U3E
LIN1LINBUS

U3A
molex_48pin_MRE
M13 M12 M11 M3 M4 M23 M22 M21
M7312V_SAFE M63
M7212V_SAFE M62
M7112V_SAFE M61
M53 M52 M51
1 12V_MREL
2 GND
3 LS2
4 E-THROTTLE+
5 12V_KEY
6 GND
7 LS1
8 E-THROTTLE-
9 Ign1
10 Ign2
11 Ign3
12 Ign4
13 GP6
14 GP5
15 USB_D-
16 USB_D+
17 GND
18 AT1
19 AV4
20 AV5
21 GND
22 AT4
23 AT2
24 AT3
25 CAM_SENSOR
26 AV2
27 AV1
28 AV10
29 MAIN_RELAY
30 AV7
31 AV3
32 AV6
33 GP3
34 GP2
35 GP1
36 AV8
37 INJECTOR-1
38 INJECTOR-2
39 5V2
40 AV9
41 INJECTOR-3
42 INJECTOR-4
43 GP4
44 5V1
45 CRNK+
46 CRNK-
47 CANL
48 CANH

U3D
5V J801 J802 12V_MREL
PB8 J803 J804 VDD
PC11 J805 J806 PB9
PA15 J807 J808 PC10
GND J809 J810 PC12

12V_MREL — D36 SS54 — 12V_SAFE
12V_KEY — D37 SS54 — 12V_SAFE
12V_SAFE — D41 SM15T33C Load Dump TVS — GND

Communication Header
J4
Conn_02x05_Counter_Clockwise
5V 1 | 2 12V_MREL
PB8 3 | 4 VDD
PC11 5 | 6 PB9
PA15 7 | 8 PC10
GND 9 | 10 PC12

5V TP5
GND TP0
CAM_MCU TP2
CRANK TP4
12V_MREL TP12
VDD TP3

ANALOG INPUTS.
ADC 1-4 HAVE
BIAS RESISTORS
FOR TEMP SENSORS

CAN ALSO BE USED
AS DIGITAL INPUTS

AT1 AT2 AT3 AT4 AV1 AV2 AV3 AV4 AV5 AV6 AV7 AV8 AV9 AV10 CAM_SENSOR 12V_MREL 5V

Sheet: ADC
AT1 AT2 AT3 AT4 AV1 AV2 AV3 AV4 AV5 AV6 AV7 AV8 AV9 AV10 CAM 12V-SWITCH 5V
AT1_MCU AT2_MCU AT3_MCU AT4_MCU AV1_MCU AV2_MCU AV3_MCU AV4_MCU AV5_MCU AV6_MCU AV7_MCU AV8_MCU AV9_MCU AV10_MCU CAM_MCU Vbat_MCU AV11_MCU AGND
TP1
File: adc.sch

GP OUT 5 AND 6 ARE HIGH SIDE DRIVEN

Sheet: MCU
VDD GND
VDD GND PA0 PA1 PA2 PA3 PC0 PA6 PA7 PC2 PC3 PC4 PC5 PB0 PB1 PA4 PA5 PC1 USB_VBUS USB_D- USB_D+ VSSA
AT1_MCU AT2_MCU AT3_MCU AT4_MCU AV1_MCU AV2_MCU AV3_MCU AV4_MCU AV5_MCU AV6_MCU AV7_MCU AV8_MCU AV9_MCU AV10_MCU CAM_MCU Vbat_MCU
AV4
USB_D-
USB_D+
D7
Analog Ground Net Tie
NT3
GND
File: stm32.sch

6A H-BRIDGE
E-THROTTLE+
E-THROTTLE-
12V_MREL
VDD
GND

Sheet: H-BRIDGE
OUT1 OUT2 12V VDD GND
DIR PWM DIS SO SI SCK CS
PA8 PC7 PC8 PC9
File: TLE9201SG.sch

Sheet: FlashMemory
VDD
SO SI SCK CS HOLD WP
PB14 PB15 PB13 PE15 PB11 PB10
File: FlashMemory.sch

PE2 PE4 PE3 PB8 PB2-BOOT1
J6
NT2
GND
Net-Tie_2

PC10 PC11 PA15

Sheet: TLE8888-1QK
PD12 PD13 PD14 PD15 PE14 PE13 PE12 PE11 PE10 PE9 PE8 PE7 PB6 PB12 PB4 PD5 PB5 PB3 PC6 PD8 PD9 PD10 PD11
IGN_IN_1 IGN_IN_2 IGN_IN_3 IGN_IN_4 INJ_IN_1 INJ_IN_2 INJ_IN_3 INJ_IN_4 IN_9 IN_10 IN_11 IN_12 CAN_TX CAN_RX SDO CSN SIP FCLP CRNK_IN LIN_TX LIN_RX IGN_EN INJ_EN
SO SI CS_TLE SCK CRANK
D28 LED-RED 1k R29
NRST RST PE1
RST R2 n.a. 0R
GND 12V_KEY 12V_SAFE 12V_KEY 12V_SAFE
U7 XC6206 3.3V
VBAT 5V VO VI GND 5V_STBY
File: TLE8888-1QK.sch

U3F
IGN_OUT_1 IGN_OUT_2 IGN_OUT_3 IGN_OUT_4
J51 J52 J53 J54
R21 R33 R80 R81 0R
Ign1 Ign2 Ign3 Ign4
INJ_1 INJ_2 INJ_3 INJ_4
OUT_5 OUT_6 OUT_7
1 J14
INJECTOR-1 INJECTOR-2 INJECTOR-3 INJECTOR-4 2.2A
LS2 LS1 4.5A
LOW SIDE OUTPUTS
Populate for freewheeling.
Bypasses internal clamps.
D20 D15 12V_MREL
OUT_14 OUT_15 OUT_16 OUT_17 OUT_18 OUT_19 OUT_20 OUT_21 OUT_22 OUT_23 OUT_24
J61 J62 J63 J64 J65
U3B
0.6A low side drivers
J3 J5 J12 J13
D4 D3 D6 D5
Push-Pull half bridge
LOW-SIDE OR HIGH-SIDE
GP1 GP2 GP3 GP4 0.6A
CRNK+ CRNK- LINBUS CANL CANH MAIN_RELAY VDD
LIN_IO CAN_L CAN_H MAIN_RELAY VDD
OUT8 DFB8 OUT9 DFB9 OUT10 DFB10 OUT11 DFB11 OUT12 DFB12 OUT13 DFB13
TLE_OUT10_PRE TLE_DFB10 TLE_OUT11_PRE TLE_DFB11 TLE_OUT12_PRE TLE_DFB12 TLE_OUT13_PRE TLE_DFB13

Sheet: hi-lo
PD4 PD3 PD2 PD1 PD7 PD6 PB9 PB7 PC12 PD0 PC13 PE6 PE5 PA14
Ign1_MCU Ign2_MCU Ign3_MCU Ign4_MCU GP5_MCU GP6_MCU
Ign1 Ign2 Ign3 Ign4 GP5 GP6
HIGH-SIDE PP OUTPUTS
PB9 PB7 PC12
J8 J16 J9 J10 J11
5V 12V
5V 12V_MREL
File: hi-lo.sch

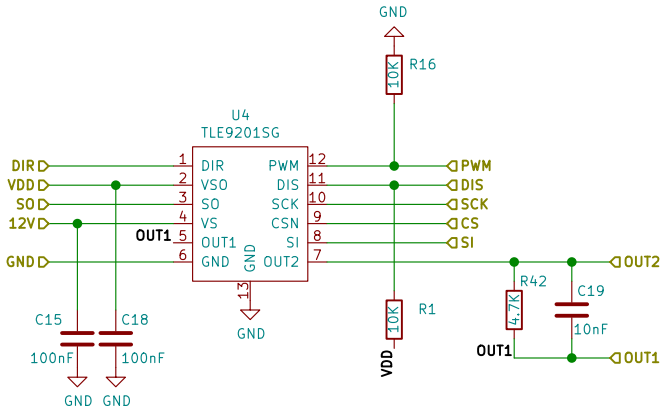
TLE_DFB10
TLE_OUT10_PRE TLE_OUT11_PRE
Sheet: LowSides_3-4
IN2 IN1 OUT2 OUT1
AV9 AV8
File: pair.sch
TLE_DFB11
TLE_DFB13
TLE_OUT13_PRE TLE_OUT12_PRE
Sheet: LowSides_1-2
IN1 IN2 OUT1 OUT2
AV10 AV6
File: pair.sch
TLE_DFB12

5V
D30 D32 D34 D35
LED-RED
D31 D33
1k R36 R49 R51
LS2 INJECTOR-1 GP5

12V_SAFE
D43
1k R10
LINBUS
LIN bus termination

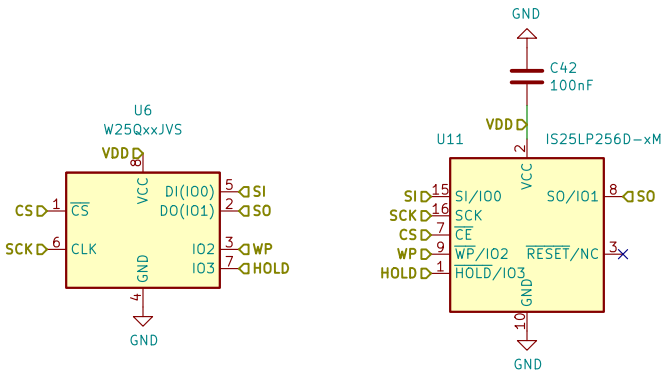
LED-YELLOW PE1 D27
LED-BLUE PE2 D23
LED-RED PE3 D21
LED-GREEN PE4 D22
1k RN1 GND
PE1 is yellow- warning
PE2 is blue - communication
PE3 is red - fatal
PE4 is green - running

AI6OD
Donald Becker
rusEFI.com
Sheet: /
File: microRusEfi.sch
Title: microRusEfi-2L
Size: B | Date: 2020-04-22 | Rev: R0.5.0
KiCad E.D.A. kicad (5.1.5)-3 | Id: 1/9



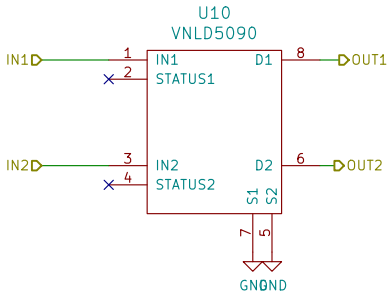
AI6OD
Donald Becker

rusEFI.com		
Sheet: /H-BRIDGE/ File: TLE9201SG.sch		
Title: microRusEfi-2L		
Size: A	Date: 2020-04-22	**Rev: R0.5.0**
KiCad E.D.A. kicad (5.1.5)-3		Id: 2/9

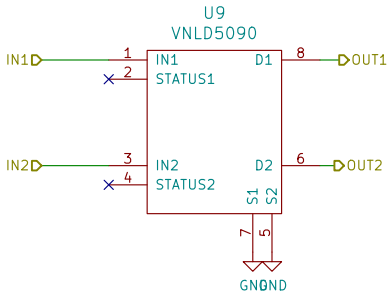


AI6OD
Donald Becker

rusEFI.com		
Sheet: /FlashMemory/ File: FlashMemory.sch		
Title: microRusEfi-2L		
Size: A	Date: 2020-04-22	**Rev: R0.5.0**
KiCad E.D.A. kicad (5.1.5)-3		Id: 3/9

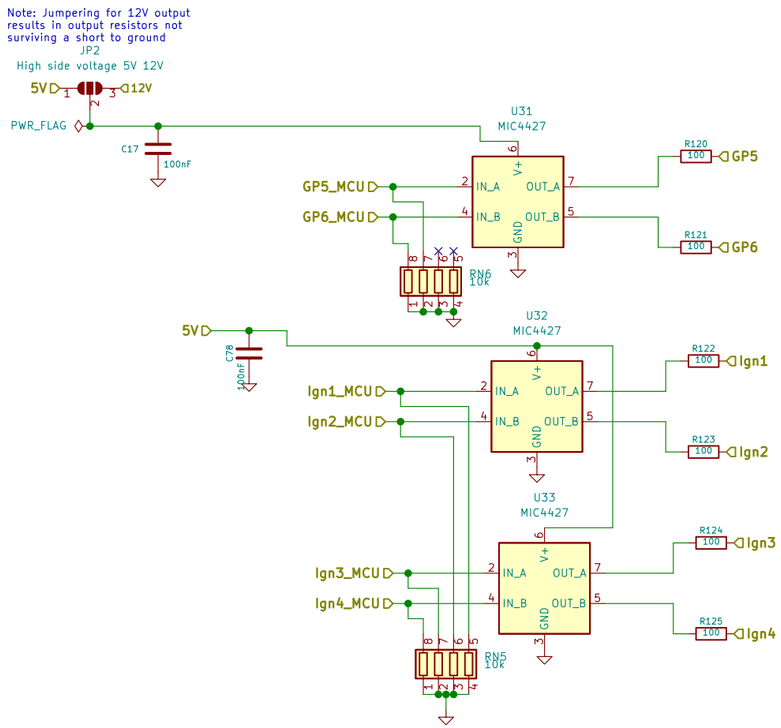


rusEFI.com		
Sheet: /LowSides_3-4/ File: pair.sch		
Title: microRusEfi-2L		
Size: A4	Date: 2020-04-22	**Rev: R0.5.0**
KiCad E.D.A. kicad (5.1.5)-3		Id: 4/9



rusEFI.com		
Sheet: /LowSides_1-2/ File: pair.sch		
Title: microRusEfi-2L		
Size: A4	Date: 2020-04-22	**Rev: R0.5.0**
KiCad E.D.A. kicad (5.1.5)-3		Id: 5/9

6 channel high / low side driver



AI60D
Donald Becker
rusEFI.com

Sheet: /hi-lo/
File: hi-lo.sch

Title: microRusEfi-2L

Size: B	Date: 2020-04-22	**Rev: R0.5.0**
KiCad E.D.A. kicad (5.1.5)-3		Id: 6/9

FID5
Fiducial
FID6
Fiducial

5V 5V 5V 5V
R14 27K
R23 27K
R24 27K
R25 27K
R27 27K

RN3
10k
AT4
AT3
AT2
AT1

D38
SRV05-4
5V

U35B MCP6004
U35A MCP6004
U35D MCP6004
U35C MCP6004
6.8K R64
6.8K R65
6.8K R66
6.8K R67
10K R68
10K R69
10K R70
10K R71
AGND
AT4_MCU
AT3_MCU
AT2_MCU
AT1_MCU

5V
C79 10nF
V+ 4
V- 11
U35E MCP6004

CN17
10nF

AV3
AV2
AV10
AV1

RN4
10k
470K R24
470K R31
470K R34
470K R37

SRV05-4
D39
5V

U36D MCP6004
U36C MCP6004
U36B MCP6004
U36A MCP6004
6.8K R5
6.8K R26
6.8K R32
6.8K R35
10K R38
10K R39
10K R44
10K R46
AGND
AV1_MCU
AV10_MCU
AV2_MCU
AV3_MCU

5V
C80 10nF
V+ 4
V- 11
U36E MCP6004

10nF
CN6

5V
LED-RED
D29
R28 2.2K

AV5
AV4
CAM

RN13
10k

R11 DNP
R131 470K
R40 DNP
R41 470K
12V-SWITCH
R139 39K
R114 10K

SRV05-4
D40
5V

U46D MCP6004
U46C MCP6004
U46B MCP6004
U46A MCP6004
6.8K R72
6.8K R73
6.8K R74
6.8K R75
10K R76
10K R77
10K R78
10K R79
AGND
CAM_MCU
AV11_MCU
Vbat_MCU
AV4_MCU
AV5_MCU

Comparator with histeresis for CAM input?
Usign this OpAmp.

CN14
10nF

5V
C82 10nF
V+ 4
V- 11
U46E MCP6004

5V
R7 DNP

AV9
AV8
AV7
AV6

RN2
10k
470K R52
470K R54
470K R56
470K R58

D13
SRV05-4
5V

U8B MCP6004
U8A MCP6004
U8D MCP6004
U8C MCP6004
6.8K R53
6.8K R55
6.8K R57
6.8K R59
10K R60
10K R61
10K R62
10K R63
AGND
AV9_MCU
AV8_MCU
AV7_MCU
AV6_MCU

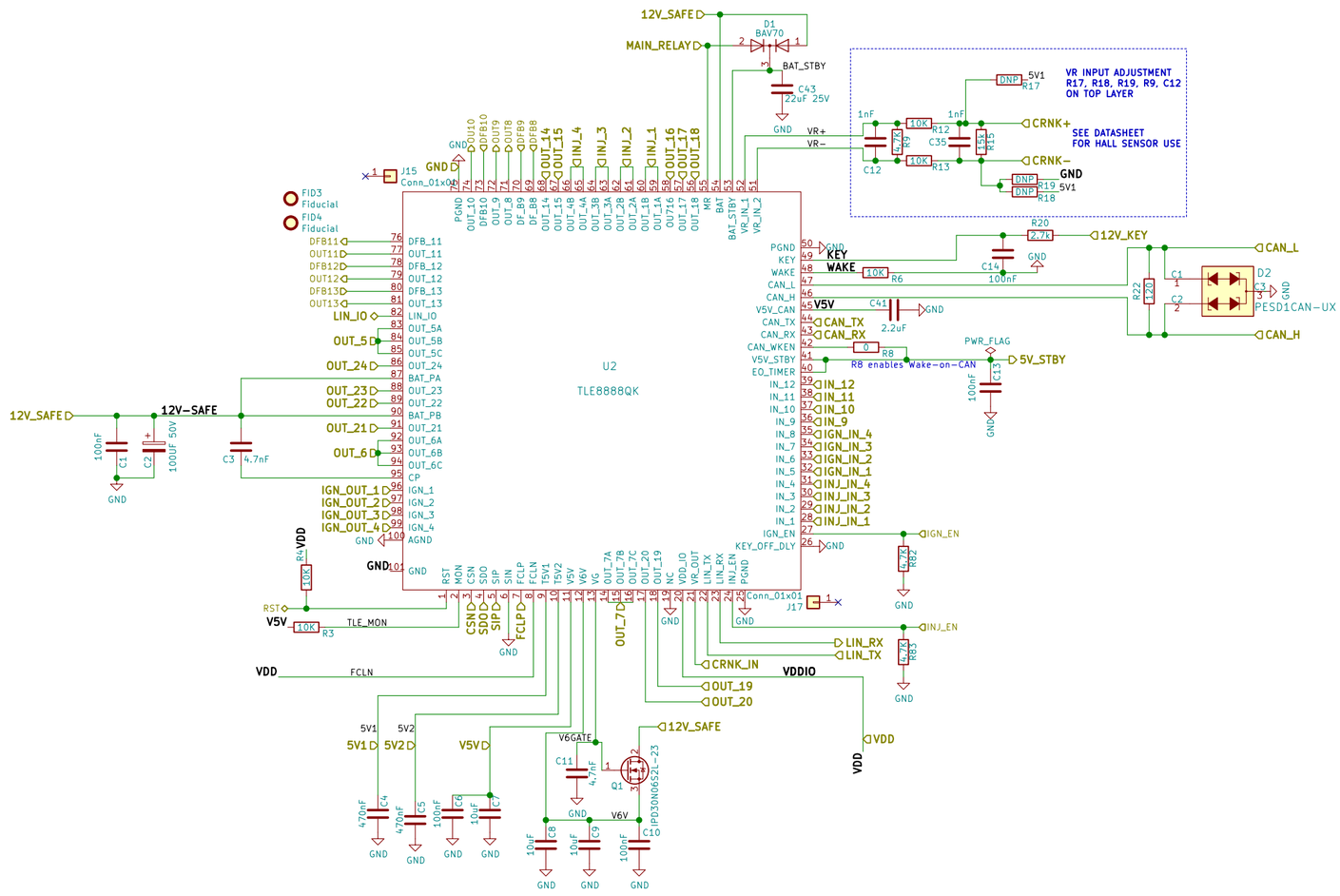
5V
C40 10nF
V+ 4
V- 11
U8E MCP6004

CN5
10nF

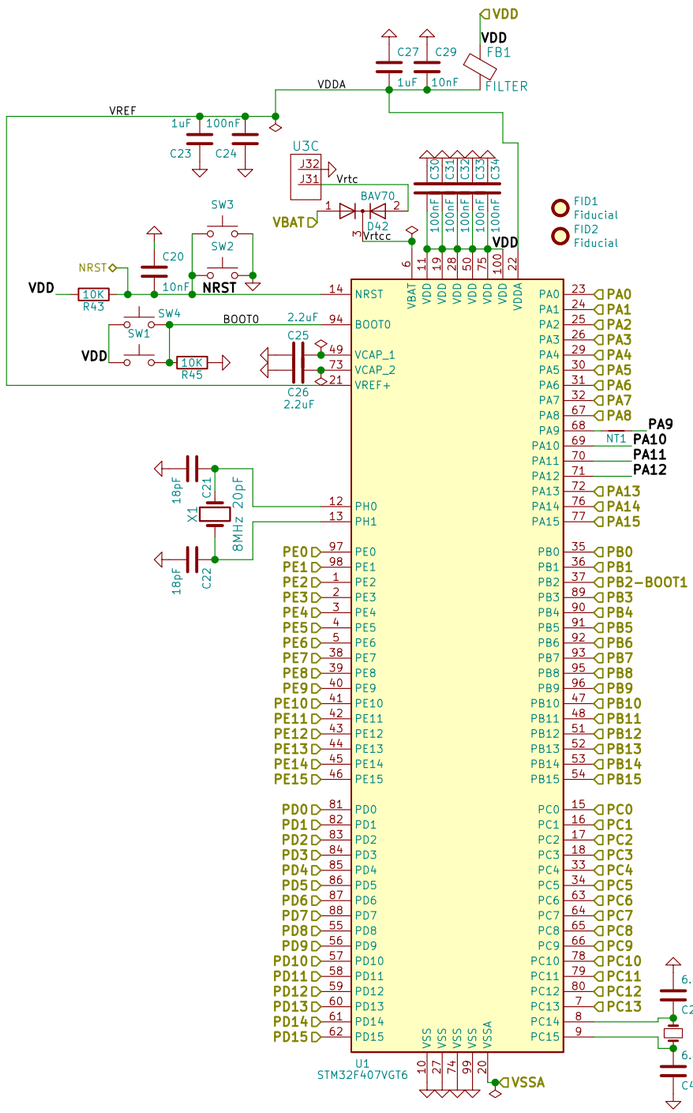
AI6OD
Donald Becker

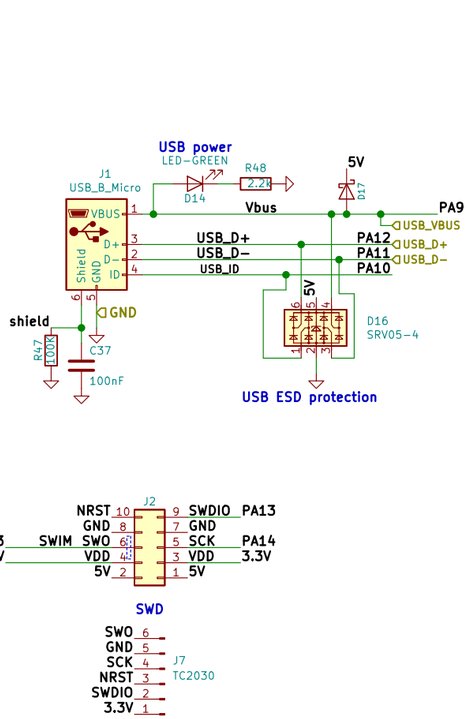
rusEFI.com		
Sheet: /ADC/		
File: adc.sch		
Title: microRusEfi-2L		
Size: B	Date: 2020-04-22	**Rev: R0.5.0**
KiCad E.D.A. kicad (5.1.5)-3		Id: 7/9

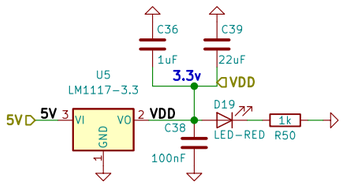
rusEFI MRE was measured to consume 235mA from the 12V battery, for 2.9 watts



AI6OD	
Donald Becker	
rusEFI.com	
Sheet: /TLE8888-1QK/	
File: TLE8888-1QK.sch	
Title: microRusEfi-2L	
Size: User	Date: 2020-04-22
KiCad E.D.A. kicad (5.1.5)-3	**Rev: R0.5.0**
	Id: 8/9







http://www.crystek.com/documents/appnotes/Pierce-GateIntroduction.pdf
PCB per predictions with SaturnPCB has less then 3.5pF traces,
STM32 pins assumed 5pF
ESR = 80ohms max???
Rf = 2meg could be between 1meg and 10meg.
Cload should be 8pF per XTAL datasheet
Cload = ([Cin+C1][C2+Cout])/(Cin+C1+C2_Cout)+PCBstray
Cload = ([5+4.7][4.7+5])/(5+4.7+4.7+5)+3.5= 8.35pF
C1=C2=C166=C167 = 4.7pF
Rs = 1/(2piFC2) = 1/(2*pi*8MHz*4.7pF) = 4.2ohms.

AI60D
Donald Becker

rusEFI.com		
Sheet: /MCU/		
File: stm32.sch		
Title: microRusEfi-2L		
Size: B	Date: 2020-04-22	**Rev: R0.5.0**
KiCad E.D.A. kicad (5.1.5)-3		Id: 9/9