are transmitted by Platform.

The Vehicle Dynamics Yaw Rate signal represent the vehicles rotation around its vertical axis. The value of the Yaw Rate is positive for a left turn.

Vehicle Dynamics Yaw Rate Validity indicates if the signal is valid. The signal can be invalid in the following cases:
1) an internal error is present.
2) the yaw rate sensor self test is active.

5.2.4.177 Vehicle Identification Number Digits 10 - 17

Signal	Length	Data Type	Range	Conversion
Vehicle Identification Number Digits 10 - 17	64	ASC	N/A	One ACSII Character

Powertrain Interface Definition:

Vehicle Identification Number Digits 10 - 17 is used to determine when a Powertrain controller has been transferred from one vehicle to another. If this condition has been detected, the powertrain adaptive parameters that are stored in EEPROM equivalent memory will be re-initialized. It is critical that certain OBD-II diagnostic parameters also get re-initialized to avoid indicating a false diagnostic status.

Platform Interface Definition:

Vehicle Identification Number Digits 10 - 17 is transmitted by Platform. The VIN is programmed at the vehicle assembly plant. The data consists of digits 10 through 17 of the VIN encoded in ASCII. The Platform shall transmit this signal with the data value set to $00 (all ASCII null characters) when the VIN has not been programmed in the Platform module.

If there is a communication failure with the source of this information, the module on the high speed data link shall continue to transmit the last known value and store this value in non-volatile memory at power-down.

5.2.4.178 Vehicle Lift/Dive Status, Vehicle Lift/Dive Status Validity

Signal	Length	Data Type	Range	Conversion
Vehicle Lift/Dive Status	2	ENM	N/A	$0=Neutral $1=Lift $2=Dive
Vehicle Lift/Dive Status Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:

Vehicle Lift/Dive Status is transmitted by the Powertrain. The value of the status is set to $1 if the Lift/dive algorithm in the powertrain electronics determines that the vehicle is in a “lift” condition. If the algorithm determines that a “dive” condition is present, the status will be set to $2. Under normal driving conditions, the lift/dive status will be $0 indicating that no lift/dive event is occurring.

Vehicle Lift/Dive Status Validity shall be set to “Invalid” if the Powertrain is unable to provide an accurate indication of vehicle lift/dive status. This may occur if any of the inputs to the algorithm are unavailable or their associated sensors failed.

Data Delay: 12.5ms

Platform Interface Definition:

Vehicle Lift/Dive Status is used for real time damping control.

The data in Vehicle Lift/Dive Status shall be ignored if Vehicle Lift/Dive Status Validity is set to “Invalid”.

5.2.4.179 Vehicle Odometer, Vehicle Odometer Validity

Signal	Length	Data Type	Range	Conversion
Vehicle Odometer	32	UNM	0 - 6.71089 e+07 km	E = N * 0.015625
Vehicle Odometer Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Vehicle Odometer is used by the oil life algorithm. Engine revolutions will be estimated based on vehicle odometer when a powertrain controller is replaced. Since there are already incentives to tamper with vehicle odometer information, Vehicle Odometer shall not be used directly for any emission related purpose, e.g. to compensate closed loop fuel control for converter or O2 sensor aging phenomenon, etc. Instead, if necessary, other emission related algorithms may be developed that create a separate emission-related odometer type function that will have sufficient security features applied.

The data in Vehicle Odometer shall be ignored if Vehicle Odometer Validity is set to “Invalid”.

Platform Interface Definition:
Vehicle Odometer is transmitted by Platform. Platform owns and maintains vehicle odometer and reports the value of vehicle odometer for powertrain usage. Vehicle Odometer Validity shall be set to “Invalid” if the sensor providing the data has failed and a backup value cannot be determined.
Input Delay: TBD

Accuracy Requirement: TBD

5.2.4.180 Vehicle Security Non Immobilizer Password

Signal	Length	Data Type	Range	Conversion
Vehicle Security Non Immobilizer Password	16	UNM	0 - 65535 passwrd	E = N * 1

Powertrain Interface Definition:
Vehicle Security Non Immobilizer Password is used in the vehicle security algorithm. Powertrain compares the password transmitted via this signal with its internally learned password to determine if fuel should be enabled to allow engine run. Powertrain reports the security status via the Vehicle Security Non Immobilizer Powertrain Status signal whenever the status changes or in response to the Vehicle Security Non Immobilizer Password signal. Powertrain shall allow engine run regardless of correct password if serial data communication is lost with Platform while the engine is running.

Output Actuation Delay: TBD

Platform Interface Definition:
Vehicle Security Non Immobilizer Password is transmitted by Platform. Platform periodically transmits the password. Powertrain indicates the security status through the Vehicle Security Non Immobilizer Powertrain Status signal. To avoid setting codes and taking failsoft action, it is important that the Platform controller be awake during the power modes that the Powertrain controller is awake.

If there is a communication failure with the source of this information, the module on the high speed data link shall enter fail enable mode during current ignition cycle and use the power-up default value at the next ignition cycle.

Data Delay: TBD

5.2.4.181 Vehicle Security Non Immobilizer Password Status

Signal	Length	Data Type	Range	Conversion
Vehicle Security Non Immobilizer Password Status	3	ENM	N/A	$0 = No Information $1 = Information Valid $2 = Tamper Detected $3 = Undecided $4 = VTD Failed

Powertrain Interface Definition:
Vehicle Security Non Immobilizer Password Status is received by Powertrain. Vehicle Security Non Immobilizer Password status is used in the vehicle security algorithm. Powertrain shall use the status information in addition to the Vehicle Security Non Immobilizer Password signal to determine the appropriate security state. The Vehicle Security Non Immobilizer Password signal shall only be compared to Powertrain's stored password when the Vehicle Security Non Immobilizer Password Status signal indicates Information Valid. Otherwise, Powertrain shall react to the information provided within the Vehicle Security Non Immobilizer Password Status signal.

The source of this signal shall be monitored by the Vehicle Theft Deterrent Non Immobilizer Virtual Device Availability signal.

Power-Up Default: "No Information"
Communication Failure Value: "VTD Failed"

Platform Interface Definition:
Vehicle Security Non Immobilizer Password Status is transmitted periodically by Platform. The password status signal is determined by the vehicle security module.

The vehicle security module will initialize the Vehicle Security Non Immobilizer Password Status to "Undecided" upon power up. The vehicle security module will determine the status of the driver authentication device (e.g., key code) and will set Vehicle Security Non Immobilizer Password Status to "Information Valid" or "Tamper Detected" for valid or invalid authorization respectively. The vehicle security module will set the Vehicle Security Non Immobilizer Password Status to "No Information" once the security module has received proper Vehicle Security Non Immobilizer Powertrain Status.

Data Delay: TBD

5.2.4.182 Vehicle Security Non Immobilizer Powertrain Status

Signal	Length	Data Type	Range	Conversion
Vehicle Security Non Immobilizer Powertrain Status	8	PKT	N/A	N/A
Bit 0: Fuel Continue State Active	1	BLN	N/A	$1=True; $0=False
Bit 1: Fuel Disable Timeout State Active	1	BLN	N/A	$1=True; $0=False
Bit 2: Fuel Disable Until Ignition Off State Active	1	BLN	N/A	$1=True; $0=False
Bit 3: Autolearn Timer Active	1	BLN	N/A	$1=True; $0=False
Bit 4: Theft Deterrent Fail Enable Active	1	BLN	N/A	$1=True; $0=False
Bit 5: Password Learning Enabled	1	BLN	N/A	$1=True; $0=False
Bit 6: Unused and Reserved	1	BLN	N/A	$1=True; $0=False
Bit 7: Unused and Reserved	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Vehicle Security Non Immobilizer Powertrain Status is transmitted by Powertrain. Powertrain reports the security via the Vehicle Security Non Immobilizer Powertrain Status signal whenever the status changes or in response to the Vehicle Security Non Immobilizer Password signal.

Data Delay: TBD

Platform Interface Definition:
Vehicle Security Non Immobilizer Powertrain Status is used to determine the theft status within the Powertrain electronics. Platform periodically transmits the password until Powertrain indicates that it has received the correct password. This is indicated by the Password Learning Enabled bit of this signal. If serial data communication is lost between Powertrain and Platform, Platform will typically set a communications diagnostic code and illuminate a telltale. To avoid setting codes and taking failsoft action, it is important that the Platform controller be awake during the Power Modes that the Powertrain controller is awake.

Output Actuation Delay: TBD

5.2.4.183 Vehicle Speed, Vehicle Speed Validity

Signal	Length	Data Type	Range	Conversion
Vehicle Speed	16	UNM	0 - 511.92 km / h	E = N * 0.0078125
Vehicle Speed Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Vehicle Speed is transmitted by Powertrain. Powertrain calculates vehicle speed by using vehicle speed sensor information that is obtained via either hardwire or serial data. Vehicle Speed Validity shall be set to "Invalid" if the sensor providing the data has failed and a backup value cannot be determined.

The source of the vehicle speed information shall be calibratable and must be specified by the platform from one of the available sources for that application. Not all applications will have 7 possible sources for the input data. The 7 possible sources are:

1) Wheel Angular Velocity Front Left data from ABS
2) Wheel Angular Velocity Front Right data from ABS
3) Wheel Angular Velocity Rear Left data from ABS
4) Wheel Angular Velocity Rear Right data from ABS
5) Hardwired Wheel Speed Sensor input to powertrain controller
6) Hardwired Transmission Output Speed input to powertrain controller
7) Transmission Output Speed data from TCM to ECM

Data Delay: TBD
Accuracy Requirement: TBD

Platform Interface Definition:
Vehicle speed is used for miscellaneous body functions. It is also used by some devices using the VSS hard-wired signal in the event of a pulse train signal failure. The Brake Apply Sensing System uses it in its algorithm for determining brake lamp operation in the event of a brake apply sensor failure

The data in Vehicle Speed shall be ignored if Vehicle Speed Validity is set to "Invalid".

5.2.4.184 Vehicle Theft Deterrent Non Immobilizer Virtual Device Availability

Signal	Length	Data Type	Range	Conversion
Vehicle Theft Deterrent Non Immobilizer Virtual Device Availability	1	ENM	N/A	$0=Virtual Device Unavailable $1=Virtual Device Available

Powertrain Interface Definition:
Vehicle Theft Deterrent Non Immobilizer Virtual Device Availability is received by Powertrain (ECM, PCM). If the value of this signal is "$0", then the Vehicle Security Non Immobilizer Password signal shall be defaulted to "$0" and the Vehicle Security Non Immobilizer Password Status signal shall be defaulted to "VTD Failed" within the powertrain controller.

Power-Up Default: "$1"

Communication Failure Value: “$0”

Platform Interface Definition:
Vehicle Theft Deterrent Non Immobilizer Virtual Device Availability is transmitted by Platform. If the Vehicle Security Non Immobilizer Password and Vehicle Security Non Immobilizer Password Status signals are transmitted to Powertrain through a gateway, then the Vehicle Theft Deterrent Non Immobilizer Virtual Device Availability signal indicates the availability of the source of the Vehicle Security Non Immobilizer Password and Vehicle Security Non Immobilizer Password Status signals.

Data Delay: TBD

5.2.4.185 Vehicle Top Speed Limit Value

Signal	Length	Data Type	Range	Conversion
Vehicle Top Speed Limit Value	8	UNM	0 - 255 km / h	E = N * 1

Powertrain Interface Definition:
Vehicle Top Speed Limit Value is transmitted by Powertrain. Powertrain reports the speed value at which the vehicle will be limited to in the event of a suspension control failure.

Data Delay: TBD

Platform Interface Definition:
Vehicle Top Speed Limit Value is used for display purposes. This is the speed at which the vehicle will be limited if Powertrain reports a suspension control failure via the Vehicle Top Speed Limitation Indication On signal to inform the driver that the vehicle speed will be limited. This speed limit may also be related to vehicle top speed limiting based on something such as tire speed limitations.

5.2.4.186 Vehicle Top Speed Limitation Indication On

Signal	Length	Data Type	Range	Conversion
Vehicle Top Speed Limitation Indication On	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Vehicle Top Speed Limitation Indication On is transmitted by Powertrain. This signal may be used to indicate a vehicle speed limitation due to a top speed fuel cut off condition, a suspension control failure or for other reasons. Powertrain shall set the data value to “True” when vehicle speed is being limited. When the vehicle speed is being limited, Powertrain shall also set the data value of the Vehicle Top Speed Limit to the appropriate value so that Platform may display the proper speed limit indication to the driver.

Data Delay: 1025 ms
Platform Interface Definition:

Vehicle Top Speed Limitation Indication On is used for display purposes.

5.2.4.187 Wheel Angular Velocity Front Left, Wheel Angular Velocity Front Left Validity, Wheel Angular Velocity Rear Left, Wheel Angular Velocity Rear Left Validity Wheel Angular Velocity Front Right, Wheel Angular Velocity Front Right Validity Wheel Angular Velocity Rear Right, Wheel Angular Velocity Rear Right Validity

Signal	Length	Data Type	Range	Conversion
Wheel Angular Velocity (LF or LR or RF or RR)	15	SNM	-4096 - 4095 rpm	E = N * 0.25
Wheel Angular Velocity (LF or LR or RF or RR) Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Wheel Angular Velocity (LF or LR or RF or RR) is used as one of the enabling criteria for differential score protection. Wheel speed difference of the driven wheels normalized by the wheel speed difference of the non-driven wheels must exceed a threshold before differential score protection is enabled. These signals are also used for calculating vehicle speed on GME applications with ABS. Required when ABS and ETC are both present. These signals enable additional ETC functionality.
The data in Wheel Angular Velocity (LF or LR or RF or RR) shall be ignored if Wheel Angular Velocity (LF or LR or RF or RR) is set to "Invalid".

Platform Interface Definition:
Wheel Angular Velocity (LF or LR or RF or RR)is transmitted by Platform. It is comprised of the calculated wheel speeds of the right and left front wheels and the calculated wheel speeds of the right and left rear wheels.

The Wheel Speed values communicated in this message should be the Compensated Wheel Speed values. The Compensated Wheel Speeds are Wheel Speed values that have been corrected for unequal tire diameters (ex. a mini-spare tire is mounted, significant differences in tire inflation pressures, etc.).

Wheel Angular Velocity (LF or LR or RF or RR) Validity shall be set to "Invalid" if the sensor providing the data has failed and a backup value cannot be determined.

Input Delay: 25ms

Accuracy Requirement: TBD

5.2.4.188 Wheel Angular Velocity High Resolution Front Left, Wheel Angular Velocity High Resolution Front Left Validity, Wheel Angular Velocity High Resolution Rear Left, Wheel Angular Velocity High Resolution Rear Left Validity Wheel Angular Velocity High Resolution Front Right, Wheel Angular Velocity High Resolution Front Right Validity Wheel Angular Velocity High Resolution Rear Right, Wheel Angular Velocity High Resolution Rear Right Validity

Signal	Length	Data Type	Range	Conversion
Wheel Angular Velocity High Resolution (FL or FR or RL or RR)	15	UNM	0- 4095.875 rpm	E = N * 0.125
Wheel Angular Velocity High Resolution (FL or FR or RL or RR) Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition

Wheel Angular Velocity High Resolution (FL or FR or RL or RR) and Wheel Angular Velocity High Resolution (FL or FR or RL or RR) Validity signals are received by Powertrain.

AWD uses the Wheel Angular Velocity High Resolution (FL or FR or RL or RR) for: Differential speed over AWD calculation, Vehicle velocity calculation, cornering detection, Tire roll-radius difference detection and Wheel slip detection. The Wheel

Angular VelocityHigh Resolution (FL or FR or RL or RR) Validity signal is used by the AWD for determining if the Wheel Angular Velocity High Resolution (FL or FR or RL or RR) is correct.

Platform Interface Definition

Wheel Angular Velocity High Resolution (FL or FR or RL or RR) is transmitted by Platform.

It is comprised of the calculated wheel speeds of the right and left front wheels and the calculated wheel speeds of the right and left rear wheels.

The Wheel Speed values communicated in this message should be the Compensated Wheel Speed values. The Compensated Wheel Speeds are Wheel Speed values that have been corrected for unequal tire diameters (ex. a mini-spare tire is mounted, significant differences in tire inflation pressures, etc.).

Wheel Angular Velocity High Resolution (FL or FR or RL or RR) Validity shall be set to “Invalid” if the sensor providing the data has failed and a backup value cannot be determined.

Input Delay: 25 ms

5.2.4.189 Wheel Average Peak to Peak Acceleration, Wheel Average Peak to Peak Acceleration Validity

Signal	Length	Data Type	Range	Conversion
Wheel Average Peak to Peak Acceleration	8	UNM	0 - 1 g	E = N * 0.00392157
Wheel Average Peak to Peak Acceleration Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:

Wheel Average Peak to Peak Acceleration is received by Powertrain. It is generated by the brake module. It is used to disable the OBD-II Misfire diagnostic on rough roads when the Average Peak To Peak Acceleration is above a Powertrain calibratable level. The Misfire diagnostic uses engine speed variations to detect engine misfire. Rough roads can cause driveline torsionals that affect the engine speed variation, causing rough roads to look like engine misfire to the Misfire diagnostic. Powertrain also needs to know if a failure occurs such that the ABS is unable to determine Average Peak To Peak Acceleration. This failure is communicated via the Wheel Average Peak to Peak Acceleration Validity signal. Powertrain continues to run the Misfire diagnostic in this case. However, if a misfire is detected, an additional diagnostic code is logged to inform the service technician that the misfire code may be the result of vehicle operation on a rough road with a failure that prevented the ABS from detecting the rough road. In this case, it cannot be determined whether a true misfire or a rough road caused the misfire code.
The data in Wheel Average Peak to Peak Acceleration shall be ignored if Wheel Average Peak to Peak Acceleration is set to “Invalid”.

Platform Interface Definition:

Wheel Average Peak to Peak Acceleration is transmitted by the ABS per the “GM Powertrain Rough Road Detection Algorithm Specification”, Document Number TL.17.0015. This document is maintained by GM Powertrain.

If any fault/defect prevents the Rough Road Variable Calculation from being properly performed, a value of 255 decimal should be stored in the Rough Road Variable. If ABS or the Traction Control system were active at any time during the last Rough Road Variable Calculation Loop, a value of 254 decimal should be stored in the Rough Road Variable.

Wheel Average Peak to Peak Acceleration Validity shall be set to “Invalid” if the sensor providing the data has failed and a backup value cannot be determined.

Data Delay: 500 ms

Accuracy Requirement: TBD

5.2.4.190 Wheel Rotations Left Driven Rolling Count, Wheel Rotations Left Driven Rolling Count Reset Occurred, Wheel Rotations Left Driven Rolling Count Validity, Wheel Rotations Right Driven Rolling Count, Wheel Rotations Right Driven Rolling Count Reset Occurred, Wheel Rotations Right Driven Rolling Count Validity, Wheel Rotations Left Non Driven Rolling Count, Wheel Rotations Left Non Driven Rolling Count Reset Occurred, Wheel Rotations Left Non Driven Rolling Count Validity, Wheel Rotations Right Non Driven Rolling Count, Wheel Rotations Right Non Driven Rolling Count Reset Occurred, Wheel Rotations Right Non Driven Rolling Count Validity

Signal	Length	Data Type	Range	Conversion
Wheel Rotations (Driven or Non Driven) Rolling Count	14	UNM	0 – 127.992 rot	E = N * 0.0078125
Wheel Rotations (Driven or Non Driven) Rolling Count Reset Occurred	1	BLN	N/A	$1=True; $0=False
Wheel Rotations (Driven or Non Driven) Rolling Count Validity	1	ENM	N/A	$0=Valid; $1=Invalid

Powertrain Interface Definition:
Wheel Rotations Rolling Count is used to calculate the Distance Rolling Count signals (Driven and Non Driven) that are transmitted by the Powertrain controller. This is used for applications without a transmission output speed sensor. The powertrain controller must keep track of rollovers. Powertrain and Platform must maintain rolling count in some type of battery backed keep alive memory to retain the latest value over ignition cycles. When the data value of the Wheel Rotations Rolling Count Reset Occurred signal is “True” (that indicates that the Platform electronics memory has been reset), the Powertrain controller should reset its rolling count memory to the data value within the Wheel Rotations Rolling Count signal. If Powertrain detects a restoration of serial data communications with Platform after a loss of communications with Platform, Powertrain should reset its rolling count memory to the value received in the Wheel Rotations Rolling Count signal from Platform.
The data in Wheel Rotations Rolling Count shall be ignored if Wheel Rotations Rolling Count Validity is set to “Invalid”.

Platform Interface Definition:
Wheel Rotations Rolling Count is transmitted by Platform for each of the four wheels on GME vehicles equipped with ABS. Each is the accumulated count of wheel rotations. The wheel rotation counters are designed to roll over after they have exceeded their maximum range. The accuracy of the computation should be the same regardless of whether or not a rollover has just occurred. The powertrain module must keep track of roll-overs for each. Powertrain and Platform must maintain rolling count in some type of battery backed keep alive memory to retain the latest value over ignition cycles. To avoid loss of data or inaccurate data used by Powertrain, Platform will set the data value of the Wheel Rotations (for each wheel) Rolling Count Reset Occurred signal to “True” whenever the Platform memory that maintains the rolling count is reset due to a failure that causes a reset of the memory that contains the rolling count information. If on-board diagnostics of the wheel speed sensors indicate a fault, then Wheel Rotations Rolling Count Validity for each wheel with a fault shall be set to “Invalid”.

Wheel Rotations (Driven or Non Driven) Validity shall be set to “Invalid” if the sensor providing the data has failed and a backup value cannot be determined.

Input Delay: 1 second

Accuracy Requirement: TBD

5.2.4.191 Wheel Speed Sensing Diagnostic Completed

Signal	Length	Data Type	Range	Conversion
Wheel Speed Sensing Diagnostic Completed	1	BLN	N/A	$1=True; $0=False

Powertrain Interface Definition:
Wheel Speed Sensing Diagnostic Completed is used by Powertrain to properly control the fault counters for the OBD-II related faults in the ABS/TCS-system, i.e. the Control Module and the Wheel Speed Sensors.

Platform Interface Definition:
Wheel Speed Sensing Diagnostic Completed is transmitted by Platform. The signal is set to "True" when the ABS/TCS Control Module has completed its diagnostics checks for monitoring of the Wheel Speed Sensors and the ECU internal faults at least once during the latest ignition cycle.

Data Delay: 1 second

5.2.4 GMLAN Frame Definition Recommendations for PPEI Version 2.5

This section describes the GMLAN frame definitions, based upon PPEI 2.5, that are suggested for use in conjunction with the signals in this document. The shaded rows represent space that is either unused or reserved for a signal that is not described in this document. For details on the use of the space designated by the shaded rows, the application engineer for the program of interest should be consulted.

Message	ID	Periodic Interval (ms)	Update Time (ms)	Supervision Timeout (ms)	Event Trigger	Signal	Start Byte	Start Bit	Length	Data Type	Range	Conversion	Transmitter
Engine Speed and Pedal Position	$110	12.5		31.25		Engine Speed Validity	0	7	1	ENM	N/A	$0=Valid $1=Invalid	ECM
						Accelerator Effective Position Validity	0	6	1	ENM	N/A	$0=Valid $1=Invalid	
						Accelerator Actual Position Validity	0	5	1	ENM	N/A	$0=Valid $1=Invalid	
						Throttle Position Validity	0	4	1	ENM	N/A	$0=Valid $1=Invalid	
							0	3	1				
						Cruise Control Active	0	2	1	BLN	N/A	$1=True; $0=False	
							0	1	1				
							0	0	1				
						Engine Speed	1	7	16	UNM	0 - 16383.75 rpm	E = N * .25	
						Accelerator Effective Position	3	7	8	UNM	0 - 100 %	E = N * 100/255	
						Accelerator Actual Position	4	7	8	UNM	0 - 100 %	E = N * 100/255	
						Throttle Position	5	7	8	UNM	0 - 100 %	E = N * 100/255	
						Reserved for ETEI	6	7	8				
							7	7	8				

Message	ID	Periodic Interval (ms)	Update Time (ms)	Supervision Timeout (ms)	Event Trigger	Signal	Start Byte	Start Bit	Length	Data Type	Range	Conversion	Transmitter
Engine Torque	$120	12.5		31.25		Engine Torque Actual Validity	0	7	1	ENM	N/A	$0=Valid $1=Invalid	ECM
						Engine Torque Driver Requested Validity	0	6	1	ENM	N/A	$0=Valid $1=Invalid	
						Engine Torque Maximum Validity	0	5	1	ENM	N/A	$0=Valid $1=Invalid	
						Engine Torque Minimum Validity	0	4	1	ENM	N/A	$0=Valid $1=Invalid	
						Engine Torque Actual	0	3	12	UNM	-200 - 823.75 Nm	E = N * .25 - 200	
						Engine Torque Reduction Failure Status	2	7	3	ENM	N/A	$0=Torque Reduction OK $1=Torque Reduction Temporarily Failed $2=Torque Reduction Permanently Failed $3=Torque Reduction Limited	
						Engine Torque Traction Control Request Failed	2	4	1	BLN	N/A	$1=True; $0=False	
						Engine Torque Driver Requested	2	3	12	UNM	-200 - 823.75 Nm	E = N * .25 - 200	
							4	7	1				
						Vehicle Lift/Dive Status Validity	4	6	1	ENM	N/A	$0=Valid $1=Invalid	
						Vehicle Lift/Dive Status	4	5	2	ENM	N/A	$0=Neutral $1=Lift $2=Dive	
						Engine Torque Maximum	4	3	12	UNM	-200 - 823.75 Nm	E = N * .25 - 200	
							6	7	1				
							6	6	1				
							6	5	1				
							6	4	1				
						Engine Torque Minimum	6	3	12	UNM	-200 - 823.75 Nm	E = N * .25 - 200	

Message	ID	Periodic Interval (ms)	Update Time (ms)	Supervision Timeout (ms)	Event Trigger	Signal	Start Byte	Start Bit	Length	Data Type	Range	Conversion	Transmitter
Brake Pedal Status	$128	10		25		Brake Pedal Initial Travel Achieved	0	7	1	BLN	N/A	$1=True; $0=False	GW
						Brake Pedal Moderate Travel Achieved	0	6	1	BLN	N/A	$1=True; $0=False	
						Brake Pedal Position Failure	0	5	1	ENM	N/A	$0=Brake Position Sensing Valid $1=Brake Position Sensing Invalid	
							0	4	1				
							0	3	1				
							0	2	1				
						Brake Pedal Position Rolling Count	0	1	2	UNM	0 - 3 N/A	E = N * 1	
							1	7	8				
							2	7	1				
							2	6	1				
							2	5	1				
							2	4	1				
							2	3	1				
							2	2	1				
						Brake Pedal Initial Travel Achieved Protection	2	1	2	UNM	0 - 3 N/A	E = N * 1	
Vehicle Security Passwords	$130	200	20	500		Vehicle Security Non Immobilizer Password	0	7	16	UNM	0 - 65535 passwrd	E = N * 1	GW
						Outside Air Temperature Corrected Value Validity	2	7	1	ENM	N/A	$0=Valid $1=Invalid	
						Air Conditioning Refrigerant Low Side Fluid Temperature Validity	2	6	1	ENM	N/A	$0=Valid $1=Invalid	
							2	5	1				
							2	4	1				
							2	3	1				
						Vehicle Security Non Immobilizer Password Status	2	2	3	ENM	N/A	$0=No Information $1=Information Valid $2=Tamper Detected $3=Undecided $4=VTD Failed	
						Outside Air Temperature Corrected Value	3	7	8	UNM	-40 - 87.5 deg C	E = N * .5 - 40	
						Generator Regulator Setpoint Duty Cycle Request	4	7	8	UNM	0 - 100 %	E = N * 100/255	
						Air Conditioning Refrigerant Low Side Fluid Temperature	5	7	8	UNM	-40 - 215 deg C	E = N * 1 - 40	
VIN Digits 10_17 HS	$131	310		775		Vehicle Identification Number Digits 10-17	0	7	64	ASC	N/A	Eight ASCII Characters	GW

Message	ID	Periodic Interval (ms)	Update Time (ms)	Supervision Timeout (ms)	Event Trigger	Signal	Start Byte	Start Bit	Length	Data Type	Range	Conversion	Transmitter
Chassis Control Dynamic Data 1	$140	20		50		Traction Control Torque Request	0	7	16	PKT	N/A	N/A	ABS
						Torque Intervention Type	0	7	2	ENM	N/A	$0=No Intervention $1=Reduce Torque $2=Increase Torque	
						Torque Reduction Realization Suggestion	0	5	2	ENM	N/A	$0=No Suggestion $1=No Throttle Usage $2=Throttle Only	
						Torque Request Value	0	3	12	UNM	-200 - 823.75 Nm	E = N * 1/4 - 200	
						Traction Control Alive Rolling Count	2	7	2	UNM	0 - 3	E = N * 1	
						Traction Control Torque Request Validity	2	5	1	ENM	N/A	$0=Valid $1=Invalid	
						Vehicle Dynamics Lateral Acceleration Validity	2	4	1	ENM	N/A	$0=Valid $1=Invalid	
						Vehicle Dynamics Lateral Acceleration	2	3	12	SNM	-32 - 31.9844 m/s^2	E = N * 1/64	
						Traction Control Torque Request Protection	4	7	16	UNM	0 - 65535	E = N * 1	
							6	7	1				
							6	6	1				
							6	5	1				
							6	4	1				
							6	3	1				
						Traction Torque Decay Control	6	2	11	PKT	N/A	N/A	
						Traction Torque Decay Enable	6	2	1	BLN	N/A	$1=True; $0=False	
						Traction Torque Decay Gradient	6	1	10	UNM	0 - 1.5 % / ms	E = N * 1.5/1023	

Message	ID	Periodic Interval (ms)	Update Time (ms)	Supervision Timeout (ms)	Event Trigger	Signal	Start Byte	Start Bit	Length	Data Type	Range	Conversion	Transmitter
Vehicle Security PT Status Non Immo	$170	500		1250		Vehicle Security Non Immobilizer Powertrain Status	0	7	8	PKT	N/A	N/A	ECM
						Unused and Reserved	0	7	1	BLN	N/A	$1=True; $0=False	
						Unused and Reserved	0	6	1	BLN	N/A	$1=True; $0=False	
						Password Learning Enabled	0	5	1	BLN	N/A	$1=True; $0=False	
						Theft Deterrent Fail Enable Active	0	4	1	BLN	N/A	$1=True; $0=False	
						Autolearn Timer Active	0	3	1	BLN	N/A	$1=True; $0=False	
						Fuel Disable Until Ignition Off State Active	0	2	1	BLN	N/A	$1=True; $0=False	
						Fuel Disable Timeout State Active	0	1	1	BLN	N/A	$1=True; $0=False	
						Fuel Continue State Active	0	0	1	BLN	N/A	$1=True; $0=False	
						Powertrain Crank Aborted	1	7	1	BLN	N/A	$1=True; $0=False	
						Powertrain Run Aborted	1	6	1	BLN	N/A	$1=True; $0=False	
							1	5	1				
							1	4	1				
							1	3	1				
							1	2	1				
							1	1	1				
						Engine Oil Temperature Validity	1	0	1	ENM	N/A	$0=Valid $1=Invalid	
						Engine Oil Temperature	2	7	8	UNM	-40 - 215 deg C	E = N * 1 - 40	
Wheel Speed	$280	100		250		Wheel Angular Velocity Front Left Validity	0	7	1	ENM	N/A	$0=Valid $1=Invalid	ABS
						Wheel Angular Velocity Front Left	0	6	15	SNM	-4096 - 4095.75 rpm	E = N * .25	
						Wheel Angular Velocity Front Right Validity	2	7	1	ENM	N/A	$0=Valid $1=Invalid	
						Wheel Angular Velocity Front Right	2	6	15	SNM	-4096 - 4095.75 rpm	E = N * .25	
						Wheel Angular Velocity Rear Left Validity	4	7	1	ENM	N/A	$0=Valid $1=Invalid	
						Wheel Angular Velocity Rear Left	4	6	15	SNM	-4096 - 4095.75 rpm	E = N * .25	
						Wheel Angular Velocity Rear Right Validity	6	7	1	ENM	N/A	$0=Valid $1=Invalid	
						Wheel Angular Velocity Rear Right	6	6	15	SNM	-4096 - 4095.75 rpm	E = N * .25	

Message	ID	Periodic Interval (ms)	Update Time (ms)	Supervision Timeout (ms)	Event Trigger	Signal	Start Byte	Start Bit	Length	Data Type	Range	Conversion	Transmitter
Chassis General Status	$2F0	100		250		Traction Torque Decay Control Active	0	7	1	BLN	N/A	$1=True; $0=False	ABS
						Wheel Average Peak to Peak Acceleration Validity	0	6	1	ENM	N/A	$0=Valid $1=Invalid	
							0	5	1				
						Wheel Speed Sensing Diagnostic Completed	0	4	1	BLN	N/A	$1=True; $0=False	
							0	3	1				
						Spare Tire Status	0	2	3	ENM	N/A	$0=Undetermined $1=No Spare Detected $2=Spare Detected	
						Wheel Average Peak to Peak Acceleration	1	7	8	UNM	0 - 1 g's	E = N * 1/255	
							2	7	8				
							3	7	1				
						Antilock Brake System Active	3	6	1	BLN	N/A	$1=True; $0=False	
						Antilock Brake System Failed	3	5	1	BLN	N/A	$1=True; $0=False	
						Traction Control System Enabled	3	4	1	BLN	N/A	$1=True; $0=False	
						Traction Control System Active	3	3	1	BLN	N/A	$1=True; $0=False	
							3	2	1				
							3	1	1				
							3	0	1				
							4	7	1				
						Vehicle Dynamics Control Active	4	6	1	BLN	N/A	$1=True; $0=False	
							4	5	1				
						Suspension System Dampers Failed Full Soft	4	4	1	BLN	N/A	$1=True; $0=False	
						Traction Control System Failed	4	3	1	BLN	N/A	$1=True; $0=False	
							4	2	1				
							4	1	1				
							4	0	1				

Message	ID	Periodic Interval (ms)	Update Time (ms)	Supervision Timeout (ms)	Event Trigger	Signal	Start Byte	Start Bit	Length	Data Type	Range	Conversion	Transmitter
Engine General Status 1	$300	100	25	250		Cruise Control Clutch Switch Active Validity	0	7	1	ENM	N/A	$0=Valid $1=Invalid	ECM
						Cruise Control Clutch Switch Active	0	6	1	BLN	N/A	$1=True; $0=False	
					X	Cruise Control Active	0	5	1	BLN	N/A	$1=True; $0=False	
						Cruise Control Enabled	0	4	1	BLN	N/A	$1=True; $0=False	
						Engine Limp Home Mode Active	0	3	1	BLN	N/A	$1=True; $0=False	
						Generator Enabled	0	2	1	BLN	N/A	$1=True; $0=False	
						Generator Failed	0	1	1	BLN	N/A	$1=True; $0=False	
							0	0	1				
						Reserved for ETEI	1	7	1				
						Reserved for ETEI	1	6	1				
					X	Accelerator Kick Down Detected	1	5	1	BLN	N/A	$1=True; $0=False	
						Reserved for ETEI	1	4	1				
						Reserved for ETEI	1	3	1				
						Remote Vehicle Start Engine Running	1	2	1	BLN	N/A	$1=True; $0=False	
					X	Engine Running Status	1	1	2	ENM	N/A	$0=Not Running $1=Running and Idling $2=Running and Not Idling	

Message	ID	Periodic Interval (ms)	Update Time (ms)	Supervision Timeout (ms)	Event Trigger	Signal	Start Byte	Start Bit	Length	Data Type	Range	Conversion	Transmitter
						Fuel Injected Rolling Count Reset Occurred	2	7	1	BLN	N/A	$1=True; $0=False	
						Engine Oil Level Low Indication On	2	6	1	BLN	N/A	$1=True; $0=False	
						Engine Oil Pressure Low Indication On	2	5	1	BLN	N/A	$1=True; $0=False	
						Engine Calculated Actual Gear Validity	2	4	1	ENM	N/A	$0=Valid $1=Invalid	
						Engine Calculated Actual Gear	2	3	4	ENM	N/A	$0=Shift in Progress $1=First Gear $2=Second Gear $3=Third Gear $4=Fourth Gear $5=Fifth Gear $6=Sixth Gear $7=Seventh Gear $8=Reverse $9=Neutral	
						Fuel Injected Rolling Count	3	7	16	UNM	0 - 1.99993 liters	E = N * 1/32768	
						Service Engine System Non Emission Related Indication Request	5	7	2	ENM	N/A	$0=No Indication $1=Continuous Indication $2=Flashing Indication	
							5	5	1				
							5	4	1				
					X	Brake Pedal Switch Active Validity	5	3	1	ENM	N/A	$0=Valid $1=Invalid	
					X	Brake Pedal Switch Active	5	2	1	BLN	N/A	$1=True; $0=False	
					X	Brake Extended Travel Switch Active Validity	5	1	1	ENM	N/A	$0=Valid $1=Invalid	
					X	Brake Extended Travel Switch Active	5	0	1	BLN	N/A	$1=True; $0=False	
						Reserved for ETEI	6	7	8				
						Reserved for ETEI	7	7	1				
						Reserved for ETEI	7	6	1				
						Reserved for ETEI	7	5	1				
						Reserved for ETEI	7	4	1				
							7	3	1				
							7	2	1				
							7	1	1				
							7	0	1				

Message	ID	Periodic Interval (ms)	Update Time (ms)	Supervision Timeout (ms)	Event Trigger	Signal	Start Byte	Start Bit	Length	Data Type	Range	Conversion	Transmitter
Engine General Status 2	$308	100		250		Fuel Level Percent Validity	0	7	1	ENM	N/A	$0=Valid $1=Invalid	ECM
						Engine Oil Pressure Validity	0	6	1	ENM	N/A	$0=Valid $1=Invalid	
							0	5	1				
							0	4	1				
						Starting Disabled Indication On	0	3	1	BLN	N/A	$1=True; $0=False	
						Engine Coolant Hot Indication On	0	2	1	BLN	N/A	$1=True; $0=False	
						Engine Recommended Shift Indication	0	1	2	ENM	N/A	$0=None $1=Shift Up $2=Shift Down $3=Neutral	
						Fuel Level Percent	1	7	8	UNM	0 - 100 %	E = N * 100/255	
						Engine Oil Pressure	2	7	8	UNM	0 - 1020 kPa	E = N * 4	
						Engine Hot / Stop Engine Indication On	3	7	1	BLN	N/A	$1=True; $0=False	
						Vehicle Top Speed Limitation Indication On	3	6	1	BLN	N/A	$1=True; $0=False	
						Transmission Skip Shift Indication On	3	5	1	BLN	N/A	$1=True; $0=False	
						Check Fuel Filler Cap Indication On	3	4	1	BLN	N/A	$1=True; $0=False	
						Engine Oil Starvation Indication On	3	3	1	BLN	N/A	$1=True; $0=False	
						Engine Oil Life Reset Performed	3	2	1	BLN	N/A	$1=True; $0=False	
						Throttle Progression Status	3	1	2	ENM	N/A	$0=Map A $1=Map B $2=Map C $3=ECM Selected Progression	
						Engine Water In Fuel Indication On	4	7	1	BLN	N/A	$1=True; $0=False	
						Diesel Glow Plug Indication On	4	6	1	BLN	N/A	$1=True; $0=False	
						Engine Boost Pressure Indication Validity	4	5	1	ENM	N/A	$0=Valid $1=Invalid	
						Powertrain Exhaust Particle Filter Warning Indication On	4	4	1	BLN	N/A	$1=True; $0=False	
						Powertrain High Electrical Load Request	4	3	1	BLN	N/A	$1=True; $0=False	
						Engine Emissions Related Malfunction Indication Request	4	2	3	ENM	N/A	$0=Continuous Indication $1=No Indication $2=Flashing 1 Hertz Indication $3=Flashing 2 Hertz Indication $4=Flashing 0.5 Hertz Indication	
						Engine Boost Pressure Indication	5	7	8	UNM	0 - 100 %	E = N * 100/255	
						Vehicle Top Speed Limit Value	6	7	8	UNM	0 - 255 km / h	E = N * 1	
							7	7	8				

Message	ID	Periodic Interval (ms)	Update Time (ms)	Supervision Timeout (ms)	Event Trigger	Signal	Start Byte	Start Bit	Length	Data Type	Range	Conversion	Transmitter
Transmission General Status	$320	100	25	250	X	Transmission Actual Gear Validity	0	7	1	ENM	N/A	$0=Valid $1=Invalid	TCM ECM[1]
						Transmission Gear Ratio Validity	0	6	1	ENM	N/A	$0=Valid $1=Invalid	
					X	Transmission Gear Selector Position Validity	0	5	1	ENM	N/A	$0=Valid $1=Invalid	
						Transmission Oil Temperature Validity	0	4	1	ENM	N/A	$0=Valid $1=Invalid	
					X	Transmission Performance Algorithm Shift Mode Active	0	3	1	BLN	N/A	$1=True; $0=False	
						All Wheel Drive Mode Active	0	2	1	BLN	N/A	$1=True; $0=False	
					X	Transmission Gear Shift Direction	0	1	2	ENM	N/A	$0=No Shift in Progress $1=Upshift in Progress $2=Downshift in Progress	
						Reserved for ETEI	1	7	1				
						Reserved for ETEI	1	6	1				
						Reserved for ETEI	1	5	1				
						Transmission Limp Home Mode Active	1	4	1	BLN	N/A	$1=True; $0=False	
					X	Transmission Actual Gear	1	3	4	ENM	N/A	$0=Shift in Progress $1=First Gear $2=Second Gear $3=Third Gear $4=Fourth Gear $5=Fifth Gear $6=Sixth Gear $7=Seventh Gear $8=Reverse $9=Neutral $A=Park	

Message	ID	Periodic Interval (ms)	Update Time (ms)	Supervision Timeout (ms)	Event Trigger	Signal	Start Byte	Start Bit	Length	Data Type	Range	Conversion	Transmitter
						Reserved for ETEI	2	7	1				
						Reserved for ETEI	2	6	1				
						Reserved for ETEI	2	5	1				
						Transmission Sport Shift Pattern Status	2	4	1	ENM	N/A	$0=Sport Shift Pattern Inactive $1=Sport Shift Pattern Active	
						Transmission Winter Mode Status	2	3	1	ENM	N/A	$0=Winter Mode Inactive $1=Winter Mode Active	
						Transmission Tap Up/Tap Down Mode Indication On	2	2	1	BLN	N/A	$1=True; $0=False	
						Reserved for ETEI	2	1	1				
						Reserved for ETEI	2	0	1				
						Transmission Gear Ratio	3	7	8	UNM	0 - 7.96875	E = N * 1/32	
						Transmission Trailering Shift Pattern Status	4	7	1	ENM	N/A	$0=Trailering Shift Pattern Inactive $1=Trailering Shift Pattern Active	
							4	6	1				
					X	Transmission Gear Selector Position	4	5	6	ENM	N/A	$00=Shift In Progress $01=First Gear $02=Second Gear $03=Third $04=Fourth Gear $05=Fifth Gear $06=Sixth Gear $07=Seventh Gear $08=Reverse $09=Neutral $0A=Park $0B=Drive $0C=Overdrive $0D=Intermediate $0E=Low $0F=Manual	
						Reserved for ETEI	5	7	8				
						Reserved for ETEI	6	7	8				
						Transmission Oil Temperature	7	7	8	UNM	-40 - 215 deg C	E = N * 1 - 40	

Message	ID	Periodic Interval (ms)	Update Time (ms)	Supervision Timeout (ms)	Event Trigger	Signal	Start Byte	Start Bit	Length	Data Type	Range	Conversion	Transmitter
Engine HVAC PTC and Gen Status	$348	250		625		Air Conditioning Refrigerant High Side Fluid Pressure Validity	0	7	1	ENM	N/A	$0=Valid $1=Invalid	ECM
						Generator Field Duty Cycle Validity	0	6	1	ENM	N/A	$0=Valid $1=Invalid	
							0	5	1				
						Air Conditioning Off Indication On	0	4	1	BLN	N/A	$1=True; $0=False	
						Air Conditioning Compressor Clutch Engaged	0	3	1	BLN	N/A	$1=True; $0=False	
						Engine Cylinder Deactivation Mode	0	2	2	ENM	N/A	$0=All Cylinders Active $1=Deactivation In Progress $2=Half of Total Cylinders Active $3=Reactivation In Progress	
						Outside Air Temperature Powertrain Estimated Validity	0	0	1	ENM	N/A	$0=Valid $1=Invalid	
						Air Conditioning Refrigerant High Side Fluid Pressure	1	7	8	UNM	0 - 3570 kPa	E = N * 14	
						Engine Cooling Fan Speed	2	7	8	UNM	0 - 100 %	E = N * 100/255	
						Generator Field Duty Cycle	3	7	8	UNM	0 - 100 %	E = N * 100/255	
							4	7	1				
							4	6	1				
							4	5	1				
						Outside Air Temperature Powertrain Estimated Mask	4	4	1	ENM	N/A	$0=Don't Use Data $1=Use Data	
						Instantaneous Fuel Consumption Rate	4	3	12	UNM	0 - 102.375 ltrs/hr	E = N * .025	
						Outside Air Temperature Powertrain Estimated	6	7	8	UNM	-40 to 87.5 °C	E = (N*0.5) - 40	

Message	ID	Periodic Interval (ms)	Update Time (ms)	Supervision Timeout (ms)	Event Trigger	Signal	Start Byte	Start Bit	Length	Data Type	Range	Conversion	Transmitter
Platform General Status 1	$380	25		62.5		Airbag Deployed	0	7	1	BLN	N/A	$1=True; $0=False	GW
						Cruise Control Set Switch Active	0	6	1	BLN	N/A	$1=True; $0=False	
						Cruise Control Resume Switch Active	0	5	1	BLN	N/A	$1=True; $0=False	
						Cruise Control Cancel Request	0	4	1	ENM	N/A	$0=Do Not Cancel $1=Cancel	
						Cruise Control On Switch Active	0	3	1	BLN	N/A	$1=True; $0=False	
						Cruise Control Switch Failed	0	2	1	BLN	N/A	$1=True; $0=False	
						Air Conditioning Compressor Clutch Request	0	1	2	ENM	N/A	$0=No Action $1=Engage $2=Disengage $3=Disengage Immediately	
						Transmission Electronic Range Select Mode Request	1	7	1	ENM	N/A	$0=Disable $1=Enable	
						Manual Transmission Reverse Gear Switch Virtual Device Availability	1	6	1	ENM	N/A	$0=Virtual Device Unavailable $1=Virtual Device Available	
						Remote Vehicle Start Request	1	5	1	ENM	N/A	$0=Remote Start Not Requested $1=Remote Start Requested	
						Power Mode Master Accessory Terminal Status	1	4	1	ENM	N/A	$0=Inactive $1=Active	
						Power Mode Master Run Crank Terminal Status	1	3	1	ENM	N/A	$0=Inactive $1=Active	
						Engine Coolant Level Low	1	2	1	BLN	N/A	$1=True; $0=False	
						System Power Mode	1	1	2	ENM	N/A	$0=Off $1=Accessory $2=Run $3=Crank Request	

Message	ID	Periodic Interval (ms)	Update Time (ms)	Supervision Timeout (ms)	Event Trigger	Signal	Start Byte	Start Bit	Length	Data Type	Range	Conversion	Transmitter
						Engine Oil Life Reset Request	2	7	1	BLN	N/A	$1=True; $0=False	
						Transmission Oil Life Reset Request	2	6	1	BLN	N/A	$1=True; $0=False	
						Backup Power Mode Master Virtual Device Availability	2	5	1	ENM	N/A	$0=Virtual Device Unavailable $1=Virtual Device Available	
						Park Brake Switch Active	2	4	1	BLN	N/A	$1=True; $0=False	
						Transmission Trailering Shift Pattern Request	2	3	1	ENM	N/A	$0=Deactivate Trailering Shift Pattern $1=Activate Trailering Shift Pattern	
						Energy Management Minimum Idle Boost Level Request	2	2	3	ENM	N/A	$0=No Boost Requested $1=Boost Level 1 $2=Boost Level 2 $3=Boost Level 3	
						Engine Cooling Fan Speed Adjustment	3	7	8	SNM	-100 - 99.2188 %	E = N * 200/256	
						Air Conditioning Compressor Present	4	7	1	BLN	N/A	$1=True; $0=False	
						Antilock Brake System Present	4	6	1	BLN	N/A	$1=True; $0=False	
						Traction Control System Present	4	5	1	BLN	N/A	$1=True; $0=False	
							4	4	1				
						Real Time Damping System Present	4	3	1	BLN	N/A	$1=True; $0=False	
						Transmission Winter Mode Request	4	2	1	ENM	N/A	$0=Deactivate Winter Mode $1=Activate Winter Mode	
						Transmission Sport Shift Pattern Request	4	1	1	ENM	N/A	$0=Deactivate Sport Shift Pattern $1=Activate Sport Shift Pattern	
						Transmission Tap Up/Tap Down Mode Request	4	0	1	ENM	N/A	$0=Disable $1=Enable	

Message	ID	Periodic Interval (ms)	Update Time (ms)	Supervision Timeout (ms)	Event Trigger	Signal	Start Byte	Start Bit	Length	Data Type	Range	Conversion	Transmitter
						System Backup Power Mode Enabled	5	7	1	BLN	N/A	$1=True; $0=False	
						System Backup Power Mode	5	6	2	ENM	N/A	$0=Off $1=Accessory $2=Run $3=Crank Request	
						Manual Transmission Reverse Gear Active Validity	5	4	1	ENM	N/A	$0=Valid $1=Invalid	
						Manual Transmission Reverse Gear Active	5	3	1	BLN	N/A	$1=True; $0=False	
							5	2	1				
						Throttle Progression Request	5	1	2	ENM	N/A	$0=Map A $1=Map B $2=Map C	
						Airbag Virtual Device Availability	6	7	1	ENM	N/A	$0=Virtual Device Unavailable $1=Virtual Device Available	
							6	6	1				
						Climate Control Virtual Device Availability	6	5	1	ENM	N/A	$0=Virtual Device Unavailable $1=Virtual Device Available	
						Outside Air Temperature Virtual Device Availability	6	4	1	ENM	N/A	$0=Virtual Device Unavailable $1=Virtual Device Available	
						Park Brake Virtual Device Availability	6	3	1	ENM	N/A	$0=Virtual Device Unavailable $1=Virtual Device Available	
						Vehicle Theft Deterrent Non Immobilizer Virtual Device Availability	6	2	1	ENM	N/A	$0=Virtual Device Unavailable $1=Virtual Device Available	
						Cruise Control Alive Rolling Count	6	1	2	UNM	0 - 3	E = N * 1	
							7	7	1				
							7	6	1				
							7	5	1				
						Engine Coolant Level Switch Virtual Device Availability	7	4	1	ENM	N/A	$0=Virtual Device Unavailable $1=Virtual Device Available	
						Cruise Control Switch Protection Value	7	3	4	UNM	0 - 15 N/A	E = N * 1	

Message	ID	Periodic Interval (ms)	Update Time (ms)	Supervision Timeout (ms)	Event Trigger	Signal	Start Byte	Start Bit	Length	Data Type	Range	Conversion	Transmitter
Vehicle Speed and Odometer	$410	100		250		Vehicle Speed Validity	0	7	1	ENM	N/A	$0=Valid $1=Invalid	ECM
						Distance Rolling Count Driven Wheel Validity	0	6	1	ENM	N/A	$0=Valid $1=Invalid	
						Distance Rolling Count Driven Wheel Reset Occurred	0	5	1	BLN	N/A	$1=True; $0=False	
							0	4	1				
							0	3	1				
							0	2	1				
							0	1	1				
							0	0	1				
						Vehicle Speed	1	7	16	UNM	0 - 511.992 km / h	E = N * 1/128	
						Distance Rolling Count Driven Wheel	3	7	16	UNM	0 - 1023.98 m	E = N * 1/64	
						Cruise Control Driver Selected Speed Active	6	4	1	BLN	N/A	$1=True; $0=False	
						Cruise Control Driver Selected Speed	6	3	12	UNM	0 – 255.9375 km / h	E = N * 1/16	
Engine Sensor Data	$510	500		1250		Engine Coolant Temperature Validity	0	7	1	ENM	N/A	$0=Valid $1=Invalid	ECM
						Engine Intake Air Temperature Validity	0	6	1	ENM	N/A	$0=Valid $1=Invalid	
						Barometric Pressure Absolute Validity	0	5	1	ENM	N/A	$0=Valid $1=Invalid	
						Reserved for ETEI	0	4	1				
							0	3	1				
							0	2	1				
						Engine Oil Change Now Indication On	0	1	1	BLN	N/A	$1=True; $0=False	
						Engine Oil Change Soon Indication On	0	0	1	BLN	N/A	$1=True; $0=False	
						Engine Coolant Temperature	1	7	8	UNM	-40 - 215 deg C	E = N * 1 - 40	
						Engine Intake Air Temperature	2	7	8	UNM	-40 - 215 deg C	E = N * 1 - 40	
						Fuel Capacity	3	7	16	UNM	0 - 255.996 liters	E = N * 1/256	
						Barometric Pressure Absolute	5	7	8	UNM	0 - 127.5 kPa	E = N * .5	
						Engine Oil Remaining Life	6	7	8	UNM	0 - 100 %	E = N * 100/255	
						Reserved for ETEI	7	7	8				

Message	ID	Periodic Interval (ms)	Update Time (ms)	Supervision Timeout (ms)	Event Trigger	Signal	Start Byte	Start Bit	Length	Data Type	Range	Conversion	Transmitter
Transmission Sensor Data	$520	100		250			0	7	1				TCM ECM[1]
						Transmission Change Oil Now Indication On	0	6	1	BLN	N/A	$1=True; $0=False	
						Service Transmission System Indication On	0	5	1	BLN	N/A	$1=True; $0=False	
						Transmission Hot Indication On	0	4	1	BLN	N/A	$1=True; $0=False	
						Transmission Gear Indication Validity	0	3	1	ENM	N/A	$0=Valid $1=Invalid	
						Transmission Shift Lever Lock Requested	0	2	1	BLN	N/A	$1 = True; $0 = False	
						Driver Shift Control Request Denied Indication On	0	1	1	BLN	N/A	$1=True; $0=False	
							0	0	1				
						Transmission Oil Remaining Life	1	7	8	UNM	0 - 100 %	E = N * 100/255	
						Transmission Gear Indication	2	7	6	ENM	N/A	$00=Shift In Progress $01=First Gear $02=Second Gear $03=Third Gear $04=Fourth Gear $05=Fifth Gear $06=Sixth Gear $07=Seventh Gear $08=Reverse $09=Neutral $0A=Park $0B=Drive $0C=Overdrive $0D=Intermediate $0E=Low $0F=Manual $10=Simulated Automatic $3F=Failure	
							2	1	1				
						All Wheel Drive Clutch Temperature Validity	2	0	1	ENM	N/A	$0 = Valid $1 = Invalid	
						All Wheel Drive Clutch Temperature	3	7	8	UNM	-40–215 degC	E = N * 1 - 40	

1 - transmitted by the ECM in applications with a manual transmission, due to the absence of the TCM

The following frames are reserved for ETEI: $124, $150, $151.

The following frames are reserved for Powertrain communications with the tester: $101, $5E8, $5EA, $7DF, $7E0, $7E2, $7E8, $7EA.

Notes:

The following list of messages are exclusively used by either Opel or Saab and are not shown in the recommended common framing model.

Air Conditioning Compressor Normalized Load, Air Conditioning Compressor Normalized Load Validity
Air Conditioning Compressor Stroke Request
Continuous Variable Transmission Present
Engine Oil Remaining Distance
Anticipated Electrical Load Estimation
Apply Brake Pedal Indication On
Clutch Start Switch Active, Clutch Start Switch Active Validity (may be needed by AWD module)
Distance Rolling Count Non Driven Wheel, Distance Rolling Count Non Driven Wheel Reset Occurred, Distance Rolling Count Non Driven Wheel Validity
Distance Rolling Count Left Non Driven Wheel, Distance Rolling Count Left Non Driven Wheel Reset Occurred, Distance Rolling Count Left Non Driven Wheel Validity
Distance Rolling Count Right Non Driven Wheel, Distance Rolling Count Right Non Driven Wheel Reset Occurred, Distance Rolling Count Right Non Driven Wheel Validity
Engine Emissions Related Malfunction Active
Engine System Regular Production Option Identifier
Powertrain Brake Pedal Discrete Input Status
Powertrain Brake Pedal Discrete Input Status Validity
Powertrain Brake Pedal Secondary Discrete Input Status
Powertrain Brake Pedal Secondary Discrete Input Status Validity
Powertrain Customer Snapshot Request
Powertrain Exhaust Particle Filter Warning Indication On
Powertrain High Electrical Load Request
Transmission Load Management Shift Pattern Request
Transmission Load Management Shift Pattern Status
Transmission Tap Up/Tap Down Request, Transmission Tap Up/Tap Down Request Validity
Vehicle Odometer, Vehicle Odometer Validity
Wheel Rotations Left Driven Rolling Count, Wheel Rotations Left Driven Rolling Count Reset Occurred, Wheel Rotations Left Driven Rolling Count Validity
Wheel Rotations Left Non Driven Rolling Count, Wheel Rotations Left Non Driven Rolling Count Reset Occurred, Wheel Rotations Left Non Driven Rolling Count Validity
Wheel Rotations Right Driven Rolling Count, Wheel Rotations Right Driven Rolling Count Reset Occurred, Wheel Rotations Right Driven Rolling Count Validity
Wheel Rotations Right Non Driven Rolling Count, Wheel Rotations Right Non Driven Rolling Count Reset Occurred, Wheel Rotations Right Non Driven Rolling Count Validity

The following list of new all wheel drive messages are exclusive to Saab and are not shown in the recommended common framing model.

All Wheel Drive Clutch Completely Open
All Wheel Drive Oil Temperature, All Wheel Drive Oil Temperature Validity

All Wheel Drive Overheated Indication On
All Wheel Drive System Failure Status
All Wheel Drive Torque Request Achievable
All Wheel Drive Transferred Torque, All Wheel Drive Transferred Torque Status, All Wheel Drive Transferred Torque Validity
Body Virtual Device Availability
Brake Pedal Driver Applied Pressure, Brake Pedal Driver Applied Pressure Validity
Engine Off Time, Engine Off Time Validity
Steering Wheel Angle, Steering Wheel Angle Validity
Transfer Case Non Emissions Related Malfunction Active
Vehicle Dynamics Alive Rolling Count
Vehicle Dynamics Control Enabled
Vehicle Dynamics Control Failed
Vehicle Dynamics Declutch Request, Vehicle Dynamics Declutch Request Validity
Vehicle Dynamics Over Under Steer, Vehicle Dynamics Over Under Steer Validity
Vehicle Dynamics Torque Transfer Request, Vehicle Dynamics Torque Transfer Request Protection, Vehicle Dynamics Torque Transfer Request Validity
Vehicle Dynamics Yaw Rate, Vehicle Dynamics Yaw Rate Validity
Wheel Angular Velocity High Resolution Front Left, Wheel Angular Velocity High Resolution Front Left Validity
Wheel Angular Velocity High Resolution Front Right, Wheel Angular Velocity High Resolution Front Right Validity
Wheel Angular Velocity High Resolution Rear Left, Wheel Angular Velocity High Resolution Rear Left Validity
Wheel Angular Velocity High Resolution Rear Right, Wheel Angular Velocity High Resolution Rear Right Validity

5.2.5 Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/ AUTHORIZATION
5.2.2, 5.2.3, 5.2.4 5.2.2, 5.2.3, 5.2.4	Removed Cruise Control Selected Speed from Signal Summary, Definition and Framing. Reserved Frame for ETEI $300 Byte 6 Bit 7 - The Cruise Control Selected Speed is now an ETEI signal. This frame space will be reserved for its use. Added GMLAN signals Cruise Control Driver Selected Speed and Cruise Control Driver Selected Speed Active to Signal Summary, Signal Definition and GMLAN frame $410 sections.	ICR 320
5.2.2, 5.2.3, 5.2.4	Added 'Air Conditioning Compressor Stroke Request' GMLAN Signal to signal summary list, definition and frame:	ICR 2009
5.2.3, 5.2.4	Revise Transmission Shift Lever Lock Requested signal data delay and power-up default values and add a Communication Failure Value.	ICR 2019
5.2.2, 5.2.3, 5.2.4	Added GMLAN Signals: Powertrain Exhaust Particle Filter Warning Indication On and Powertrain High Electrical Load Request to GMLAN Signal Summary, Signal Definition and Framing Sections.	ICR 2023
5.2.2, 5.2.3, 5.2.4	Added GMLAN signal "Driver Shift Control Request Denied Indication On" to GMLAN Signal Summary, GMLAN Signal Definitions section, and GMLAN Frame $520	ICR 2040
5.2.4	Removed GMLAN Signal 'Transmission Shift Lever Lock Requested' from Opel and Saab exclusive "non-common" framing list. Added GMLAN Signal 'Transmission Shift Lever Lock Requested' to common GMLAN Frame $540.	ICR 2044
5.2.1	Added Definition of Terms to PPEI 2, section 5.02. Added description to Definition of Terms for Periodic Interval, which explains that the interval specified in PPEI is the "maximum" allowable interval.	ICR 2056
5.2.2	Modified description of the GMLAN signal descriptions for "All Wheel Drive Clutch Temperature" and "All Wheel Drive Clutch	ICR 2058

 5.2.3 5.2.4	Temperature Validity” to make it more generic for use in VersaTrak applications. Added GMLAN signals “All Wheel Drive Clutch Temperature” and “All Wheel Drive Clutch Temperature Validity” to recommended common Frame $520. Removed GMLAN Signals “All Wheel Drive Clutch Temperature” and “All Wheel Drive Clutch Temperature Validity” from the…exclusive to Saab framing list.	
5.2.2 5.2.3 5.2.4	Added the following GMLAN signals: Engine Oil Temperature, Engine Oil Temperature Validity to signal summary list, signal definition and framed in $170.	ICR 2069
5.2.2 5.2.3 5.2.4	Added the following GMLAN signals to the signal summary list, signal definitions and framing: Outside Air Temperature Powertrain Estimated, Validity and Mask.	ICR 2071
5.2.2 5.2.3	For GMLAN signal “Engine Cooling Fan Speed”, added Section 2.16 to PPEI Section Number column and revised notes from “Optional” to “Required for RVC” Revise signal “Engine Cooling Fan Speed” Platform Interface description to add usage for “RVC calculations”.	ICR 2073
5.2.4	Revised framing for signals “Cruise Control Driver Selected Speed Active and Cruise Control Driver Selected Speed.” – moved from Byte 5 to Byte 6. Comment on GMLAN Signal Cruise Control Enabled changed from “Optional” to “Required with Cruise Control”.	ICR 2079
5.2.2 5.2.3 5.2.4	Updated GMLAN Signal Summary notes to state, “Optional with Diesel” for GMLAN Signals: Powertrain Exhaust Particle Filter Warning Indication On and Powertrain High Electrical Load Request. Update Powertrain and Platform Interface Definitions for GMLAN Signals: Powertrain Exhaust Particle Filter Warning Indication On and Powertrain High Electrical Load Request. Updated Data Delay to 525 ms. Added signals to unique framing list for Opel/Saab.	ICR 2096

5.2.2 5.2.3 5.2.4	Add new GMLAN signal "Engine Cylinder Deactivation Mode".	ICR 2106
5.2.3	Updated signal definitions for 'Air Conditioning Off Indication On' to add A/C protection to the list of items that can set this signal to "true".	ICR 2119
5.2.2	Added Vehicle Theft Deterrent to the GMLAN Signals Remote Vehicle Start Request and Remote Vehicle Start Engine Running.	ICR 2121
5.2	Added existing GMLAN Signal 'Engine System Regular Production Option Identifier' to the GMLAN signal summary table, signal definitions and GME framing sections.	ICR 2144
5.2.2	Updated TRANSMITTER for the Remote Vehicle Start Request FROM Powertrain TO Platform.	ICR 2153

6. APPENDIX

This section contains the following additional reference information for this specification:

6.1 PPEI Charter *(was removed for PPEI 2.4, PPEI Charter was for reference during the initial release of the GMW3119 PPEI Specification. Information contained in the PPEI Charter was archived for historical reference.)*

6.2 PPEI Rationale *(was removed for PPEI 2.4, PPEI Rationale is contained at the end of each PPEI Subsystem.)*

6.3 Interface Change Request (ICR) Form *(was removed for PPEI 2.4, ICRs are originated and maintained in the PPEI ICR Summary Database. Information on this database can be found in PPEI 2.4 Section 1.4 Document Control on page 1-2)*

6.4 Approved ICRs

6.5 PPEI Agreement Template

6.4 Approved Incident Change Requests (ICRs)

No.	Description
30	Brake switch diagnostic enhancement for PCM (included in version 1.0)
33	L-term interface
34	Clarify use of “Odometer Rolling Count” C2 message (7A-06)
40	Regulated Voltage Control
43	Cruise switch debounce
47	Fuel level input time constant
51	Cruise switch latency / debounce
900	Consolidate all cruise cancel criteria in Brakes Subsystem Section.
	Above Released with GMW3119 Version 1.1, March 18, 1999
35	Fuel Volume Algorithm
36	Brake Apply Sensing System (GMLAN only)
37	Remote Vehicle Start
38	Easy Key
50	AWD Serial Data Requirements
55	PPEI Agreement Template
56	Power Moding GMLAN Signals
57	Starter Control Algorithm Changes
58	BLS Input Circuit
59	Throttle Control Signals
63	SDM Flight Recorder Signals
64	Misc. GMLAN Signals / Interface Definitions
802	Sensor Input Time Constants
804	Fuel Level Sensor Impedance
805	BLS Source Voltage
806	Fuel-related Signals
807	TCS Protection Signals
902	OBD II / EOBD Requirements
	Above Released with GMW3119 Version 2.0, July 1, 1999
46	Define cluster pull-up voltage for MIL.
53	Add C2 message (32-20) and GMLAN signal for parking brake switch active.
60	Add optional C2 message (EA-29-9B) and optional GMLAN signal ‘Traction Control System Enabled’ to Section 2.4.
62	Add C2 message (D2-07) and GMLAN signal ‘Air Bag Deployed’ for ETC flight recorder usage.
67	Add C2 message (EA-20-76).
68	Add C2 message (EA-20-77).
70	Revise C2 message (EA-0A) state matrix to define additional 5^{th} & 6^{th} gear PRNDL states.
71	Update fuel sender graphic.
81	Prevent setting of communication trouble codes in Accessory mode.
87	Revise change trigger requirements for percent-based C2 messages.
93	Revise C2 message (3A-32).

No.	Description
94	Revise powertrain and platform interface definitions for GMLAN signal 'Accelerator Kickdown Detected'.
98	Correct definition of GMLAN signal 'Brake Pedal Initial Travel Achieved Protection' for Brake Apply Sensing System.
99	Correct definition of GMLAN signal 'Wheel Average Peak to Peak Acceleration'.
102	Clarify bit assignments for GMLAN signal 'Vehicle Security Non Immobilizer Powertrain Status'.
108	Correct Easy Key power moding block diagram for power and signal distribution.
110	Correct summary of GMLAN 'Wheel Angular Velocity' signals in PPEI Agreement Template.
112	Revise powertrain interface definitions for GMLAN signals 'Transmission Load Management Shift Pattern Request', 'Transmission Sport Shift Pattern Request', and 'Transmission Trailering Shift Pattern Request'.
808	Revise A/C compressor control algorithm.
809	Add GMLAN signal 'Transmission Gear Ratio'.
810	Delete GMLAN signals 'Transmission High Gear Start Request', 'Transmission High Gear Start Status', 'Transmission Winter Shift Pattern Request', and 'Transmission Winter Shift Pattern Status'. Add GMLAN signals 'Transmission Winter Mode Request' and 'Transmission Winter Mode Status'.
815	Redefine GMLAN signal 'Service Engine System Non Emission Related Indication On' as 'Service Engine System Non Emission Related Indication Request'.
904	Add GMLAN signal and revise signal descriptions for cruise control.
	Above Released with GMW3119 Version 2.1, Feb 18, 2000
73	Define C2 messages and associated hardware requirements for Brake Apply Sensing System..
74	Define C2 messages for Remote Start.
79	Add missing GMLAN signal 'Vehicle Security Non Immobilizer Password Status' for Vehicle Theft Deterrent. Correct GMLAN signal names to match signal database.
83	Define new serial data requirements for throttle position.
100	Add C2 message (3A-36) for traction control (Trans. Gear Shift Direction).
107	Clarify fuel volume determination algorithm for manual transmission applications.
113	Revise serial data interface for Tap-up / Tap-down.
119	Add GMLAN signal 'Throttle Decay Control'.
122	Revise powertrain interface definition for C2 message (FE-06).
125	Learn source ID and specify failsoft actions for C2 messages (32-03), (3A-33) and (48-0B).
126	Revise C2 message (32-2A) for Brake Apply Sensing System.
134	Revise C2 message (52-22) to add engines.
905	Revise range and resolution of GMLAN signal 'Air Conditioning Refrigerant Low Side Fluid Temperature Sensor '.
	Above Released with GMW3119 Version 2.2, May 11, 2000
48	Revise slip power algorithm for cooling fan control.
49	Delete lift/dive signal.
89	Add GMLAN signals for Real Time Damping.
91	Revise active transfer case diagnostic. Revise block diagrams.

No.	Description
92	Revise section to remove platform control of the secondary fuel pump to Powertrain.
97	Clarify description of distance rolling counters and associated primary/backup strategy utilized by Powertrain.
114	Add GMLAN signal ‘Engine Torque Reduction Failure Status’.
116	Correct Tap-up / Tap-down resistor tolerance.
118	Revise enable modes for C2 message (3A-03).
121	Revise change trigger for C2 message (0A-20). Clarify platform interface definition for GMLAN signal ‘Engine Intake Air Temperature’.
123	Clarify powertrain interface definitions for C2 messages (EA-20-BA), (EA-20-BD), (EA-20-D6), and (EA-20-BE).
124	Clarify powertrain interface definitions for GMLAN signals ‘Service Fuel System Indication On’ and ‘Service Transmission System Indication On’.
130	Delete GMLAN signals ‘Engine System Regular Production Option Identifier’ and ‘Automatic Transmission Present’.
131	Delete VIN message digits 2 – 9.
132	Revise GMLAN signal ‘Transmission Actual Gear’ and C2 message (3A-03).
136	Allow electronic transmissions shifts into Drive 2 and Drive 1 via TUTD switches.
137	Revise GMLAN signal ‘Transmission Gear Indication’ to allow PRNDL updates when TUTD shifts are performed when vehicle is stopped. Also add C2 messages (3A-0E) and (3A-0F).
139	Correct range and resolution of GMLAN signal ‘Vehicle Dynamics Lateral Acceleration’.
141	Revise A/C compressor control algorithm.
142	Specify use of GMLAN signal ‘Generator Field Duty Cycle’ and C2 message (72-20) as “Required with RVC”.
145	Add C2 identifiers for new engines.
147	Add RVC validity check requirements for intake air temperature and F-terminal duty cycle on C2 applications. Also reflect RVC requirement for intake air temperature during ACCESSORY mode.
148	Add RVC validity check requirements for intake air temperature and F-terminal duty cycle on GMLAN applications. Also reflect RVC requirement for intake air temperature during ACCESSORY mode.
149	Add RVC validity check requirement for L-terminal duty cycle to generator control algorithm.
150	Change GMLAN signal ‘Outside Air Temperature’ to ‘Outside Air Temperature Corrected Value’.
151	Delete GMLAN signals ‘Engine Oil Remaining Life Validity’ and ‘Transmission Oil Remaining Life Validity’ from Section 2.3.
153	Add automatic TUTD transmission option to C2 message (3A-3C).
154	Correct GMLAN signal ‘Traction Control Torque Request Protection’.
158	Miscellaneous document “clean-up”.
814	Add GMLAN signal ‘Engine Torque Traction Control Request Failed’.
818	Add GMLAN signals ‘Cruise Control Alive Rolling Count’ and ‘Cruise Control Switch Protection Value’.
819	Specify VDA bits and associated functional mapping for all GMLAN signals that are

No.	Description
	received by gateway module, sent to powertrain, and require powertrain failsofting.
903	Add GMLAN signals for transmission tap-up / tap-down via serial data.
	Above Released with GMW3119 Version 2.3, October 26, 2000
75	Revise fan control algorithm to address EV system requirements.
84	Add GMLAN signal 'Throttle Progression Request'
157	Add hardwire interface for EV fan control.
158	Miscellaneous document "clean-up."
233	Define battery as pull-up source for canister vent solenoid on EONV applications.
235	Add GMLAN signal 'Traction Torque Decay Control Active.'
236	Revise brake lamp load requirement in sections 2.7.3.3 and 2.7.5.2
237	Revise starter control algorithm to avoid unwanted cranks.
243	Revise L/F-term monitor algorithm.
245	Add GMLAN signal 'Engine Protection Mode – Oil Starvation.'
247	Add AIR valve relay to reflect new OBD2 requirements.
248	Revise section 2.1 to correct power moding specification reference and add serial data requirements for back-up power moding.
249	Add GMLAN signals 'Throttle Position' and 'Throttle Position Validity.'
254	Revise cooling fan control algorithm to reflect use of fan speed and rpm in calculations/calibration.
259	Revise starting system operation to prevent ECM use of discrete ignition signals to initiate engine cranking in backup power moding.
260	Revise Class 2 message 3A-31 trigger criteria.
261	Extend MinCrank time in the starter algorithm.
265	Add ECM-controlled Remote Vehicle Start back-up timer and calibration.
268	Revise RVS requirements in sections 2.5 and 4.1.
271	Modify EV fan algorithm diagnostic default speed and rate limit.
275	Algorithm change for manual transmission: add calibratable depress clutch crank enable feature.
292	Add new signal "Engine Oil Life Reset Indication On" to section 2.3
295	Correct discrepancy in PPEI 'Crank Abort' signal description verses Starter Control text description.
299	Revise section 2.6 (VTD) and the Theft specification to add "post release" mode.
300	Change enumeration value $3 for signal Engine Emissions Related Malfunction Indication Request to Flashing ½ Hertz Indication.
307	Define 4K PPM FailSafe Action if Vehicle Speed data is unavailable.
319	Revise checklist to correct hardwire signals for A/C Pressure Sensor.
322	Revise VSS Block Diagram in PPEI 2.3 Section 2.19 Vehicle Speed and Rough Road to indicate that ABS is used optionally as negotiated by Platform and Powertrain
826	Add GMLAN signal 'Engine Oil Life Remaining Mileage.'
828	Add GMLAN signal 'Continuous Variable Transmission Present.'
829	Add GMLAN signal 'Transmission Shift Lever Lock Request' – required for CVT
830	Add GMLAN signal 'Continuous Variable Transmission Present.'
832	Add GMLAN signal 'Brake Pedal Switch Active Validity Status
912	Add electronically controlled active transfer case (BLS hardwire interface and the GMLAN signals)

No.	Description
1000	Add GMLAN signal ‘Instantaneous Fuel Consumption Rate.’
1002	Add GMLAN signal ‘Throttle Progression Status.’
	Above Released with GMW3119 Version 2.4, August 20, 2002
303	Specific service parameter definitions should be eliminated from, or redefined in PPEI 2.5 for RVS.
314	Modify HVAC algorithm in 2.3 to protect compressor from high engine speeds. Changes will reflect 3.2 revision per ICR 294.
320	Cruise Control Driver Selected Speed resolution to 12 bits.
321	Revised mode triggers on Class 2 messages to support remote start applications.
325	Add criteria for RVS starter enable.
917	Revised Crank Request Processing Criteria for clarification
2009	Add GMLAN signal ´Air Conditioning Compressor Stroke Request´ to PPEI document.
2010	Add variable speed fuel pump and new algorithm to PPEI Version 2.5.
2011	Clarify requirements for Remaining Remote Starts DID - PPEI 2.5.
2019	Revise Transmission Shift Lever Lock Request signal.
2023	Diesel Particle Filter Extensions.
2030	Modify Fuel Level Algorithm to improve accuracy processing.
2031	Cooling Fan Algorithm Enhancements.
2040	Add Driver Shift Control Request Denied Indication On signal.
2044	Add GMLAN signal ´Transmission Shift Lever Lock Requested´ to PPEI 2.5 common framing.
2045	Modify PPEI to require the use of a Cruise Disable (Top of Travel) Clutch Switch in PPEI 2.x for North American Applications.
2052	Add Tap-Up/Tap-shift denied Class 2 message.
2056	Modify serial data section to include description that describes maximum time transmissions.
2058	Added GMLAN Signal “All Wheel Drive Clutch Temperature” and put in common frame, and Added Class-2 Message “Engine System Other – Calculated RDM Clutch Temperature ($52-26)”.
2069	Add GMLAN signal Engine Oil Temperature.
2071	Add GMLAN signal ‘Outside Air Temperature Powertrain Estimated’.
2073	Add Class II message: Engine Coolant - Fan 1 (All) Speed for RVC (Regulated Voltage Control) and GMLAN signal Engine Cooling Fan Speed
2079	Revise framing for ´Cruise Control Driver Selected Speed and Active´ signals
2080	Define functional relationship between engine load and EV fan load management in section 2.8.1.
2092	Modify A/C Clutch Control to account for Catalyst Monitor Diagnostic and EGR Quick Flow requirements for PPEI 2.5.
2096	Clarify Diesel Particulate Filter interface requirements defined in original ICR 2023.
2099	Enhance after-run fan control logic to support 2 coolant thresholds and 2 resultant fan speeds.
2102	Document that the Class 2 message $08/20 is used in Full Function TCS.
2103	Renamed Class 2 message $3A/$38 Transmission Gear Ratio in PPEI 2.5 for Traction Control.
2106	Create new Class 2 message to indicate engine cylinder deactivation is in progress. Add

No.	Description
	existing GMLAN signal ´Engine Cylinder Deactivation Mode´ to PPEI Version 2.5.
2110	Add Class 2 message Engine Oil – Fluid Temperature ($4A/$10).
2111	Add new Class 2 Message 'Outside Air Temperature Powertrain Estimated' to PPEI 2.5.
2113	Modified Remote Vehicle Start Monitor Algorithm.
2119	Updated existing PPEI 2.4 Class 2 and GMLAN signal 'Air Conditioning Compressor Off Indication On.
2121	Global PPEI Core Team Approval of the GMW3119 PPEI Version 2.5 Draft Documents for release.
2126	Add new serial data definition guidelines in PPEI 2.5.
2130	Add 6-Speed Clutch-to-Clutch Automatic Transmission Variants to Class 2 Message $3A/$3C Transmission Options Data Definition Table.
2131	Clarify Accessory hardwire requirements in Post Release mode for Starter.
2144	ECM Upgrade Protection.
2153	GMLAN Signal Remote Vehicle Start Request: Corrected Signal Summary Table to reflect Platform as the Transmitter.
2165	After-Run Cooling Fan Control based on Modeled Exhaust Temperature.
2178	Enhancements to Post Release for Starter Functionality.
2196	Added revision level "R03" to the GM Powertrain Rough Road Detection Algorithm Description (TL.17.0015.R03) for PPEI 2.x.
2209	Revise Starter Algorithm for Remote Starting.
	Above Released with GMW3119 Version 2.5, August 25, 2004

6.5 PPEI Agreement Template

The purpose of this section is to provide a summary of the PPEI hardwires, serial data signals and algorithm calibrations. It can be used as a means of documenting a particular vehicle's build event compliance with PPEI. Use of this template shall be by mutual agreement between Platform and Powertrain.

The Agreement Template is made up of three parts:
Part A: Class-2, Part B: GMLAN and Part C: Algorithm Calibrations.

Use of Part A or Part B is determined by the serial data link chosen for a vehicle's architecture. Part C is used for all vehicles.

6.5.a PPEI Agreement Template for Class-2 Systems (see page 6.5a-1)

6.5.b PPEI Agreement Template for GMLAN Systems (see page 6.5b-1)

6.5.c PPEI Agreement Template for Algorithm Calibrations (see page 6.5c-1)

6.5.1 Format of Template

Parts A and B are organized in the PPEI subsystem format. Each subsystem section is divided into Hardwire and Serial Data tables. For subsystems with more than one interface variation (e.g., cooling fans), each variation has a separate set of Hardwire and Serial Data tables. A check box is provided to indicate that a subsystem and/or its variant is applicable to a vehicle. Each hardwire and serial data signal has a column indicating the standard PPEI usage (normally Required or Optional). Yes/No check boxes are provided for each hardwire or serial data signal. A comments section is also provided.

Part C is organized by Algorithm Description section and provides a single line item for each calibration value. The owner of the calibration is reflected (Powertrain or Platform) is noted.

6.5.2 Meaning of "Used? Y/N" Columns

A "Y" indicates that a vehicle uses the hardwire or serial data signal as defined in PPEI.
Example: A vehicle uses the GMLAN signal Air Conditioning Compressor Clutch Request as defined in PPEI - Therefore, it is checked "Y".

A "N" indicates that a vehicle does not use the hardwire or serial data signal which is optional. It is also checked when a required hardwire or serial data signal is not used. It also is checked when a hardwire interface or serial data signal is used by the vehicle but not as defined by PPEI. The last two types are highly discouraged and should be clarified by using the comments section in the template.

Examples:

1. A vehicle doesn't have the optional Powertrain Relay - Therefore, the Powertrain Relay Output and Powertrain Relay Control are checked "N".

2. A vehicle doesn't use the standard Accessory hardwire - Therefore, it is checked "N" and a statement is added to the comments section explaining why the standard interface is not being used.
3. A vehicle uses the Fuel Level hardwire, but the pull-up voltage in the PCM is 12 volts rather than the specified 5 volts - Therefore, it is checked "N" and a statement is added to the comments section explaining the reason for the deviation from the standard interface.
4. A vehicle uses the Class 2 message $12/$11-Throttle Position Sensor but the min rep interval, Power-up default value or change trigger is different than specified in PPEI - Therefore, it is checked "N" and a statement is added to the comments explaining the reason for the deviation from the standard interface.

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2.1 Power and Signal Distribution

Used?

Y	N	Hardwire	Usage
		12 Volt (Battery)	Required
		Accessory	Required
		Engine Block Ground	Required
		Powertrain Relay Control	Optional
		Powertrain Relay Output	Optional
		Run/Crank Relay Output	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Network Control – System Power Modes	Required	Platform

Comments:

2.2 Transfer Case Controls

Manual Transfer Cases

Used?

Y	N	Hardwire	Usage
		4 WD Low	Required
		4 WD Mode	Required
		TC Speed Sensor	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$EA20E4 - Displays - Driver Notification - Four Wheel Drive	Required	Powertrain

Comments:

Active Transfer Cases

Push Button Control

Used?

Y	N	Hardwire	Usage
		4 WD Low	Required
		Clutch Start	Required with manual trans
		TC Speed Sensor	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$0822 - Engine Torque - Delivered Torque	Required	Powertrain
		$0A20 - Engine Air Intake - Intake Air Temperature	Required	Powertrain
		$1211 - Throttle Position Sensor - Pedal Position	Required	Powertrain
		$2802 - Vehicle Speed - High resolution - Metric	Required	Powertrain
		$3A02 - Transmission/Transaxle/PRNDL - Clutch Enable	Required with man transmission	Powertrain

		$3A03 - Transmission/Transaxle/PRNDL - Estimated Trans Gear Engaged	Required	Powertrain
		$3A05 - Transmission/Transaxle/PRNDL - Transfer Front Axle	Required	Platform
		$3A22 - Transmission/Transaxle/PRNDL - Transfer Case TPS Thresholds	Required	Platform
		$3A3C - Transmission/Transaxle/PRNDL - Transmission Options	Required	Powertrain
		$3A3D - Transmission/Transaxle/PRNDL - Tire/Axle Correction	Required	Powertrain
		$5204 - Engine System Other - Engine Run Flag	Required	Powertrain
		$5222 - Engine System Other - Engine Type	Required	Powertrain

Comments:

☐ **All Wheel Drive**

Used?

Y	N	Hardwire	Usage
		TC Speed Sensor	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$0822 - Engine Torque - Delivered Torque	Required	Powertrain
		$1211 - Throttle Position Sensor - Pedal Position	Required	Powertrain
		$2409 – Wheels – Individual Wheel Speeds	Required with Non-Truck AWD	Platform
		$2802 - Vehicle Speed - High resolution - Metric	Required	Powertrain
		$320A – Brakes – System Fault	Optional	Platform
		$3A02 - Transmission/Transaxle/PRNDL - Clutch Enable	Required with man transmission	Powertrain
		$3A03 - Transmission/Transaxle/PRNDL - Estimated Trans Gear Engaged	Required	Powertrain
		$3A22 - Transmission/Transaxle/PRNDL - Transfer Case TPS Thresholds	Required	Platform
		$3A35 – Transmission/Transaxle/PRNDL – Driven Wheel Configuration	Optional with Non-Truck AWD	Powertrain
		$3A3C - Transmission/Transaxle/PRNDL - Transmission Options	Required	Powertrain
		$3A3D - Transmission/Transaxle/PRNDL - Tire/Axle Correction	Required	Powertrain
		$5204 - Engine Run Flag	Required	Powertrain
		$5222 - Engine System Other - Engine Type	Required	Powertrain
		$5226 Engine System Other – Calculated RDM Clutch Temperature	Required with VersaTrak applications	Powertrain
		$E418 - Tires - Spare Status	Optional with Non-Truck AWD	Platform
		$EA20FE – Displays – Driver Notification – All Wheel Drive Disabled	Optional with Non-Truck AWD	Powertrain

Comments:

2.3 Display & Gauges

☐

Used?

Y	N	Hardwire	Usage
		MIL	Required
		Engine Speed	Optional
		Fuel Level	Required
		+5 Volt Fuel Level Return	Required
		Glow Plug	Optional

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$0A10 - Engine Air Intake - Intake Boost Pressure- Gage	Optional for supercharger	Powertrain
		$1A10 - Engine RPM - High Resolution	Required	Powertrain
		$2802 - Vehicle Speed - High Resolution - Metric	Required	Powertrain
		$3A0E - Transmission/Transaxle/PRNDL – Transmission Shift Solenoids State	Optional	Powertrain
		$3A0F - Transmission/Transaxle/PRNDL – Tap Up/Tap Down Target Gear	Optional	Powertrain
		$3A10 - Transmission/Transaxle/PRNDL - Fluid Temperature	Optional	Powertrain
		$3A14 - Transmission/Transaxle/PRNDL - Fluid Remaining Life	Optional	Powertrain
		$3A31 - Transmission/Transaxle/PRNDL - Performance Shift Mode	Optional	Powertrain
		$4810 - Engine Coolant - Fluid Temperature	Required	Powertrain
		$4A10 – Engine Oil – Fluid Temperature	Optional	Powertrain
		$4A11 - Engine Oil - Fluid Pressure	Optional	Powertrain
		$4A14 - Engine Oil - Fluid Remaining Life	Optional	Powertrain
		$5204 - Engine System Other - Engine Run Flag	Required	Powertrain
		$5222 - Engine System Other - Engine Type	Optional	Powertrain
		$5230 - Engine System Other - Displacement on Demand Status	Required with Displacement on Demand (DoD)	Powertrain
		$6210 - Vehicle Speed Control - Speed Limit Value	Optional with suspension control	Powertrain
		$7A01 - Odometer -Vehicle Metric	Optional	Platform
		$7A06 - Odometer -Rolling Count	Required	Powertrain
		$820A - Fuel System - Cumulative Fuel	Optional	Powertrain
		$8212 - Fuel System - Fuel Level - Percent (Filtered)	Required	Powertrain
		$8216 - Fuel System - Fuel Capacity Metric	Required	Powertrain
		$EA0A - Displays - PRNDL	Required with electronic PRNDL	Powertrain
		$EA2076 - Displays - Driver Notification - Transmission Shifts Delayed	Optional	Platform
		$EA2077 - Displays - Driver Notification - Engine Overspeed Warning	Optional	Platform
		$EA2081 - Displays - Driver Notification - Engine Oil Change Soon	Optional	Powertrain
		$EA2082 - Displays - Driver Notification - Engine Oil Change Now	Optional	Powertrain
		$EA2083 - Displays - Driver Notification - Engine Oil Low Pressure	Required	Powertrain
		$EA2084 - Displays - Driver Notification - Engine Oil Low Level	Optional	Powertrain
		$EA2085 - Displays - Driver Notification - Engine Hot/Stop Engine	Powertrain Optional	Powertrain
		$EA2088 - Displays - Driver Notification - Transmission Skip Skift	Optional	Powertrain
		$EA2089 - Displays - Driver Notification - Transmission Upshift	Optional	Powertrain
		$EA208C - Displays - Driver Notification - Vehicle Speed Control Active	Optional	Powertrain
		$EA208E - Displays - Driver Notification - Charging System/Generator Fault	See PPEI	Powertrain
		$EA208F - Displays - Driver Notification - Service Vehicle Soon	Optional	Powertrain
		$EA209D - Displays - Driver Notification - Engine Coolant Hot	Required	Powertrain
		$EA20AA - Displays - Driver Notification - Change Transmission Oil Now	Optional	Powertrain
		$EA20B4 - Displays - Driver Notification - A/C Off For Engine Protection	Optional	Powertrain
		$EA20B7 - Displays - Driver Notification - Reduced Engine Power	Required with ETC	Powertrain
		$EA20C3 - Displays - Driver Notification - Top Speed Fuel Cut Off	Optional	Powertrain
		$EA20CB - Displays - Driver Notification - Transmission Hot	Optional	Powertrain
		$EA20CC - Displays - Driver Notification - Check Gas Cap	Optional	Powertrain

		$EA20D5 - Displays - Driver Notification - Reduce Top Speed	Optional	Powertrain
		$EA20D6 - Displays - Driver Notification - Service Transmission	Optional	Powertrain
		$EA20D9 - Displays - Driver Notification - Water-in Fuel	Optional with Diesel	Powertrain
		$EA20E2 - Displays - Driver Notification - Generator indicator	See PPEI	Powertrain
		$EA20E4 - Displays - Driver Notification - Four Wheel Drive	See PPEI	Powertrain
		$EA20E7 - Displays - Driver Notification - Starting Disabled ETC	Optional	Powertrain
		$EA20F7 - Displays - Driver Notification - Tap Up/Tap Down Mode	Required with Tap Up/Tap Down	Powertrain
		$EA20FE - Displays - Driver Notification – All Wheel Drive Disabled	Optional for Non-Truck AWD	Powertrain
		$EA22A4 - Displays-Driver Notification-Tap Up/ Tap Down Request Denied	Optional with Tap Up/Tap Down	Powertrain

Comments:

2.4 Engine Power Management

Brake Torque Management

Used?

Y	N	Hardwire	Usage
		Ext Travel Brake Switch	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$322A – Brakes – Brake Pedal Status	Required with BASS with BTM	Platform
		$EA209B - Displays-Driver Notification-Traction Control System Off	Optional	Platform

Comments:

Platform Requested Idle Boost

Used?

Y	N	Hardwire	Usage

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$7426 - Electrical Energy Management - Requested Minimum Idle Boost Level	Required	Platform

Comments:

Misc Powertrain Functions

Used?

Y	N	Hardwire	Usage

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$4832 - Engine Coolant - Coolant Level	Powertrain Optional	Platform

		$F210 - Exterior Environment - Outside Air Temperature	Optional	Platform

Comments:

2.5 Starter System

Controlled Start

Used?

Y	N	Hardwire	Usage
		Accessory	Required
		Clutch Start	Required *1
		Engine Block Ground	Required
		Neutral Start	Required *2
		Run/Crank Relay Output	Required
		Starter Battery Feed	Required
		Starter Control	Required
		Starter Solenoid	Required

*1 GMNA vehicles only
*2 Only on Non-IMS trans

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$5214 – Remote Engine System Other - Remote Start Engine Run Flag	Required with RVS	Powertrain
		$8615 – Ignition Switch/Starter – Crank Aborted	Required with Easy Key and RVS	Powertrain
		$8618 – Ignition Switch/Starter – Remote Start Aborted	Required with RVS	Powertrain
		$8616 – Ignition Switch/Starter – Remote Start Crank	Required with RVS	Platform
		$9201 - Vehicle Security - Password	Required with GMNA VTD	Platform
		$9202 - Vehicle Security - Powertrain Status	Required with GMNA VTD	Powertrain
		$EA20E7 - Displays - Driver Notification - Starting Disabled ETC	Optional	Powertrain
		$FE06- Network Control - System Power Modes	Required	Platform

Comments:

2.6 Vehicle Theft

GMNA VTD

Used?

Y	N	Hardwire	Usage

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$9201 - Vehicle Security - Password	Required	Platform
		$9202 - Vehicle Security - Powertrain Status	Required	Powertrain

Comments:

2.7 Throttle Control

ETC no Cruise

Used?

Y	N	Hardwire	Usage
		Brake Lamp Switch	Required
		Cruise/ETC/TCC Brake	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$1211 - Throttle Position Sensor - Pedal Position	Required	Powertrain
		$2403 - Wheels - Wheel Reference Vehicle Speed Metric	See PPEI	Platform
		$320A - Brakes - System Fault	Required	Platform
		$3220 - Brakes - Parking Brake Active	Required with auto trailering mode	Platform
		$322A – Brakes – Brake Pedal Status	Required with BASS	Platform
		$D207 - Restraints - Airbags Deployed	Powertrain Optional with ETC	Platform
		$EA20B7 - Displays - Driver Notification - Reduced Engine Power	Required	Powertrain

Comments:

ETC with Cruise

Used?

Y	N	Hardwire	Usage
		+12V Cruise Mode	Required
		Brake Lamp Switch	Required
		Cruise Disable - Clutch	Optional
		Cruise/ETC/TCC Brake	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$1211 - Throttle Position Sensor - Pedal Position	Required	Powertrain
		$2403 - Wheels - Wheel Reference Vehicle Speed Metric	See PPEI	Platform
		$320A - Brakes - System Fault	Required	Platform
		$3220 - Brakes - Parking Brake Active	Required with auto trailering mode	Platform
		$322A – Brakes – Brake Pedal Status	Required with BASS	Platform
		$6202 - Vehicle Speed Control - Set Speed, Low Res Metric	Optional	Powertrain
		$6207 - Vehicle Speed Control - Cruise Cancel	Optional	Platform
		$D207 - Restraints - Airbags Deployed	Powertrain Optional with ETC	Platform
		$EA208C - Displays - Driver Notification - Vehicle Speed Control Active	Optional	Powertrain
		$EA20B7 - Displays - Driver Notification - Reduced Engine Power	Required	Powertrain

Comments:

Mechanical Throttle no Cruise

Used?

Y	N	Hardwire	Usage
		Brake Lamp Switch	Required on vehicles without BASS

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$1211 - Throttle Position Sensor - Pedal Position	Required	Powertrain
		$320A - Brakes - System Fault	Required	Platform
		$3220 - Brakes - Parking Brake Active	Required with auto trailering mode	Platform
		$322A – Brakes – Brake Pedal Status	Required with BASS	Platform

Comments:

☐ **Mechanical Throttle with Cruise**

Used?

Y	N	Hardwire	Usage
		+12V Cruise Mode	Required
		Brake Lamp Switch	Required
		Cruise Disable - Clutch	Optional
		Cruise/ETC/TCC Brake	Required
		Run/Crank Relay Output	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$1211 - Throttle Position Sensor - Pedal Position	Required	Powertrain
		$320A - Brakes - System Fault	Required	Platform
		$3220 - Brakes - Parking Brake Active	Required with auto trailering mode	Platform
		$322A – Brakes – Brake Pedal Status	Required with BASS	Platform
		$6202 - Vehicle Speed Control - Set Speed, Low Res Metric	Optional	Powertrain
		$6207 - Vehicle Speed Control - Cruise Cancel	Optional	Platform
		$EA208C - Displays - Driver Notification - Vehicle Speed Control Active	Optional	Powertrain

Comments:

2.8 Cooling Fan Control

☐ **Single Speed Fan**

Used?

Y	N	Hardwire	Usage
		Fan Control #1	Required
		A/C High-Side Pressure	Optional
		A/C High-Side Pressure Supply	Optional
		+5V Return	Optional

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$1410 - A/C Clutch - Clutch Permission	See PPEI	Platform
		$2802 - Vehicle Speed - High Resolution - Metric	Optional	Powertrain

		$4801 - Engine Coolant - Fan 1 (All) Speed	Optional	Powertrain
		$480B - Engine Coolant - Fan Speed Offset	Optional	Platform
		$EA209D - Displays - Driver Notification - Engine Coolant Hot	Required	Powertrain
		$EA20B4 - Displays - Driver Notification - A/C Off For Engine Protection	Optional	Powertrain

Comments:

Dual Speed Fan

Used?

Y	N	Hardwire	Usage
		Fan Control #1	Required
		Fan Control #2	Required
		A/C High-Side Pressure	Optional
		A/C High-Side Pressure Supply	Optional
		+5V Return	Optional

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$1410 - A/C Clutch - Clutch Permission	See PPEI	Platform
		$2802 - Vehicle Speed - High Resolution - Metric	Optional	Powertrain
		$4801 - Engine Coolant - Fan 1 (All) Speed	Optional	Powertrain
		$480B - Engine Coolant - Fan Speed Offset	Optional	Platform
		$EA209D - Displays - Driver Notification - Engine Coolant Hot	Required	Powertrain
		$EA20B4 - Displays - Driver Notification - A/C Off For Engine Protection	Optional	Powertrain

Comments:

Multiple Speed Fan

Used?

Y	N	Hardwire	Usage
		Fan Control #1	Required
		Fan Control #2	Required
		Fan Control #3	Required
		A/C High-Side Pressure	Optional
		A/C High-Side Pressure Supply	Optional
		+5V Return	Optional

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$1410 - A/C Clutch - Clutch Permission	See PPEI	Platform
		$2802 - Vehicle Speed - High Resolution - Metric	Optional	Powertrain
		$4801 - Engine Coolant - Fan 1 (All) Speed	Optional	Powertrain
		$480B - Engine Coolant - Fan Speed Offset	Optional	Platform
		$EA209D - Displays - Driver Notification - Engine Coolant Hot	Required	Powertrain
		$EA20B4 - Displays - Driver Notification - A/C Off For Engine Protection	Optional	Powertrain

Comments:

Variable Speed Fan

Electric PWM Fan

Used?

Y	N	Hardwire	Usage
		Fan Control #1	Required
		A/C High-Side Pressure	Optional
		A/C High-Side Pressure Supply	Optional
		+5V Return	Optional

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$1410 - A/C Clutch - Clutch Permission	See PPEI	Platform
		$2802 - Vehicle Speed - High Resolution - Metric	Optional	Powertrain
		$4801 - Engine Coolant - Fan 1 (All) Speed	Optional	Powertrain
		$480B - Engine Coolant - Fan Speed Offset	Optional	Platform
		$EA209D - Displays - Driver Notification - Engine Coolant Hot	Required	Powertrain
		$EA20B4 - Displays - Driver Notification - A/C Off For Engine Protection	Optional	Powertrain

Comments:

☐ **Engine Driven EV Fan**

Used?

Y	N	Hardwire	Usage
		Fan Control #1	Required
		Fan Control #2	Required
		Fan Speed Feedback	Optional
		Fan Speed Feedback Sensor Supply	Optional
		Fan Speed Feedback Sensor Return	Optional
		A/C High-Side Pressure	Optional
		A/C High-Side Pressure Supply	Optional
		+5V Return	Optional

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$1410 - A/C Clutch - Clutch Permission	See PPEI	Platform
		$2802 - Vehicle Speed - High Resolution - Metric	Optional	Powertrain
		$4801 - Engine Coolant - Fan 1 (All) Speed	Optional	Powertrain
		$480B - Engine Coolant - Fan Speed Offset	Optional	Platform
		$EA209D - Displays - Driver Notification - Engine Coolant Hot	Required	Powertrain
		$EA20B4 - Displays - Driver Notification - A/C Off For Engine Protection	Optional	Powertrain

Comments:

☐ **Engine Driven MRF Fan**

Used?

Y	N	Hardwire	Usage
		Fan Control #1	Required
		Fan Control #2	Required
		Fan Speed Feedback	Optional
		Fan Speed Feedback Sensor Supply	Optional
		Fan Speed Feedback Sensor Return	Optional
		A/C High-Side Pressure	Optional
		A/C High-Side Pressure Supply	Optional
		+5V Return	Optional

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$1410 - A/C Clutch - Clutch Permission	See PPEI	Platform
		$2802 - Vehicle Speed - High Resolution - Metric	Optional	Powertrain
		$4801 - Engine Coolant - Fan 1 (All) Speed	Optional	Powertrain
		$480B - Engine Coolant - Fan Speed Offset	Optional	Platform
		$EA209D - Displays - Driver Notification - Engine Coolant Hot	Required	Powertrain
		$EA20B4 - Displays - Driver Notification - A/C Off For Engine Protection	Optional	Powertrain

Comments:

2.9 Compressor Control

Cycling clutch fixed displacement or Pneumatic variable displacement

Used?

Y	N	Hardwire	Usage
		A/C High-Side Pressure	Optional
		A/C High-Side Pressure Supply	Optional
		+5V Return	Optional
		Clutch Control	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$1401 - A/C Clutch - Enable	Optional	Powertrain
		$1410 - A/C Clutch - Clutch Permission	Required	Platform
		$B211 - Climate Control (HVAC) - Fluid Pressure, High Side	Optional	Powertrain
		$B220 - Climate Control (HVAC) - Low Side Fluid Temp	Optional	Platform
		$B23C - Climate Control (HVAC) - A/C Options	Required*	Platform

* if A/C Optional on vehicle

Comments:

Electronically Controlled Compressor

Used?

Y	N	Hardwire	Usage
		Clutch Control	Optional
		A/C High-Side Pressure	Optional
		A/C High-Side Pressure Supply	Optional
		+5V Return	Optional

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$1401 - A/C Clutch - Enable	Optional	Powertrain
		$1410 - A/C Clutch - Clutch Permission	Required	Platform
		$B211 - Climate Control (HVAC) - Fluid Pressure, High Side	Optional	Powertrain
		$B220 - Climate Control (HVAC) - Low Side Fluid Temp	Optional	Platform
		$B23C - Climate Control (HVAC) - A/C Options	Required*	Platform

* if A/C Optional on vehicle

Comments:

2.10 Serial Data Architecture

Used?

Y	N	Hardwire	Usage
		Class 2 Bus	Required

		K Line	Required For EOBD Diagnostics

Comments:

Used?

Y	N	Miscellaneous Serial Data (not identified elsewhere)	Usage	Transmitter
		$0A20 - Engine Air Intake - Intake Air Temperature	Optional	Powertrain
		$1211 - Throttle Position - Pedal Position	Required with BASS	Powertrain
		$2802 - Vehicle Speed - High Resolution - Metric	Required with BASS	Powertrain
		$3A3C - Transmission/Transaxle/PRNDL - Transmission Options	Optional	Powertrain
		$5204 - Engine System Other - Engine Run Flag	Required	Powertrain
		$5221 - Engine System Other - Immediate Engine Snapshot n	Optional	Powertrain
		$EA0A - Displays - PRNDL	Required with BASS	Powertrain
		$F211 - Exterior Environment Barometric Pressure (Absolute)	Optional	Powertrain
		$FA03 - Vehicle ID (VIN) - VIN Packet 3 (digits 6-9)	Optional	Platform
		$FA04 - Vehicle ID (VIN) - VIN Packet 4 (digits 10-13)	Optional	Platform
		$FA05 - Vehicle ID (VIN) - VIN Packet 5 (digits 14-17)	Optional	Platform
		$FE03 - Network Control - Node Alive	Required	All
		$FE06 - Network Control - System Power Modes	Required	Platform

Comments:

2.11 Brakes Subsystems

☐ **Non ABS and ABS**

Used?

Y	N	Hardwire	Usage
		Engine Speed	Optional
		Rear Wheel Speed	Optional *

**Systems w/o rear wheel sensors

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$1A10 - Engine RPM - High Resolution	Required	Powertrain
		$2403 - Wheels - Wheel Reference Vehicle Speed Metric	Required	Platform
		$2405 - Wheels - Maximum Driven Wheel Velocity Metric	Optional	Platform
		$2407 - Wheels - Average Peak to Peak Acceleration (Rough Road)	See PPEI	Platform
		$2409 - Wheels - Individual Wheel Speeds	Required *[1]	Platform
		$2A3C - Traction Control - Options	Optional	Platform
		$3203 - Brakes - Variable Proportioning	Required	Platform
		$320A - Brakes - System Fault	Required	Platform
		$3222 - Brake Switch Active	Required for vehicles without BASS	Powertrain
		$323C - Brakes - Options	Required *[2]	Platform
		$3A35 - Transmission/Transaxle/PRNDL - Driven Wheel Configuration	See PPEI	Powertrain
		$E418 - Tires - Spare Status	See PPEI	Platform

*[1] Required on systems with 4 wheel speed sensors
*[2] Required on vehicles where ABS is optional

Comments:

Enhanced Traction Control (These are in addition to the ABS hardwires and signals above)

Used?

Y	N	Hardwire	Usage

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$0811 - Engine Torque - Wheel Slip Prevent Required Torque	See PPEI	Platform
		$0820 - Engine Torque - Driver Intended Torque	See PPEI	Powertrain
		$0821 - Engine Torque - Requested Torque	See PPEI	Platform
		$0822 - Engine Torque - Delivered Torque	See PPEI	Powertrain
		$1211 - Throttle Position Sensor - Pedal Position	Required	Powertrain
		$2A07 - Traction Control - Platform Temporary Inhibit of TCS	Required	Platform
		$2A0B - Traction Control - PT Traction Failure Status	Required	Powertrain
		$3A03 - Transmission/Transaxle/PRNDL - Estimated Trans Gear Engaged	Required	Powertrain
		$3A06 - Transmission/Transaxle/PRNDL - Commanded Gear	Required	Platform
		$3A36 - Transmission/Transaxle/PRNDL - Transmission Gear Shift Direction	Optional	Powertrain
		$3A3C - Transmission/Transaxle/PRNDL - Transmission Options	Required	Powertrain
		$5222 - Engine System Other - Engine Type	Required	Powertrain
		$EA0A - Displays - PRNDL	Required	Powertrain

Comments:

Traction Control System (These are in addition to the ABS hardwires and signals above)

Used?

Y	N	Hardwire	Usage
		Requested Torque (PWM)	Required
		Delivered Torque (PWM)	Required
		TCS Data Control Signal	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$0820 - Engine Torque-Driver Intended Torque	Optional	Powertrain
		$0A20 - Engine Air Intake - Intake Air Temperature	Required	Powertrain
		$1211 - Throttle Position Sensor - Pedal Position	Required	Powertrain
		$2A07 - Traction Control - Platform Temporary Inhibit of TCS	Required	Platform
		$2A09 - Traction Control - Initiate Engine Drag Control Test	Required	Powertrain
		$2A0B - Traction Control - PT Traction Failure Status	Required	Powertrain
		$3A03 - Transmission/Transaxle/PRNDL - Estimated Trans Gear Engaged	Required	Powertrain
		$3A0E - Transmission/Transaxle/PRNDL-Transmission Shift Solenoids State	Optional	Powertrain
		$3A36 - Transmission/Transaxle/PRNDL - Transmission Gear Shift Direction	Optional	Powertrain
		$3A38 - Transmission/Transaxle/PRNDL – Transmission Gear Ratio	Required for traction control with CVT	Powertrain
		$3A3C - Transmission/Transaxle/PRNDL - Transmission Options	Required	Powertrain
		$3A3D - Transmission/Transaxle/PRNDL - Tire/Axle Correction Factor	Optional	Powertrain
		$5222 - Engine System Other - Engine Type	Required	Powertrain
		$EA209B - Displays - Driver Notification - Traction Control System Off	Optional	Platform

Comments:

☐ **Vehicle Stability Enhancement System (These are in addition to the ABS and TCS signals above)**

Used?

Y	N	Hardwire	Usage

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$0820 - Engine Torque - Driver Intended Torque	Required	Powertrain
		$3206 - Brakes - Active Brake Control Active	Required	Platform
		$3224 - Brakes - Extended Travel Brake Switch	Optional for vehicles without BASS	Powertrain
		$8403 - Vehicle Motion - Actual Lateral Acceleration	Required for Performance Shift Algorithm	Platform

Comments:

2.12 Enhanced Evaporative Emissions and Fuel System

☐ **Fuel System**

Used?

Y	N	Hardwire	Usage
		Fuel Level	Required
		+5Volt Return	Required
		Fuel Pump Speed Control Diagnostics	Optional
		Primary Fuel Pump Control	Required
		Secondary Fuel Level	Optional *
		Secondary Fuel Pump Control	Optional*
		Service Engine Soon	Required

* Dual Fuel Tank Only

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$8212 - Fuel System - Fuel Level - Percent (Filtered)	Required	Powertrain
		$8216 - Fuel System - Fuel Capacity Metric	Required	Powertrain

Comments:

☐ **Enhanced Evap**

Used?

Y	N	Hardwire	Usage
		Fuel Tank Vapor Pressure	Required
		Fuel Tank Vapor Pressure Supply	Required
		+5 Volt Return	Required
		Canister Vent (wired to ☐Run/Crank or ☐ Battery)	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$EA20CC - Displays - Driver Notification - Check Gas Cap	Optional	Powertrain

Comments:

2.13 Exhaust After-Treatment

☐ **Air Injection Reaction (AIR)**

Used?

Y	N	Hardwire	Usage
		AIR Pump Command	Required
		AIR Pump Signal	Required
		AIR Valve Command	Required
		AIR Valve Signal	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter

Comments:

☐ **Electrically Heated Catalyst (EHC)**

Used?

Y	N	Hardwire	Usage
		EHC Command	Required
		EHC Voltage Sense	Required
		EHC Current Sense	Required
		EHC Analog Return	Required
		Generator High Voltage Output	Required
		L-Terminal Control	Required *

* See Section 2.16 for Details

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$5209 - Engine System Other - Electrically Heated Catalyst Status	Optional	Powertrain

Comments:

2.14 Suspension Control

☐

Used?

Y	N	Hardwire	Usage
		Lift/Dive	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$0A20 - Engine Air Intake - Intake Air Temperature	Required	Powertrain
		$2802 - Vehicle Speed - High Resolution - Metric	Required	Powertrain

		$580B - Suspension - Failure Status	Required	Platform
		$583C - Suspension - Suspension Options	Optional	Platform
		$6210 - Vehicle Speed Control - Speed Limit Value	Optional	Powertrain
		$EA20D5 - Displays - Driver Notification - Reduce Top Speed	Optional	Powertrain

Comments:

2.15 Transmission

☐ **Manual Transmissions**

Used?

Y	N	Hardwire	Usage
		Reverse Switch	Required
		Cruise Disable - Clutch	Optional

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$3A03 - Transmission/Transaxle/PRNDL - Estimated Trans Gear Engaged	Optional	Powertrain
		$EA2088 - Displays - Driver Notification - Transmission Skip Skift	Optional	Powertrain
		$EA2089 - Displays - Driver Notification - Transmission Upshift	Optional	Powertrain

Comments:

Automatic Transmissions

☐ **Transmissions with IMS**

Used?

Y	N	Hardwire	Usage
		Brake Lamp Switch	Required on vehicles without BASS
		Tap-up/Tap-down	Required with Tap up/Tap down

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$3222 - Brake Switch Active	Required on vehicles without BASS	Powertrain
		$322A – Brakes – Brake Pedal Status	Required with BASS	Platform
		$3A03 - Transmission/Transaxle/PRNDL - Estimated Trans Gear Engaged	Optional	Powertrain
		$3A0E - Transmission/Transaxle/ PRNDL -Transmission Shift Solenoids State	Optional	Powertrain
		$3A0F - Transmission/Transaxle/ PRNDL -Tap Up/Tap Down Target Gear	Optional	Powertrain
		$3A30 - Transmission/Transaxle/PRNDL - Shift Feel	Optional	Platform
		$3A31 - Transmission/Transaxle/PRNDL - Performance Shift Mode	Optional	Powertrain
		$3A32 - Transmission/Transaxle/PRNDL - Tap Up/Tap Down Mode Status	See note *[1]	Platform
		$3A33 - Transmission/Transaxle/PRNDL - Winter Mode Status	Optional	Platform
		$EA0A - Displays - PRNDL	Required	Powertrain
		$EA20F7 - Displays - Driver Notification - Tap Up/Tap Down Mode	See note*[1]	Powertrain
		$EA22A4 – Displays – Driver Notification – Tap Up/Tap Down Request Denied	Optional with Tap Up/Tap Down	Powertrain

*[1] Required with Tap up/Tap down

Comments:

Transmissions with NSBU

Used?

Y	N	Hardwire	Usage
		Brake Lamp Switch	Required on vehicles without BASS
		Park Only	Optional
		Reverse	Optional
		Tap-up / Tap-down	Required with Tap up/Tap down

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$3222 - Brake Switch Active	Required on vehicles without BASS	Powertrain
		$322A – Brakes – Brake Pedal Status	Required with BASS	Platform
		$3A03 - Transmission/Transaxle/PRNDL - Estimated Trans Gear Engaged	Optional	Powertrain
		$3A0E - Transmission/Transaxle/ PRNDL -Transmission Shift Solenoids State	Optional	Powertrain
		$3A0F - Transmission/Transaxle/ PRNDL -Tap Up/Tap Down Target Gear	Optional	Powertrain
		$3A30 - Transmission/Transaxle/PRNDL - Shift Feel	Optional	Platform
		$3A31 - Transmission/Transaxle/PRNDL - Performance Shift Mode	Optional	Powertrain
		$3A32 - Transmission/Transaxle/PRNDL - Tap Up/Tap Down Mode Status	See Note *[2]	Platform
		$3A33 - Transmission/Transaxle/PRNDL - Winter Mode Status	Optional	Platform
		$EA0A - Displays - PRNDL	See Note *[1]	Powertrain
		$EA20F7 - Displays - Driver Notification - Tap Up/Tap Down Mode	See Note *[2]	Powertrain
		$EA22A4 – Displays – Driver Notification – Tap Up/Tap Down Request Denied	Optional with Tap Up/Tap Down	Powertrain

*[1] Required on vehicles with electronic PRNDL
*[2] Required with Tap up/Tap down

Comments:

2.16 Generator Control

F-Term Monitor, L-Term Monitor

Used?

Y	N	Hardwire	Usage
		F - Terminal	Required
		L - Terminal	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$7220 - Charging System - Field Duty Cycle	Optional	Powertrain
		$EA208E - Displays - Driver Notification - Charging System/Generator Fault	Required *[1]	Powertrain
		$EA20E2 - Displays - Driver Notification - Generator indicator	Required *[1]	Powertrain

*[1] One of the two is required, the other is optional

Comments:

F-Term Monitor, L-Term Monitor, L-Term Control

Used?

Y	N	Hardwire	Usage
		F - Terminal	Required
		L - Terminal	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$7220 - Charging System - Field Duty Cycle	Optional	Powertrain
		$EA208E - Displays - Driver Notification - Charging System/Generator Fault	Required *[1]	Powertrain
		$EA20E2 - Displays - Driver Notification - Generator indicator	Required *[1]	Powertrain

*[1] One of the two is required, the other is optional

Comments:

F-Term Monitor, L-Term Monitor, L-Term Regulated Voltage Control (RVC)

Used?

Y	N	Hardwire	Usage
		F - Terminal	Required
		L - Terminal (PWM)	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$0A20 - Engine Air Intake - Intake Air Temperature	Required	Powertrain
		$4801 - Engine Coolant - Fan 1 (All) Speed	Required	Powertrain
		$7220 - Charging System - Field Duty Cycle	Required	Powertrain
		$7224 - Charging System - L Terminal Duty Cycle	Required	Platform
		$EA208E - Displays - Driver Notification - Charging System/Generator Fault	Required *[1]	Powertrain
		$EA20E2 - Displays - Driver Notification - Generator indicator	Required *[1]	Powertrain
		$F208 - Exterior Environment – Estimated Outside Air Temperature	Required	Powertrain

*[1] One of the two is required, the other is optional

Comments:

2.17 Supplemental Inflatable Restraints

Used?

Y	N	Hardwire	Usage
		Brake Lamp Switch	Required on vehicles without BASS

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$1211 - Throttle Position Sensor - Pedal Position	Required	Powertrain
		$1A10 - Engine RPM - High Resolution	Required	Powertrain

		$2802 - Vehicle Speed - High Resolution - Metric	Required	Powertrain
		$3222 - Brake Switch Active	Required on vehicles without BASS	Powertrain
		$D207 - Restraints-Airbags Deployed	Powertrain Optional with ETC	Platform

Comments:

2.18 Power Take-Off - Not Yet Defined

Used?

Y	N	Hardwire	Usage

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter

2.19 Vehicle Speed and Rough Road Sensing

GMNA Vehicles

Used?

Y	N	Hardwire	Usage
		4K PPM	Optional for Navigation Systems and Truck Up-Fitters

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		$2802 - Vehicle Speed - High Resolution - Metric	Required	Powertrain
		$7A06 - Odometer -Rolling Count	Required	Powertrain
		$2405 - Wheels - Maximum Driven Wheel Velocity Metric	Optional	Platform
		$2407 - Wheels - Average Peak to Peak Acceleration (Rough Road)	See PPEI	Platform

Comments:

Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
2.10	Added Fuel Pump Speed Control Diagnostics hardwire.	ICR 2010
2.3 2.15	Added Class 2 message “Displays – Driver Notification – Tap Up/Tap Down Request Denied” to Displays and Gauges section and the Transmission section for Automatic Transmissions with IMS and NSBU.	ICR 2052
2.2	Added Class 2 message “Engine System Other – Calculated RDM Clutch Temperature” $52/26 to the Class 2 Serial Data Link Table.	ICR 2058
2.16	Added Class 2 message “Engine Coolant - Fan 1 (All) Speed, $48/$01” to Generator Control Section for F-Term Monitor, L-Term Monitor, L-Term Regulated Voltage Control (RVC).	ICR 2073
2.11	Added Class 2 message “"Engine Torque-Driver Intended Torque" ($08/$20) to the Full Function TCS table.	ICR 2102
2.11	Added Class 2 message “Transmission/Transaxle/PRNDL-Transmission Gear Ratio” ($3A/$38).	ICR 2103
2.3	Added Class 2 Message “Engine System Other – Displacement on Demand Status ($52/$30)”.	ICR 2106
2.16	Added Class 2 message “Engine System Other – Estimated Outside Air Temperature ($F2/$08)” to Generator Control Section for F-	ICR 2111

	Term Monitor, L-Term Monitor, L-Term Regulated Voltage Control (RVC).	

2.1 Power and Signal Distribution

Used?

Y	N	Hardwire	Usage
		12 Volt (Battery)	Required
		Accessory	Required
		Engine Block Ground	Required
		Powertrain Relay Control	Optional
		Powertrain Relay Output	Optional
		Run/Crank Relay Output	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Backup Power Mode Master Virtual Device Availability	Required	Platform
		Power Mode Master Accessory Terminal Status	Powertrain Optional	Platform
		Power Mode Master Run Crank Terminal Status	Powertrain Optional	Platform
		System Backup Power Mode	Required	Platform
		System Backup Power Mode Enabled	Required for GMNA	Platform
		System Power Mode	Required for GMNA	Platform

Comments:

2.2 Transfer Case Controls

Manual Transfer Cases

Used?

Y	N	Hardwire	Usage
		4 WD Low	Required
		4 WD Mode	Required
		TC Speed Sensor	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		All Wheel Drive Mode Active	Required	Powertrain

Comments:

Active Transfer Cases

Push Button Control

Used?

Y	N	Hardwire	Usage
		4 WD Low	Required
		ATCCM MIL Request	Required
		Clutch Start	Required with manual trans
		TC Speed Sensor	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Accelerator Actual Position	Required	Powertrain
		Acceleration Actual Position Validity	Required	Powertrain
		Clutch Start Switch	Req'd with M/T	Powertrain
		Clutch Start Switch Validity	Req'd with M/T	Powertrain
		Engine Torque Actual	Required	Powertrain
		Engine Torque Actual Validity	Required	Powertrain
		Engine Intake Air Temperature	Required	Powertrain
		Engine Intake Air Temperature Validity	Required	Powertrain
		Engine Running Status	Required	Powertrain
		Transmission Actual Gear	Required	Powertrain
		Transmission Actual Gear Validity	Required	Powertrain
		Vehicle Speed	Required	Powertrain
		Vehicle Speed Validity	Required	Powertrain

Comments:

☐ **All Wheel Drive**

Used?

Y	N	Hardwire	Usage
		ATCCM MIL Request	Required
		TC Speed Sensor	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Accelerator Actual Position	Required	Powertrain
		Acceleration Actual Position Validity	Required	Powertrain
		Clutch Start Switch	Req'd with M/T	Powertrain
		Clutch Start Switch Validity	Req'd with M/T	Powertrain
		Engine Torque Actual	Required	Powertrain
		Engine Torque Actual Validity	Required	Powertrain
		Engine Running Status	Required	Powertrain
		Spare Tire Status	Optional with Non-Truck AWD	Platform
		Transmission Actual Gear	Required	Powertrain
		Transmission Actual Gear Validity	Required	Powertrain
		Vehicle Speed	Required	Powertrain
		Vehicle Speed Validity	Required	Powertrain

Comments:

☐ **Electronically Controlled Active Transfer Case**

Used?

Y	N	Hardwire	Usage
		Brake Lamp Switch	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		All Wheel Drive Clutch Completely Open	Required	Powertrain
		All Wheel Drive Clutch Temperature	Required	Powertrain
		All Wheel Drive Clutch Temperature Validity	Required	Powertrain
		All Wheel Drive Oil Temperature	Required	Powertrain
		All Wheel Drive Oil Temperature Validity	Required	Powertrain
		All Wheel Drive Overheated Indication On	Required	Powertrain
		All Wheel Drive System Failure Status	Required	Powertrain
		All Wheel Drive Torque Request Achievable	Required	Powertrain
		All Wheel Drive Transferred Torque	Required	Powertrain
		All Wheel Drive Transferred Torque Status	Required	Powertrain
		All Wheel Drive Transferred Torque Validity	Required	Powertrain
		Antilock Brake System Active	Required	Platform
		Body Virtual Device Availability	Required	Platform
		Brake Pedal Driver Applied Pressure	Required	Platform
		Brake Pedal Driver Applied Pressure Validity	Required	Platform
		Engine Off Time	Required	Platform
		Engine Off Time Validity	Required	Platform
		Park Brake Switch Active	Required	Platform
		Steering Wheel Angle	Required	Platform
		Steering Wheel Angle Validity	Required	Platform
		Traction Control System Active	Required	Platform
		Transfer Case Non Emissions Related Malfunction Active	Required	Powertrain
		Vehicle Dynamics Alive Rolling Count	Required	Platform
		Vehicle Dynamics Control Active	Required	Platform
		Vehicle Dynamics Control Enabled	Required	Platform
		Vehicle Dynamics Control Failed	Required	Platform
		Vehicle Dynamics Declutch Request	Required	Platform
		Vehicle Dynamics Declutch Request Validity	Required	Platform
		Vehicle Dynamics Over Under Steer	Required	Platform
		Vehicle Dynamics Over Under Steer Validity	Required	Platform
		Vehicle Dynamics Torque Transfer Request	Required	Platform
		Vehicle Dynamics Torque Transfer Request Protection	Required	Platform
		Vehicle Dynamics Torque Transfer Request Validity	Required	Platform
		Vehicle Dynamics Yaw Rate	Required	Platform
		Vehicle Dynamics Yaw Rate Validity	Required	Platform
		Wheel Angular Velocity High Resolution Front Left	Required	Platform
		Wheel Angular Velocity High Resolution Front Left Validity	Required	Platform
		Wheel Angular Velocity High Resolution Front Right	Required	Platform
		Wheel Angular Velocity High Resolution Front Right Validity	Required	Platform
		Wheel Angular Velocity High Resolution Rear Left	Required	Platform
		Wheel Angular Velocity High Resolution Rear Left Validity	Required	Platform
		Wheel Angular Velocity High Resolution Rear Right	Required	Platform
		Wheel Angular Velocity High Resolution Rear Right Validity	Required	Platform

Comments:

2.3 Display & Gauges

Used?

Y	N	Hardwire	Usage
		MIL	Required
		Engine Speed	Optional

		Fuel Level	Required
		+5 Volt Fuel Level Return	Required
		Glow Plug	Optional

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Air Conditioning Off Indication On	Platform Optional	Powertrain
		All Wheel Drive Mode Active	See PPEI	Powertrain
		All Wheel Drive Overheated Indication On	Required with Electronically Controlled Active Transfer Case	Powertrain
		Apply Brake Pedal Indication On	Platform Optional with cruise	Powertrain
		Check Fuel Filler Cap Indication On	Optional	Powertrain
		Continuous Variable Transmission Present	Required with CVT transmissions (GME use only)	Powertrain
		Cruise Control Active	Required with Cruise Control	Powertrain
		Cruise Control Driver Selected Speed	Required with Cruise Control	Powertrain
		Cruise Control Driver Selected Speed Active	Required with Cruise Control	Powertrain
		Cruise Control Enabled	Required with Cruise Control	Powertrain
		Diesel Glow Plug Indication On	Optional	Powertrain
		Distance Rolling Count Driven Wheel	Ref PPEI	Powertrain
		Distance Rolling Count Driven Wheel Reset Occurred	Ref PPEI	Powertrain
		Distance Rolling Count Driven Wheel Validity	Ref PPEI	Powertrain
		Distance Rolling Count Left Non Driven Wheel	Ref PPEI	Powertrain
		Distance Rolling Count Left Non Driven Wheel Reset Occurred	Ref PPEI	Powertrain
		Distance Rolling Count Left Non Driven Wheel Validity	Ref PPEI	Powertrain
		Distance Rolling Count Non Driven Wheel	Ref PPEI	Powertrain
		Distance Rolling Count Non Driven Wheel Reset Occurred	Ref PPEI	Powertrain
		Distance Rolling Count Non Driven Wheel Validity	Ref PPEI	Powertrain
		Distance Rolling Count Right Non Driven Wheel	Ref PPEI	Powertrain
		Distance Rolling Count Right Non Driven Wheel Reset Occurred	Ref PPEI	Powertrain
		Distance Rolling Count Right Non Driven Wheel Validity	Ref PPEI	Powertrain
		Driver Shift Control Request Denied Indication On	Optional for Tap Up/Tap Down	Powertrain
		Engine Boost Pressure Indication	Optional on Turbo	Powertrain
		Engine Boost Pressure Indication Validity	Optional on Turbo	Powertrain
		Engine Coast Fuel Cut Off Active	Optional	Powertrain
		Engine Coolant Hot Indication On	Required	Powertrain
		Engine Coolant Temperature	Required	Powertrain
		Engine Coolant Temperature Validity	Required	Powertrain
		Engine Cylinder Deactivation Mode	Required with Displacement on	Powertrain

			Demand (DoD)	
		Engine Emission Related Malfunction Indication Request	Optional	Powertrain
		Engine Hot/Stop Engine Indication On	Powertrain Optional	Powertrain
		Engine Limp Home Mode Active	Required with ETC	Powertrain
		Engine Oil Change Now Indication On	Optional	Powertrain
		Engine Oil Change Soon Indication On	Optional	Powertrain
		Engine Oil Level Low Indication On	Optional	Powertrain
		Engine Oil Life Reset Performed	Optional	Powertrain
		Engine Oil Life Reset Request	Optional	Platform
		Engine Oil Pressure	Optional	Powertrain
		Engine Oil Pressure Validity	Optional	Powertrain
		Engine Oil Pressure Low Indication On	Required	Powertrain
		Engine Oil Remaining Life	Optional	Powertrain
		Engine Oil Remaining Mileage	Optional (GME use only)	Powertrain
		Engine Oil Starvation Indication On	Optional	Powertrain
		Engine Oil Temperature	Optional	Powertrain
		Engine Oil Temperature Validity	Optional	Powertrain
		Engine Recommended Shift Indication	Optional	Powertrain
		Engine Running Status	Required	Powertrain
		Engine Speed	Required	Powertrain
		Engine Speed Validity	Required	Powertrain
		Engine Water In Fuel Indication On	Optional with diesel	Powertrain
		Fuel Capacity	Required	Powertrain
		Fuel Injected Rolling Count	Optional	Powertrain
		Fuel Injected Rolling Count Reset Occurred	Optional	Powertrain
		Fuel Level Percent	Required	Powertrain
		Fuel Level Percent Validity	Required	Powertrain
		Generator Failed	Required	Powertrain
		Instantaneous Fuel Consumption Rate	Required	Powertrain
		Powertrain Exhaust Particle Filter Warning Indication On	Optional with Diesel	Powertrain
		Powertrain High Electrical Load Requested	Optional with Diesel	Powertrain
		Service Engine System Non Emission Related Indication Request	Platform Optional	Powertrain
		Service Transmission System Indication On	Optional	Powertrain
		Starting Disabled Indication On	Platform Optional	Powertrain
		Throttle Progression Request	Optional	Platform
		Throttle Progression Status	Required	Powertrain
		Transmission Change Oil Now Indication On	Optional	Powertrain
		Transmission Gear Indication	Optional	Powertrain
		Transmission Gear Indication Validity	Optional	Powertrain
		Transmission Gear Selector Position	Required	Powertrain
		Transmission Gear Selector Position Validity	Required	Powertrain
		Transmission Hot Indication On	Optional	Powertrain
		Transmission Limp Home Mode Active	Optional	Powertrain
		Transmission Load Management Shift Pattern Status	Optional	Powertrain
		Transmission Oil Life Reset Request	Optional	Platform
		Transmission Oil Remaining Life	Optional	Powertrain
		Transmission Oil Temperature	Optional	Powertrain
		Transmission Oil Temperature Validity	Optional	Powertrain
		Transmission Performance Algorithm Shift Mode Active	Optional	Powertrain

		Transmission Skip Shift Indication On	Optional	Powertrain
		Transmission Sport Shift Pattern Status	Optional	Powertrain
		Transmission Tap Up/Tap Down Mode Indication On	Optional	Powertrain
		Transmission Trailering Shift Pattern Status	Optional	Powertrain
		Transmission Winter Mode Status	Optional	Powertrain
		Vehicle Odometer	Optional	Platform
		Vehicle Odometer Validity	Optional	Platform
		Vehicle Speed	Required	Powertrain
		Vehicle Speed Validity	Required	Powertrain
		Vehicle Top Speed Limit Value	Optional with Suspension Control	Powertrain
		Vehicle Top Speed Limitation Indication On	Required with Suspension Control	Powertrain

Comments:

2.4 Engine Power Management

☐ **Brake Torque Management**

Used?

Y	N	Hardwire	Usage
		Ext Travel Brake Switch	Required for vehicles without BASS

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Brake Pedal Moderate Travel Achieved	Required with BASS	Platform
		Brake Pedal Position Failure	Required with BASS	Platform
		Traction Control System Enabled	Optional	Platform

Comments:

☐ **Platform Requested Idle Boost**

Used?

Y	N	Hardwire	Usage

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Energy Management Minimum Idle Boost Level Request	Optional	Platform

Comments:

Misc Powertrain Functions

Used?

Y	N	Hardwire	Usage

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Anticipated Electrical Load Estimation	Optional	Platform
		Engine Coolant Level Low	Required with Premium V6	Platform
		Outside Air Temperature Corrected Value	Optional	Platform
		Outside Air Temperature Corrected Value Validity	Optional	Platform
		Powertrain Exhaust Particle Filter Warning Indication On	Optional with Diesel	Powertrain
		Powertrain High Electrical Load Requested	Optional with Diesel	Powertrain

Comments:

2.5 Starter System

Controlled Start

Used?

Y	N	Hardwire	Usage
		Accessory	Required
		Clutch Start	Required *1
		Engine Block Ground	Required
		Neutral Start	Required *2
		Run/Crank Relay Output	Required
		Starter Battery Feed	Required
		Starter Control	Required
		Starter Solenoid	Required

*1 GMNA vehicles only
*2 Only on Non-IMS trans

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Backup Power Mode Master Virtual Device Availability	Required	Platform
		Starting Disabled Indication On	Platform Optional	Powertrain
		System Backup Power Mode	Required	Platform
		System Backup Power Mode Enabled	Required	Platform
		System Power Mode	Required	Platform
		Vehicle Security Non Immobilizer Password	Required with Non-Immobilizer	Platform
		Vehicle Security Non Immobilizer Password Status	Required with Non-Immobilizer	Platform
		Vehicle Security Non Immobilizer Powertrain Status	Required with Non-Immobilizer	Powertrain
		Powertrain Crank Aborted	Required with	Powertrain

			Easy Key and RVS	
		Powertrain Run Aborted	Required with RVS	Powertrain
		Remote Vehicle Start Request	Required with Easy Key and RVS	Platform
		Remote Vehicle Start Engine Running	Required with RVS	Powertrain

Comments:

2.6 Vehicle Theft

GMNA VTD

Used?

Y	N	Hardwire	Usage

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Remote Vehicle Start Request	Required with Easy Key and RVS	Platform
		Remote Vehicle Start Engine Running	Required with Easy Key and RVS	Powertrain
		Vehicle Security Non Immobilizer Password	Required	Platform
		Vehicle Security Non Immobilizer Password Status	Required	Platform
		Vehicle Security Non Immobilizer Powertrain Status	Required	Powertrain

Comments:

Immobilizer

Used?

Y	N	Hardwire	Usage

Comments:

Used?

Y	N	Serial Data	Usage	Transmitters
		Immobilizer Information (see specification)	Required	Platform/ Powertrain

Comments:

2.7 Throttle Control

ETC no Cruise

Used?

Y	N	Hardwire	Usage
		Brake Lamp Switch	Required
		Cruise/ETC/TCC Brake	Required without BASS

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter

		Airbag Deployed	Powertrain optional	Platform
		Accelerator Actual Position	Required with BASS and SDM	Powertrain
		Accelerator Actual Position Validity	Required with BASS and SDM	Powertrain
		Accelerator Effective Position	Required for traction control. Required for ATC with active pushbutton control and Truck AWD.	Powertrain
		Accelerator Effective Position Validity	Required for traction control. Required for ATC with active pushbutton control and Truck AWD.	Powertrain
		Antilock Brake System Failed	Required w/ABS	Platform
		Brake Pedal Position Failure	Required with BASS	Platform
		Brake Pedal Position Rolling Count	Required with BASS	Platform
		Brake Pedal Initial Travel Achieved	Required with BASS	Platform
		Brake Pedal Initial Travel Achieved Protection	Required with BASS	Platform
		Engine Limp Home Mode Active	Required	Powertrain
		Powertrain Brake Pedal Discrete Input Status	Optional (GME use only)	Powertrain
		Powertrain Brake Pedal Discrete Input Status Validity	Optional (GME use only)	Powertrain
		Powertrain Brake Pedal Secondary Discrete Input	Optional (GME use only)	Powertrain
		Powertrain Brake Pedal Secondary Discrete Input Validity	Optional (GME use only)	Powertrain
		Wheel Angular Velocity Front Left	See PPEI	Platform
		Wheel Angular Velocity Front Left Validity	See PPEI	Platform
		Wheel Angular Velocity Front Right	See PPEI	Platform
		Wheel Angular Velocity Front Right Validity	See PPEI	Platform
		Wheel Angular Velocity Rear Left	See PPEI	Platform
		Wheel Angular Velocity Rear Left Validity	See PPEI	Platform
		Wheel Angular Velocity Rear Right	See PPEI	Platform
		Wheel Angular Velocity Rear Right Validity	See PPEI	Platform

Comments:

ETC with Cruise

Used?

Y	N	Hardwire	Usage
		Brake Lamp Switch	Required
		Cruise/ETC/TCC Brake	Required without BASS

		Cruise Disable - Clutch	Optional

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Airbag Deployed	Powertrain optional	Platform
		Accelerator Actual Position	Required for BASS and SDM	Powertrain
		Accelerator Actual Position Validity	Required for BASS and SDM	Powertrain
		Accelerator Effective Position	Required for traction control. Required for ATC with active pushbutton control and Truck AWD.	Powertrain
		Accelerator Effective Position Validity	Required for traction control. Required for ATC with active pushbutton control and Truck AWD.	Powertrain
		Antilock Brake System Failed	Required w/ABS	Platform
		Apply Brake Pedal Indication On	Platform Optional	Powertrain
		Brake Pedal Position Failure	Required with BASS	Platform
		Brake Pedal Position Rolling Count	Required with BASS	Platform
		Brake Pedal Initial Travel Achieved	Required with BASS	Platform
		Brake Pedal Initial Travel Achieved Protection	Required with BASS	Platform
		Cruise Control Active	Required	Powertrain
		Cruise Control Alive Rolling Count	Required	Platform
		Cruise Control Cancel Request	Optional	Platform
		Cruise Control Driver Selected Speed	Required	Powertrain
		Cruise Control Driver Selected Speed Active	Required	Powertrain
		Cruise Control Enabled	Required	Powertrain
		Cruise Control On Switch Active	Required	Platform
		Cruise Control Resume Switch Active	Required	Platform
		Cruise Control Set Switch Active	Required	Platform
		Cruise Control Switch Failed	Required	Platform
		Cruise Control Switch Protection Value	Required	Platform
		Engine Limp Home Mode Active	Required	Powertrain
		Powertrain Brake Pedal Discrete Input Status	Optional (GME use only)	Powertrain
		Powertrain Brake Pedal Discrete Input Status Validity	Optional (GME use only)	Powertrain
		Powertrain Brake Pedal Secondary Discrete Input	Optional (GME use only)	Powertrain
		Powertrain Brake Pedal Secondary Discrete Input Validity	Optional (GME use only)	Powertrain

		Wheel Angular Velocity Front Left	See PPEI	Platform
		Wheel Angular Velocity Front Left Validity	See PPEI	Platform
		Wheel Angular Velocity Front Right	See PPEI	Platform
		Wheel Angular Velocity Front Right Validity	See PPEI	Platform
		Wheel Angular Velocity Rear Left	See PPEI	Platform
		Wheel Angular Velocity Rear Left Validity	See PPEI	Platform
		Wheel Angular Velocity Rear Right	See PPEI	Platform
		Wheel Angular Velocity Rear Right Validity	See PPEI	Platform

Comments:

Mechanical Throttle no Cruise

Used?

Y	N	Hardwire	Usage
		Brake Lamp Switch	Required on vehicles without BASS

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Accelerator Actual Position	Required for BASS and SDM. Traction control	Powertrain
		Accelerator Actual Position Validity	Required for BASS and SDM. Traction control	Powertrain
		Antilock Brake System Failed	Required w/ABS	Platform
		Brake Pedal Position Failure	Required with BASS	Platform
		Brake Pedal Position Rolling Count	Required with BASS	Platform
		Brake Pedal Initial Travel Achieved	Required with BASS	Platform
		Brake Pedal Initial Travel Achieved Protection	Required with BASS	Platform

Comments:

Mechanical Throttle with Cruise

Used?

Y	N	Hardwire	Usage
		Brake Lamp Switch	Required
		Cruise/ETC/TCC Brake	Required
		Run/Crank Relay Output	Required
		Cruise Disable - Clutch	Optional

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Accelerator Actual Position	Required for BASS and SDM. Traction control	Powertrain
		Accelerator Actual Position Validity	Required for BASS and SDM. Traction control	Powertrain
		Antilock Brake System Failed	Required w/ABS	Platform
		Brake Pedal Position Failure	Required with	Platform

			BASS	
		Brake Pedal Position Rolling Count	Required with BASS	Platform
		Brake Pedal Initial Travel Achieved	Required with BASS	Platform
		Brake Pedal Initial Travel Achieved Protection	Required with BASS	Platform
		Cruise Control Active	Optional	Powertrain
		Cruise Control Alive Rolling Count	Required	Platform
		Cruise Control Cancel Request	Required	Platform
		Cruise Control Driver Selected Speed	Required	Powertrain
		Cruise Control Driver Selected Speed Active	Required	Powertrain
		Cruise Control Enabled	Required	Powertrain
		Cruise Control On Switch Active	Required	Platform
		Cruise Control Resume Switch Active	Required	Platform
		Cruise Control Set Switch Active	Required	Platform
		Cruise Control Switch Failed	Required	Platform
		Cruise Control Switch Protection Value	Required	Platform
		Press Brakes Indication On	Platform Optional	Powertrain

Comments:

2.8 Cooling Fan Control

☐ **Single Speed Fan**

Used?

Y	N	Hardwire	Usage
		Fan Control #1	Required
		A/C High-Side Pressure	Optional
		A/C High-Side Pressure Supply	Optional
		+5V Return	Optional

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Air Conditioning Compressor Clutch Request	Required with A/C	Platform
		Air Conditioning Off Indication On	Optional	Powertrain
		Engine Coolant Hot Indication On	Required	Powertrain
		Engine Cooling Fan Speed	Optional	Powertrain
		Engine Cooling Fan Speed Adjustment	Optional	Platform
		Vehicle Speed	Optional	Powertrain
		Vehicle Speed Validity	Optional	Powertrain

Comments:

☐ **Dual Speed Fan**

Used?

Y	N	Hardwire	Usage
		Fan Control #1	Required
		Fan Control #2	Required
		A/C High-Side Pressure	Optional
		A/C High-Side Pressure Supply	Optional
		+5V Return	Optional

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Air Conditioning Compressor Clutch Request	Required with A/C	Platform
		Air Conditioning Off Indication On	Optional	Powertrain
		Engine Coolant Hot Indication On	Required	Powertrain
		Engine Cooling Fan Speed	Optional	Powertrain
		Engine Cooling Fan Speed Adjustment	Optional	Platform
		Vehicle Speed	Optional	Powertrain
		Vehicle Speed Validity	Optional	Powertrain

Comments:

☐ **Multiple Speed Fan**

Used?

Y	N	Hardwire	Usage
		Fan Control #1	Required
		Fan Control #2	Required
		Fan Control #3	Required
		A/C High-Side Pressure	Optional
		A/C High-Side Pressure Supply	Optional
		+5V Return	Optional

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Air Conditioning Compressor Clutch Request	Required with A/C	Platform
		Air Conditioning Off Indication On	Optional	Powertrain
		Engine Coolant Hot Indication On	Required	Powertrain
		Engine Cooling Fan Speed	Optional	Powertrain
		Engine Cooling Fan Speed Adjustment	Optional	Platform
		Vehicle Speed	Optional	Powertrain
		Vehicle Speed Validity	Optional	Powertrain

Comments:

Variable Speed Fan

☐ **Electric PWM Fan**

Used?

Y	N	Hardwire	Usage
		Fan Control #1	Required
		A/C High-Side Pressure	Optional
		A/C High-Side Pressure Supply	Optional
		+5V Return	Optional

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Air Conditioning Compressor Clutch Request	Required with A/C	Platform
		Air Conditioning Off Indication On	Optional	Powertrain
		Engine Coolant Hot Indication On	Required	Powertrain
		Engine Cooling Fan Speed	Optional	Powertrain
		Engine Cooling Fan Speed Adjustment	Optional	Platform
		Vehicle Speed	Optional	Powertrain
		Vehicle Speed Validity	Optional	Powertrain

Comments:

☐ **Engine Driven EV Fan**

Used?

Y	N	Hardwire	Usage
		Fan Control #1	Required
		Fan Control #2	Required
		Fan Speed Feedback	Optional
		Fan Speed Feedback Sensor Supply	Optional
		Fan Speed Feedback Sensor Return	Optional
		A/C High-Side Pressure	Optional
		A/C High-Side Pressure Supply	Optional
		+5V Return	Optional

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Air Conditioning Compressor Clutch Request	Required with A/C	Platform
		Air Conditioning Off Indication On	Optional	Powertrain
		Engine Coolant Hot Indication On	Required	Powertrain
		Engine Cooling Fan Speed	Optional	Powertrain
		Engine Cooling Fan Speed Adjustment	Optional	Platform
		Vehicle Speed	Optional	Powertrain
		Vehicle Speed Validity	Optional	Powertrain

Comments:

☐ **Engine Driven MRF Fan**

Used?

Y	N	Hardwire	Usage
		Fan Control #1	Required
		Fan Control #2	Required
		Fan Speed Feedback	Optional
		Fan Speed Feedback Sensor Supply	Optional
		Fan Speed Feedback Sensor Return	Optional
		A/C High-Side Pressure	Optional
		A/C High-Side Pressure Supply	Optional
		+5V Return	Optional

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Air Conditioning Compressor Clutch Request	Required with A/C	Platform
		Air Conditioning Off Indication On	Optional	Powertrain
		Engine Coolant Hot Indication On	Required	Powertrain
		Engine Cooling Fan Speed	Optional	Powertrain
		Engine Cooling Fan Speed Adjustment	Optional	Platform
		Vehicle Speed	Optional	Powertrain
		Vehicle Speed Validity	Optional	Powertrain

Comments:

2.9 Compressor Control

☐ **Cycling clutch fixed displacement or Pneumatic variable displacement**

Used?

Y	N	Hardwire	Usage
		Clutch Control	Required
		A/C High-Side Pressure	Optional
		A/C High-Side Pressure Supply	Optional
		+5V Return	Optional

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Air Conditioning Compressor Clutch Engaged	Optional	Powertrain
		Air Conditioning Compressor Clutch Request	Required	Platform
		Air Conditioning Compressor Off Indication On	Required	Powertrain
		Air Conditioning Compressor Present	Required *	Platform
		Air Conditioning Compressor Stroke Request	Required with clutchless AC, GME only	Powertrain
		Air Conditioning Refrigerant High Side Fluid Pressure	Optional	Powertrain
		Air Conditioning Refrigerant High Side Fluid Pressure Validity	Optional	Powertrain
		Air Conditioning Refrigerant Low Side Fluid Temperature	Optional	Platform
		Air Conditioning Refrigerant Low Side Fluid Temperature Validity	Optional	Platform

* if A/C Optional on vehicle

Comments:

☐ **Electronically Controlled Compressor**

Used?

Y	N	Hardwire	Usage
		Clutch Control	Optional
		A/C High-Side Pressure	Optional
		A/C High-Side Pressure Supply	Optional
		+5V Return	Optional

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Air Conditioning Compressor Clutch Engaged	Optional	Powertrain
		Air Conditioning Compressor Clutch Request	Optional?	Platform
		Air Conditioning Compressor Normalized Load	Required with ECVD (GME use only)	Platform
		Air Conditioning Compressor Normalized Load Validity	Required with ECVD (GME use only)	Platform
		Air Conditioning Compressor Off Indication On	Required	Powertrain
		Air Conditioning Compressor Present	Required *	Platform
		Air Conditioning Compressor Stroke Request	Required with clutchless AC, GME only	Powertrain
		Air Conditioning Refrigerant High Side Fluid Pressure	Optional	Powertrain
		Air Conditioning Refrigerant High Side Fluid Pressure Validity	Optional	Powertrain
		Air Conditioning Refrigerant Low Side Fluid Temperature	Optional	Platform
		Air Conditioning Refrigerant Low Side Fluid Temperature Validity	Optional	Platform

* if A/C Optional on vehicle

Comments:

2.10 Serial Data Architecture

Used?

Y	N	Hardwire	Usage
		Hi Speed CAN bus	Required
		K Line	Required For EOBD Diagnostics

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Airbag System Virtual Device Availability	See PPEI	Platform
		Barometric Pressure Absolute	Optional	Powertrain
		Barometric Pressure Absolute Validity	Optional	Powertrain
		Climate Control Virtual Device Availability	See PPEI	Platform
		Engine Coolant Level Switch Virtual Device Availability	See PPEI	Platform
		Engine Intake Air Temperature	Optional	Powertrain
		Engine Intake Air Temperature Validity	Optional	Powertrain
		Engine Running Status	Required	Powertrain
		Engine System Regular Production Option Identifier	Optional use for GME Only (vehicles sold in non-North American markets)	Platform
		Manual Transmission Reverse Gear Switch Virtual Device Availability	See PPEI	Platform
		Outside Air Temperature Virtual Device Availability	See PPEI	Platform
		Powertrain Customer Snapshot Request	Optional	Platform
		System Power Mode	Required	Platform
		Vehicle Identification Number Digits 10-17	Optional	Platform
		Vehicle Theft Deterrent Non Immobilizer Virtual Device Availability	See PPEI	Platform

Comments:

2.11 Brakes Subsystems

Non ABS and ABS

Used?

Y	N	Hardwire	Usage
		Rear Wheel Speed	Optional *

* Systems w/o rear wheel sensors

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Antilock Brake System Active	Required *1	Platform
		Antilock Brake System Failed	Required *1	Platform
		Antilock Brake System Present	Required for platforms with optional ABS	Platform
		Brake Pedal Switch Active	Required for vehicles without BASS	Powertrain

		Brake Pedal Switch Active Validity	Required for vehicles without BASS	Powertrain
		Powertrain Brake Pedal Discrete Input Status	Optional (GME use only)	Powertrain
		Powertrain Brake Pedal Discrete Input Status Validity	Optional (GME use only)	Powertrain
		Powertrain Brake Pedal Secondary Discrete Input	Optional (GME use only)	Powertrain
		Powertrain Brake Pedal Secondary Discrete Input Validity	Optional (GME use only)	Powertrain
		Spare Tire Status	See PPEI	Platform
		Wheel Angular Velocity Front Left	Required	Platform
		Wheel Angular Velocity Front Left Validity	Required	Platform
		Wheel Angular Velocity Front Right	Required	Platform
		Wheel Angular Velocity Front Right Validity	Required	Platform
		Wheel Angular Velocity Rear Left	Required	Platform
		Wheel Angular Velocity Rear Left Validity	Required	Platform
		Wheel Angular Velocity Rear Right	Required	Platform
		Wheel Angular Velocity Rear Right Validity	Required	Platform
		Wheel Average Peak to Peak Acceleration	See PPEI	Platform
		Wheel Average Peak to Peak Acceleration Validity	See PPEI	Platform
		Wheel Speed Sensing Diagnostics Completed	Required	Platform

*[1] Required for GMNA

Comments:

☐ **Traction Control System (These are in addition to the ABS hardwires and signals above)**

Used?

Y	**N**	**Hardwire**	**Usage**

Comments:

Used?

Y	**N**	**Serial Data**	**Usage**	**Transmitter**
		Accelerator Actual Position	Required	Powertrain
		Accelerator Actual Position Validity	Required	Powertrain
		Accelerator Effective Position	Required	Powertrain
		Accelerator Effective Position Validity	Required	Powertrain
		Accelerator Kick Down Detected	Auto Trans only	Powertrain
		Cruise Control Clutch Switch Active	Optional on Man Trans	Powertrain
		Cruise Control Clutch Switch Active Validity	Optional on Man Trans	Powertrain
		Engine Calculated Actual Gear	Optional	Powertrain
		Engine Calculated Actual Gear Validity	Optional	Powertrain
		Engine Coolant Temperature	Required	Powertrain
		Engine Coolant Temperature Validity	Required	Powertrain
		Engine Intake Air Temperature	Required	Powertrain
		Engine Intake Air Temperature Validity	Required	Powertrain
		Engine Running Status	Required	Powertrain
		Engine Speed	Required	Powertrain
		Engine Speed Validity	Required	Powertrain
		Engine System Regular Production Option Identifier	Required	Powertrain
		Engine Torque Actual	Required	Powertrain

		Engine Torque Actual Validity	Required	Powertrain
		Engine Torque Driver Requested	Required	Powertrain
		Engine Torque Driver Requested Validity	Required	Powertrain
		Engine Torque Maximum	Required	Powertrain
		Engine Torque Maximum Validity	Required	Powertrain
		Engine Torque Minimum	Required	Powertrain
		Engine Torque Minimum Validity	Required	Powertrain
		Engine Torque Reduction Failed	Required	Powertrain
		Engine Torque Reduction Failure Status	Required	Powertrain
		Engine Torque Traction Control Request Failed	Required	Powertrain
		Traction Control Alive Rolling Count	Required	Platform
		Traction Control System Active	Required	Platform
		Traction Control System Enabled	Required	Platform
		Traction Control System Failed	Required	Platform
		Traction Control System Present	Required	Platform
		Traction Control Torque Request	Required	Platform
		Traction Control Torque Request Protection	Required	Platform
		Traction Control Torque Request Validity	Required	Platform
		Traction Torque Decay Control	Optional	Powertrain
		Traction Torque Decay Control Active	Required	Platform
		Transmission Actual Gear	Required	Powertrain
		Transmission Actual Gear Validity	Required	Powertrain
		Transmission Gear Ratio	Required with CVT transmission	Powertrain
		Transmission Gear Ratio Validity	Required with CVT transmission	Powertrain
		Transmission Gear Selector Position	Required	Powertrain
		Transmission Gear Selector Position Validity	Required	Powertrain
		Transmission Gear Shift Direction	Required	Powertrain

Comments:

Vehicle Stability Enhancement System (These are in addition to the ABS and TCS signals above)

Used?

Y	N	Hardwire	Usage

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Brake Extended Travel Switch Active	Optional for vehicles without BASS	Powertrain
		Brake Extended Travel Switch Active Validity	Optional for vehicles without BASS	Powertrain
		Vehicle Dynamics Lateral Acceleration	Required	Platform
		Vehicle Dynamics Lateral Acceleration Validity	Required	Platform
		Vehicle Dynamics Control Active	Required	Platform

Comments:

2.12 Enhanced Evaporative Emissions and Fuel System

☐ **Fuel System**

Used?

Y	N	Hardwire	Usage
		Fuel Level	Required
		+5Volt Return	Required
		Fuel Pump Speed Control Diagnostics	Optional
		Primary Fuel Pump Control	Required
		Secondary Fuel Level	Optional *
		Secondary Fuel Pump Control	Optional *
		Service Engine Soon	Required

* Dual Fuel Tank Only

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Fuel Capacity	Required	Powertrain
		Fuel Level Percent	Required	Powertrain
		Fuel Level Percent Validity	Required	Powertrain

Comments:

☐ **Enhanced Evap**

Used?

Y	N	Hardwire	Usage
		Fuel Tank Vapor Pressure	Required
		Fuel Tank Vapor Pressure Supply	Required
		+5 Volt Return	Required
		Canister Vent (wired to ☐Run/Crank or ☐ Battery(EONV applications))	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Check Fuel Filler Cap Indication On	Optional	Powertrain

Comments:

2.13 Exhaust After-Treatment

☐ Air Injection Reaction (AIR)

Used?

Y	N	Hardwire	Usage
		AIR Pump Command	Required
		AIR Pump Signal	Required
		AIR Valve Command	Required
		AIR Valve Signal	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Powertrain Exhaust Particle Filter Warning Indication On	Optional with Diesel	Powertrain
		Powertrain High Electrical Load Requested	Optional with Diesel	Powertrain

Comments:

☐ Electrically Heated Catalyst (EHC)

Used?

Y	N	Hardwire	Usage
		EHC Command	Required
		EHC Voltage Sense	Required
		EHC Current Sense	Required
		EHC Analog Return	Required
		Generator High Voltage Output	Required
		L-Terminal Control	Required *

* See Section 2.16 for Details

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Powertrain Exhaust Particle Filter Warning Indication On	Optional with Diesel	Powertrain
		Powertrain High Electrical Load Requested	Optional with Diesel	Powertrain

Comments:

2.14 Suspension Control

☐

Used?

Y	N	Hardwire	Usage
		Lift/Dive	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Engine Intake Air Temperature	Required	Powertrain
		Engine Intake Air Temperature Validity	Required	Powertrain
		Real Time Damping System Present	Optional	Platform
		Suspension System Dampers Failed Full Soft	Required	Platform
		Vehicle Lift/Dive Status	Optional	Powertrain
		Vehicle Lift/Dive Status Validity	Optional	Powertrain
		Vehicle Speed	Required	Powertrain
		Vehicle Speed Validity	Required	Powertrain
		Vehicle Top Speed Limit Value	Optional	Powertrain
		Vehicle Top Speed Limitation Indication On	Optional	Powertrain

Comments:

2.15 Transmission

☐ Manual Transmissions

Used?

Y	N	Hardwire	Usage
		Reverse Switch	Required
		Cruise Disable – Clutch	Optional

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Engine Calculated Actual Gear	Optional	Powertrain
		Engine Calculated Actual Gear Validity	Optional	Powertrain
		Engine Recommended Shift Indication	Optional	Powertrain
		Manual Transmission Reverse Gear Active	Optional	Platform
		Manual Transmission Reverse Gear Active Validity	Optional	Platform
		Transmission Actual Gear	Optional	Powertrain
		Transmission Actual Gear Validity	Optional	Powertrain
		Transmission Skip Shift Indication	Optional	Powertrain

Comments:

Automatic Transmissions

☐ Transmissions with IMS

Used?

Y	N	Hardwire	Usage
		Brake Lamp Switch	Required on vehicles without BASS
		Tap-up/Tap-down	Required with Tap up/Tap down

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Antilock Brake System Active	Optional	Platform
		Antilock Brake System Present	Optional	Platform
		Brake Pedal Switch Active	Optional on vehicles without BASS	Powertrain
		Brake Pedal Switch Active Validity	Optional on vehicles without BASS	Powertrain
		Brake Pedal Initial Travel Achieved	Required on vehicles with BASS	Platform
		Brake Pedal Position Failure	Required on vehicles with BASS	Platform
		Continuous Variable Transmission Present	Required with CVT transmissions (GME use only)	Powertrain
		Driver Shift Control Request Denied Indication On	Optional for Tap	Powertrain

			Up/Tap Down	
		Powertrain Brake Pedal Discrete Input Status	Optional (GME use only)	Powertrain
		Powertrain Brake Pedal Discrete Input Status Validity	Optional (GME use only)	Powertrain
		Powertrain Brake Pedal Secondary Discrete Input	Optional (GME use only)	Powertrain
		Powertrain Brake Pedal Secondary Discrete Input Validity	Optional (GME use only)	Powertrain
		Transmission Actual Gear	Optional	Powertrain
		Transmission Actual Gear Validity	Optional	Powertrain
		Transmission Electronic Range Select Mode Request	Optional	Platform
		Transmission Gear Indication	Optional	Powertrain
		Transmission Gear Indication Validity	Optional	Powertrain
		Transmission Gear Selector Position	Required	Powertrain
		Transmission Gear Selector Position Validity	Required	Powertrain
		Transmission Load Management Shift Pattern Request	Optional	Platform
		Transmission Load Management Shift Pattern Status	Optional	Powertrain
		Transmission Performance Algorithm Shift Mode Active	Optional	Powertrain
		Transmission Shift Lever Lock Requested	Required with CVT transmissions	Powertrain
		Transmission Sport Shift Pattern Request	Optional	Platform
		Transmission Sport Shift Pattern Status	Optional	Powertrain
		Transmission Tap Up/Tap Down Mode Indication On	See Note *[1]	Powertrain
		Transmission Tap Up/Tap Down Mode Request	See Note *[1]	Platform
		Transmission Tap Up/Tap Down Request	See PPEI	Platform
		Transmission Tap Up/Tap Down Request Validity	See PPEI	Platform
		Transmission Trailering Shift Pattern Request	Optional	Platform
		Transmission Trailering Shift Pattern Status	Optional	Powertrain
		Transmission Winter Mode Request	Optional	Platform
		Transmission Winter Mode Status	Optional	Powertrain

*[1] Required with Tap up/Tap down

Comments:

☐ **Transmissions with NSBU**

Used?

Y	**N**	**Hardwire**	**Usage**
		Brake Lamp Switch	Required on vehicles without BASS
		Park Only	Optional
		Reverse	Optional
		Tap-up / Tap-down	Required with Tap up/Tap down

Comments:

Used?

Y	**N**	**Serial Data**	**Usage**	**Transmitter**
		Antilock Brake System Active	Optional	Platform
		Antilock Brake System Present	Optional	Platform
		Brake Pedal Switch Active	Optional on vehicles without BASS	Powertrain
		Brake Pedal Switch Active Validity	Optional on	Powertrain

			vehicles without BASS	
		Brake Pedal Initial Travel Achieved	Required on vehicles with BASS	Platform
		Brake Pedal Position Failure	Required on vehicles with BASS	Platform
		Driver Shift Control Request Denied Indication On	Optional for Tap Up/Tap Down	Powertrain
		Transmission Actual Gear	Optional	Powertrain
		Transmission Actual Gear Validity	Optional	Powertrain
		Transmission Electronic Range Select Mode Request	Optional	Platform
		Transmission Gear Indication	Optional	Powertrain
		Transmission Gear Indication Validity	Optional	Powertrain
		Transmission Gear Selector Position	Required	Powertrain
		Transmission Gear Selector Position Validity	Required	Powertrain
		Transmission Load Management Shift Pattern Request	Optional	Platform
		Transmission Load Management Shift Pattern Status	Optional	Powertrain
		Transmission Performance Algorithm Shift Mode Active	Optional	Powertrain
		Transmission Sport Shift Pattern Request	Optional	Platform
		Transmission Sport Shift Pattern Status	Optional	Powertrain
		Transmission Tap Up/Tap Down Mode Indication On	See Note *[1]	Powertrain
		Transmission Tap Up/Tap Down Mode Request	See Note *[1]	Platform
		Transmission Tap Up/Tap Down Request	See PPEI	Platform
		Transmission Tap Up/Tap Down Request Validity	See PPEI	Platform
		Transmission Trailering Shift Pattern Request	Optional	Platform
		Transmission Trailering Shift Pattern Status	Optional	Powertrain
		Transmission Winter Shift Pattern Request	Optional	Platform
		Transmission Winter Shift Pattern Status	Optional	Powertrain

*[1] Required with Tap up/Tap down

Comments:

2.16 Generator Control

☐ F-Term Monitor, L-Term Monitor

Used?

Y	N	Hardwire	Usage
		F – Terminal	Required
		L – Terminal	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Generator Failed	Required	Powertrain
		Generator Enabled	Optional	Powertrain
		Generator Field Duty Cycle	Optional	Powertrain

Comments:

☐ F-Term Monitor, L-Term Monitor, L-Term Control

Used?

Y	N	Hardwire	Usage

		F – Terminal	Required
		L – Terminal	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Generator Failed	Required	Powertrain
		Generator Enabled	Optional	Powertrain
		Generator Field Duty Cycle	Optional	Powertrain

Comments:

☐ F-Term Monitor, L-Term Monitor, L-Term Regulated Voltage Control (RVC)

Used?

Y	N	Hardwire	Usage
		F – Terminal	Required
		L – Terminal (PWM)	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Engine Cooling Fan Speed	Required	Powertrain
		Engine Intake Air Temperature	Required	Powertrain
		Engine Intake Air Temperature Validity	Required	Powertrain
		Generator Enabled	Optional	Powertrain
		Generator Failed	Required	Powertrain
		Generator Field Duty Cycle	Required	Powertrain
		Generator Field Duty Cycle Validity	Required	Powertrain
		Generator Regulator Setpoint Duty Cycle Request	Required	Platform
		Outside Air Temperature Powertrain Estimated	Required	Powertrain
		Outside Air Temperature Powertrain Estimated Mask	Required	Powertrain
		Outside Air Temperature Powertrain Estimated Validity	Required	Powertrain

Comments:

2.17 Supplemental Inflatable Restraints

☐

Used?

Y	N	Hardwire	Usage
		Brake Lamp Switch	Required on vehicles without BASS

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Air Bag Deployed	Powertrain optional with ETC	Platform
		Accelerator Actual Position	Required	Powertrain
		Accelerator Actual Position Validity	Required	Powertrain
		Brake Pedal Switch Active	Required for vehicles without	Powertrain

			BASS	
		Brake Pedal Switch Active Validity	Required for vehicles without BASS	Powertrain
		Cruise Control Active	Required with Cruise Control	Powertrain
		Engine Calculated Actual Gear	Required with manual trans and ECM	Powertrain
		Engine Calculated Actual Gear Validity	Required with manual trans and ECM	Powertrain
		Engine Emissions Related Malfunction Active	Required	Powertrain
		Engine Limp Home Mode Active	Required with ETC	Powertrain
		Engine Speed	Required	Powertrain
		Engine Speed Validity	Required	Powertrain
		Service Engine System Non Emission Related Indication Request	Optional	Powertrain
		Throttle Position	Required for GMNA	Powertrain
		Throttle Position Validity	Required for GMNA	Powertrain
		Transmission Actual Gear	Required on vehicles with Auto Trans or with PCM	Powertrain
		Transmission Actual Gear Validity	Required on vehicles with Auto Trans or with PCM	Powertrain
		Vehicle Speed	Required	Powertrain
		Vehicle Speed Validity	Required	Powertrain

Comments:

2.18 Power Take-Off – Not Yet Defined

Used?

Y	N	Hardwire	Usage

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter

Comments:

2.19 Vehicle Speed and Rough Road Sensing

GMNA Vehicles

Used?

Y	N	Hardwire	Usage
		4K PPM	Optional for Navigation Systems and Truck Up-Fitters

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Distance Rolling Count Driven Wheel	See PPEI	Powertrain
		Distance Rolling Count Driven Wheel Reset Occurred	See PPEI	Powertrain
		Distance Rolling Count Driven Wheel Validity	See PPEI	Powertrain

		Distance Rolling Count Non Driven Wheel	See PPEI	Powertrain
		Distance Rolling Count Non Driven Wheel Reset Occurred	See PPEI	Powertrain
		Distance Rolling Count Non Driven Wheel Validity	See PPEI	Powertrain
		Distance Rolling Count Left Non Driven Wheel	See PPEI	Powertrain
		Distance Rolling Count Left Non Driven Wheel Reset Occurred	See PPEI	Powertrain
		Distance Rolling Count Left Non Driven Wheel Validity	See PPEI	Powertrain
		Distance Rolling Count Right Non Driven Wheel	See PPEI	Powertrain
		Distance Rolling Count Right Non Driven Wheel Reset Occurred	See PPEI	Powertrain
		Distance Rolling Count Right Non Driven Wheel Validity	See PPEI	Powertrain
		Vehicle Speed	Required	Powertrain
		Vehicle Speed Validity	Required	Powertrain
		Wheel Angular Velocity Front Left	Required *	Platform
		Wheel Angular Velocity Front Left Validity	Required *	Platform
		Wheel Angular Velocity Front Right	Required *	Platform
		Wheel Angular Velocity Front Right Validity	Required *	Platform
		Wheel Angular Velocity Rear Left	Required *	Platform
		Wheel Angular Velocity Rear Left Validity	Required *	Platform
		Wheel Angular Velocity Rear Right	Required *	Platform
		Wheel Angular Velocity Rear Right Validity	Required *	Platform
		Wheel Average Peak to Peak Acceleration	See PPEI	Platform
		Wheel Average Peak to Peak Acceleration Validity	See PPEI	Platform

* Required with ABS

Comments:

GMIO

☐ **ABS Vehicles**

Used?

Y	N	Hardwire	Usage

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Distance Rolling Count Driven Wheel	See PPEI	Powertrain
		Distance Rolling Count Driven Wheel Reset Occurred	See PPEI	Powertrain
		Distance Rolling Count Driven Wheel Validity	See PPEI	Powertrain
		Distance Rolling Count Non Driven Wheel	See PPEI	Powertrain
		Distance Rolling Count Non Driven Wheel Reset Occurred	See PPEI	Powertrain
		Distance Rolling Count Non Driven Wheel Validity	See PPEI	Powertrain
		Distance Rolling Count Left Non Driven Wheel	See PPEI	Powertrain
		Distance Rolling Count Left Non Driven Wheel Reset Occurred	See PPEI	Powertrain
		Distance Rolling Count Left Non Driven Wheel Validity	See PPEI	Powertrain
		Distance Rolling Count Right Non Driven Wheel	See PPEI	Powertrain
		Distance Rolling Count Right Non Driven Wheel Reset Occurred	See PPEI	Powertrain
		Distance Rolling Count Right Non Driven Wheel Validity	See PPEI	Powertrain
		Vehicle Speed	Required	Powertrain
		Vehicle Speed Validity	Required	Powertrain
		Wheel Angular Velocity Front Left	Required	Platform

		Wheel Angular Velocity Front Left Validity	Required	Platform
		Wheel Angular Velocity Front Right	Required	Platform
		Wheel Angular Velocity Front Right Validity	Required	Platform
		Wheel Angular Velocity Rear Left	Required	Platform
		Wheel Angular Velocity Rear Left Validity	Required	Platform
		Wheel Angular Velocity Rear Right	Required	Platform
		Wheel Angular Velocity Rear Right Validity	Required	Platform
		Wheel Rotations Left Driven Rolling Count	Required	Platform
		Wheel Rotations Left Driven Rolling Count Reset Occurred	Required	Platform
		Wheel Rotations Left Driven Rolling Count Validity	Required	Platform
		Wheel Rotations Left Non Driven Rolling Count	Required	Platform
		Wheel Rotations Left Non Driven Rolling Count Reset Occurred	Required	Platform
		Wheel Rotations Left Non Driven Rolling Count Validity	Required	Platform
		Wheel Rotations Right Driven Rolling Count	Required	Platform
		Wheel Rotations Right Driven Rolling Count Reset Occurred	Required	Platform
		Wheel Rotations Right Driven Rolling Count Validity	Required	Platform
		Wheel Rotations Right Non Driven Rolling Count	Required	Platform
		Wheel Rotations Right Non Driven Rolling Count Reset Occurred	Required	Platform
		Wheel Rotations Right Non Driven Rolling Count Validity	Required	Platform

Comments:

☐ **Non-ABS applications**

Used?

Y	N	Hardwire	Usage
		Wheel Speed Signal	Required

Comments:

Used?

Y	N	Serial Data	Usage	Transmitter
		Distance Rolling Count Driven Wheel	See PPEI	Powertrain
		Distance Rolling Count Driven Wheel Reset Occurred	See PPEI	Powertrain
		Distance Rolling Count Driven Wheel Validity	See PPEI	Powertrain
		Distance Rolling Count Non Driven Wheel	See PPEI	Powertrain
		Distance Rolling Count Non Driven Wheel Reset Occurred	See PPEI	Powertrain
		Distance Rolling Count Non Driven Wheel Validity	See PPEI	Powertrain
		Distance Rolling Count Left Non Driven Wheel	See PPEI	Powertrain
		Distance Rolling Count Left Non Driven Wheel Reset Occurred	See PPEI	Powertrain
		Distance Rolling Count Left Non Driven Wheel Validity	See PPEI	Powertrain
		Distance Rolling Count Right Non Driven Wheel	See PPEI	Powertrain
		Distance Rolling Count Right Non Driven Wheel Reset Occurred	See PPEI	Powertrain
		Distance Rolling Count Right Non Driven Wheel Validity	See PPEI	Powertrain
		Vehicle Speed	Required	Powertrain
		Vehicle Speed Validity	Required	Powertrain

Comments:

Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
2.3 2.7	Revised Cruise Control Active GMLAN signal usage from "Optional" to "Required with Cruise Control". Revised Cruise Control Enabled GMLAN signal usage from "Platform Optional" to "Required with Cruise Control". Added new GMLAN signals: 1. Cruise Control Driver Selected Speed and 2. Cruise Control Driver Selected Speed Active	ICR 320
2.9	Added GMLAN Signal Air Conditioning Compressor Stroke Request.	ICR 2009
2.12	Added Fuel Pump Speed Control Diagnostics hardwire.	ICR 2010
2.3 2.4 2.13	Added new GMLAN signals "Powertrain Exhaust Particle Filter Warning Indication On" and "Powertrain High Electrical Load Requested".	ICR 2023
2.3 2.15	Added new GMLAN signal "Driver Shift Control Request Denied Indication On" to the Displays and Gauges Section and the Transmission Section for Automatic Transmissions with IMS and NSBU.	ICR 2040
2.3	Added new GMLAN signals "Engine Oil Temperature" and "Engine Oil Temperature Validity".	ICR 2069
2.16	Added GMLAN signals "Outside Air Temperature Powertrain Estimated, Outside Air Temperature Powertrain Estimated Validity and Outside Air Temperature Powertrain Estimated Mask" to Generator Control Section for F-Term Monitor, L-Term Monitor, L-Term Regulated Voltage Control (RVC).	ICR 2071

2.16	Added GMLAN signal “Engine Cooling Fan Speed” to Generator Control Section for F-Term Monitor, L-Term Monitor, L-Term Regulated Voltage Control (RVC).	ICR 2073
2.3 2.4 2.13	Revised the Usage from “Optional for GME” to read “Optional with Diesel” (associated ICR 2023).	ICR 2096
2.3	Added new GMLAN signal “Engine Cylinder Deactivation mode”.	ICR 2106
2.6	Added existing GMLAN signal “Remote Vehicle Start Engine Running” to the Vehicle Theft Deterrent subsystem section.	ICR 2113
2.3 2.9	Revised usage for Air Conditioning Off Indication On from “Optional” to “Platform Optional”.	ICR 2119
2.6	Added Remote Vehicle Start Request to the Vehicle Theft Deterrent subsystem. Added Easy Key to Remote Vehicle Start Engine Running signal usage.	ICR 2121
2.4	Added existing GMLAN Signal “Engine System Regular Production Option Identifier”.	ICR 2144
2.5	Revised usage and transmitter for GMLAN Signal Remote Vehicle Start Request to include Easy Key in the usage and reflect Platform as the Transmitter.	ICR 2153

4.1 Starter Control

	Owner	Value	Units
K_Cnt_EngRevs[0]	Powertrain		Revolutions
K_Cnt_EngRevs[1]	Powertrain		Revolutions
K_Cnt_EngRevs[2]	Powertrain		Revolutions
K_Cnt_EngRevs[3]	Powertrain		Revolutions
K_Cnt_EngRevs[4]	Powertrain		Revolutions
K_Cnt_EngRevs[5]	Powertrain		Revolutions
K_Cnt_EngRevs[6]	Powertrain		Revolutions
K_Cnt_EngRevs[7]	Powertrain		Revolutions
K_Cnt_EngRevs[8]	Powertrain		Revolutions
K_Cnt_EngRevs[9]	Powertrain		Revolutions
K_Cnt_EngRevs[10]	Powertrain		Revolutions
K_Cnt_EngRevs[11]	Powertrain		Revolutions
K_Cnt_EngRevs[12]	Powertrain		Revolutions
K_Cnt_EngRevs[13]	Powertrain		Revolutions
K_Cnt_EngRevs[14]	Powertrain		Revolutions
K_Cnt_EngRevs[15]	Powertrain		Revolutions
K_Cnt_EngRevs[16]	Powertrain		Revolutions
K_EngThresh[0]	Powertrain		RPM
K_EngThresh[1]	Powertrain		RPM
K_EngThresh[2]	Powertrain		RPM
K_EngThresh[3]	Powertrain		RPM
K_EngThresh[4]	Powertrain		RPM
K_EngThresh[5]	Powertrain		RPM
K_EngThresh[6]	Powertrain		RPM
K_EngThresh[7]	Powertrain		RPM
K_EngThresh[8]	Powertrain		RPM
K_EngThresh[9]	Powertrain		RPM
K_EngThresh[10]	Powertrain		RPM
K_EngThresh[11]	Powertrain		RPM
K_EngThresh[12]	Powertrain		RPM
K_EngThresh[13]	Powertrain		RPM
K_EngThresh[14]	Powertrain		RPM
K_EngThresh[15]	Powertrain		RPM
K_EngThresh[16]	Powertrain		RPM
K_FuelPumpDelay	Powertrain		milliseconds
K_MaxCrank	Powertrain		Seconds
K_Max_Starts_Allowed	Platform		
K_MinCrank	Powertrain		milliseconds
K_PwrModeDelay	Platform		milliseconds
K_ShortLowEngRunTime	Powertrain		Seconds

	Owner	Value	Units
4.2 Cooling Fan			
K_%PWM[0][500 RPM]	Platform	______	Percent
K_%PWM[1][500 RPM]	Platform	______	Percent
K_%PWM[2][500RPM]	Platform	______	Percent
K_%PWM[3][500 RPM]	Platform	______	Percent
K_%PWM[4][500 RPM]	Platform	______	Percent
K_%PWM[5][500 RPM]	Platform	______	Percent
K_%PWM[6][500RPM]	Platform	______	Percent
K_%PWM[7][500RPM]	Platform	______	Percent
K_%PWM[8][500RPM]	Platform	______	Percent
K_%PWM[9][500RPM]	Platform	______	Percent
K_%PWM[10][500 RPM]	Platform	______	Percent
K_%PWM[11][500 RPM]	Platform	______	Percent
K_%PWM[12][500 RPM]	Platform	______	Percent
K_%PWM[13][500 RPM]	Platform	______	Percent
K_%PWM[14][500 RPM]	Platform	______	Percent
K_%PWM[15][500 RPM]	Platform	______	Percent
K_%PWM[16][500 RPM]	Platform	______	Percent
K_%PWM[0][1000 RPM]	Platform	______	Percent
K_%PWM[1][1000 RPM]	Platform	______	Percent
K_%PWM[2][1000 RPM]	Platform	______	Percent
K_%PWM[3][1000 RPM]	Platform	______	Percent
K_%PWM[4][1000 RPM]	Platform	______	Percent
K_%PWM[5][1000 RPM]	Platform	______	Percent
K_%PWM[6][1000 RPM]	Platform	______	Percent
K_%PWM[7][1000 RPM]	Platform	______	Percent
K_%PWM[8][1000 RPM]	Platform	______	Percent
K_%PWM[9][1000 RPM]	Platform	______	Percent
K_%PWM[10][1000 RPM]	Platform	______	Percent
K_%PWM[11][1000 RPM]	Platform	______	Percent
K_%PWM[12][1000 RPM]	Platform	______	Percent
K_%PWM[13][1000 RPM]	Platform	______	Percent
K_%PWM[14][1000 RPM]	Platform	______	Percent
K_%PWM[15][1000 RPM]	Platform	______	Percent
K_%PWM[16][1000 RPM]	Platform	______	Percent
K_%PWM[0][1500 RPM]	Platform	______	Percent
K_%PWM[1][1500 RPM]	Platform	______	Percent
K_%PWM[2][1500 RPM]	Platform	______	Percent
K_%PWM[3][1500RPM]	Platform	______	Percent
K_%PWM[4][1500 RPM]	Platform	______	Percent
K_%PWM[5][1500 RPM]	Platform	______	Percent
K_%PWM[6][1500 RPM]	Platform	______	Percent
K_%PWM[7][1500 RPM]	Platform	______	Percent

	Owner	Value	Units
K_%PWM[8][1500 RPM]	Platform	________	Percent
K_%PWM[9][1500 RPM]	Platform	________	Percent
K_%PWM[10][1500 RPM]	Platform	________	Percent
K_%PWM[11][1500 RPM]	Platform	________	Percent
K_%PWM[12][1500 RPM]	Platform	________	Percent
K_%PWM[13][1500 RPM]	Platform	________	Percent
K_%PWM[14][1500 RPM]	Platform	________	Percent
K_%PWM[15][1500 RPM]	Platform	________	Percent
K_%PWM[16][1500 RPM]	Platform	________	Percent
K_%PWM[0][2000 RPM]	Platform	________	Percent
K_%PWM[1][2000 RPM]	Platform	________	Percent
K_%PWM[2][2000 RPM]	Platform	________	Percent
K_%PWM[3][2000 RPM]	Platform	________	Percent
K_%PWM[4][2000 RPM]	Platform	________	Percent
K_%PWM[5][2000 RPM]	Platform	________	Percent
K_%PWM[6][2000 RPM]	Platform	________	Percent
K_%PWM[7][2000 RPM]	Platform	________	Percent
K_%PWM[8][2000 RPM]	Platform	________	Percent
K_%PWM[9][2000 RPM]	Platform	________	Percent
K_%PWM[10][2000 RPM]	Platform	________	Percent
K_%PWM[11][2000 RPM]	Platform	________	Percent
K_%PWM[12][2000 RPM]	Platform	________	Percent
K_%PWM[13][2000 RPM]	Platform	________	Percent
K_%PWM[14][2000 RPM]	Platform	________	Percent
K_%PWM[15][2000 RPM]	Platform	________	Percent
K_%PWM[16][2000 RPM]	Platform	________	Percent
K_%PWM[0][2500 RPM]	Platform	________	Percent
K_%PWM[1][40002500 RPM]	Platform	________	Percent
K_%PWM[2][2500 RPM]	Platform	________	Percent
K_%PWM[3][2500 RPM]	Platform	________	Percent
K_%PWM[4][2500 RPM]	Platform	________	Percent
K_%PWM[5][2500 RPM]	Platform	________	Percent
K_%PWM[6][2500 RPM]	Platform	________	Percent
K_%PWM[7][2500 RPM]	Platform	________	Percent
K_%PWM[8][2500 RPM]	Platform	________	Percent
K_%PWM[9][2500 RPM]	Platform	________	Percent
K_%PWM[10][2500 RPM]	Platform	________	Percent
K_%PWM[11][2500 RPM]	Platform	________	Percent
K_%PWM[12][2500 RPM]	Platform	________	Percent
K_%PWM[13][2500 RPM]	Platform	________	Percent
K_%PWM[14][2500 RPM]	Platform	________	Percent
K_%PWM[15][2500 RPM]	Platform	________	Percent
K_%PWM[16][2500 RPM]	Platform	________	Percent
K_%PWM[0][3000 RPM]	Platform	________	Percent

	Owner	Value	Units
K_%PWM[1][3000 RPM]	Platform	________	Percent
K_%PWM[2][3000 RPM]	Platform	________	Percent
K_%PWM[3][3000 RPM]	Platform	________	Percent
K_%PWM[4][3000 RPM]	Platform	________	Percent
K_%PWM[5][3000 RPM]	Platform	________	Percent
K_%PWM[6][3000 RPM]	Platform	________	Percent
K_%PWM[7][3000 RPM]	Platform	________	Percent
K_%PWM[8][3000 RPM]	Platform	________	Percent
K_%PWM[9][3000 RPM]	Platform	________	Percent
K_%PWM[10][3000 RPM]	Platform	________	Percent
K_%PWM[11][3000 RPM]	Platform	________	Percent
K_%PWM[12][3000 RPM]	Platform	________	Percent
K_%PWM[13][3000 RPM]	Platform	________	Percent
K_%PWM[14][3000 RPM]	Platform	________	Percent
K_%PWM[15][3000 RPM]	Platform	________	Percent
K_%PWM[16][3000 RPM]	Platform	________	Percent
K_%PWM[0][3500 RPM]	Platform	________	Percent
K_%PWM[1][3500 RPM]	Platform	________	Percent
K_%PWM[2][3500 RPM]	Platform	________	Percent
K_%PWM[3][3500 RPM]	Platform	________	Percent
K_%PWM[4][3500 RPM]	Platform	________	Percent
K_%PWM[5][3500 RPM]	Platform	________	Percent
K_%PWM[6][3500 RPM]	Platform	________	Percent
K_%PWM[7][3500 RPM]	Platform	________	Percent
K_%PWM[8][3500 RPM]	Platform	________	Percent
K_%PWM[9][3500 RPM]	Platform	________	Percent
K_%PWM[10][3500 RPM]	Platform	________	Percent
K_%PWM[11][3500 RPM]	Platform	________	Percent
K_%PWM[12][3500 RPM]	Platform	________	Percent
K_%PWM[13][3500 RPM]	Platform	________	Percent
K_%PWM[14][3500 RPM]	Platform	________	Percent
K_%PWM[15][3500 RPM]	Platform	________	Percent
K_%PWM[16][3500 RPM]	Platform	________	Percent
K_%PWM[0][4000 RPM]	Platform	________	Percent
K_%PWM[1][4000 RPM]	Platform	________	Percent
K_%PWM[2][4000 RPM]	Platform	________	Percent
K_%PWM[3][4000 RPM]	Platform	________	Percent
K_%PWM[4][4000 RPM]	Platform	________	Percent
K_%PWM[5][4000 RPM]	Platform	________	Percent
K_%PWM[6][4000 RPM]	Platform	________	Percent
K_%PWM[7][4000 RPM]	Platform	________	Percent
K_%PWM[8][4000 RPM]	Platform	________	Percent
K_%PWM[9][4000 RPM]	Platform	________	Percent
K_%PWM[10][4000 RPM]	Platform	________	Percent

	Owner	Value	Units
K_%PWM[11][4000 RPM]	Platform	________	Percent
K_%PWM[12][4000 RPM]	Platform	________	Percent
K_%PWM[13][4000 RPM]	Platform	________	Percent
K_%PWM[14][4000 RPM]	Platform	________	Percent
K_%PWM[15][4000 RPM]	Platform	________	Percent
K_%PWM[16][4000 RPM]	Platform	________	Percent
K_AC_%FanReq[0]	Platform	________	Percent
K_AC_%FanReq[1]	Platform	________	Percent
K_AC_%FanReq[2]	Platform	________	Percent
K_AC_%FanReq[3]	Platform	________	Percent
K_AC_%FanReq[4]	Platform	________	Percent
K_AC_%FanReq[5]	Platform	________	Percent
K_AC_%FanReq[6]	Platform	________	Percent
K_AC_%FanReq[7]	Platform	________	Percent
K_AC_%FanReq[8]	Platform	________	Percent
K_AC_%FanReq[9]	Platform	________	Percent
K_AC_%FanReq[10]	Platform	________	Percent
K_AC_%FanReq[11]	Platform	________	Percent
K_AC_%FanReq[12]	Platform	________	Percent
K_AC_%FanReq[13]	Platform	________	Percent
K_AC_%FanReq[14]	Platform	________	Percent
K_AC_%FanReq[15]	Platform	________	Percent
K_AC_%FanReq[16]	Platform	________	Percent
K_AC_OffTempFault	Platform	________	True/False
K_AC_OffTempHi	Platform	________	Degrees C
K_AC_OffTempLo	Platform	________	Degrees C
K_AC_On_%FanRequired	Platform	________	Percent
K_AC_PressureHigh	Platform	________	kPa
K_Adjust_PWM_Exec_Rate(0)	Platform	________	Seconds
K_Adjust_PWM_Exec_Rate(1)	Platform	________	Seconds
K_Adjust_PWM_Exec_Rate(2)	Platform	________	Seconds
K_Adjust_PWM_Exec_Rate(3)	Platform	________	Seconds
K_Adjust_PWM_Exec_Rate(4)	Platform	________	Seconds
K_Adjust_PWM_Exec_Rate(5)	Platform	________	Seconds
K_Adjust_PWM_Exec_Rate(6)	Platform	________	Seconds
K_Adjust_PWM_Exec_Rate(7)	Platform	________	Seconds
K_Adjust_PWM_Exec_Rate(8)	Platform	________	Seconds
K_Adjust_PWM_Exec_Rate(9)	Platform	________	Seconds
K_Adjust_PWM_Exec_Rate(10)	Platform	________	Seconds
K_Adjust_PWM_Exec_Rate(11)	Platform	________	Seconds
K_Adjust_PWM_Exec_Rate(12)	Platform	________	Seconds
K_Adjust_PWM_Exec_Rate(13)	Platform	________	Seconds
K_Adjust_PWM_Exec_Rate(14)	Platform	________	Seconds
K_Adjust_PWM_Exec_Rate(15)	Platform	________	Seconds

	Owner	Value	Units
K_Adjust_PWM_Exec_Rate(16)	Platform	______________	Seconds
K_AfterRun%Fan	Platform	______________	Percent
K_AfterRunHi%Fan	Platform	______________	Percent
K_AfterRunTime[0]	Platform	______________	Minutes
K_AfterRunTime[1]	Platform	______________	Minutes
K_AfterRunTime[2]	Platform	______________	Minutes
K_AfterRunTime[3]	Platform	______________	Minutes
K_AfterRunTime[4]	Platform	______________	Minutes
K_AfterRunContinueTemp[0]	Platform	______________	Degrees C
K_AfterRunContinueTemp[1]	Platform	______________	Degrees C
K_AfterRunContinueTemp[2]	Platform	______________	Degrees C
K_AfterRunContinueTemp[3]	Platform	______________	Degrees C
K_AfterRunContinueTemp[4]	Platform	______________	Degrees C
K_AfterRunExhaustTempHi[0]	Platform	______________	Degrees C
K_AfterRunExhaustTempHi[1]	Platform	______________	Degrees C
K_AfterRunHiContinueTemp[0]	Platform	______________	Degrees C
K_AfterRunHiContinueTemp[1]	Platform	______________	Degrees C
K_AfterRunHiContinueTemp[2]	Platform	______________	Degrees C
K_AfterRunHiContinueTemp[3]	Platform	______________	Degrees C
K_AfterRunHiContinueTemp[4]	Platform	______________	Degrees C
K_AfterRunHiStartTempHi	Platform	______________	Degrees C
K_AfterRunHiStartTempLo	Platform	______________	Degrees C
K_AfterRunStartTempHi	Platform	______________	Degrees C
K_AfterRunStartTempLo	Platform	______________	Degrees C
K_AfterRunTimeMax	Platform	______________	Minutes
K_CoolantTempOverride	Platform	______________	Degrees C
K_D1_Speed1	Platform	______________	ON/OFF
K_D1_Speed2	Platform	______________	ON/OFF
K_D1_Speed3	Platform	______________	ON/OFF
K_D1_Speed4	Platform	______________	ON/OFF
K_D1_Speed5	Platform	______________	ON/OFF
K_D1_Speed6	Platform	______________	ON/OFF
K_D2_Speed1	Platform	______________	ON/OFF
K_D2_Speed2	Platform	______________	ON/OFF
K_D2_Speed3	Platform	______________	ON/OFF
K_D2_Speed4	Platform	______________	ON/OFF
K_D2_Speed5	Platform	______________	ON/OFF
K_D2_Speed6	Platform	______________	ON/OFF
K_D3_Speed1	Platform	______________	ON/OFF
K_D3_Speed2	Platform	______________	ON/OFF
K_D3_Speed3	Platform	______________	ON/OFF
K_D3_Speed4	Platform	______________	ON/OFF
K_D3_Speed5	Platform	______________	ON/OFF
K_D3_Speed6	Platform	______________	ON/OFF

	Owner	Value	Units
K_Delta[0][500 RPM]	Platform	________	Percent
K_Delta[1][500 RPM]	Platform	________	Percent
K_Delta[2][500 RPM]	Platform	________	Percent
K_Delta[3][500 RPM]	Platform	________	Percent
K_Delta[4][500 RPM]	Platform	________	Percent
K_Delta[5][500 RPM]	Platform	________	Percent
K_Delta[6][500 RPM]	Platform	________	Percent
K_Delta[7][500 RPM]	Platform	________	Percent
K_Delta[8][500 RPM]	Platform	________	Percent
K_Delta[9][500 RPM]	Platform	________	Percent
K_Delta[10][500 RPM]	Platform	________	Percent
K_Delta[11][500 RPM]	Platform	________	Percent
K_Delta[12][500 RPM]	Platform	________	Percent
K_Delta[13][500 RPM]	Platform	________	Percent
K_Delta[14][500 RPM]	Platform	________	Percent
K_Delta[15][500 RPM]	Platform	________	Percent
K_Delta[16][500 RPM]	Platform	________	Percent
K_Delta[0][1000 RPM]	Platform	________	Percent
K_Delta[1][1000 RPM]	Platform	________	Percent
K_Delta[2][1000 RPM]	Platform	________	Percent
K_Delta[3][1000 RPM]	Platform	________	Percent
K_Delta[4][1000 RPM]	Platform	________	Percent
K_Delta[5][1000 RPM]	Platform	________	Percent
K_Delta[6][1000 RPM]	Platform	________	Percent
K_Delta[7][1000 RPM]	Platform	________	Percent
K_Delta[8][1000RPM]	Platform	________	Percent
K_Delta[9][1000 RPM]	Platform	________	Percent
K_Delta[10][1000 RPM]	Platform	________	Percent
K_Delta[11][1000 RPM]	Platform	________	Percent
K_Delta[12][1000 RPM]	Platform	________	Percent
K_Delta[13][1000 RPM]	Platform	________	Percent
K_Delta[14][1000 RPM]	Platform	________	Percent
K_Delta[15][1000 RPM]	Platform	________	Percent
K_Delta[16][1000 RPM]	Platform	________	Percent
K_Delta[0][1500 RPM]	Platform	________	Percent
K_Delta[1][1500 RPM]	Platform	________	Percent
K_Delta[2][1500 RPM]	Platform	________	Percent
K_Delta[3][1500 RPM]	Platform	________	Percent
K_Delta[4][1500 RPM]	Platform	________	Percent
K_Delta[5][1500 RPM]	Platform	________	Percent
K_Delta[6][1500 RPM]	Platform	________	Percent
K_Delta[7][1500 RPM]	Platform	________	Percent
K_Delta[8][1500 RPM]	Platform	________	Percent
K_Delta[9][1500 RPM]	Platform	________	Percent

	Owner	Value	Units
K_Delta[10][1500 RPM]	Platform	______________	Percent
K_Delta[11][1500 RPM]	Platform	______________	Percent
K_Delta[12][1500 RPM]	Platform	______________	Percent
K_Delta[13][1500 RPM]	Platform	______________	Percent
K_Delta[14][1500 RPM]	Platform	______________	Percent
K_Delta[15][1500 RPM]	Platform	______________	Percent
K_Delta[16][1500 RPM]	Platform	______________	Percent
K_Delta[0][2000 RPM]	Platform	______________	Percent
K_Delta[1][2000 RPM]	Platform	______________	Percent
K_Delta[2][2000 RPM]	Platform	______________	Percent
K_Delta[3][2000 RPM]	Platform	______________	Percent
K_Delta[4][2000 RPM]	Platform	______________	Percent
K_Delta[5][2000 RPM]	Platform	______________	Percent
K_Delta[6][2000 RPM]	Platform	______________	Percent
K_Delta[7][2000 RPM]	Platform	______________	Percent
K_Delta[8][2000 RPM]	Platform	______________	Percent
K_Delta[9][2000 RPM]	Platform	______________	Percent
K_Delta[10][2000 RPM]	Platform	______________	Percent
K_Delta[11][2000 RPM]	Platform	______________	Percent
K_Delta[12][2000 RPM]	Platform	______________	Percent
K_Delta[13][2000 RPM]	Platform	______________	Percent
K_Delta[14][2000 RPM]	Platform	______________	Percent
K_Delta[15][2000 RPM]	Platform	______________	Percent
K_Delta[16][2000 RPM]	Platform	______________	Percent
K_Delta[0][2500 RPM]	Platform	______________	Percent
K_Delta[1][2500RPM]	Platform	______________	Percent
K_Delta[2][2500 RPM]	Platform	______________	Percent
K_Delta[3][2500 RPM]	Platform	______________	Percent
K_Delta[4][2500RPM]	Platform	______________	Percent
K_Delta[5][2500 RPM]	Platform	______________	Percent
K_Delta[6][2500 RPM]	Platform	______________	Percent
K_Delta[7][2500 RPM]	Platform	______________	Percent
K_Delta[8][2500 RPM]	Platform	______________	Percent
K_Delta[9][2500 RPM]	Platform	______________	Percent
K_Delta[10][2500 RPM]	Platform	______________	Percent
K_Delta[11][2500 RPM]	Platform	______________	Percent
K_Delta[12][2500 RPM]	Platform	______________	Percent
K_Delta[13][2500 RPM]	Platform	______________	Percent
K_Delta[14][2500 RPM]	Platform	______________	Percent
K_Delta[15][2500 RPM]	Platform	______________	Percent
K_Delta[16][2500 RPM]	Platform	______________	Percent
K_Delta[0][3000 RPM]	Platform	______________	Percent
K_Delta[1][3000 RPM]	Platform	______________	Percent
K_Delta[2][3000 RPM]	Platform	______________	Percent

	Owner	Value	Units
K_Delta[3][3000 RPM]	Platform	________________	Percent
K_Delta[4][3000 RPM]	Platform	________________	Percent
K_Delta[5][3000 RPM]	Platform	________________	Percent
K_Delta[6][3000 RPM]	Platform	________________	Percent
K_Delta[7][3000 RPM]	Platform	________________	Percent
K_Delta[8][3000 RPM]	Platform	________________	Percent
K_Delta[9][3000 RPM]	Platform	________________	Percent
K_Delta[10][3000 RPM]	Platform	________________	Percent
K_Delta[11][3000 RPM]	Platform	________________	Percent
K_Delta[12][3000 RPM]	Platform	________________	Percent
K_Delta[13][3000 RPM]	Platform	________________	Percent
K_Delta[14][3000 RPM]	Platform	________________	Percent
K_Delta[15][3000 RPM]	Platform	________________	Percent
K_Delta[16][3000 RPM]	Platform	________________	Percent
K_Delta[0][3500 RPM]	Platform	________________	Percent
K_Delta[1][3500 RPM]	Platform	________________	Percent
K_Delta[2][3500 RPM]	Platform	________________	Percent
K_Delta[3][3500 RPM]	Platform	________________	Percent
K_Delta[4][3500 RPM]	Platform	________________	Percent
K_Delta[5][3500 RPM]	Platform	________________	Percent
K_Delta[6][3500 RPM]	Platform	________________	Percent
K_Delta[7][3500 RPM]	Platform	________________	Percent
K_Delta[8][3500 RPM]	Platform	________________	Percent
K_Delta[9][3500 RPM]	Platform	________________	Percent
K_Delta[10][3500 RPM]	Platform	________________	Percent
K_Delta[11][3500 RPM]	Platform	________________	Percent
K_Delta[12][3500 RPM]	Platform	________________	Percent
K_Delta[13][3500 RPM]	Platform	________________	Percent
K_Delta[14][3500 RPM]	Platform	________________	Percent
K_Delta[15][3500 RPM]	Platform	________________	Percent
K_Delta[16][3500 RPM]	Platform	________________	Percent
K_Delta[0][4000 RPM]	Platform	________________	Percent
K_Delta[1][4000 RPM]	Platform	________________	Percent
K_Delta[2][4000 RPM]	Platform	________________	Percent
K_Delta[3][4000 RPM]	Platform	________________	Percent
K_Delta[4][4000 RPM]	Platform	________________	Percent
K_Delta[5][4000 RPM]	Platform	________________	Percent
K_Delta[6][4000 RPM]	Platform	________________	Percent
K_Delta[7][4000 RPM]	Platform	________________	Percent
K_Delta[8][4000 RPM]	Platform	________________	Percent
K_Delta[9][4000 RPM]	Platform	________________	Percent
K_Delta[10][4000 RPM]	Platform	________________	Percent
K_Delta[11][4000 RPM]	Platform	________________	Percent
K_Delta[12][4000 RPM]	Platform	________________	Percent

	Owner	Value	Units
K_Delta[13][4000 RPM]	Platform		Percent
K_Delta[14][4000 RPM]	Platform		Percent
K_Delta[15][4000 RPM]	Platform		Percent
K_Delta[16][4000 RPM]	Platform		Percent
K_DiagFanSensorFreqMin	Platform		RPM
K_DiagFanSpeedHiMax	Platform		RPM
K_DiagFanSpeedSlowDelta	Platform		RPM
K_ECT_%FanReq[0]	Platform		Percent
K_ECT_%FanReq[1]	Platform		Percent
K_ECT_%FanReq[2]	Platform		Percent
K_ECT_%FanReq[3]	Platform		Percent
K_ECT_%FanReq[4]	Platform		Percent
K_ECT_%FanReq[5]	Platform		Percent
K_ECT_%FanReq[6]	Platform		Percent
K_ECT_%FanReq[7]	Platform		Percent
K_ECT_%FanReq[8]	Platform		Percent
K_ECT_%FanReq[9]	Platform		Percent
K_ECT_%FanReq[10]	Platform		Percent
K_ECT_%FanReq[11]	Platform		Percent
K_ECT_%FanReq[12]	Platform		Percent
K_ECT_%FanReq[13]	Platform		Percent
K_ECT_%FanReq[14]	Platform		Percent
K_ECT_%FanReq[15]	Platform		Percent
K_ECT_%FanReq[16]	Platform		Percent
K_EngineCoolantHotHi	Platform		Degrees C
K_EngineCoolantHotLo	Platform		Degrees C
K_EngOilTempHi	Platform		Degrees C
K_ExhaustTempAfterRunResetTrig[0]	Platform		Minutes
K_ExhaustTempAfterRunResetTrig[1]	Platform		Minutes
K_ExhaustTempAfterRunSetTrig[0]	Platform		Minutes
K_ExhaustTempAfterRunSetTrig[1]	Platform		Minutes
K_ExhaustTempAfterRunTime[0]	Platform		Minutes
K_ExhaustTempAfterRunTime[1]	Platform		Minutes
K_FanAdjustLimitHi	Platform		Percent
K_FanAdjustLimitLo	Platform		Percent
K_FanChangeDelay	Powertrain		Seconds
K_FanCommandForCTSFault	Platform		Percent
K_FanFailSpeed	Platform		RPM
K_FanLockUpEngineRPM	Platform		RPM
K_FanLockUpTime	Platform		Seconds
K_FanPwrUpDelay	Powertrain		Seconds
K_FanRPM_Offset	Platform		RPM
K_FanRPM_Max	Platform		RPM
K_FanSpdChgIdle	Platform		True/False

	Owner	Value	Units
K_Fan_Speed_Limit[0][400 RPM]	Platform		RPM
K_Fan_Speed_Limit[1][600 RPM]	Platform		RPM
K_Fan_Speed_Limit[2][800 RPM]	Platform		RPM
K_Fan_Speed_Limit[3][1000 RPM]	Platform		RPM
K_Fan_Speed_Limit[4][1200 RPM]	Platform		RPM
K_Fan_Speed_Limit[5][1400 RPM]	Platform		RPM
K_Fan_Speed_Limit[6][1600 RPM]	Platform		RPM
K_Fan_Speed_Limit[7][1800 RPM]	Platform		RPM
K_Fan_Speed_Limit[8][2000 RPM]	Platform		RPM
K_Fan_Speed_Limit[9][2200 RPM]	Platform		RPM
K_Fan_Speed_Limit[10][2400 RPM]	Platform		RPM
K_Fan_Speed_Limit[11][2600 RPM]	Platform		RPM
K_Fan_Speed_Limit[12][2800 RPM]	Platform		RPM
K_Fan_Speed_Limit[13][3000 RPM]	Platform		RPM
K_Fan_Speed_Limit[14][3200 RPM]	Platform		RPM
K_Fan_Speed_Limit[15][3400 RPM]	Platform		RPM
K_Fan_Speed_Limit[16][3600 RPM]	Platform		RPM
K_FanSpeedMinTime	Platform		Seconds
K_FanSpeedSanityFailLimit	Platform		True/False
K_FanSpeedSanityPassLimit	Platform		True/False
K_FanSpeedSanityWindow	Platform		Valid/Invalid
K_I_Deadband	Platform		RPM
K_I_%PWM	Platform		Percent
K_Integrator_High	Platform		Percent
K_Integrator_Low	Platform		Percent
K_MaxFanRPMCmd	Platform		RPM
K_MaxFanPWMGradientNeg	Platform		%/Second
K_MaxFanPWMGradientPos	Platform		%/Second
K_MaxVehicleSpeed	Platform		KPH
K_MinRPMtoDetectFanLockup	Platform		RPM
K_RPM%min_[1]	Platform		Percent
K_RPM%min_[2]	Platform		Percent
K_RPM%min_[3]	Platform		Percent
K_RPM%min_[4]	Platform		Percent
K_RPM%max_[1]	Platform		Percent
K_RPM%max_[2]	Platform		Percent
K_RPM%max_[3]	Platform		Percent
K_RPM%max_[4]	Platform		Percent
K_ServiceOverrideAllowed	Platform		Percent
K_SlipECT_MaxHi	Platform		Degrees C
K_SlipECT_MaxLo	Platform		Degrees C
K_SlipFanDriveHi	Platform		RPM
K_SlipFanDriveLo	Platform		RPM

	Owner	Value	Units
K_SlipFanRPMHi	Platform		RPM
K_Speed[0]_OFF_%Fan	Platform		Percent
K_Speed[1]_OFF_%Fan	Platform		Percent
K_Speed[2]_OFF_%Fan	Platform		Percent
K_Speed[3]_OFF_%Fan	Platform		Percent
K_Speed[4]_OFF_%Fan	Platform		Percent
K_Speed[5]_OFF_%Fan	Platform		Percent
K_Speed[6]_OFF_%Fan	Platform		Percent
K_Speed[1]_ON_%Fan	Platform		Percent
K_Speed[2]_ON_%Fan	Platform		Percent
K_Speed[3]_ON_%Fan	Platform		Percent
K_Speed[4]_ON_%Fan	Platform		Percent
K_Speed[5]_ON_%Fan	Platform		Percent
K_Speed[6]_ON_%Fan	Platform		Percent
K_Speed[7]_ON_%Fan	Platform		Percent
K_SysVoltsNominal	Platform		Volts
K_TempEngOilHi	Platform		Degrees C
K_TempEngOilLo	Platform		Degrees C
K_TempTransOilHi	Platform		Degrees C
K_TempTransOilLo	Platform		Degrees C
K_TransOilTempHi	Platform		Degrees C
K_VehicleSpdFanAdjustHi	Platform		KPH
K_VehicleSpdFanAdjustLo	Platform		KPH
K_VehicleSpdIsZeroHi	Platform		KPH
K_VehicleSpdIsZeroLo	Platform		KPH
K_WaterPumpPulleyRatio	Platform		Ratio
K_WOTFanRPM	Platform		RPM
K_WOT_CoolantTemp	Platform		Degrees C
K_WOT_MaxDisable	Platform		Seconds

4.3 A/C Compressor Control Algorithm

K_BarometerThreshold	Platform		kPa
K_CompressorHiSpdDsblTme	Platform		Seconds
K_CompressorLoSpdDsblTme	Platform		Seconds
K_ContinuousGearDsngeOff	Platform		RPM
K_ContinuousPN_Dsnge	Platform		RPM
K_DiagClutchDelay_CatMon	Platform		Seconds
K_DiagOverrideOnMax_CatMon	Platform		Seconds

	Owner	Value	Units
K_DiagOverrideOnMax_EGR	Platform		Seconds
K_DwnShftDsblTme	Powertrain		Seconds
K_FullPedDsnge	Platform		Percent
K_FullPedEnge	Platform		Percent
K_HighPresDsnge	Platform		kPa
K_HighPresEnge	Platform		kPa
K_HighSpeedGearEngeOff	Platform		RPM
K_HighSpeedPN_EngeOff	Platform		RPM
K_HiSpdFullPedDsnge	Platform		RPM
K_HiSpdFullPedEnge	Platform		RPM
K_HighVoltDsnge	Platform		Volts
K_HighVoltEnge	Platform		Volts
K_IdleSwClosedDsblTme	Powertrain		Seconds
K_LaunchPedPosDsnge	Platform		RPM, %
K_LetOffPedDsblTme	Platform		Seconds
K_LowAccelDsnge	Platform		m/s^2
K_LowAccelEnge	Platform		m/s^2
K_LowPresDsnge	Platform		kPa
K_LowPresEnge	Platform		kPa
K_LowSpeedDsnge	Platform		RPM
K_LowSpeedEngeOff	Platform		RPM
K_LowVehSpdDsnge	Platform		km/h
K_LowVehSpdEnge	Platform		km/h
K_LowVoltDsnge	Platform		Volts
K_LowVoltEnge	Platform		Volts
K_MaxAntiSlugTme	Platform		milliseconds
K_MaxClutchDelay	Platform		Seconds
K_MaxFullPedDsblTme	Powertrain		Seconds
K_MinClutchDsblTme[0]	Platform		Seconds
K_MinClutchDsblTme[1]	Platform		Seconds
K_MinClutchDsblTme[2]	Platform		Seconds
K_MinClutchDsblTme[3]	Platform		Seconds
K_MinClutchDsblTme[4]	Platform		Seconds
K_MinClutchDsblTme[5]	Platform		Seconds
K_MinClutchDsblTme[6]	Platform		Seconds
K_MinClutchDsblTme[7]	Platform		Seconds
K_MinClutchDsblTme[8]	Platform		Seconds
K_MinClutchDsblTme[9]	Platform		Seconds
K_MinClutchDsblTme[10]	Platform		Seconds
K_MinClutchDsblTme[11]	Platform		Seconds
K_MinClutchDsblTme[12]	Platform		Seconds
K_MinClutchDsblTme[13]	Platform		Seconds
K_MinClutchDsblTme[14]	Platform		Seconds
K_MinClutchDsblTme[15]	Platform		Seconds

	Owner	Value	Units
K_MinClutchDsblTme[16]	Platform	________	Seconds
K_MinEngRunningTme[0]	Powertrain	________	Seconds
K_MinEngRunningTme[1]	Powertrain	________	Seconds
K_MinEngRunningTme[2]	Powertrain	________	Seconds
K_MinEngRunningTme[3]	Powertrain	________	Seconds
K_MinEngRunningTme[4]	Powertrain	________	Seconds
K_MinFullPedDsblCycTme	Powertrain	________	Seconds
K_MinFullPedDsblTme	Powertrain	________	Seconds
K_ServOvrdMaxTme	Platform	________	Seconds
K_ShiftClutchDelay	Powertrain	________	Seconds
K_SlugCoolTempThrsh	Platform	________	Degrees C
K_SlugIgnVoltThrsh	Platform	________	Volts
K_SlugKoffMnfdTempThrsh	Platform	________	Degrees C
K_SlugMaxRefPulses	Platform	________	pulses
K_SlugMnfdTempThrsh	Platform	________	Degrees C
K_SlugUnderPresLmt	Platform	________	kPa
K_StallSaveMinDsblTme	Powertrain	________	Seconds
K_TransientGearDsngeOff	Platform	________	RPM
K_TransientPN_DsngeOff	Platform	________	RPM

4.4 Generator Status Algorithm

K_F_DC_KeyOnTest	Platform	________	Percent
K_F_DC_RunTest	Platform	________	Percent
K_F_KeyOnTestTime	Platform	________	Seconds
K_F_RPM_RunTest	Platform	________	RPM
K_F_RunTestTime	Platform	________	Seconds
K_F_TerminalPresent	Platform	________	True/False
K_F_TermInFilt	Platform	________	Factor
K_L_KeyOnTestTime	Platform	________	Seconds
K_L_RunTestTime	Platform	________	Seconds

4.5 Generator L-Terminal Control Algorithm

K_ColdStartDsbl[0]	Powertrain	________	Seconds
K_ColdStartDsbl[1]	Powertrain	________	Seconds
K_ColdStartDsbl[2]	Powertrain	________	Seconds
K_ColdStartDsbl[3]	Powertrain	________	Seconds
K_ColdStartDsbl[4]	Powertrain	________	Seconds
K_ColdStartDsbl[5]	Powertrain	________	Seconds
K_ColdStartDsbl[6]	Powertrain	________	Seconds
K_ColdStartDsbl[7]	Powertrain	________	Seconds
K_ColdStartDsbl[8]	Powertrain	________	Seconds
K_ColdStartDsbl[9]	Powertrain	________	Seconds

	Owner	Value	Units
K_ColdStartDsbl[10]	Powertrain	________	Seconds
K_ColdStartDsbl[11]	Powertrain	________	Seconds
K_ColdStartDsbl[12]	Powertrain	________	Seconds
K_ColdStartDsbl[13]	Powertrain	________	Seconds
K_ColdStartDsbl[14]	Powertrain	________	Seconds
K_ColdStartDsbl[15]	Powertrain	________	Seconds
K_ColdStartDsbl[16]	Powertrain	________	Seconds
K_CumulativeL_TermOff	Platform	________	Seconds
K_CumulativeL_TermOffDC	Platform	________	Seconds
K_EngSpdCutout[0][PN]	Powertrain	________	RPM
K_EngSpdCutout[1][PN]	Powertrain	________	RPM
K_EngSpdCutout[2][PN]	Powertrain	________	RPM
K_EngSpdCutout[3][PN]	Powertrain	________	RPM
K_EngSpdCutout[4][PN]	Powertrain	________	RPM
K_EngSpdCutout[5][PN]	Powertrain	________	RPM
K_EngSpdCutout[6][PN]	Powertrain	________	RPM
K_EngSpdCutout[7][PN]	Powertrain	________	RPM
K_EngSpdCutout[8][PN]	Powertrain	________	RPM
K_EngSpdCutout[9][PN]	Powertrain	________	RPM
K_EngSpdCutout[10][PN]	Powertrain	________	RPM
K_EngSpdCutout[11][PN]	Powertrain	________	RPM
K_EngSpdCutout[12][PN]	Powertrain	________	RPM
K_EngSpdCutout[13][PN]	Powertrain	________	RPM
K_EngSpdCutout[14][PN]	Powertrain	________	RPM
K_EngSpdCutout[15][PN]	Powertrain	________	RPM
K_EngSpdCutout[16][PN]	Powertrain	________	RPM
K_EngSpdCutout[0][NotPN]	Powertrain	________	RPM
K_EngSpdCutout[1][NotPN]	Powertrain	________	RPM
K_EngSpdCutout[2][NotPN]	Powertrain	________	RPM
K_EngSpdCutout[3][NotPN]	Powertrain	________	RPM
K_EngSpdCutout[4][NotPN]	Powertrain	________	RPM
K_EngSpdCutout[5][NotPN]	Powertrain	________	RPM
K_EngSpdCutout[6][NotPN]	Powertrain	________	RPM
K_EngSpdCutout[7][NotPN]	Powertrain	________	RPM
K_EngSpdCutout[8][NotPN]	Powertrain	________	RPM
K_EngSpdCutout[9][NotPN]	Powertrain	________	RPM
K_EngSpdCutout[10][NotPN]	Powertrain	________	RPM
K_EngSpdCutout[11][NotPN]	Powertrain	________	RPM
K_EngSpdCutout[12][NotPN]	Powertrain	________	RPM
K_EngSpdCutout[13][NotPN]	Powertrain	________	RPM
K_EngSpdCutout[14][NotPN]	Powertrain	________	RPM
K_EngSpdCutout[15][NotPN]	Powertrain	________	RPM
K_EngSpdCutout[16][NotPN]	Powertrain	________	RPM
K_RVC_FunctionPresent	Platform	________	True/False

	Owner	Value	Units
K_RVC_MinDutyCycle	Platform	________	Percent
K_ZeroSpdThresh	Powertrain	________	KPH

4.6 Fuel Volume Algorithm

	Owner	Value	Units
K_FastFillEngRun	Platform	________	Seconds
K_FastFiltGearTime	Platform	________	Seconds
K_FastFiltVehSpeedTime	Platform	________	Seconds
K_FuelLvlDiagFilt	Powertrain	________	Factor
K_FuelLvlFastFiltHysPair[Low]	Platform	________	Litres
K_FuelLvlFastFiltHysPair[High]	Platform	________	Litres
K_FuelLvlFastFiltHysPairTime	Platform	________	Seconds
K_FuelLvlInFiltDiagPri	Powertrain	________	Factor
K_FuelLvlInFiltDiagSec	Powertrain	________	Factor
K_FuelLvlInFiltDsplyPri	Platform	________	Factor
K_FuelLvlInFIltDsplySec	Platform	________	Factor
K_FuelLvlIntgrTmDiag	Powertrain	________	Seconds
K_FuelLvlIntgrTmDsply	Powertrain	________	Seconds
K_FuelLvlVehSpeedDiag	Powertrain	________	kph
K_FuelLvlVehSpeedDsply	Platform	________	kph
K_FuelPlatFastFilt	Platform	________	Factor
K_FuelPlatNormalFilt	Platform	________	Factor
K_FuelSenderUnitType	Platform	________	Type of Fuel Sender
K_FuelSystemRatedCapDiag	Powertrain	________	Litres
K_FuelSystemRatedCapDsply	Platform	________	Litres
K_FuelTankSt1_ChgDiag	Powertrain	________	Seconds
K_FuelTankSt1_ChgDsply	Platform	________	Seconds
K_FuelTankSt2_ChgDiag	Powertrain	________	Seconds
K_FuelTankSt2_ChgDsply	Platform	________	Seconds
K_FuelTankSt3_ChgDiag	Powertrain	________	Seconds
K_FuelTankSt3_ChgDsply	Platform	________	Seconds
K_FuelTankSt4_ChgDiag	Powertrain	________	Seconds
K_FuelTankSt4_ChgDsply	Platform	________	Seconds
K_FuelTankSt5_ChgDiag	Powertrain	________	Seconds
K_FuelTankSt5_ChgDsply	Platform	________	Seconds
K_MaxFuelVolDlvdInState2_Diag	Powertrain	________	Litres
K_MaxFuelVolDlvdInState2_Dsplay	Platform	________	Litres
K_PrimaryFuelTankDiag[0]	Powertrain	________	Litres
K_PrimaryFuelTankDiag[1]	Powertrain	________	Litres
K_PrimaryFuelTankDiag[2]	Powertrain	________	Litres
K_PrimaryFuelTankDiag[3]	Powertrain	________	Litres
K_PrimaryFuelTankDiag[4]	Powertrain	________	Litres
K_PrimaryFuelTankDiag[5]	Powertrain	________	Litres

	Owner	Value	Units
K_PrimaryFuelTankDiag[6]	Powertrain	______	Litres
K_PrimaryFuelTankDiag[7]	Powertrain	______	Litres
K_PrimaryFuelTankDiag[8]	Powertrain	______	Litres
K_PrimaryFuelTankDiag[9]	Powertrain	______	Litres
K_PrimaryFuelTankDiag[10]	Powertrain	______	Litres
K_PrimaryFuelTankDiag[11]	Powertrain	______	Litres
K_PrimaryFuelTankDiag[12]	Powertrain	______	Litres
K_PrimaryFuelTankDiag[13]	Powertrain	______	Litres
K_PrimaryFuelTankDiag[14]	Powertrain	______	Litres
K_PrimaryFuelTankDiag[15]	Powertrain	______	Litres
K_PrimaryFuelTankDiag[16]	Powertrain	______	Litres
K_PrimaryFuelTankDiag[17]	Powertrain	______	Litres
K_PrimaryFuelTankDiag[18]	Powertrain	______	Litres
K_PrimaryFuelTankDiag[19]	Powertrain	______	Litres
K_PrimaryFuelTankDiag[20]	Powertrain	______	Litres
K_PrimaryFuelTankDiag[21]	Powertrain	______	Litres
K_PrimaryFuelTankDiag[22]	Powertrain	______	Litres
K_PrimaryFuelTankDiag[23]	Powertrain	______	Litres
K_PrimaryFuelTankDiag[24]	Powertrain	______	Litres
K_PrimaryFuelTankDiag[25]	Powertrain	______	Litres
K_PrimaryFuelTankDiag[26]	Powertrain	______	Litres
K_PrimaryFuelTankDiag[27]	Powertrain	______	Litres
K_PrimaryFuelTankDiag[28]	Powertrain	______	Litres
K_PrimaryFuelTankDiag[29]	Powertrain	______	Litres
K_PrimaryFuelTankDiag[30]	Powertrain	______	Litres
K_PrimaryFuelTankDiag[31]	Powertrain	______	Litres
K_PrimaryFuelTankDiag[32]	Powertrain	______	Litres
K_PrimaryFuelTankDsply	Platform	______	Litres
K_PriTankFullDiag	Powertrain	______	Litres
K_PriTankFullDsply	Platform	______	Litres
K_PriTankRatedCapDiag	Powertrain	______	Litres
K_PriTankRatedCapDsply	Platform	______	Litres
K_SecondaryFuelTankDiag[0]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[1]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[2]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[3]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[4]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[5]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[6]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[7]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[8]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[9]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[10]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[11]	Powertrain	______	Litres

	Owner	Value	Units
K_SecondaryFuelTankDiag[12]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[13]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[14]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[15]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[16]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[17]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[18]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[19]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[20]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[21]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[22]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[23]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[24]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[25]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[26]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[27]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[28]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[29]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[30]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[31]	Powertrain	______	Litres
K_SecondaryFuelTankDiag[32]	Powertrain	______	Litres
K_SecondaryFuelTankDsply	Platform	______	Litres
K_SecTankEmptyDiag	Powertrain	______	Litres
K_SecTankEmptyDsply	Platform	______	Litres
K_SecTankEstimateDiag	Powertrain	______	Litres
K_SecTankEstimateDsply	Platform		Litres

4.7 Remote Vehicle Start Monitor

K_EngOilPresLowLmpOnTime	Platform	______	Seconds
K_EngSpdThresh_1	Platform	______	RPM
K_EngSpdThresh_1_Tme	Platform	______	Seconds
K_EngSpdThresh_2	Platform	______	RPM
K_EngSpdThresh_2_Tme	Platform	______	Seconds
K_Max_Starts_Allowed	Platform	______	(defined in Starter Control Algorithm Section)
K_RVSPCMBackupTimerFirstStart	Platform	______	Minutes
K_RVSPCMBackupTimerSecondStart	Platform	______	Minutes
K_ThrottlePct	Platform	______	Percent
K_ThrottlePctTme	Platform	______	Seconds

4.8 Power Take-Off and Fast Idle Control Algorithm

Algorithm not defined for GMW3119 PPEI Version 2.5

	Owner	Value	Units

4.9 Transfer Case Controls Algorithm

Algorithm not defined for GMW3119 PPEI Version 2.5		________________	

4.10 Variable Speed Fuel Pump Control Algorithm

K_DutyCycleLookUpTable	Powertrain and Platform	________________	Percent
K_MaxDutyCycle	Powertrain and Platform	________________	Percent
K_MinDutyCycle	Powertrain and Platform	________________	Percent

5.2 Serial Data - GMLAN

Engine Oil Life Reset Performed

K_OilLifeResetOccurredTime	Platform	________________	Seconds

Change Log

SECTIONS CHANGED	DESCRIPTION OF CHANGES	RATIONALE/AUTHORIZATION
4.10	Added the following calibrations: K_DutyCycleLookUpTable K_MaxDutyCycle K_MinDutyCycle	ICR 2010
4.6	Added the following calibrations: K_FastFiltGearTime K_FastFiltVehSpeedTime K_FuelLvlIntgrTmDiag K_FuelLvlIntgrTmDsply K_FuelLvlVehSpeedDiag K_FuelLvlVehSpeedDsply K_FuelSenderUnitType K_FuelSystemRatedCapDsply K_FuelTankSt1_ChgDiag K_FuelTankSt1_ChgDsply K_FuelTankSt2_ChgDiag K_FuelTankSt2_ChgDsply K_FuelTankSt3_ChgDiag K_FuelTankSt3_ChgDsply K_FuelTankSt4_ChgDiag K_FuelTankSt4_ChgDsply K_FuelTankSt5_ChgDiag K_FuelTankSt5_ChgDsply K_MaxFuelVolDlvdInState2_Diag K_MaxFuelVolDlvdInState2_Dsplay K_PrimaryFuelTankDsply K_PriTankFullDsply K_PriTankRatedCapDiag K_SecondaryFuelTankDsply K_SecTankEmptyDsply K_SecTankEstimateDsply Revised previously existing calibration name(s) to the following: K_FuelLvlDiagFilt K_FuelSystemRatedCapDiag (and cal owner) K_PrimaryFuelTankDiag K_PriTankFullDiag (and cal location) K_PriTankRatedCapDsply K_SecondaryFuelTankDiag K_SecTankEmptyDiag (and cal location) K_SecTankEstimateDiag (and cal location) Deleted the following calibrations:	ICR 2030

	K_FuelSloshFilt K_FuelSystemUnusableFuelPri K_FuelSystemUnusableFuelSec K_FuelTankStateChgDiag K_FuelTankStChgDsply K_TotalFuelSystem	
4.2	Revised K_%PWM PRM values to increment of 500 (was increments of 800). Added the following calibrations: K_Adjust_PWM_Exec_Rate(n) K_AfterRunHi%Fan K_AfterRunExhaustTempHi(n) K_AfterRunHiContinueTemp(n) K_AfterRunHiStartTempHi K_AfterRunHiStartTempLo K_Delta(m,n) K_EngOilTempHi K_ExhaustTempAfterRunResetTrig(n) K_ExhaustTempAfterRunSetTrig(n) K_ExhaustTempAfterRunTime(n) K_Fan_Speed_Limit(m,n) K_FanSpeedSanityFailLimit K_FanSpeedSanityPassLimit K_FanSpeedSanityWindow K_I_Deadband K_I_%PWM K_Integrator_High K_Integrator_Low K_MaxFanRPMCmd K_SlipFanRPMHi K_TransOilTempHi Deleted the following calibrations: K_FanSpeedDecrRateLimit K_SlipFanSpeed K_SlipOverrideDuration K_Slip%FanHi K_Slip%FanLo K_SlipTimeMax K_WOT%Fan K_WOTFAnRPM Added comments to the following calibrations: K_TempEngOilHi K_TempEngOilLo K_TempTransOilHi K_TempTransOilLo	ICR 2031
4.3	Added the following calibrations per ICR 2092: K_DiagClutchDelay_CatMon	ICR 2092

	K_DiagOverrideOnMax_CatMon K_DiagOverrideOnMax_EGR Added the following calibration(s): K_BarometerThreshold K_FullPedDsnge K_FullPedEnge K_HiSpdFullPedDsnge K_HiSpdFullPedEnge K_LaunchPedPosDsnge K_LetOffPedDsblTme K_LowAccelDsnge K_LowAccelEnge K_LowVehSpdDsnge K_LowVehSpdEnge K_MinFullPedDsblTme K_ShiftClutchDelay	 Changes missed during previous PPEI 2.x releases
4.4	Corrected calibration name K_F_TermInFilt in the Generator Status Algorithm (originally misspelled).	Editorial Correction
4.5	Added calibration K_RVC_MinDutyCycle	Missed during the creation of Section 6.5c (This calibration was a change written against GMW3119 PPEI 2.2 for published in GMW3119 PPEI 2.3.)
4.7	Added calibration K_Max_Starts_Allowed (for reference only, this calibration is defined in the Starter Control Section) Added the following calibrations: K_EngOilPresLowLmpOnTime K_RVSPCMBackupTimerFirstStart K_RVSPCMBackupTimerSecondStart	ICR 2113 Changes missed during previous PPEI 2.x releases
4.8	Section added as a placeholder; not used in PPEI 2.x versions.	Editorial
4.9	Section added as a placeholder; not used in PPEI 2.x versions.	Editorial
4.2	Added calibrations: K_AfterRunExhaustTempHi[n] K_ExhaustTempAfterRunResetTrig[n] K_ExhaustTempAfterRunSetTrig[n K_ExhaustTempAfterRunTime[n]	ICR 2165