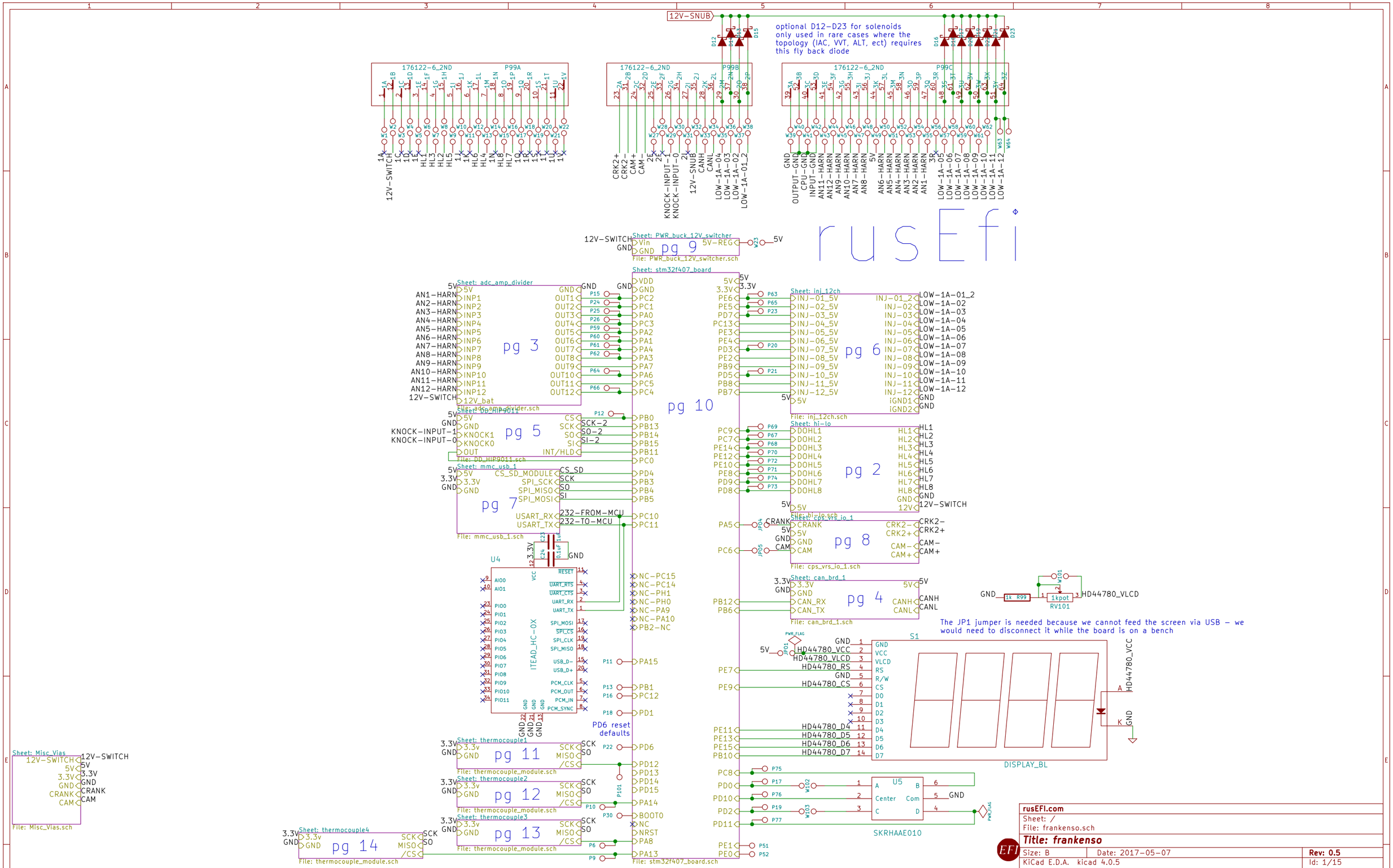

12V-SNUB
optional D12-D23 for solenoids only used in rare cases where the topology (IAC, VVT, ALT, ect) requires this fly back diode
176122-6_2ND P99A
176122-6_2ND P99B
176122-6_2ND P99C
1A
12V-SWITCH
1C
1D
1E
HL1
1F
HL3
1G
HL2
1H
HL5
1J
1K
HL6
1L
HL4
1M
1N
HL8
1O
HL7
1P
1Q
1R
1S
1T
1U
1V
2A
2B
2C
2D
2E
2F
2G
2H
2J
2K
2L
2M
2N
2P
CRK2+
CRK2-
CAM+
CAM-
2E
2F
KNOCK-INPUT-1
KNOCK-INPUT-0
2V
12V-SNUB
CANH
CANL
LOW-1A-04
LOW-1A-03
LOW-1A-02
LOW-1A-01_2
3A
3B
3C
3D
3E
3F
3G
3H
3J
3K
3L
3M
3N
3P
3R
3S
3T
3U
3V
3X
3Y
3Z
GND
OUTPUT-GND
CPU-GND
INPUT-GND
AN11-HARN
AN12-HARN
AN9-HARN
AN10-HARN
AN7-HARN
AN8-HARN
5V
AN6-HARN
AN5-HARN
AN4-HARN
AN3-HARN
AN2-HARN
AN1-HARN
3R
LOW-1A-05
LOW-1A-06
LOW-1A-07
LOW-1A-08
LOW-1A-09
LOW-1A-10
LOW-1A-11
LOW-1A-12
rusEfi
12V-SWITCH
GND
Sheet: PWR_buck_12V_switcher
Vin
GND
5V-REG
pg 9
File: PWR_buck_12V_switcher.sch
Sheet: stm32f407_board
Sheet: adc_amp_divider
5V
AN1-HARN
AN2-HARN
AN3-HARN
AN4-HARN
AN5-HARN
AN6-HARN
AN7-HARN
AN8-HARN
AN9-HARN
AN10-HARN
AN11-HARN
AN12-HARN
12V-SWITCH
INP1
INP2
INP3
INP4
INP5
INP6
INP7
INP8
INP9
INP10
INP11
INP12
12V_bat
OUT1
OUT2
OUT3
OUT4
OUT5
OUT6
OUT7
OUT8
OUT9
OUT10
OUT11
OUT12
pg 3
File: adc_amp_divider.sch
Sheet: DD_HIP9011
KNOCK-INPUT-1
KNOCK-INPUT-0
KNOCK1
KNOCK0
OUT
CS
SCK-2
SO-2
SI-2
INT/HLD
pg 5
File: DD_HIP9011.sch
Sheet: mmc_usb_1
CS_SD_MODULE
SPI_SCK
SPI_MISO
SPI_MOSI
USART_RX
USART_TX
232-FROM-MCU
232-TO-MCU
CS_SD
SCK
SO
SI
pg 7
File: mmc_usb_1.sch
U4
ITEAD_HC-0X
VCC
AIO0
AIO1
PIO0
PIO1
PIO2
PIO3
PIO4
PIO5
PIO6
PIO7
PIO8
PIO9
PIO10
PIO11
RESET
UART_RTS
UART_CTS
UART_RX
UART_TX
SPI_MOSI
SPI_CS
SPI_CLK
SPI_MISO
USB_D-
USB_D+
PCM_CLK
PCM_OUT
PCM_IN
PCM_SYNC
GND
3.3V
C23
0.1uF
C24
1uF
VDD
PC15
PC14
PH1
PH0
PA9
PA10
PB2
PA15
PB1
PC12
PD1
PD6 reset defaults
PD6
PD12
PD13
PD14
PD15
PA14
BOOT0
NC
NRST
PA8
PA13
pg 10
File: stm32f407_board.sch
Sheet: thermocouple1
Sheet: thermocouple2
Sheet: thermocouple3
Sheet: thermocouple4
SCK
MISO
/CS
SO
pg 11
pg 12
pg 13
pg 14
File: thermocouple_module.sch
Sheet: inj_12ch
INJ-01_5V
INJ-02_5V
INJ-03_5V
INJ-04_5V
INJ-05_5V
INJ-06_5V
INJ-07_5V
INJ-08_5V
INJ-09_5V
INJ-10_5V
INJ-11_5V
INJ-12_5V
INJ-01_2
INJ-02
INJ-03
INJ-04
INJ-05
INJ-06
INJ-07
INJ-08
INJ-09
INJ-10
INJ-11
INJ-12
iGND1
iGND2
pg 6
File: inj_12ch.sch
Sheet: hi-lo
DOHL1
DOHL2
DOHL3
DOHL4
DOHL5
DOHL6
DOHL7
DOHL8
HL1
HL2
HL3
HL4
HL5
HL6
HL7
HL8
12V
pg 2
File: hi-lo.sch
Sheet: cps_vrs_io_1
CRANK
CAM
CRK2-
CRK2+
CAM-
CAM+
pg 8
File: cps_vrs_io_1.sch
Sheet: can_brd_1
CAN_RX
CAN_TX
pg 4
File: can_brd_1.sch
The JP1 jumper is needed because we cannot feed the screen via USB - we would need to disconnect it while the board is on a bench
1k R99
1kpot
RV101
HD44780_VLCD
JP1
PWR_FLAG
HD44780_VCC
HD44780_RS
HD44780_CS
HD44780_D4
HD44780_D5
HD44780_D6
HD44780_D7
S1
VCC
VLCD
RS
R/W
CS
D0
D1
D2
D3
D4
D5
D6
D7
A
K
DISPLAY_BL
U5
SKRHAAE010
Center
Com
Sheet: Misc_Vias
File: Misc_Vias.sch
rusEFI.com
Sheet: /
File: frankenso.sch
Title: frankenso
Size: B
Date: 2017-05-07
KiCad E.D.A. kicad 4.0.5
Rev: 0.5
Id: 1/15

8 channel high / low side driver

rusEFI.com		
Sheet: /hi-lo/ File: hi-lo.sch		
Title: frankenso		
Size: B	Date: 2017-04-22	**Rev: 0.5**
KiCad E.D.A. kicad 4.0.5		Id: 2/15

INP12
INP11
INP10
INP9
INP8
INP7
INP6
INP5
INP4
INP3
INP2
INP1

OUT4
OUT3
OUT1
OUT2
OUT10
OUT12
OUT6
OUT5
OUT8
OUT7
OUT11
OUT9

SUGGESTED / DEFAULT ENGINE WIRING IN BLUE

O2 INP4 R240 39pF R241 500K R242 10k D240 DOUBLE_SCHOTTKY R243 100 C240 1uF U201A MCP6004 R244 1500 .1% R245 1500 .1% OUT4
low pass filter knee at 1kHz

MAP MAF INP3 R230 39pF R231 500K R232 10k D230 DOUBLE_SCHOTTKY R233 100 C230 0.01uF U201B MCP6004 R234 1500 .1% R235 1500 .1% OUT3

IAT 1K – 10K INP2 R220 2700 R221 20K R222 10k D220 DOUBLE_SCHOTTKY R223 100 C220 1uF U201C MCP6004 R224 1500 .1% R225 1500 .1% OUT2
low pass filter knee at 1kHz

CLT 1K – 10K INP1 R210 2700 R211 20K R212 10k D210 DOUBLE_SCHOTTKY R213 100 C210 1uF C211 0.1uF U201D MCP6004 R214 1500 .1% R215 1500 .1% OUT1
low pass filter knee at 1kHz

INP8 R280 10K R281 20K R282 10k D280 DOUBLE_SCHOTTKY R283 100 C280 0.01uF U202A MCP6004 R284 1500 .1% R285 1500 .1% OUT8

INP7 R270 39pF R271 500K R272 10k D270 DOUBLE_SCHOTTKY R273 100 C270 0.01uF U202B MCP6004 R274 1500 .1% R275 1500 .1% OUT7

INP6 R260 10K R261 20K R262 10k D260 DOUBLE_SCHOTTKY R263 100 C260 0.01uF U202C MCP6004 R264 1500 .1% R265 1500 .1% OUT6

TPS 1K – 10K INP5 R250 39pF R251 500K R252 10k D250 DOUBLE_SCHOTTKY R253 100 C250 0.01uF C251 0.1uF U202D MCP6004 R254 1500 .1% R255 1500 .1% OUT5

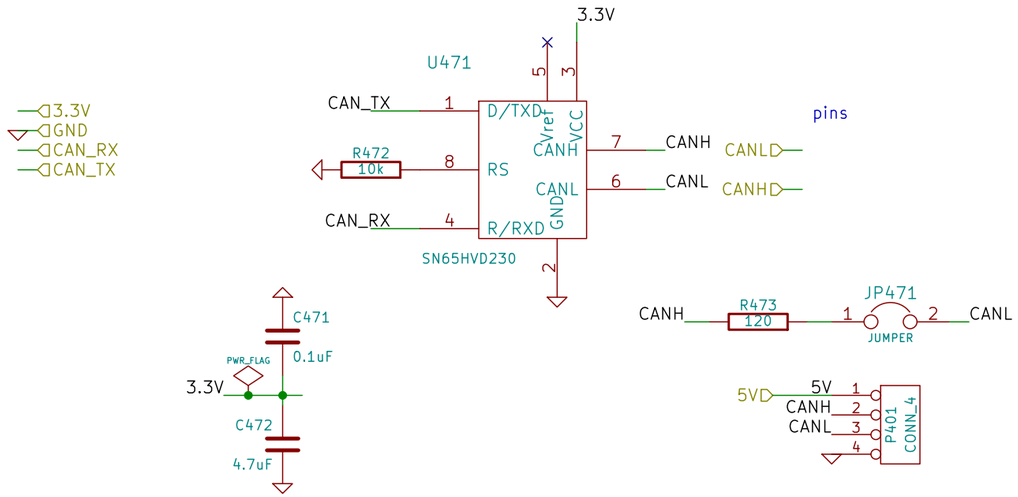
VBAT 12V_bat 12.02 50.2k R320 39K 0.1% INP12 8.93k R321 10K 1% R322 10k D320 DOUBLE_SCHOTTKY R323 100 C320 0.1uF U203A MCP6004 R324 1500 .1% R325 1500 .1% OUT12
2.445 2.160 2.443 2.160 2.443 2.160 2.426 2.160 1.246 1.0798
low pass filter knee at 10kHz

ALT CAM INP11 R310 1k R311 20K R312 10k D310 DOUBLE_SCHOTTKY R313 100 C310 0.01uF U203B MCP6004 R314 1500 .1% R315 1500 .1% JP11 OUT11
low pass filter knee at 100kHz typical

INP10 R300 10k R301 20K R302 10k D300 DOUBLE_SCHOTTKY R303 100 C300 0.01uF U203C MCP6004 R304 1500 .1% R305 1500 .1% OUT10

ALT CRANK INP9 R290 1k R291 20K R292 10k D290 DOUBLE_SCHOTTKY R293 100 C290 0.01uF C291 0.1uF PWR_FLAG U203D MCP6004 R294 1500 .1% R295 1500 .1% JP9 OUT9

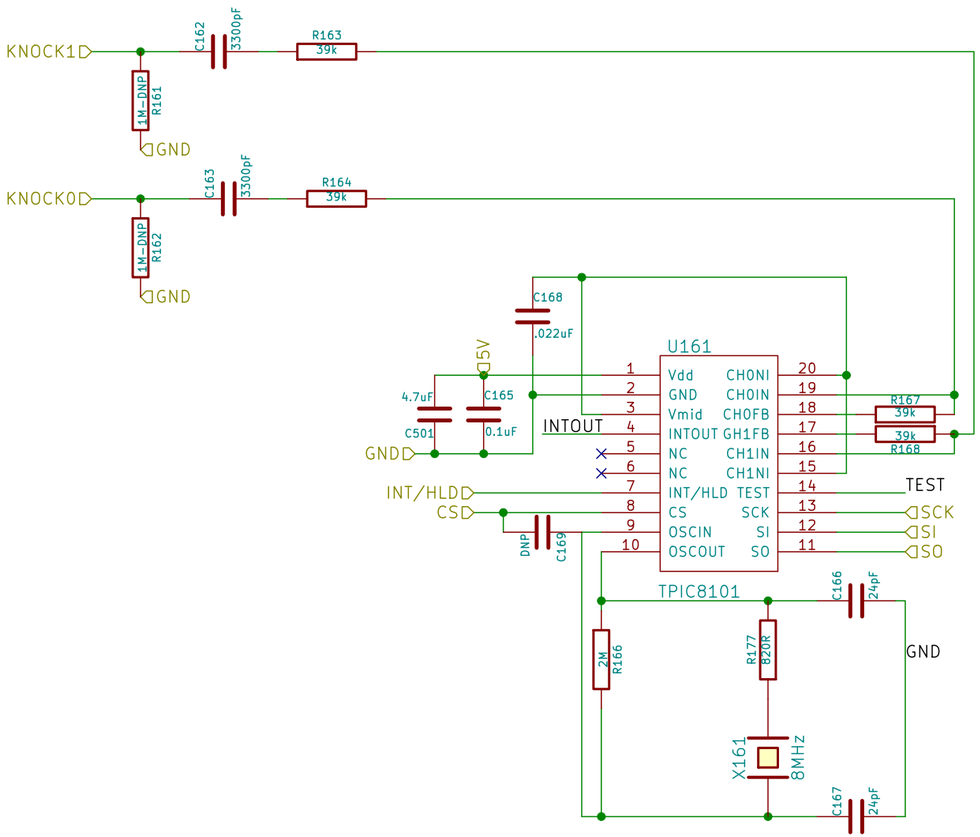
rusEFI.com		
Sheet: /adc_amp_divider/		
File: adc_amp_divider.sch		
Title: frankenso		
Size: B	Date: 2017-04-22	**Rev: 0.5**
KiCad E.D.A. kicad 4.0.5		Id: 3/15

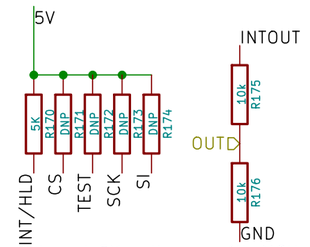


CAN level shifter

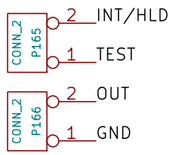
rusEFI.com		
Sheet: /can_brd_1/ File: can_brd_1.sch		
Title: frankenso		
Size: A	Date: 2017-04-22	**Rev: 0.5**
KiCad E.D.A. kicad 4.0.5		Id: 4/15

DD_HIP9011 ver.2
RusEfi.com



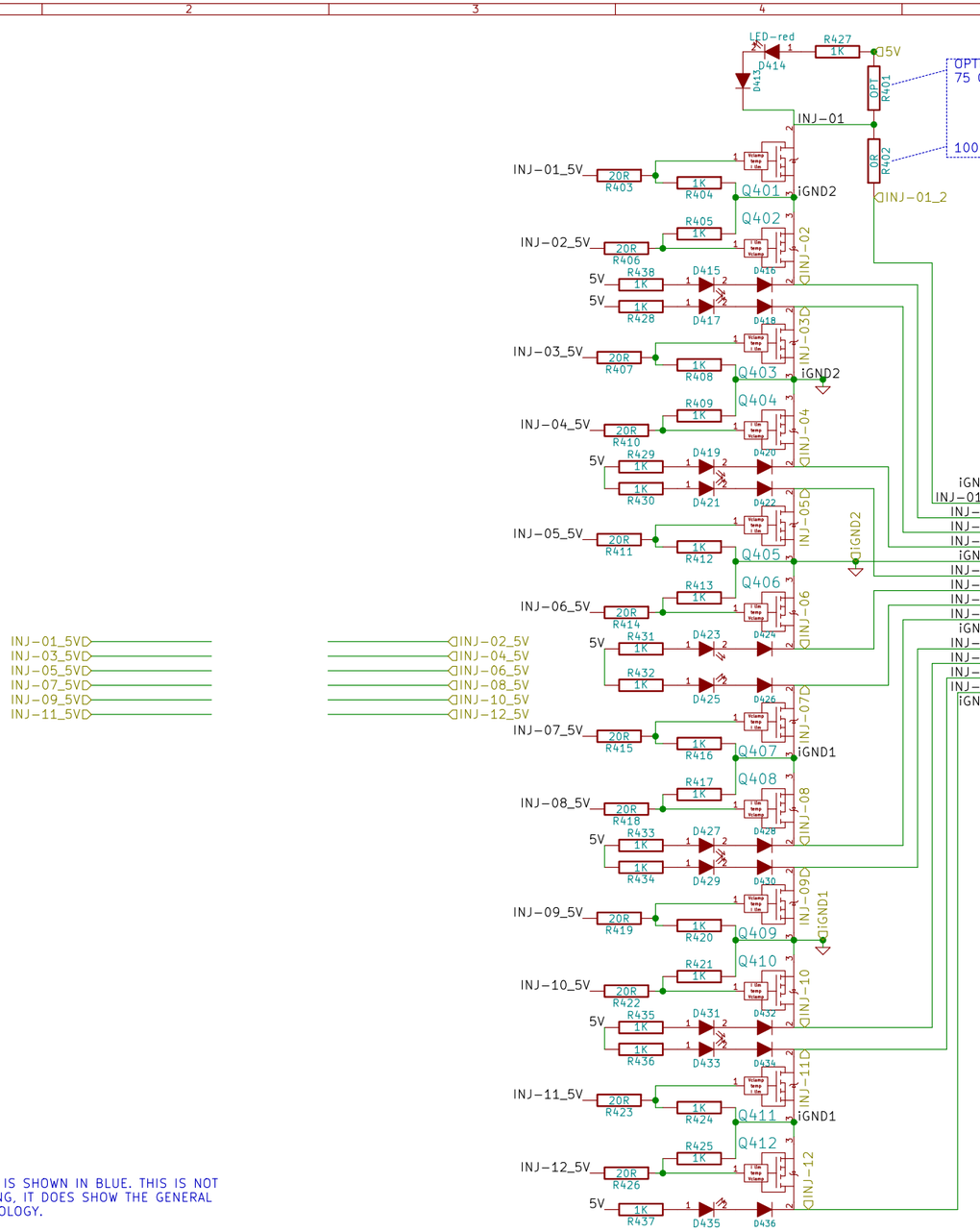


NOTE:
SPI uses internal 5V pull ups, with MCU SPI being float to pull down.
This allows 3.3V / 5V tolerante MCU's to use these SPI coms.



http://www.crystek.com/documents/appnotes/Pierce-GateIntroduction.pdf
PCB per predictions with SaturnPCB has less then 3.5pF traces,
TPIC pins assumed 5pF
ESR = 80ohms max
Rf = 2meg could be between 1meg and 10meg.
Cload should be 18pF per XTAL datasheet
Cload = ([Cin+C1][C2+Cout])/(Cin+C1+C2_Cout)+PCBstray
Cload = ([5+24][24+5])/(5+24+24+5)+3.5= 18.0pF
C1=C2=C166=C167 = 24pF
Rs = 1/(2piFC2) = 1/(2*pi*8MHz*24pF) = 829ohms, 820ohms is close enough = R177

rusEFI.com		
Sheet: /DD_HIP9011/		
File: DD_HIP9011.sch		
Title: frankenso		
Size: A	Date: 2017-04-22	**Rev: 0.5**
KiCad E.D.A. kicad 4.0.5		Id: 5/15



12 channel injector driver
also suitable for fuel pump relay, IAC solenoid etc

MISC NOTES

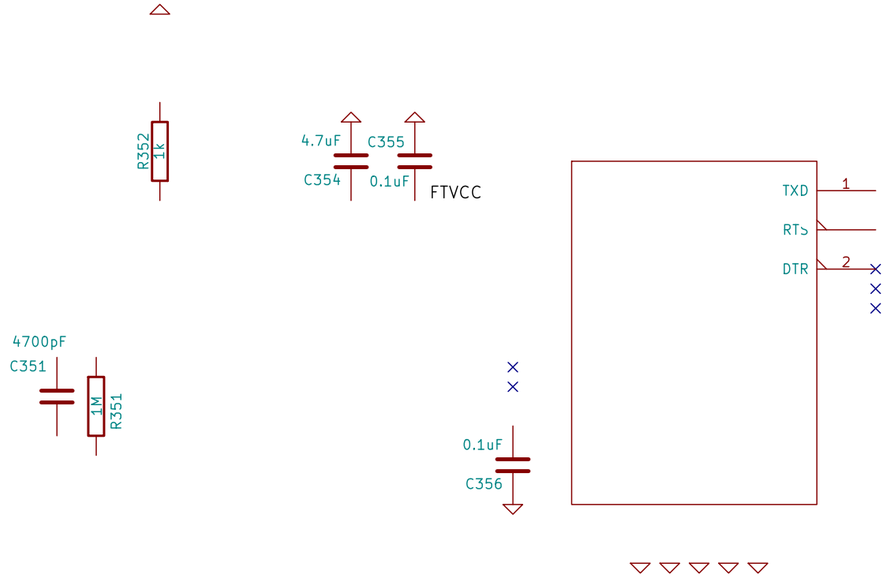
THE GENERAL SYSTEM LAYOUT IS SHOWN IN BLUE. THIS IS NOT THE SUGGESTED SYSTEM WIRING, IT DOES SHOW THE GENERAL OVERALL CIRCUIT LAYOUT TOPOLOGY.

THE PCB WIRING IS SHOWN IN RED, GREEN WITH A BLUE BUS.

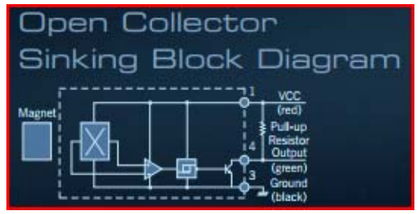
Screw terminals 1760500000

Screw connector PCB http://octopart.com/39522-1007-molex-655409
Screw connector harness http://octopart.com/partsearch#search/requestData&q=39520-0007

rusEFI.com		
Sheet: /inj_12ch/		
File: inj_12ch.sch		
Title: frankenso		
Size: B	Date: 2017-04-22	**Rev: 0.5**
KiCad E.D.A. kicad 4.0.5		Id: 6/15

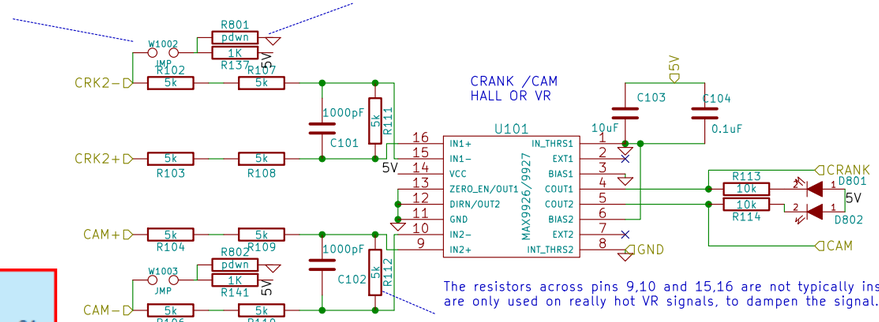

R352
1K
4.7uF
C355
C354
0.1uF
FTVCC
4700pF
C351
1M
R351
0.1uF
C356
TXD
1
RTS
DTR
2

When configured for VR, do not populate W1002 or W1003.
These jumpers allow isolation which prevents the VR signal
from getting into the 5V or GND.



Recommended pull-up resistor values are as follows:					
Volts dc	5	9	12	15	24
Ohms	1k	1.8k	2.4k	3k	3k

Many Hall sensors are set as a open collector sinking topology.
Those setups require a pull up resistor, and 1k ohm is a common size.
These pull up resistors are noted as R137 and R141 on this page.
You need to match these pull up resistors with your hall sensors requirements.
Often you need about 5mA of drive. See snippet from Cherry hall sensors to the right.
Some sensors are the inverse, and need a pull down resistor. These are less common.
These pull down resistors are noted as R801 and R802 on this page and are
not typically installed.



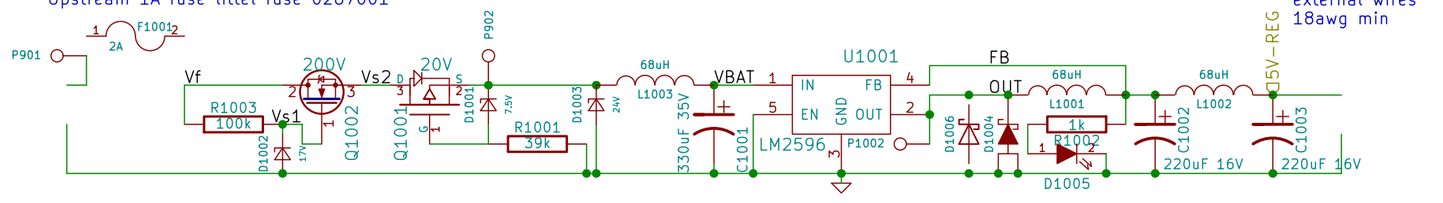
The resistors across pins 9,10 and 15,16 are not typically installed, they
are only used on really hot VR signals, to dampen the signal.

rusEFI.com		
Sheet: /cps_vrs_io_1/ File: cps_vrs_io_1.sch		
Title: frankenso		
Size: B	Date: 2017-04-22	**Rev: 0.5**
KiCad E.D.A. kicad 4.0.5		Id: 8/15

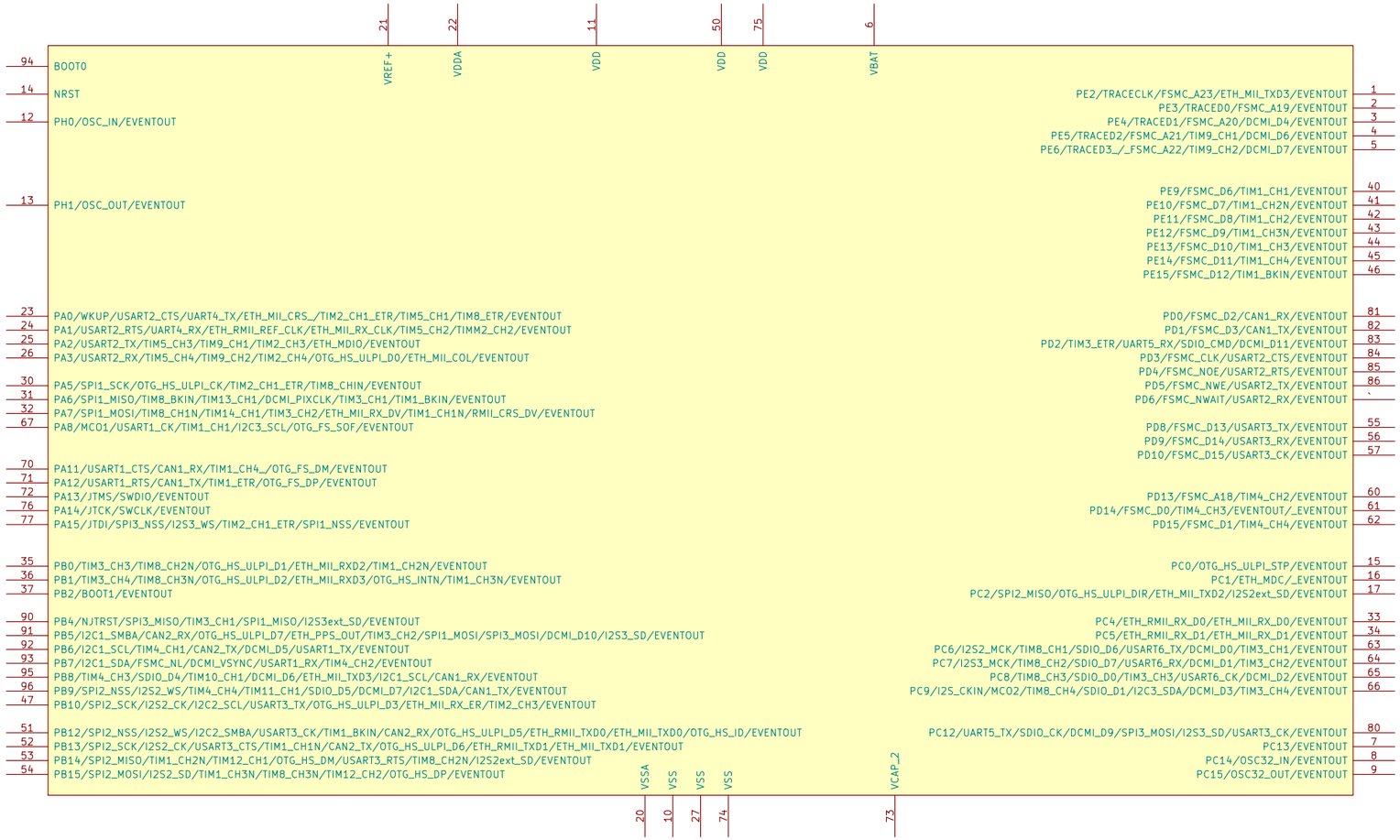
Brief overview
-- Q1002, R1003, D1002 preform an active transient protection. It will suppress voltages up to 200V down to 19V.
-- Q1001, R1001, D1001 preform a reverse polarity protection. If the input signal is the wrong polarity, the gate will not conduct which will prevent current from flowing.
-- D1003 is a second transient suppressor, it would catch faster transients allowing a brief amount of time for Q1002 to preform it's duty.
-- L1003 is a choke, it simple prevents switching noise from going up the power wire where it can get into other circuits.
-- C1001 is a bulk cap, it simply stores energy locally such that the regulator can draw large currents in short periods of time.
-- U1001 and the components to the right, are a buck style switching regulator, that will pull the 5V line up to 5V. It will not pull it down from 5V if there is an external voltage.
The U1001 circuit has been designed for 3A output and up to 20V input, but typically 14.4V or 12.4V input. L1001 wants to be about 68uH to 100uH with less than 0.3 ohms resistance.

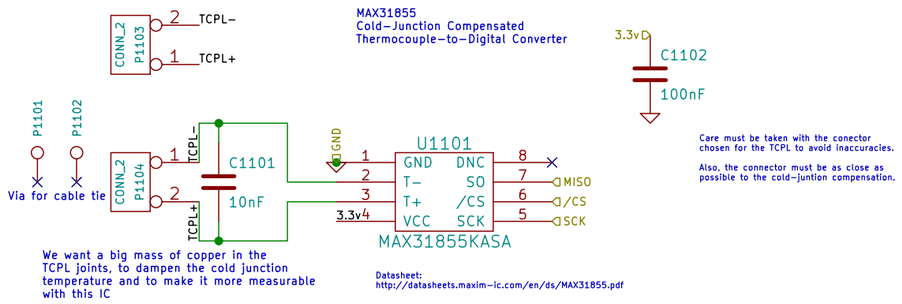
200V surge, 18V to 7V typical.
Suggested miniinium 16awg
Upstream 1A fuse littel fuse 0287001

5V 5mVp-p 3A
Suggested
external wires
18awg min

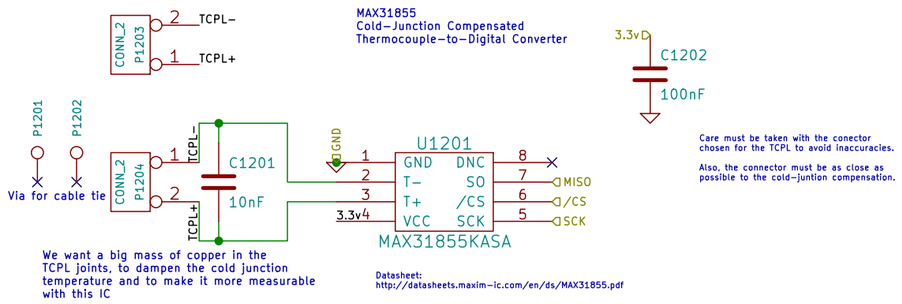


Alte

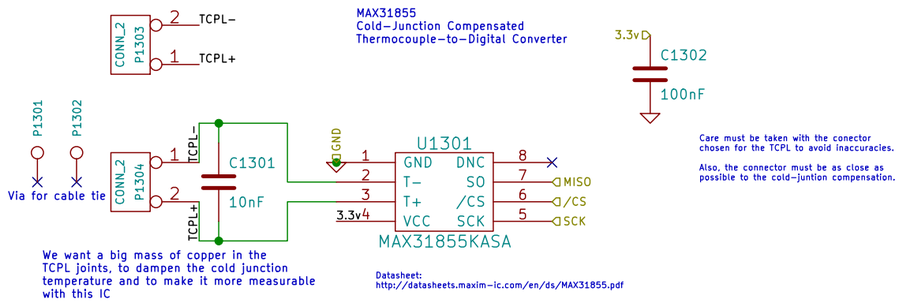

21 VREF+
22 VDDA
11 VDD
50 VDD
75 VDD
6 VBAT
94 BOOT0
14 NRST
12 PH0/OSC_IN/EVENTOUT
13 PH1/OSC_OUT/EVENTOUT
23 PA0/WKUP/USART2_CTS/UART4_TX/ETH_MII_CRS_/TIM2_CH1_ETR/TIM5_CH1/TIM8_ETR/EVENTOUT
24 PA1/USART2_RTS/UART4_RX/ETH_RMII_REF_CLK/ETH_MII_RX_CLK/TIM5_CH2/TIMM2_CH2/EVENTOUT
25 PA2/USART2_TX/TIM5_CH3/TIM9_CH1/TIM2_CH3/ETH_MDIO/EVENTOUT
26 PA3/USART2_RX/TIM5_CH4/TIM9_CH2/TIM2_CH4/OTG_HS_ULPI_D0/ETH_MII_COL/EVENTOUT
30 PA5/SPI1_SCK/OTG_HS_ULPI_CK/TIM2_CH1_ETR/TIM8_CHIN/EVENTOUT
31 PA6/SPI1_MISO/TIM8_BKIN/TIM13_CH1/DCMI_PIXCLK/TIM3_CH1/TIM1_BKIN/EVENTOUT
32 PA7/SPI1_MOSI/TIM8_CH1N/TIM14_CH1/TIM3_CH2/ETH_MII_RX_DV/TIM1_CH1N/RMII_CRS_DV/EVENTOUT
67 PA8/MCO1/USART1_CK/TIM1_CH1/I2C3_SCL/OTG_FS_SOF/EVENTOUT
70 PA11/USART1_CTS/CAN1_RX/TIM1_CH4_/OTG_FS_DM/EVENTOUT
71 PA12/USART1_RTS/CAN1_TX/TIM1_ETR/OTG_FS_DP/EVENTOUT
72 PA13/JTMS/SWDIO/EVENTOUT
76 PA14/JTCK/SWCLK/EVENTOUT
77 PA15/JTDI/SPI3_NSS/I2S3_WS/TIM2_CH1_ETR/SPI1_NSS/EVENTOUT
35 PB0/TIM3_CH3/TIM8_CH2N/OTG_HS_ULPI_D1/ETH_MII_RXD2/TIM1_CH2N/EVENTOUT
36 PB1/TIM3_CH4/TIM8_CH3N/OTG_HS_ULPI_D2/ETH_MII_RXD3/OTG_HS_INTN/TIM1_CH3N/EVENTOUT
37 PB2/BOOT1/EVENTOUT
90 PB4/NJTRST/SPI3_MISO/TIM3_CH1/SPI1_MISO/I2S3ext_SD/EVENTOUT
91 PB5/I2C1_SMBA/CAN2_RX/OTG_HS_ULPI_D7/ETH_PPS_OUT/TIM3_CH2/SPI1_MOSI/SPI3_MOSI/DCMI_D10/I2S3_SD/EVENTOUT
92 PB6/I2C1_SCL/TIM4_CH1/CAN2_TX/DCMI_D5/USART1_TX/EVENTOUT
93 PB7/I2C1_SDA/FSMC_NL/DCMI_VSYNC/USART1_RX/TIM4_CH2/EVENTOUT
95 PB8/TIM4_CH3/SDIO_D4/TIM10_CH1/DCMI_D6/ETH_MII_TXD3/I2C1_SCL/CAN1_RX/EVENTOUT
96 PB9/SPI2_NSS/I2S2_WS/TIM4_CH4/TIM11_CH1/SDIO_D5/DCMI_D7/I2C1_SDA/CAN1_TX/EVENTOUT
47 PB10/SPI2_SCK/I2S2_CK/I2C2_SCL/USART3_TX/OTG_HS_ULPI_D3/ETH_MII_RX_ER/TIM2_CH3/EVENTOUT
51 PB12/SPI2_NSS/I2S2_WS/I2C2_SMBA/USART3_CK/TIM1_BKIN/CAN2_RX/OTG_HS_ULPI_D5/ETH_RMII_TXD0/ETH_MII_TXD0/OTG_HS_ID/EVENTOUT
52 PB13/SPI2_SCK/I2S2_CK/USART3_CTS/TIM1_CH1N/CAN2_TX/OTG_HS_ULPI_D6/ETH_RMII_TXD1/ETH_MII_TXD1/EVENTOUT
53 PB14/SPI2_MISO/TIM1_CH2N/TIM12_CH1/OTG_HS_DM/USART3_RTS/TIM8_CH2N/I2S2ext_SD/EVENTOUT
54 PB15/SPI2_MOSI/I2S2_SD/TIM1_CH3N/TIM8_CH3N/TIM12_CH2/OTG_HS_DP/EVENTOUT
1 PE2/TRACECLK/FSMC_A23/ETH_MII_TXD3/EVENTOUT
2 PE3/TRACED0/FSMC_A19/EVENTOUT
3 PE4/TRACED1/FSMC_A20/DCMI_D4/EVENTOUT
4 PE5/TRACED2/FSMC_A21/TIM9_CH1/DCMI_D6/EVENTOUT
5 PE6/TRACED3_/_FSMC_A22/TIM9_CH2/DCMI_D7/EVENTOUT
40 PE9/FSMC_D6/TIM1_CH1/EVENTOUT
41 PE10/FSMC_D7/TIM1_CH2N/EVENTOUT
42 PE11/FSMC_D8/TIM1_CH2/EVENTOUT
43 PE12/FSMC_D9/TIM1_CH3N/EVENTOUT
44 PE13/FSMC_D10/TIM1_CH3/EVENTOUT
45 PE14/FSMC_D11/TIM1_CH4/EVENTOUT
46 PE15/FSMC_D12/TIM1_BKIN/EVENTOUT
81 PD0/FSMC_D2/CAN1_RX/EVENTOUT
82 PD1/FSMC_D3/CAN1_TX/EVENTOUT
83 PD2/TIM3_ETR/UART5_RX/SDIO_CMD/DCMI_D11/EVENTOUT
84 PD3/FSMC_CLK/USART2_CTS/EVENTOUT
85 PD4/FSMC_NOE/USART2_RTS/EVENTOUT
86 PD5/FSMC_NWE/USART2_TX/EVENTOUT
` PD6/FSMC_NWAIT/USART2_RX/EVENTOUT
55 PD8/FSMC_D13/USART3_TX/EVENTOUT
56 PD9/FSMC_D14/USART3_RX/EVENTOUT
57 PD10/FSMC_D15/USART3_CK/EVENTOUT
60 PD13/FSMC_A18/TIM4_CH2/EVENTOUT
61 PD14/FSMC_D0/TIM4_CH3/EVENTOUT/_EVENTOUT
62 PD15/FSMC_D1/TIM4_CH4/EVENTOUT
15 PC0/OTG_HS_ULPI_STP/EVENTOUT
16 PC1/ETH_MDC/_EVENTOUT
17 PC2/SPI2_MISO/OTG_HS_ULPI_DIR/ETH_MII_TXD2/I2S2ext_SD/EVENTOUT
33 PC4/ETH_RMII_RX_D0/ETH_MII_RX_D0/EVENTOUT
34 PC5/ETH_RMII_RX_D1/ETH_MII_RX_D1/EVENTOUT
63 PC6/I2S2_MCK/TIM8_CH1/SDIO_D6/USART6_TX/DCMI_D0/TIM3_CH1/EVENTOUT
64 PC7/I2S3_MCK/TIM8_CH2/SDIO_D7/USART6_RX/DCMI_D1/TIM3_CH2/EVENTOUT
65 PC8/TIM8_CH3/SDIO_D0/TIM3_CH3/USART6_CK/DCMI_D2/EVENTOUT
66 PC9/I2S_CKIN/MCO2/TIM8_CH4/SDIO_D1/I2C3_SDA/DCMI_D3/TIM3_CH4/EVENTOUT
80 PC12/UART5_TX/SDIO_CK/DCMI_D9/SPI3_MOSI/I2S3_SD/USART3_CK/EVENTOUT
7 PC13/EVENTOUT
8 PC14/OSC32_IN/EVENTOUT
9 PC15/OSC32_OUT/EVENTOUT
20 VSSA
10 VSS
27 VSS
74 VSS
73 VCAP_2



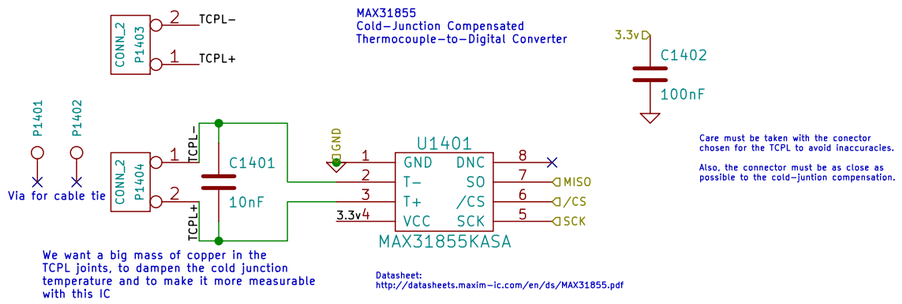
rusEFI.com		
Sheet: /thermocouple1/ File: thermocouple_module.sch		
Title: frankenso		
Size: A	Date: 2017-04-22	**Rev: 0.5**
KiCad E.D.A. kicad 4.0.5		Id: 11/15



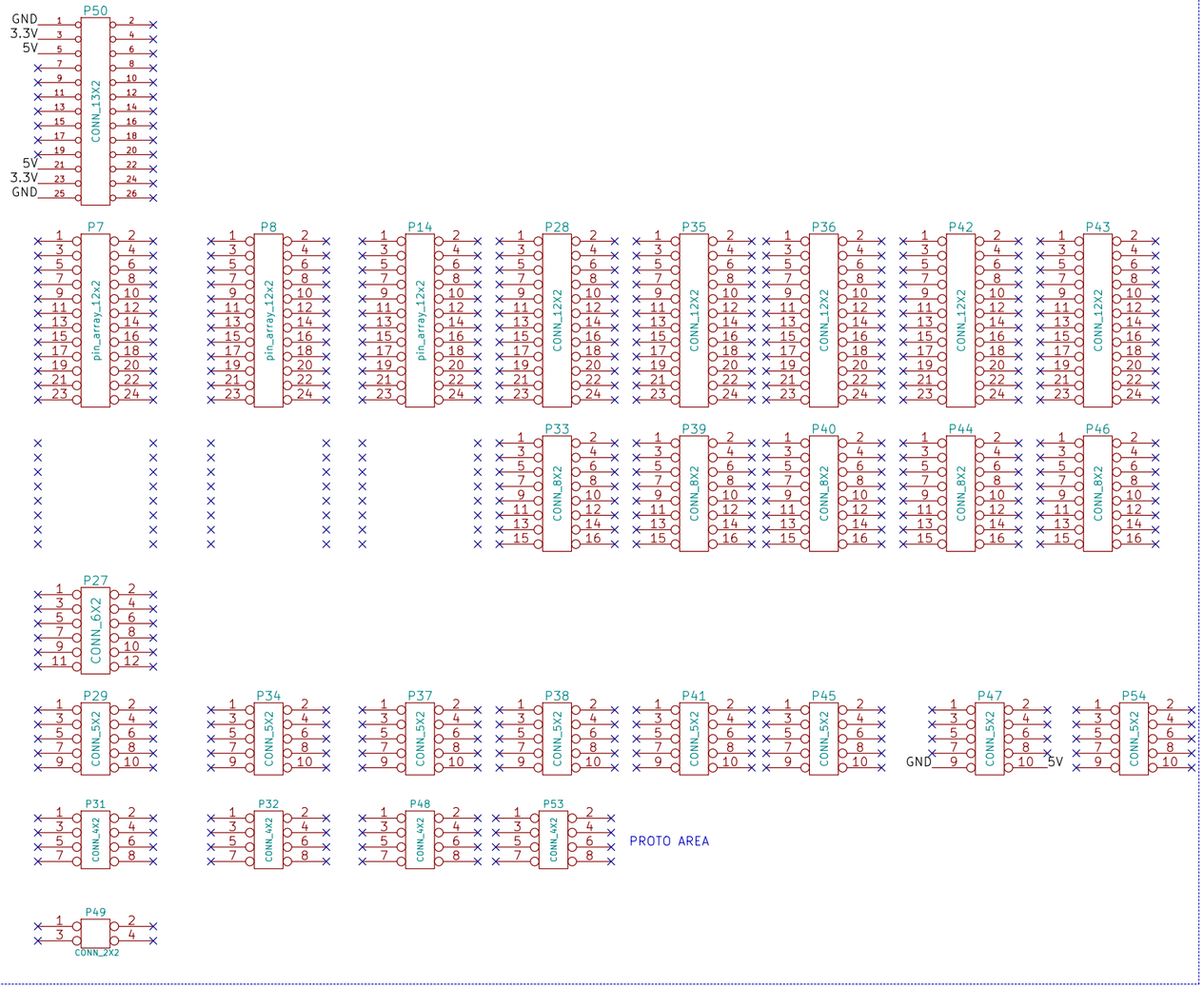
rusEFI.com		
Sheet: /thermocouple2/ File: thermocouple_module.sch		
Title: frankenso		
Size: A	Date: 2017-04-22	**Rev: 0.5**
KiCad E.D.A. kicad 4.0.5		Id: 12/15

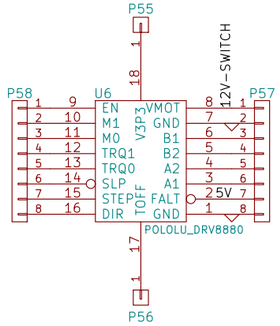


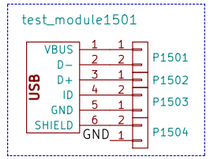
rusEFI.com		
Sheet: /thermocouple3/ File: thermocouple_module.sch		
Title: frankenso		
Size: A	Date: 2017-04-22	**Rev: 0.5**
KiCad E.D.A. kicad 4.0.5		Id: 13/15

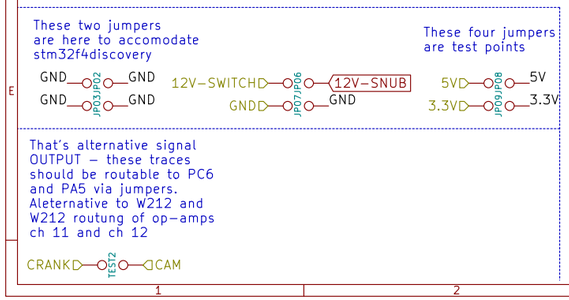


rusEFI.com		
Sheet: /thermocouple4/ File: thermocouple_module.sch		
Title: frankenso		
Size: A	Date: 2017-04-22	**Rev: 0.5**
KiCad E.D.A. kicad 4.0.5		Id: 14/15









See below links about barriers in GND planes. The current loops in the layout do not appear to need barriers.

http://rusefi.com/wiki/index.php?title=Manual:Hardware:PCB_design_rules
http://www.maximintegrated.com/en/app-notes/index.mvp/id/5450

rusEFI.com		
Sheet: /Misc_Vias/ File: Misc_Vias.sch		
Title: frankenso		
Size: B	Date: 2017-04-22	**Rev: 0.5**
KiCad E.D.A. kicad 4.0.5		Id: 15/15