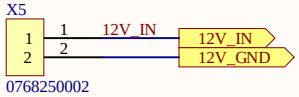
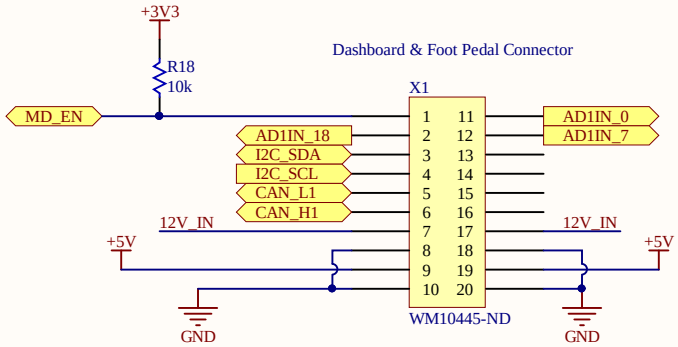
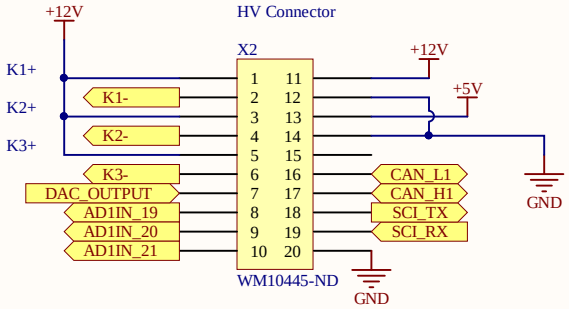
CONNECTORS







DESIGN NOTE:

Breaking out rails to power external components (Voltage Transducer, Current Transducer, LCDs, Enable Switches)

GPIO PIN MUX : ----------

PORT A :

(INPUT)	0 :	MD_EN
(INPUT)	1 :	MD_RUN
(OUTPUT)	2 :	MTR_EN
(OUTPUT)	5 :	(Pre_Charge)
(OUTPUT)	6 :	(High_Voltage)
(OUTPUT)	7 :	(Ground)

PORT B :

(INPUT)	0 :	Limit Switch
(INPUT)	1 :	S_BMS
(INPUT)	2 :	
(INPUT)	3 :	

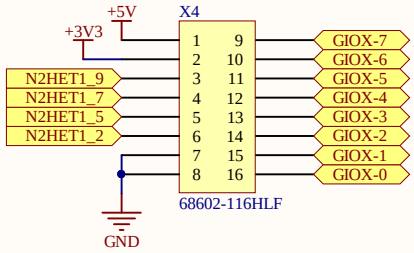
ADC : ----------

ADC 1 Group 1 :

PIN 0 : Throttle Input from Foot Pedal
PIN 7 : Voltage Transducer Analog Signal
PIN 18: Current Transducer Low Signal
PIN 19: Current Transducer High Signal
PIN 20:

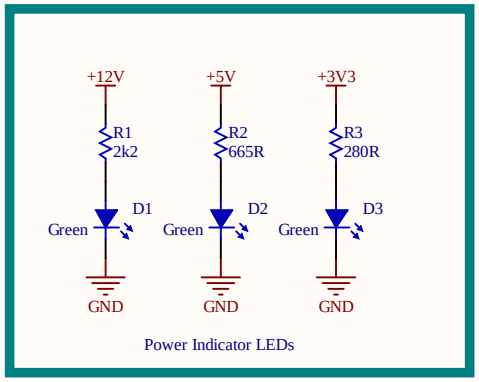
Extra Broken Out Signals

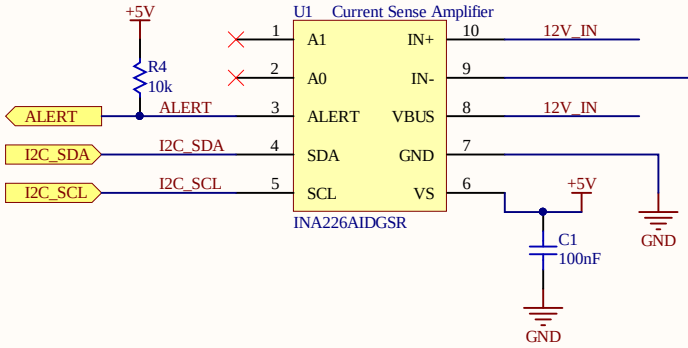
Add more analog inputs here



Title			
Size: A4	Number		Revision
Date:	2019-02-15	Sheet of	
File:	C:\Users\..\Connectors.SchDoc	Drawn By:	

POWER & CURRENT SENSING



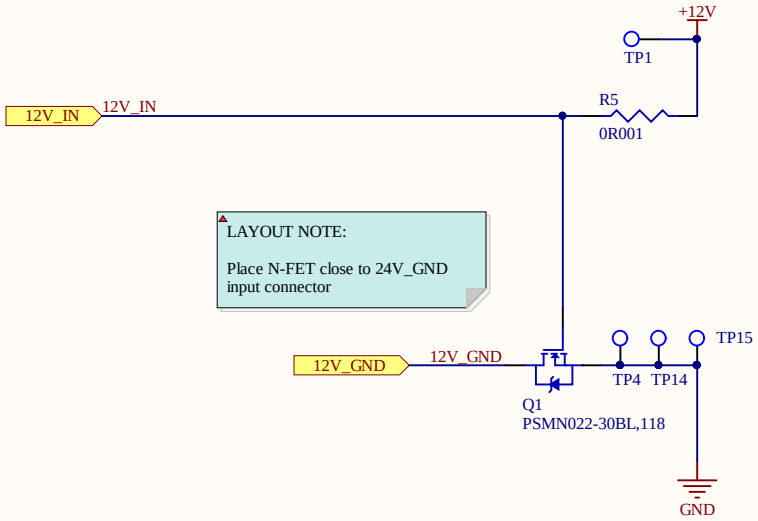


LAYOUT NOTE:

Place sensing wires (IN+, IN-) in a Kelvin connection to the shunt resistor
Route sensing wires as a differential pair

DESIGN NOTE:

Add overvoltage protection on 5V, 3.3, and 1.2

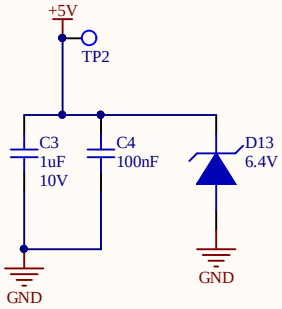


LAYOUT NOTE:

Place N-FET close to 24V_GND input connector

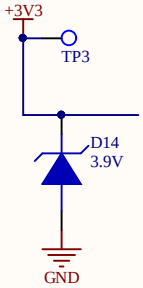
DESIGN NOTE:

N-FET placed for reverse polarity protection. Will conduct at correct 24V input polarity, will not conduct when polarity reversed.



LAYOUT NOTE:

Place output filter (inductor and capacitor) close to output of 3V3 DCDC

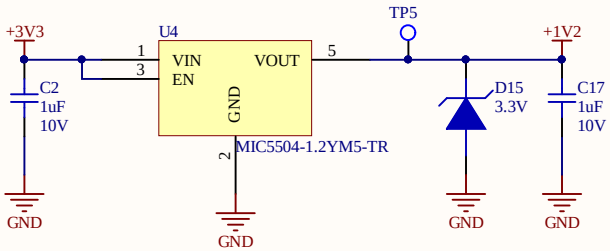


DESIGN NOTE:

Output resistor for minimum load requirement. DCDC needs min. 10% load otherwise voltage output isn't 3.3V

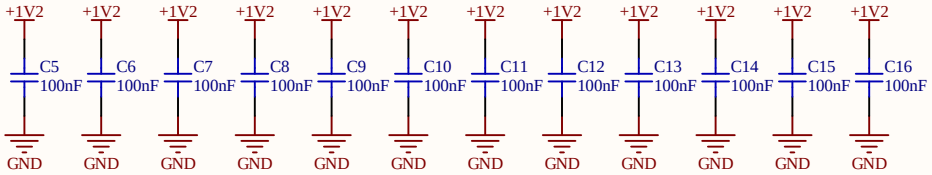
Title		
Size: A4	Number	Revision
Date: 2019-02-15		Sheet of
File: C:\Users\..\Power_Sensing.SchDoc		Drawn By:

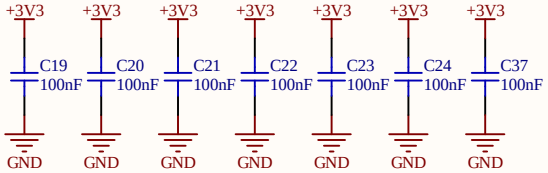
TMS570 POWER



DESIGN NOTE:

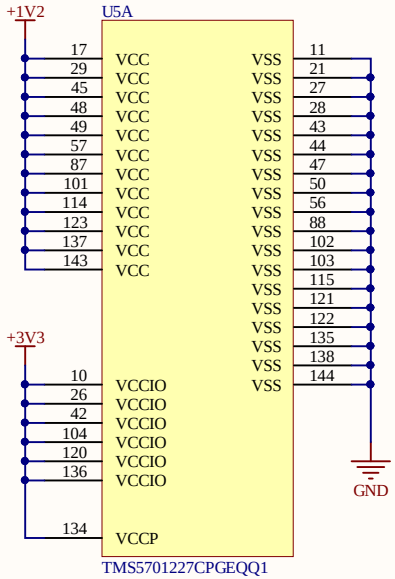
Decoupling capacitors help reduce the transients seen by the MCU on the power input pins





LAYOUT NOTE:

Place decoupling caps as close as possible to IC pin, on each power



Title		
Size: A4	Number:	Revision:
Date: 2019-02-15		Sheet of
File: C:\Users\..\Power_MCU.SchDoc		Drawn By:

MCU MAIN

DESIGN NOTE:

Overvoltage protection in case foot pedal pot shorts to 24V

D17
6.4V
GND

U5C
TMS5701227CPGEQQ1

AD1IN[16]/AD2IN[0] 58
AD1IN[17]/AD2IN[1] 59
AD1IN[0] 60
AD1IN[7] 61
AD1IN[18]/AD2IN[2] 62
AD1IN[19]/AD2IN[3] 63
AD1IN[20]/AD2IN[4] 64
AD1IN[21]/AD2IN[5] 65
AD1IN_0
AD1IN_7
AD1IN_18
AD1IN_19
AD1IN_20
AD1IN_21

CAN1TX 89 DCAN1_TX
CAN1RX 90 DCAN1_RX
CAN2TX 128
CAN2RX 129

GIOA[2] 9 MD_EN
GIOA[5] 14 K3_EN
GIOA[6] 16 K1_EN
GIOA[7] 22 K2_EN
GIOB[2] 55 IO_DRDY

N2HET1[6]/SCIRX/EPWM5A SCI_RX 38
N2HET1[13]/SCITX/EPWM5B SCI_TX 39

N2HET1[2] 30 N2HET1_2
N2HET1[5] 31 N2HET1_5
N2HET1[7] 33 N2HET1_7
N2HET1[9] 35 N2HET1_9
N2HET1[4] 36

MIBSPI3NCS[2]/I2C_SDA/N2HET1[27]/NTZ2 I2C_SDA 4
MIBSPI3NCS[3]/I2C_SCL/N2HET1[29]/NTZ1 I2C_SCL 3

MIBSPI1SOMI[0] 94
MIBSPI1SIMO[0] 93
MIBSPI1CLK 95
MIBSPI1NCS[0]/MIBSPI1SOMI[1] 105
MIBSPI1NCS[1]/N2HET1[17] 130
MIBSPI1NCS[2]/N2HET1[19] 40

MIBSPI3SIMO[0] 52
MIBSPI3CLK 53
MIBSPI3SOMI[0] 51
MIBSPI3NCS[0] 55
MIBSPI3NCS[1] 37

MIBSPI1_MOSI
MIBSPI1_CLK
MIBSPI1_NCS_0

JP5
1 SCI_RX
2 SCI_TX
3
732-5316-ND
GND

JP6
1 +3V3
2 +5V
3
732-5316-ND
GND

R6 2k2 DNS
R38 2k2 DNS
R7 2k2 DNS
R37 2k2 DNS

SCI_RX
SCI_TX
I2C_SDA
I2C_SCL

LAYOUT NOTE:

Place decoupling caps as close as possible to IC pin

JP7
1 MIBSPI1_NCS_0
2 MIBSPI1_CLK
3 MIBSPI1_MOSI
4
68002-404HLF
SPI Test Points
GND

NOTE:

GIOB[2] is only capable of input, it is meant to read interrupts from the system

DAC_POWER

U6 Digital to Analog Converter
MCP4921T-E/MS

1 VDD
2 CS_N
3 SCK
4 MOSI
8 VOUT
7 VSS
6 VREF
5 LDAC_N

DAC_OUTPUT
TP13
5015
C30 100nF
R21 10k
GND
GND

DAC_OUTPUT

+5V
R9 0R
DAC_POWER
C31 100nF
GND

DESIGN NOTE:

0 ohm resistors allow IC's to be unpowered and unused if needed. (i.e. don't need them or they draw too much power)
They also provide a footprint for a resistor, in case an RC filter is needed

LAYOUT NOTE:

Place output filter cap near connector

DESIGN NOTE:

Unstuffing the 0 ohm resistors can also allow for current to be measured using a DMM

8-GPIO EXPANDER

+5V +3V3
R40 0R DNS
R41 0R
IO_POWER
C59 100nF 10V
GND

U8 GPIO Expander
PCA9538APWJ

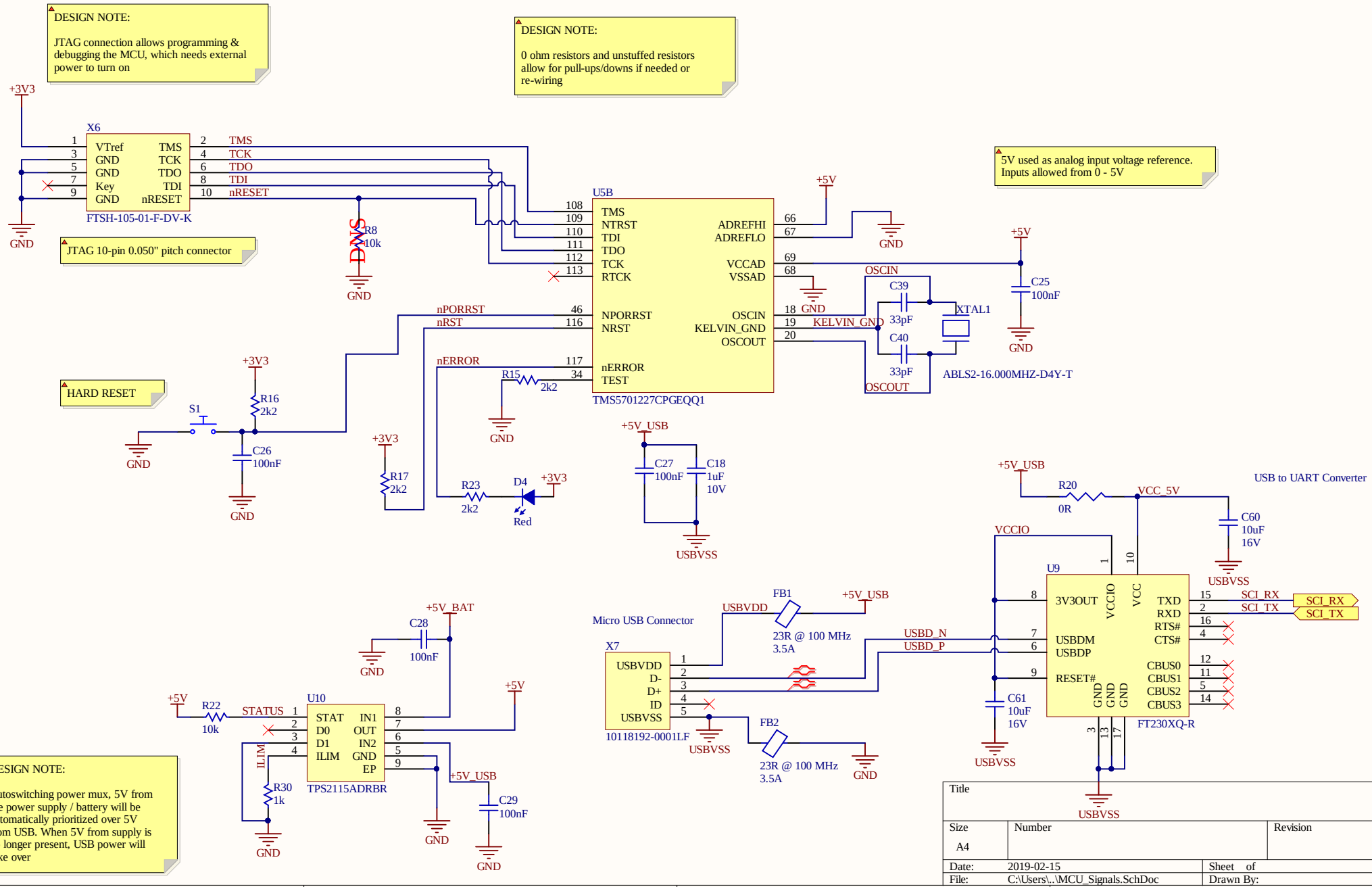
R42 10k
IO_RST

1 A0
2 A1
3 RESET_N
4 P0
5 P1
6 P2
7 P3
8 VSS
16 VDD
15 SDA I2C_SDA
14 SCL I2C_SCL
13 INT_N IO_DRDY
12 P7 GIOX-7
11 P6 GIOX-6
10 P5 GIOX-5
9 P4 GIOX-4

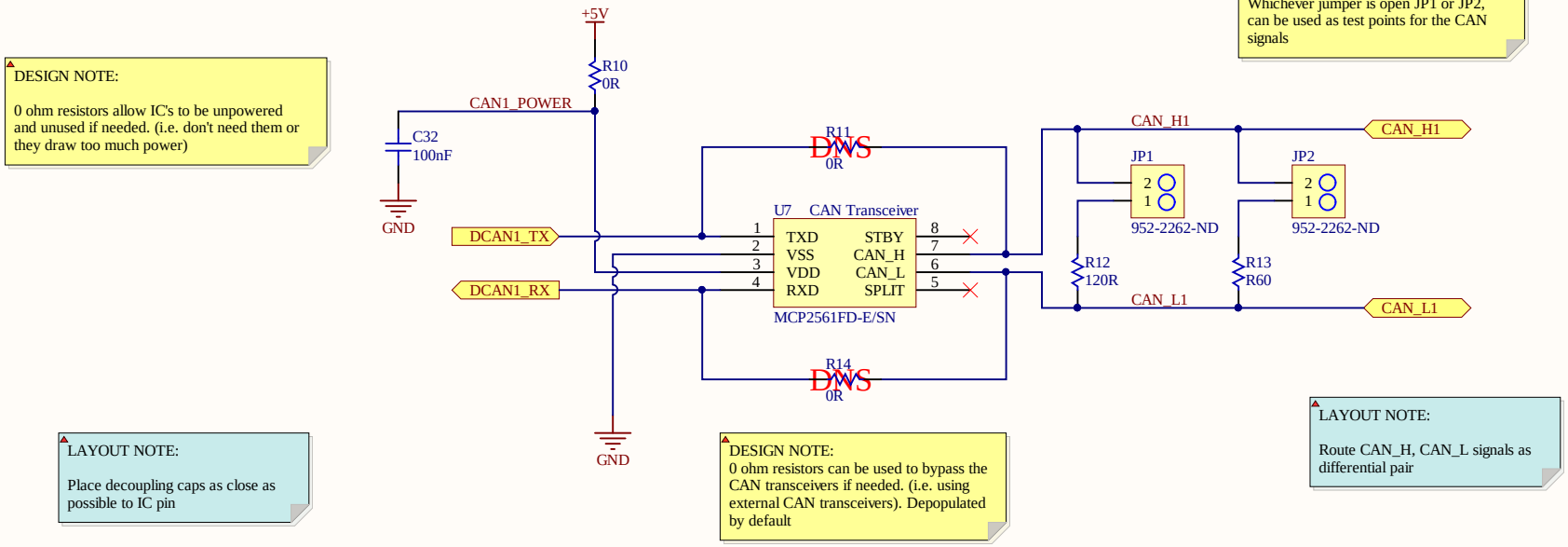
GIOX-0 GIOX-0
GIOX-1 GIOX-1
GIOX-2 GIOX-2
GIOX-3 GIOX-3

GND

Title		
Size A4	Number	Revision
Date: 2019-02-15		Sheet of
File: C:\Users\..\VCU_Schematic.SchDoc		Drawn By:


DESIGN NOTE:
JTAG connection allows programming & debugging the MCU, which needs external power to turn on
DESIGN NOTE:
0 ohm resistors and unstuffed resistors allow for pull-ups/downs if needed or re-wiring
5V used as analog input voltage reference. Inputs allowed from 0 - 5V
JTAG 10-pin 0.050" pitch connector
FTSH-105-01-F-DV-K
TMS5701227CPGEQQ1
HARD RESET
ABLS2-16.000MHZ-D4Y-T
USB to UART Converter
Micro USB Connector
10118192-0001LF
FT230XQ-R
TPS2115ADRBR
DESIGN NOTE:
Autoswitching power mux, 5V from the power supply / battery will be automatically prioritized over 5V from USB. When 5V from supply is no longer present, USB power will take over
Title
Size A4
Number
Revision
Date: 2019-02-15
Sheet of
File: C:\Users\..\MCU_Signals.SchDoc
Drawn By:

CAN TRANSCEIVER



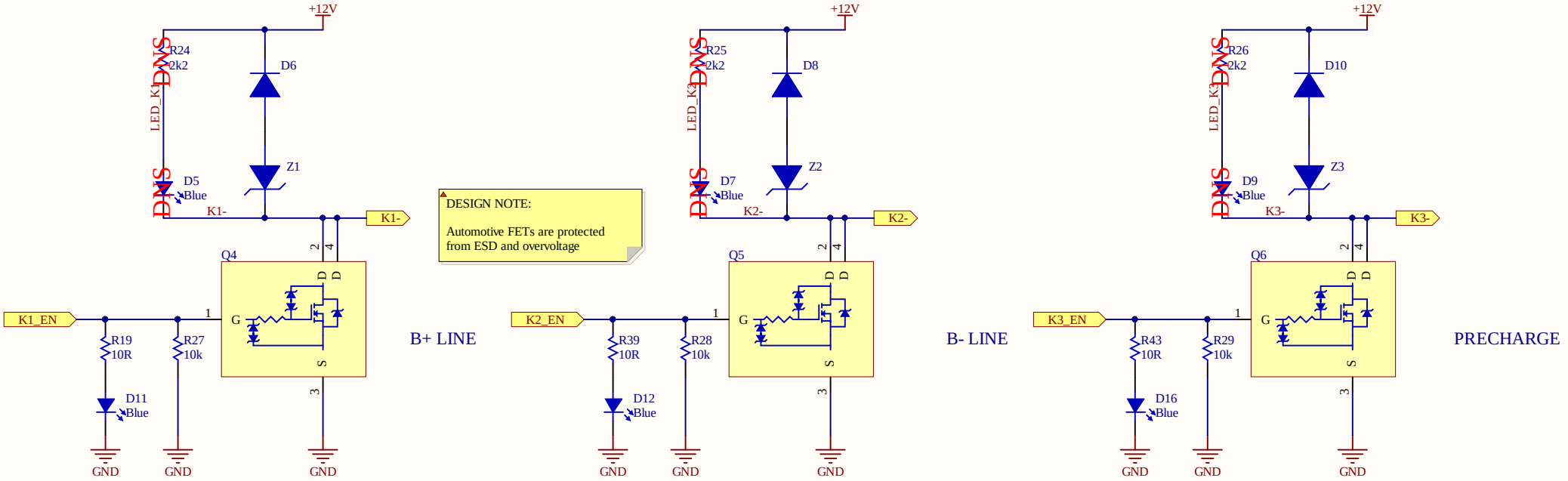
Title		
Size: A4	Number	Revision
Date: 2019-02-15		Sheet of
File: C:\Users\..\CAN.SchDoc		Drawn By:

LOW SIDE CONTACTOR SWITCHING

DESIGN NOTE:

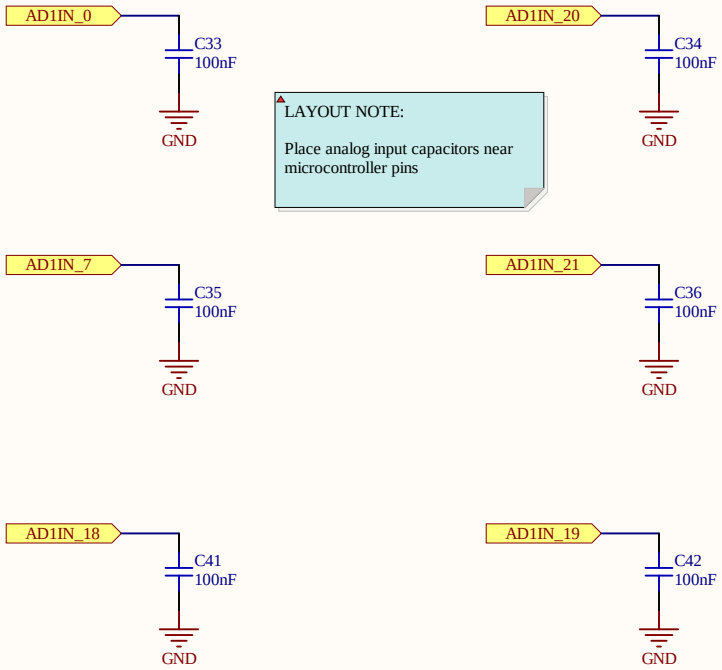
Diode-Zener snubber acts as a good way to dissipate inductive voltage kicks when the contactor opens

DESIGN NOTE:
These low-side switches go out to the rest of the shutdown circuit. The snubber circuit and LED remain for backwards compatibility with the go kart, where the contactors connect directly to the VCU.

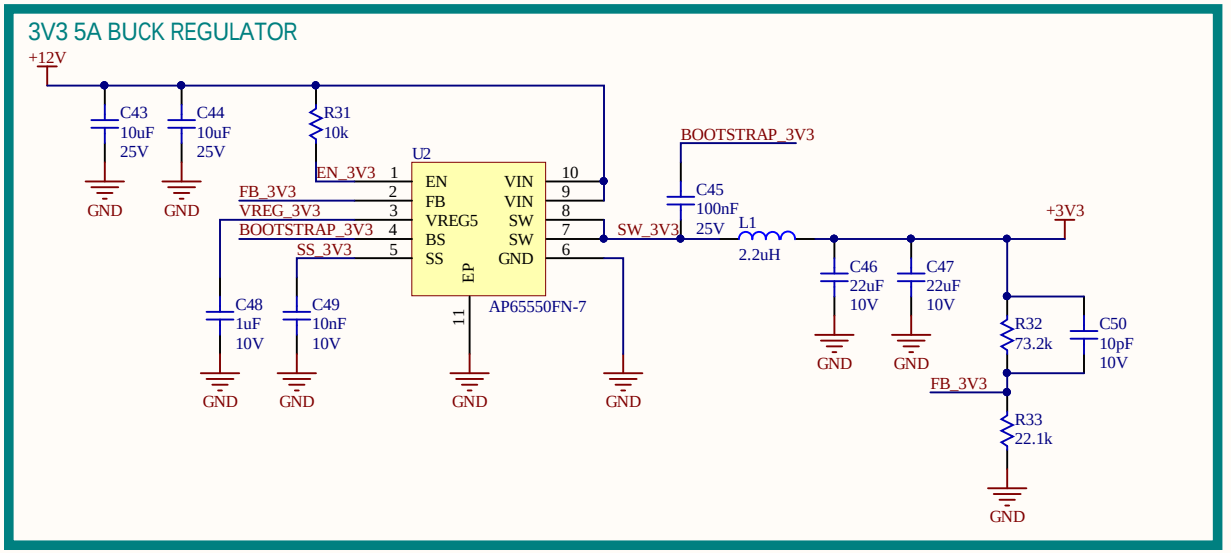


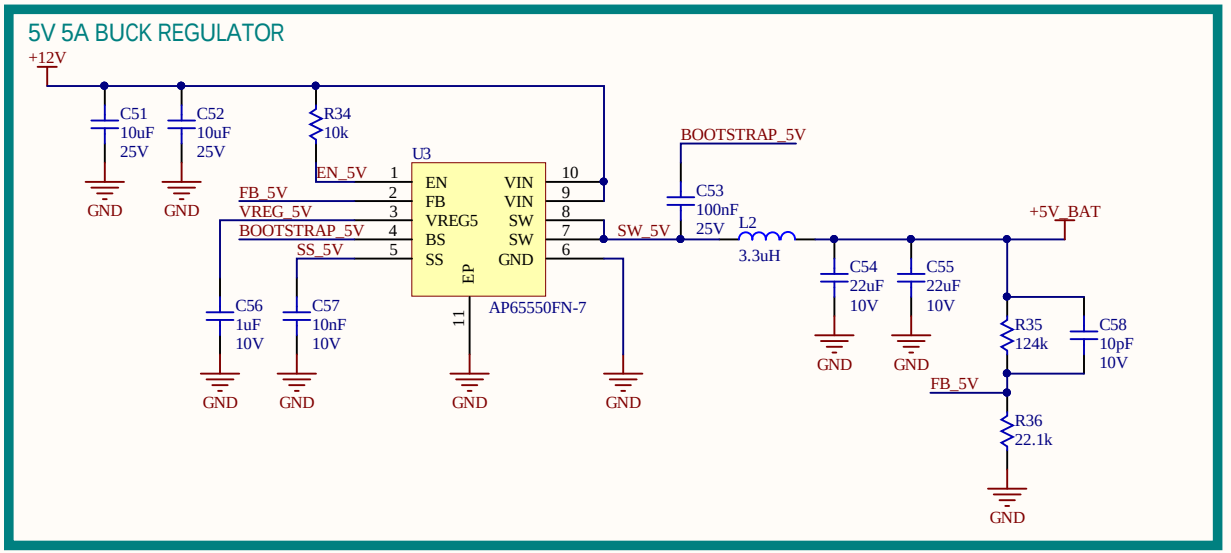
Title		
Size: A4	Number	Revision
Date: 2019-02-15		Sheet of
File: C:\Users\..\Contactor_Switching.SchDoc		Drawn By:

ADC DECOUPLING

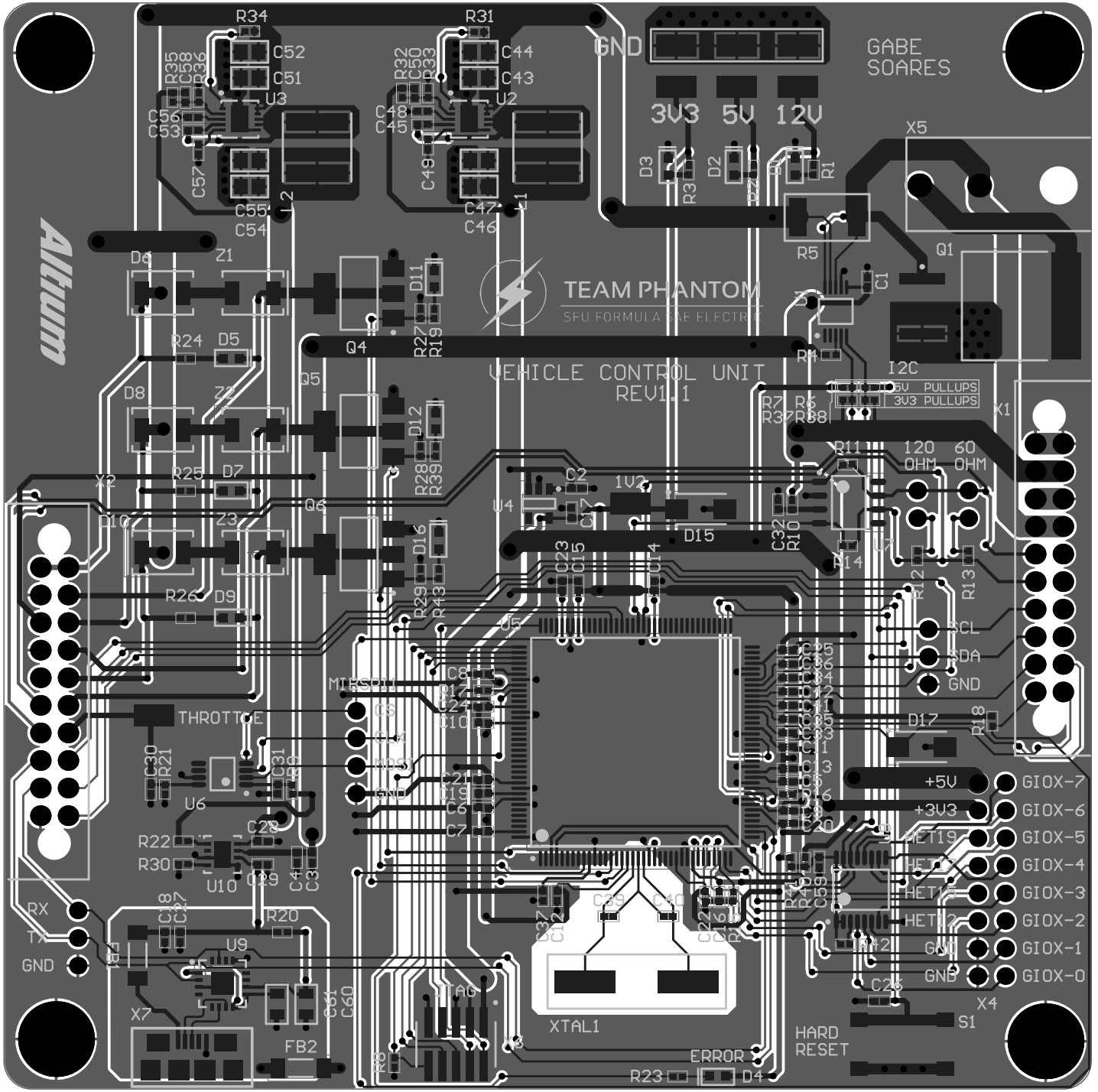


Title		
Size: A4	Number	Revision
Date: 2019-02-15		Sheet of
File: C:\Users\..\ADC_Decoupling.SchDoc		Drawn By:





Title		
Size: A4	Number	Revision
Date: 2019-02-15	Sheet of	
File: C:\Users\..\BUCK_CONVERTERS.SchDoc	Drawn By:	


GABE
SOARES
GND
3V3
5V
12V
TEAM PHANTOM
SFU FORMULA SAE ELECTRIC
VEHICLE CONTROL UNIT
REV1.1
I2C
5V PULLUPS
3V3 PULLUPS
120 OHM
60 OHM
SCL
SDA
GND
THROTTLE
RX
TX
GND
XTAL1
JTAG
HARD RESET
ERROR
+5V
+3V3
GIOX-7
GIOX-6
GIOX-5
GIOX-4
GIOX-3
GIOX-2
GIOX-1
GIOX-0
Altium