3.3.2 Accelerator Pedal Position Sensor Signals. Refer to GMW8766, PPEI Engine Power Management Subsystem Requirements.

3.3.3 Clutch Start Switch. This signal is used to determine if the clutch is fully disengaged. The clutch must be fully disengaged in order for 4WD transfer cases to be shifted into Neutral. Refer to GMW8767, Starter Control Subsystem Requirements.

3.3.4 Clutch Pedal Position Sensor. A potentiometer provides an indication of the clutch pedal position. The ECM uses this input to determine the current pedal position relative to the total range of pedal travel available on a vehicle. The current position can be used along with specified thresholds to provide positional states for the clutch pedal similar to what is provided by discrete switches.

3.3.5 Brake Pedal Apply. Refer to GMW8773, PPEI Brakes and Traction Control Subsystem Requirements.

3.3.6 Mode Switch Regulated Voltage. The Powertrain electronics shall provide a +5 V regulated supply voltage to the Operator Mode Request Switch.

This interface may be emissions-related. Refer to GMW8762, PPEI General Information on On-Board Diagnostics for platform design guidelines.

3.3.7 Mode Request. The multiplexed Operator Mode Request Switch shall provide this analog signal to the Powertrain electronics. This switch may be of a latching or momentary design as specified to meet Platform requirements. A calibration within the Powertrain controls shall be used to differentiate between the two types of switches. This switch produces an analog signal that represents the desired mode of operation. The valid operating modes are as follows: 2WD High, 4WD High, 4WD Low, Auto 4WD, AWD (Full Time 4WD), Neutral, and Differential Lock. The switch may be required to allow the selection of various subsets of these modes, depending upon the application. Currently no single system implements all of these modes. Note that the differential lock may be engaged independent of the 2WD/4WD mode, but is usually only allowed in 4WD Low.

This function shall operate ratiometrically with respect to the Mode Switch Regulated Voltage supplied by the Powertrain to the switch. Refer to 3.3.5. The powertrain electronics shall then divide the Mode Request voltage reading by the Mode Switch Regulated Voltage and compare the result with the voltages in Table 3 to determine the requested operating mode.

This interface may be emissions-related. Refer to GMW8762, PPEI General Information on On-Board Diagnostics for platform design guidelines.

3.3.8 2WD High Mode. This output of the Powertrain electronics is a discrete low side driver. It is used to illuminate an LED indicator (usually on the Operator Mode Request Switch) when the 4WD system is locked into the 2WD High mode of operation. The LED indicator shall be pulled up to Run/Crank voltage through a pulse width modulation (PWM) driver controlled by a Platform module.

3.3.9 4WD High Mode. This output of the Powertrain electronics is a discrete low side driver. It is used to illuminate an LED indicator (usually on the Operator Mode Request Switch) when the 4WD system is locked into the 4WD High mode of operation. The LED indicator shall be pulled up to Run/Crank voltage through a PWM driver controlled by a Platform module. In this mode the center differential is locked, allowing no front to rear wheel slip.

3.3.10 4WD Low Mode. This output of the Powertrain electronics is a discrete low side driver. It is used to illuminate an LED indicator (usually on the Operator Mode Request Switch) when the 4WD system is locked into the 4WD Low mode of operation. The LED indicator shall be pulled up to Run/Crank voltage through a PWM driver controlled by a Platform module. In this mode the center differential is locked, allowing no front to rear wheel slip.

3.3.11 AWD (Full Time 4WD) Mode. This output of the Powertrain electronics is a discrete low side driver. It is used to illuminate an LED indicator (usually on the Operator Mode Request Switch) when the 4WD system is locked into the AWD (Full Time 4WD) of operation. The LED indicator shall be pulled up to Run/Crank voltage through a PWM driver controlled by a Platform module. In this mode the transfer case is in the “high” range, and the center differential is open, allowing front to rear wheel slip.

3.3.12 Auto 4WD Mode. This output of the Powertrain electronics is a discrete low side driver. It is used to illuminate an LED indicator (usually on the Operator Mode Request Switch) when the 4WD system is locked into the Auto 4WD mode of operation. The LED indicator shall be pulled up to Run/Crank voltage through a PWM driver controlled by a Platform module. In this mode the center differential is open, allowing front to rear wheel slip and a clutch pack is used to dynamically regulate the front to rear torque split.

3.3.13 Transfer Case Neutral Mode. This output of the Powertrain electronics is a discrete low side driver. It is used to illuminate an LED indicator (usually on the Operator Mode Request Switch) when the 4WD transfer case is locked into the Neutral mode of operation. The LED indicator shall be pulled up to Run/Crank voltage through the driver controlled by a Platform module. This LED indicator shall not be dimmed. In this mode the transfer case is disconnected from both the front and rear propeller shafts, allowing no torque transmission to either axle.

3.3.14 Differential Lock Mode. This output of the Powertrain electronics is a discrete low side driver. On vehicle equipped with a lockable axle differential, it is used to illuminate an LED indicator (usually on the Operator Mode Request Switch) when the differential is locked allowing no left to right wheel slip. The LED indicator shall be pulled up to Run/Crank voltage through a PWM driver controlled by a Platform module.

3.3.15 Secondary Axle Control. For part time 4WD systems, this active low signal controls engagement of the secondary axle. The source of the signal is a discrete switch in the transfer case for manual 4WD systems and is a discrete low side output driver in the control module for electric/active 4WD systems.

3.3.16 Secondary Axle Feedback (4WD Mode). For part time 4WD systems, this active high discrete signal informs Powertrain that the transfer case has been engaged and the secondary axle is locked.

3.3.17 Differential Lock Control. For systems equipped with a lockable rear axle differential, this active high signal controls engagement of the differential lock.

3.4 Failure Modes and Diagnostics. Refer to GMW8772, PPEI Serial Data Architecture Subsystem Requirements for serial data failure modes and diagnostic information. Platform and Powertrain shall provide appropriate diagnostics and failsoft action for each of their inputs and outputs.

3.5 Electrical Characteristics.

3.5.1 Accelerator Pedal Position Sensor Signals. Refer to GMW8766, PPEI Engine Power Management Subsystem Requirements.

3.5.2 Clutch Start Switch. Refer to GMW8767, PPEI Starter Control Subsystem Requirements.

3.5.3 Brake Pedal Apply. Refer to GMW8773, PPEI Brakes and Traction Control Subsystem Requirements.

3.5.4 Clutch Pedal Position Sensor. Refer to GMW8777, CPPS Electrical Requirements.

3.5.5 Mode Switch Regulated Voltage. A regulated +5 V supply shall to be used according to Table 2.

Table 2: Mode Switch Regulated Voltage

Parameter	Value
Supply Voltage Nominal	5.0 ± 0.25 V
Supply Current Maximum	7.5 mA

This interface may be emissions-related. Refer to GMW8762, PPEI General Information on On-Board Diagnostics for platform design guidelines.

3.5.6 Mode Request. This interface may be emissions-related. Refer to GMW8762, PPEI General Information on On-Board Diagnostics for platform design guidelines.

Table 3 defines the required ratiometric voltage ranges for the Mode Request signal read at the powertrain controller corresponding to the Operator Mode Request Switch states. Table 4 lists the assumptions used to calculate these ranges.

Table 3: 4WD/AWD Mode Request

Operator Mode Request Switch State					Mode Request Voltage (V_M) as a percentage of the Mode Switch Regulated Voltage (V_R)	4WD/AWD Operating Mode
Sw1	Sw2	Sw3	Sw4	Sw5		
X	X	X	X	X	$V_M \leq 3.0\% V_R$	Open Circuit/Short to Ground, maintain last valid requested operating mode
X	X	X	X	X	$3.0\% V_R \leq V_M \leq 9.24\% V_R$	Not a Valid Request, maintain last valid requested operating mode
Off	Off	Off	Off	Off	$9.24\% V_R \leq V_M \leq 10.62\% V_R$	Momentary Switch at “Rest” or Latching Switch “Between Valid Positions”, maintain last valid requested operating mode
X	X	X	X	X	$10.62\% V_R < V_M < 28.18\% V_R$	Not a Valid Request, maintain last valid requested operating mode
Off	Off	Off	Off	On	$28.18\% V_R \leq V_M \leq 31.66\% V_R$	4WD Low Mode
X	X	X	X	X	$31.66\% V_R < V_M < 37.64\% V_R$	Not a Valid Request, maintain last valid requested operating mode
Off	Off	Off	On	Off	$37.64\% V_R \leq V_M \leq 41.83\% V_R$	2WD High Mode or AWD Mode, depending upon application
X	X	X	X	X	$41.83\% V_R < V_M < 47.08\% V_R$	Not a Valid Request, maintain last valid requested operating mode
Off	Off	On	Off	Off	$47.26\% V_R \leq V_M \leq 51.78\% V_R$	Transfer Case Neutral Mode (Latching Switch)
Off	Off	N/A	On	On	$47.08\% V_R \leq V_M \leq 51.69\% V_R$	Transfer Case Neutral Mode (Momentary Switch)
X	X	X	X	X	$51.78\% V_R < V_M < 57.52\% V_R$	Not a Valid Request, maintain last valid requested operating mode
Off	On	Off	Off	Off	$57.52 V_R \leq V_M \leq 62.53\% V_R$	4WD High Mode
X	X	X	X	X	$62.53\% V_R < V_M < 85.19\% V_R$	Not a Valid Request, maintain last valid requested operating mode
On	Off	Off	Off	Off	$85.19\% V_R \leq V_M \leq 89.89\% V_R$	Auto 4WD Mode or Diff Lock Mode, depending upon application
X	X	X	X	X	$89.89\% V_R < V_M < 97.0\% V_R$	Not a Valid Request, maintain last valid requested operating mode
X	X	X	X	X	$V_M \geq 97.0\% V_R$	Short to Battery, maintain last valid requested operating mode

Note: “X” in this table shall indicate a non-valid combination of switch states has generated an invalid VR voltage. When an invalid V_R voltage range has occurred, the last valid operating mode shall be retained.

In determining the $\%V_M$ in Table 3, the following implementation parameters for the Powertrain module (refer to Table 4) were assumed:

Table 4: Mode Request Voltage Calculation Value Assumptions

Parameter	Value/Condition
Analog to Digital (A/D) Accuracy	± 78.5 mV
Pull-down resistor	1 kΩ ± 3% over life and temperature
A/D Supply Reference	5 V ± 250 mV

The Operator Mode Request switch can be either of a momentary or a latching design at the discretion of the Platform. In either case, it shall utilize a shunt resistor for switch diagnostic purposes.

A momentary Operator Mode Request switch will typically be of the push-button type.

A latching Operator Mode Request switch will typically be of the rotary type and shall be of a “break before make” design with positive “detents” at all positions except Neutral. The Neutral position of this latching switch shall be momentary, with the switch reverting back to the latched 4WD Low position when released by the operator. A latching mode switch design is not compatible with systems that include differential lock control.

The Operator Mode Request Switch, regardless of type, shall have the electrical characteristics listed in Table 5.

Table 6 defines the required ratiometric voltage ranges for the Front/Rear Axle Differential Lock Mode Request signal read at the powertrain controller corresponding to the Differential Lock Request Switch states. Table 7 lists the electrical characteristics of the Differential Lock Mode Request Switch.

Table 5: Operator Mode Request Switch Electrical Characteristics

Parameter	Switch	Value/Conditions
Auto 4WD/Diff Lock Resistor	Sw1	140 Ω ± 3% over life and temperature
4WD High Resistor	Sw2	715 Ω ± 3% over life and temperature
Neutral Resistor	Sw3	1.15 kΩ ± 3% over life and temperature (latching switch only)
2WD High/Full Time 4WD Resistor	Sw4	1.82 kΩ ± 3% over life and temperature
4WD Low Resistor	Sw5	3.16 kΩ ± 3% over life and temperature
Shunt Resistor	--	9.09 kΩ ± 3% over life and temperature
Contact Resistance	--	10.0 Ω max

Table 6: Front / Rear Axle Differential Lock Mode Request

Differential Lock Request Switch State		Mode Request Voltage (V_M) as a percentage of the Mode Switch Regulated Voltage (V_R)	Front/Rear Axle Differential Mode
Sw1	**Sw2**		
X	X	$V_M \leq 3.0\% V_R$	Open Circuit/Short to Ground, maintain last valid requested operating mode
X	X	$3.0\% V_R \leq V_M \leq 9.24\% V_R$	Not a Valid Request
X	X	$9.24\% V_R \leq V_M \leq 10.62\% V_R$	Momentary Switch at “Rest” maintain last valid requested operating mode
X	X	$10.62\% V_R < V_M < 28.18\% V_R$	Not a Valid Request
Off	On	$28.18\% V_R \leq V_M \leq 31.66\% V_R$	Front Diff Lock Request
X	X	$31.66\% V_R < V_M < 85.19\% V_R$	Not a Valid Request
On	Off	$85.19\% V_R \leq V_M \leq 89.89\% V_R$	Rear Diff Lock Request
X	X	$89.89\% V_R < V_M < 97.0\% V_R$	Not a Valid Request
X	X	$V_M \geq 97.0\% V_R$	Short to Battery, maintain last valid requested operating mode

Table 7: Differential Lock Mode Request Switch Electrical Characteristics (Momentary type)

Parameter	Switch	Value/Conditions
Rear Diff Lock Resistor	Sw1	140 Ω ± 3% over life and temperature
Front Diff Lock Resistor	Sw2	3.16 kΩ ± 3% over life and temperature
Shunt Resistor	--	9.09 kΩ ± 3% over life and temperature
Contact Resistance	--	10.0 Ω max

3.5.7 2WD High Mode. This output of the Powertrain electronics shall be a low side driver, with at a minimum the capability of an LSD3 driver, as described in GMW8762, PPEI Electrical Requirements. The load shall be an LED indicator pulled up to Run/Crank voltage through a PWM driver controlled by another module. 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 ECM driver leakage.

3.5.8 4WD High Mode. This output of the Powertrain electronics shall be a low side driver, with at a minimum the capability of an LSD3 driver, as described in GMW8762, PPEI Electrical Requirements. The load shall be an LED indicator pulled up to Run/Crank voltage through a PWM driver controlled by another module. 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 ECM driver leakage.

3.5.9 4WD Low Mode. This output of the Powertrain electronics shall be a low side driver, with at a minimum the capability of an LSD3 driver, as described in GMW8762, PPEI Electrical Requirements. The load shall be an LED indicator pulled up to Run/Crank voltage through a PWM driver controlled by another module. 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 ECM driver leakage.

3.5.10 AWD (Full Time 4WD) Mode. This output of the Powertrain electronics shall be a low side driver, with at a minimum the capability of an LSD3 driver, as described in GMW8762, PPEI Electrical Requirements. The load shall be an LED indicator pulled up to Run/Crank voltage through a PWM driver controlled by another module. 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 ECM driver leakage.

3.5.11 Auto 4WD Mode. This output of the Powertrain electronics shall be a low side driver, with at a minimum the capability of an LSD3 driver, as described in GMW8762, PPEI Electrical Requirements. The load shall be an LED indicator pulled up to Run/Crank voltage through a PWM driver controlled by another module. 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 ECM driver leakage.

3.5.12 Transfer Case Neutral Mode. This output of the Powertrain electronics shall be a low side driver, with at a minimum the capability of an LSD3 driver, as described in GMW8762, PPEI Electrical Requirements. The load shall be an LED indicator pulled up to Run/Crank voltage. 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 ECM driver leakage.

3.5.13 Differential Lock Mode. This output of the Powertrain electronics shall be a low side driver, with at a minimum the capability of an LSD3 driver, as described in GMW8762, PPEI Electrical Requirements. The load shall be an LED indicator pulled up to Run/Crank voltage through a PWM driver controlled by another module. 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 ECM driver leakage.

3.5.14 Secondary Axle Control. For manual 4WD systems, this output is a discrete switch to ground with the following characteristics (Table 8).

3.5.15 Secondary Axle Feedback (4WD Mode). This input to the Powertrain electronics is determined by the secondary axle feedback switch, which is part of the secondary axle actuator assembly. It shall have the characteristics of the IDL1 switched-high discrete input described in GMW8762, PPEI Electrical Requirements.

3.5.16 Differential Lock Control. This output of the Powertrain electronics shall be a high side driver with the following electrical characteristics. Refer to Table 8.

Table 8: Front Axle Engagement Lock Control-Manual 4WD Systems

Parameter	Value/Conditions
Max Contact Voltage Drop	500 mV
Min Open Circuit Resistance	50 kΩ
Max Load Current	1.0 A at 13.5 V
Min Load Current	3 mA
Max Contact Chatter Time	40 ms
Active State	Closed to ground when the transfer case is in the 4WD position

For electric shift/active 4WD systems, this output of the Powertrain electronics shall be a low side driver, with the following electrical characteristics. Refer to Table 9.

Table 9: Front Axle Engagement Lock Control - Electric Shift/Active 4WD Systems

Parameter	Value/Conditions
Active State Definition	Output drives to ground to engage front axle
Max Sink Current	1.0 A at 13.5 V
Max Saturation Voltage (Max Output in the Low State)	1.0 A at 13.5 V
Max Leakage Current	200 μA at 13.5 V

In either case, this output will be connected to an input of the secondary axle actuator electronics. The input circuit on the secondary actuator electronics shall be compatible with the following output characteristics. Refer to Table 10.

Table 10: High Side Driver (Rear Diff Lock Output)

Parameter	Value/Conditions
Active State Definition [Note 1]	Output drives to Battery Voltage to engage differential lock
Max Saturation Voltage	18.0 V
Min Saturation Voltage	2.5 V
Max Load Current	7.0 A
Min Load Current	1.05 A
Max Leakage Current	100 μA

Note 1: Values indicated are over the operational temperature range and normal vehicle operating voltage as defined in GMW8763, PPEI Power and Ground Subsystem Requirements.

The load shall be a differential lock actuator coil with the following electrical characteristics. Refer to Table 11.

Table 11: Load Characteristics

Parameter	Value/Conditions
Coil Resistance at 25°C	2.35 Ω (Nominal) at 25°C, ± 9 mΩ/°C
Coil Inductance	4.3 to 7.3 mH at 1 kHz
Minimum “Pull-In” Voltage	2.5 V

4 Algorithm

4.1 Four Wheel Drive/All Wheel Drive Control Algorithm Requirements.

4.1.1 General Overview. Refer to Section 3 for hardware interface and serial data summary.

The AWD/4WD algorithm is partitioned between the Platform and Powertrain controllers. The Powertrain controller reads the various Platform interfaces and controls the transfer case algorithms based on the inputs it receives. The Platform controllers monitor the serial data transmitted by the Powertrain controller for Platform algorithms.

The AWD/4WD algorithm monitors various transfer case and vehicle operating conditions to determine shifting and active control of the transfer case and Platform related components.

This interface applies to the following transfer case technology types:

Full Time Four Wheel Drive Systems

Electric Shift Systems

AWD/Active systems with electronic controls

4.1.1.1 Platform Interface Requirements. Platform shall provide the following functions for determining the state of the Transfer Case System:

Transmit the status of the secondary axle/differential lock via hard wire.

Transmit the operator requested mode via hardwire.

Transmit the presence of an Anti-Lock Brake System (ABS) active event via serial data.

Transmit requested transfer case clutch signal via serial data.

Transmit wheel speed information via serial data (Active or electronic differential lock systems).

4.1.1.2 Powertrain Interface Requirements. Powertrain shall be responsible for the following functions used by Platform to determine the state of the Transfer Case Control:

- Transmit Mode status via hardwire to LED on Mode switch.
- Transmit via serial data various transfer case operating data to be used by Platform. Refer to GMW8762 for signal descriptions of the various signals.

4.1.2 Serial Data Requirements. The serial data link is the primary interface between the Platform and Powertrain controllers. The signals that are communicated are listed in 3.3.1. Complete definitions can be found in GMW8762, PPEI GMLAN Serial Data Signal and Definitions and Framing Requirements.

4.1.3 Context Diagrams. Figure 8.

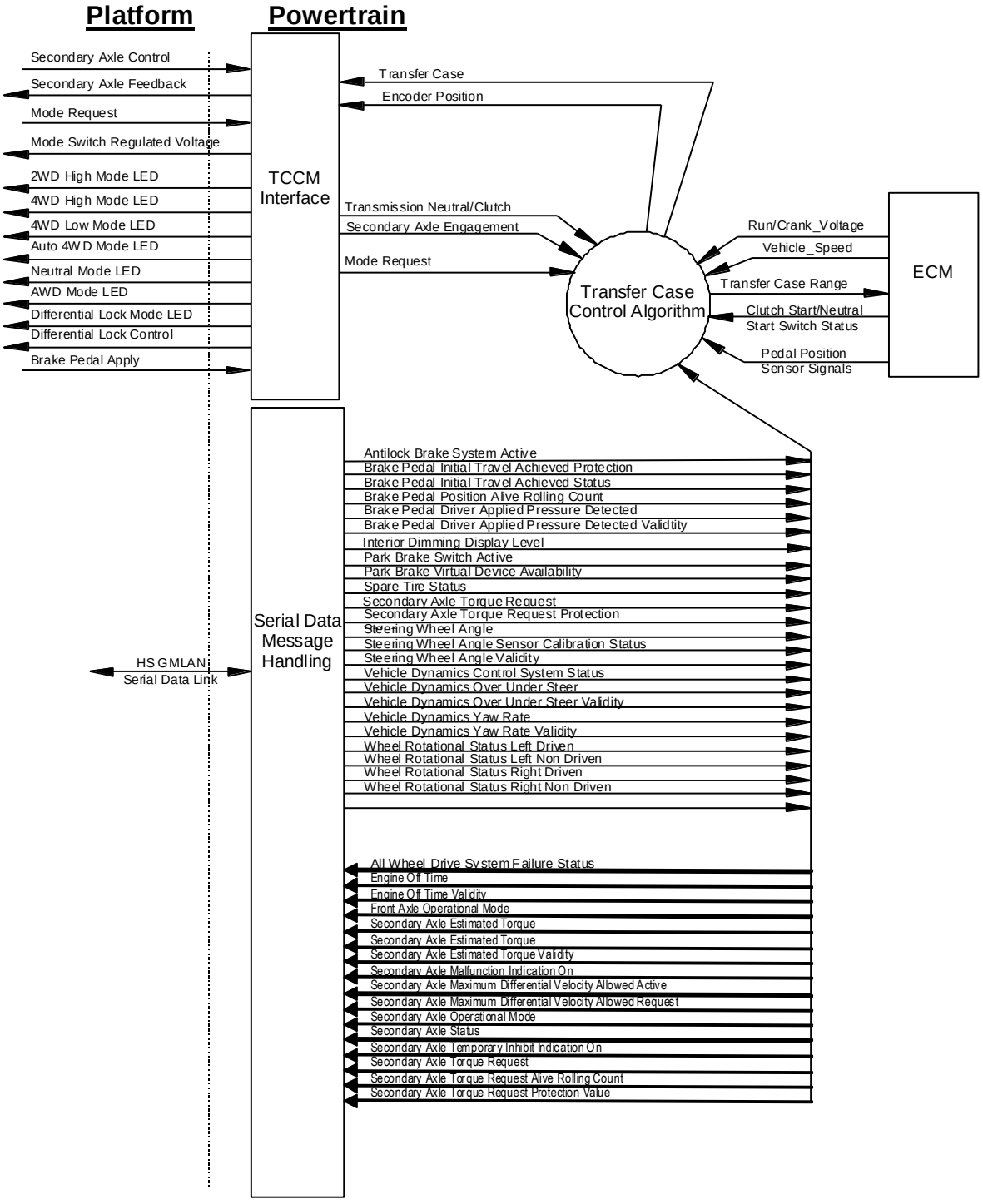

Figure 8: Four Wheel Drive/All Wheel Drive Context Diagram

4.1.4 4WD/AWD Algorithm Requirements.

4.1.4.1 ABS Active Response Algorithm. If the Powertrain TCCM module is in the AWD Mode, the vehicle speed is greater than **K_AbsSpeedThreshold** in mph, and the GMLAN signal Anti-lock Brake System Active is "True", then the TCCM module shall perform the following:

a. The TCCM module shall discontinue slip correction.
b. The TCCM module shall not allow any further adaptive events until a re-enabling condition is met.
c. The TCCM module shall resume normal AWD Mode operation within 500 ms of meeting one of the following re-enabling conditions:
    1. The GMLAN signal Anti-lock Brake System Active is "False".
    2. The next ignition cycle occurs and the GMLAN signal Anti-lock Brake System Active has not yet been received.
    3. The vehicle speed is less than **K_AbsSpeedThreshold**.

4.1.4.2 Mode Selection. The Powertrain TCCM algorithm shall decode the hardwired Mode Request signal to determine the customer selection as defined in Section 3.

4.1.4.3 Mode LED Indication. The mode LEDs indicate to the user the mode the Transfer Case system is currently operating in.

4.1.4.3.1 LED Check. A LED check shall be performed by the TCCM module for the mode indicators. This LED check shall be performed as follows:

Each time the TCCM module detects a power mode transition from OFF to RUN, all of the mode indicators shall be commanded ON for **K_BulbCheckDuration** seconds within **K_BulbCheckDelay** seconds of the power mode transition.

4.1.4.3.2 Flash Rate. The flash rate used for all required flashing of mode LEDs shall be at a rate of 2.5 Hz (± 0.5 Hz).

4.1.4.3.3 Mode Change Indication.

a. When a new mode has been selected the TCCM module shall command the following:
    1. The output of the newly requested mode shall be commanded to flash the mode LED when the new mode is selected.

       The Neutral mode LED shall only be commanded to flash after the enabling conditions have been met.
    2. The output of the previous mode shall be commanded inactive within 100.0 ms (+15.0 ms) of the shift being completed to the requested gear.
    3. Upon the completion of a shift, the mode LEDs shall be controlled in the following manner:

       If the secondary axle is not required (2HI and Neutral), the output of the newly requested mode shall be commanded solid within 100.0 ms (+ 15.0 ms) of the shift being completed, to the requested gear.
b. If the secondary axle is required (AWD, Full Time 4WD, 4HI, and 4LO), the mode LEDs shall be controlled in the following manner:
    1. If the Secondary axle is engaged, the output of the newly requested mode shall be commanded solid within 100.0 ms (+15.0 ms) of the shift being completed, to the requested gear.
    2. If the Secondary axle is not engaged, the LED will flash until another mode is selected.

4.1.4.3.4 Secondary Axle Control Indication. The secondary axle is required to be engaged for the transfer of torque to the front wheels to occur in AWD, 4HI, or 4LO modes.

a. If the Secondary Axle Feedback signal is low (secondary axle disengaged), the 2HI mode LED shall be commanded on and the selected mode LED shall be commanded to flash, both within 100.0 ms (+ 25 ms) if all of the following are met:
    1. The shift to a mode is completed.
    2. The current mode requires the secondary axle to be engaged in one of the following modes:
        a. 4LO.
        b. 4HI.
        c. AWD.
    3. The secondary axle switch input is low (secondary axle not engaged).
b. If the Secondary Axle Feedback signal is high (secondary axle engaged), the 2HI mode LED shall be commanded off and the requested mode LED shall be commanded on, both within 100.0 ms (+ 25 ms).

4.1.4.3.5 Differential Lock Indication. In vehicles equipped with electronic differential lock, the differential lock LED indication shall be illuminated whenever the differential lock control signal is active.

4.1.4.4 Electric Shift/Active Control 4WD Secondary Axle Control.

a. Transfer case mode/range changes that require a secondary axle engagement are changes from 2HI or Neutral to any of the following:
   1. AWD/Active.
   2. 4LO.
   3. 4HI.
   4. Full time 4WD.

b. The TCCM shall engage the secondary axle if a mode/range shift has been requested that requires a secondary axle engagement after the transfer case completes a shift to the new mode/range as follows:
   1. If no slip is indicated by the slip differential algorithm as described in the TCCM Component Technical Specification, the TCCM module will command the secondary axle output active.
   2. If the slip differential is great enough so as it meets the conditions for slip correction, the TCCM module shall execute the synching algorithm as described in the TCCM Component Technical Specification before activating the secondary axle output. The secondary axle output shall be commanded active after the slip differential has been corrected.

4.1.4.5 Differential Lock Engage. The TCCM shall engage the lock when requested by the operator via the mode switch as described in the TCCM Component Technical Specification.

a. The TCCM shall inhibit engagement of the lock when the vehicle speed is above **K_DiffLockEngageSpeed**.

b. The TCCM shall inhibit engagement of the lock when the side-to-side differential is above **K_DiffLockDiffSpeed**.

c. The TCCM shall disengage the lock when the vehicle speed is above **K_DiffLockDisEngageSpeed**.

d. The TCCM shall disengage the lock a different transfer case mode or range is requested.

4.1.4.6 Range Shift Enable Criteria. The TCCM shall allow range shifts based on the Neutral Determination algorithm and vehicle speed less than **K_RangeShiftVehicleSpeedMax**.

a. If the Neutral determination algorithm points to transmission engaged gear, the TCCM will allow range shifts if Transmission Engaged Gear is equal to Neutral.

b. If the Neutral determination indicates a manual transmission, the TCCM shall allow range shifts if the bottom of travel switch is active indicating a depressed clutch (reference ETEI GMLAN signal for Clutch Start/Neutral Start switch).

4.1.5 Diagnostic Action Requirements.

a. Powertrain shall perform open circuit, short to voltage and short to ground diagnostics on the following hardwired signals when available, and shall set the applicable corresponding Diagnostic Trouble Code (DTC).
   1. Mode Switch Regulated Voltage output.
   2. Mode Switch Request input.
   3. Differential Lock Control output.
   4. Secondary Axle Control output.
   5. Secondary Axle Feedback input.

b. Powertrain shall transmit the GMLAN signal Secondary Axle Malfunction Indication ON Active equal to “True” when a non-emission related DTC is active.

Refer to the signal descriptions in GMW8762 Section 4 for additional requirements.

4.1.6 Execution/Activation Requirements.

4.1.7 System State Transitions Requirements.

4.1.7.1 Power Up Initialization. Upon power-up initialization, the TCCM shall return all outputs to the last known transfer case mode and range.

a. LED indicators must complete the LED check as described in 4.1.4.3.1 before indicating the last known mode upon power-up.

b. The TCCM shall return the secondary axle or differential lock to the last known state upon power-up.

4.1.7.2 Power Down Requirements. Upon power-down, the TCCM shall save in memory the last transfer case mode and range states, secondary axle state and/or differential lock state.

4.1.8 Off Vehicle Communications. The following data should be made available from the Powertrain controllers via GMLAN Parameter Identifier Data (PID). Refer to the TCCM Component Technical Specification for details.

a. 4WD Low Switch input state (manual transfer case applications).

b. Differential Lock Control output state.

c. Transfer Case Non-Emissions Related Fault Active GMLAN signal state.

d. Transfer Case Emissions Related Fault Active GMLAN signal state.

e. LED output state for all LEDs.

f. Mode Request Switch Position input decoded state.

g. Mode Request Switch Position input A/D voltage.
h. Transmission Manual Shaft Switch (PRNDL) input state.
i. Software Version part number and design level suffix (DLS).
j. Calibration version part number and DLS.
k. TCCM hardware part number.
l. TCCM end model part number.
m. Electronically Erasable Programmable Read Only Memory (EEPROM) Checksum.
n. TCCM measured battery voltage.
o. Ignition Cycles since current DTC.
p. Secondary Axle Feedback input state.
q. Secondary Axle Control output state.
r. All other transfer case motors, sensors, and switch status as required for serviceability of each application (refer to TCCM Component Technical Specifications).

4.1.9 Data Dictionary.

4.1.9.1 Calibrations. Not applicable.

4.1.9.2 Variables.

4.1.9.2.1 Transmission Engaged Gear. This is the variable that identifies which gear the transmission is in, as determined by the Powertrain electronics. This variable is used in determining valid conditions for range shifts.

5 Provisions for Shipping

Not applicable.

6 Notes

6.1 Glossary. Not applicable.

6.2 Acronyms, Abbreviations, and Symbols. Refer to GMW8762, Appendix A3.

7 Additional Paragraphs

7.1 All materials supplied to this specification must comply with the requirements of GMW3001, **Rules and Regulations for Materials Specifications.**

7.2 All parts or systems supplied to this standard must comply with the requirements of GMW3059, **Restricted and Reportable Substances for Parts.**

8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:

GMW8764

9 Release and Revisions

This standard was originated in June 2003. It was first approved by The Global PPEI Core Team in December 2003. It was first published in February 2004.

Issue	Publication Date	Description (Organization)
1	FEB 2004	Initial publication.
2	AUG 2004	Global PPEI Version 3.5 Release.
3	JUL 2005	Global PPEI Version 3.6 Release.
4	MAR 2006	Global PPEI Version 3.7 Release.
5	AUG 2010	Global PPEI Version 3.8 Release. (Global PPEI Core Team)

Appendix A

The following are approved Change Request(s) (CRs) for the Global PPEI Version 3.8 Release that impacted the GMW8764 Four Wheel Drive/All Wheel Drive Subsystem:

Changed	Description Of Changes	Sections Rationale/Authorization
Table 1.	Remove the following signals: Rear Differential Locked Secondary Axle Engaged Traction Torque Decay Control Active Traction Torque Decay Gradient Control Transfer Case Axle Maximum Differential Velocity Allowed Active Transfer Case Axle Maximum Differential Velocity Allowed Request Transfer Case Clutch Temperature Transfer Case Clutch Temperature Validity Transfer Case Coupling Decay Gradient Control Transfer Case Coupling Report Type Transfer Case Coupling Request Transfer Case Coupling Request Alive Rolling Count Transfer Case Coupling Request Protection Transfer Case Coupling Status Transfer Case Coupling Value Actual Transfer Case Coupling Value Actual Validity Transfer Case Emissions Related DTC Transfer Case Emissions Related Malfunction Active Transfer Case Mode Transfer Case Mode Validity Transfer Case Non Emissions Related Malfunction Active Transfer Case Oil Temperature Transfer Case Oil Temperature Validity Transfer Case Overheated Indication On Transfer Case Range Transfer Case Range Validity Add the following signals: Rear Axle Operational Mode Secondary Axle Control Mode Secondary Axle Estimated Torque Secondary Axle Estimated Torque Validity Secondary Axle Malfunction Indication On Secondary Axle Maximum Differential Velocity	CR312

Changed	Description Of Changes	Sections Rationale/Authorization
	Allowed Active Secondary Axle Maximum Differential Velocity Allowed Request Secondary Axle Operational Mode Secondary Axle Status Secondary Axle Temporary Inhibit Indication On Secondary Axle Torque Request Secondary Axle Torque Request Alive Rolling Count Secondary Axle Torque Request Protection Value Revise functional descriptions. Revise block diagrams.	

Deviations

Not applicable.