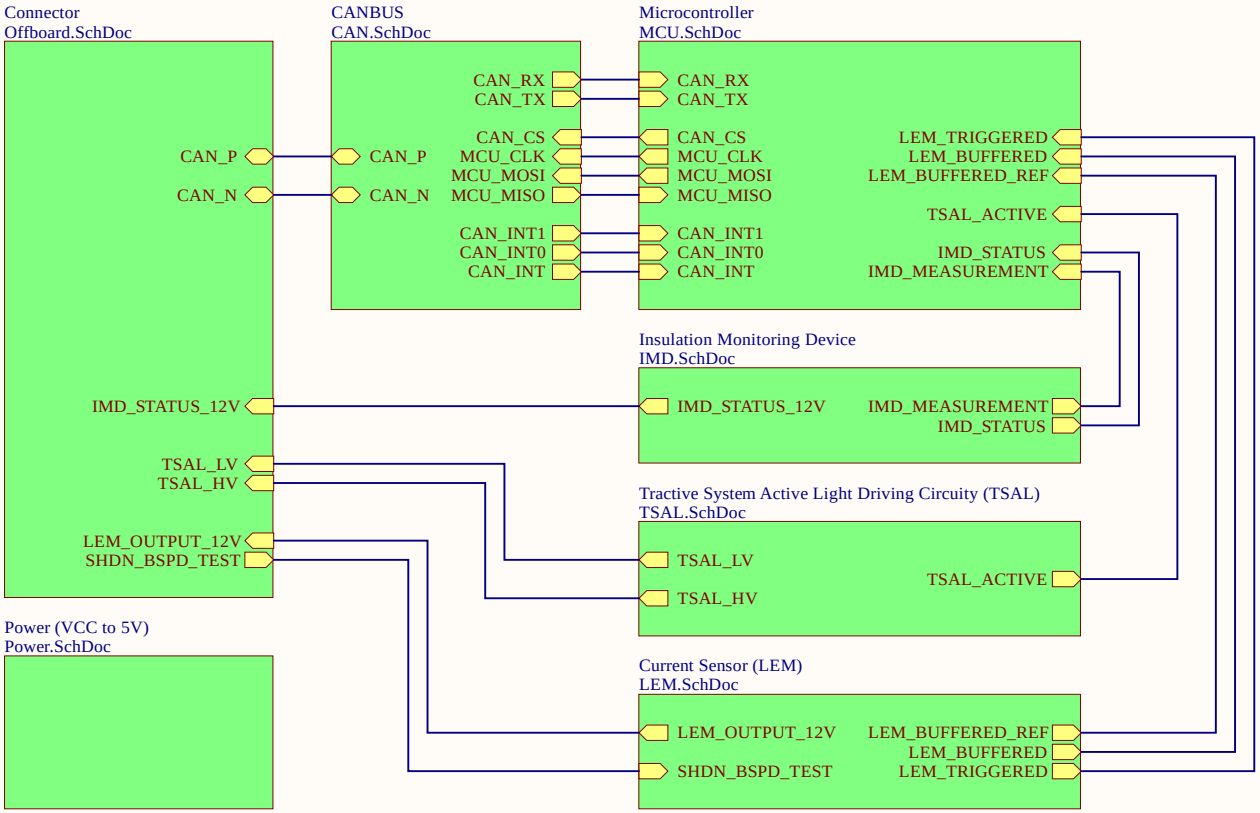
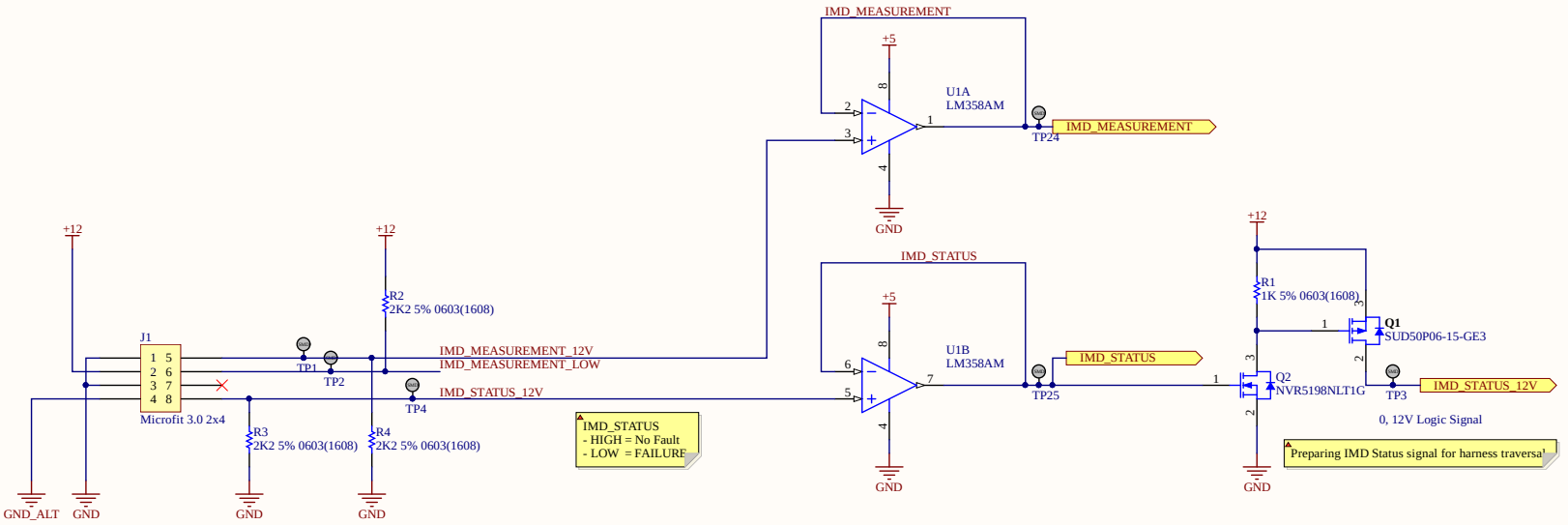


Title	***QUTMS HVBoard V1.1 - Master***		
Size: A4	Number:1	Revision:*	*QUT Motorsport, O-120*
Date: 8/04/2020	Time: 12:07:02 PM	Sheet1 of 8	*O Block, QUT Gardens Point*
			Brisbane, QLD, Australia



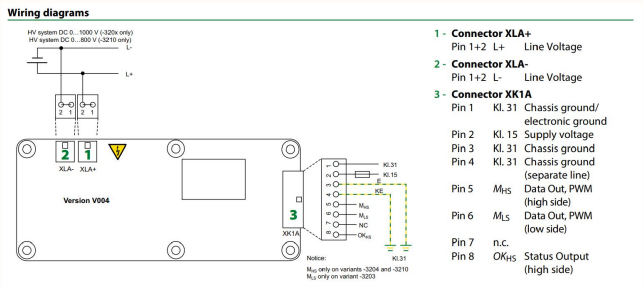
IMD Connection

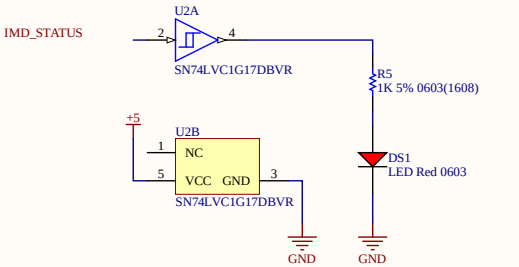
IMD Signal Buffers & 12V to 5V Shifters

12 Boost Line

Bender IMD Board Information
Part Number: IR155-3204
Serial Number: 1312000065
Mat. Number: B91068139V4
Software Version: D331 V2.01

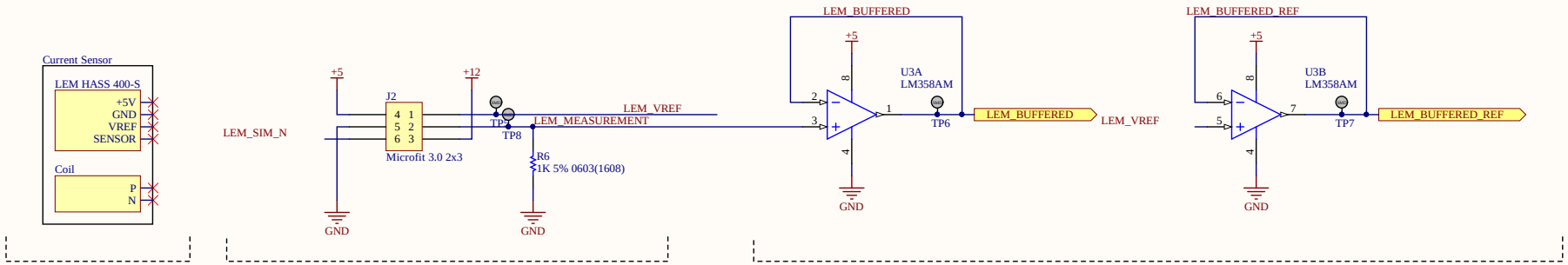
https://www.bender.de/fileadmin/content/Products/d/e/IR155-32xx-V004_D00115_D_XXEN.pdf





IMD Status Indicator

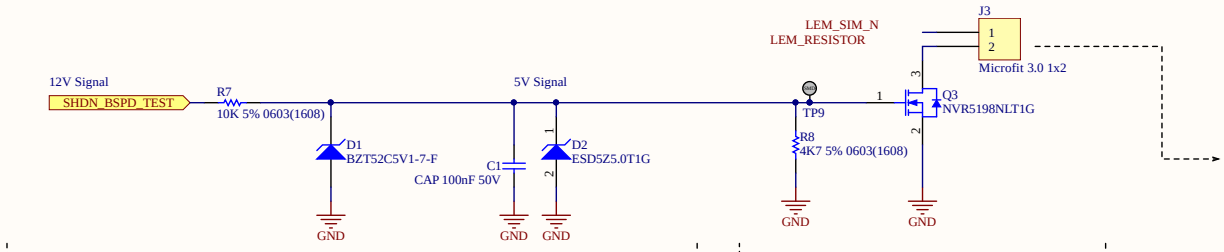
Title	QUTMS - HVBoard V1.1 - IMD		
Size: A4	Number:2	Revision2	QUT Motorsport, O-120 O Block, QUT Gardens Point Brisbane, QLD, Australia
Date: 8/04/2020	Time: 12:07:02 PM	Sheet2 of 8	



Current Sensor Diagram

Current Sensor Connector + Coil

Input Buffering



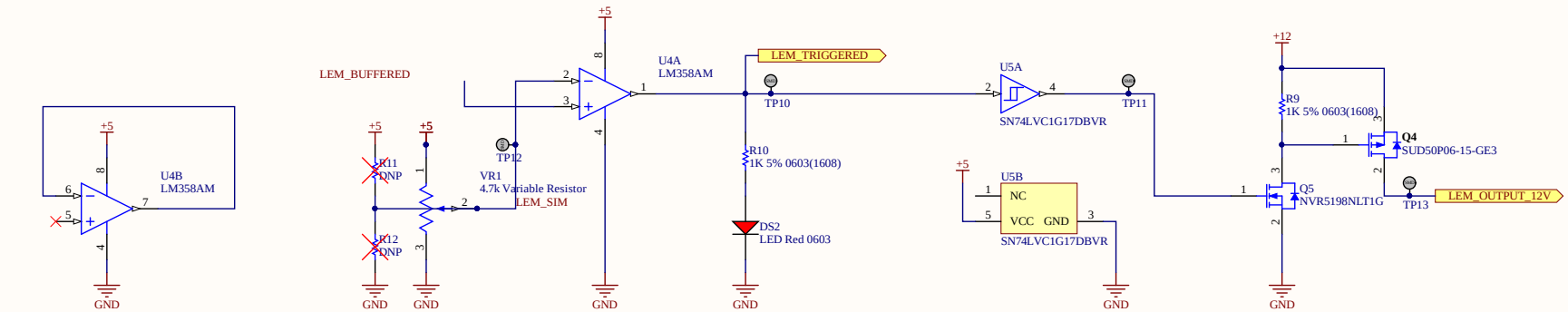
Current Generation Resistor Selection (5kW Sim)

5kW @ 100V (Nominal) = 50A

Turns	Required Current	Resistance @ 12V	Wattage @ 12V	Resistance @ 14.4V	Wattage @ 14.4V	Wire Rating
1	50A	0.24Ω	600	0.288Ω	720	AWG 10
2	25A	0.48Ω	300	0.576Ω	360	AWG 15
5	10A	1.2Ω	120	1.44Ω	144	AWG 20
10	5A	2.4Ω	60	2.88Ω	72	AWG 22
20	2.5A	4.8Ω	30	5.76Ω	36	AWG 25
50	1A	12Ω	12	14.4Ω	14.4	AWG 29
75	660mA	18Ω	8	21.6Ω	9.6	AWG 31
100	500mA	24Ω	6	28.8Ω	7.2	AWG 32
125	400mA	30Ω	4.6	36Ω	5.76	AWG 33
150	333mA	36Ω	4	43.2Ω	4.8	AWG 34
200	250mA	48Ω	3	57.6Ω	3.6	AWG 35

Shutdown Button Input Protection

Current Coil Trigger



Terminated Op-Amp

5kW Draw Detection

Op Amp Compartor Guide
If VIN (+) > VREF (-) ? 5V : 0V
If VIN (+) < VREF (-) ? 0V : 5V

LEM Detection Indicator

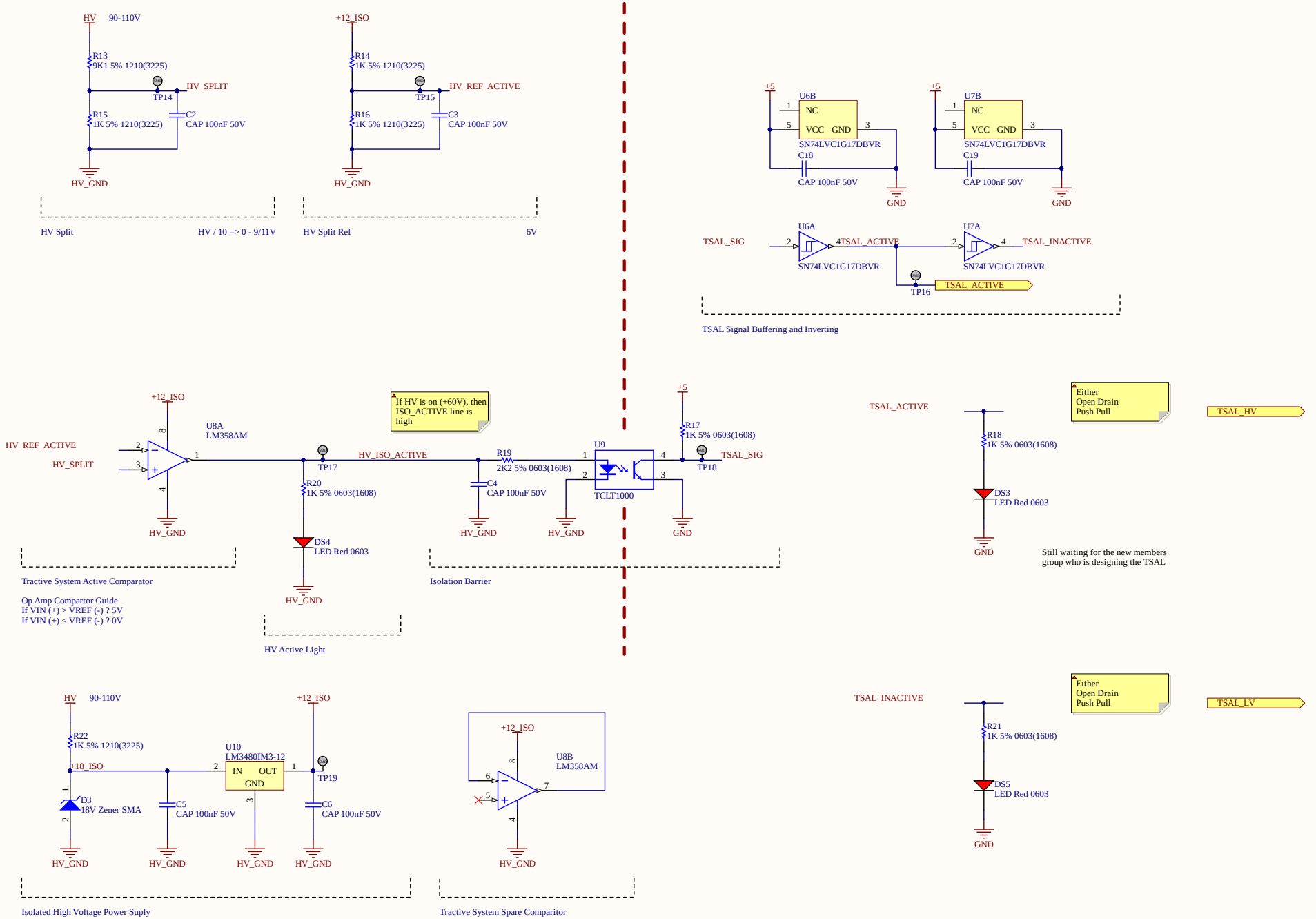
LEM Detection Inverter

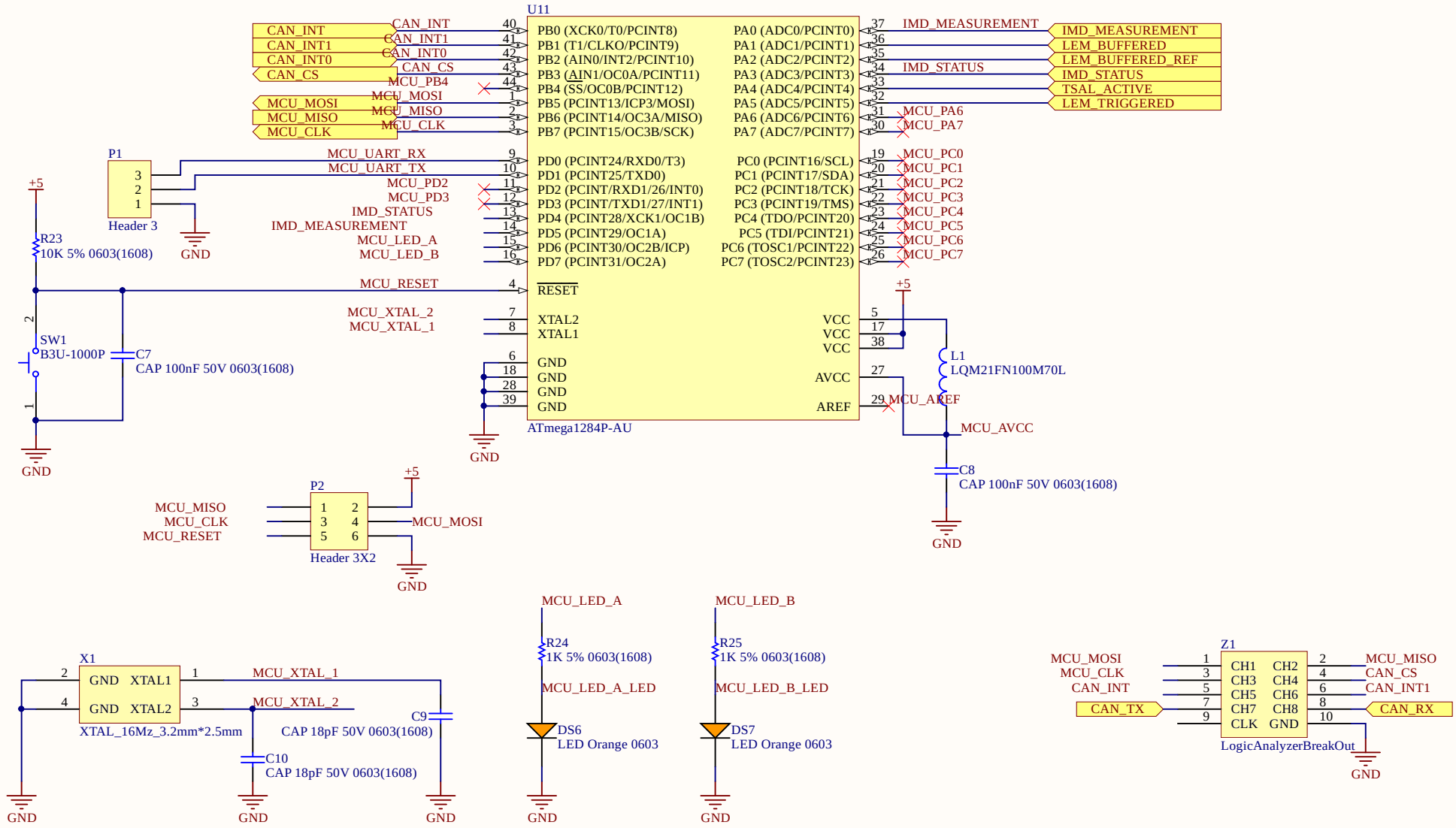
ON when not in error

LEM Buffer to 12V

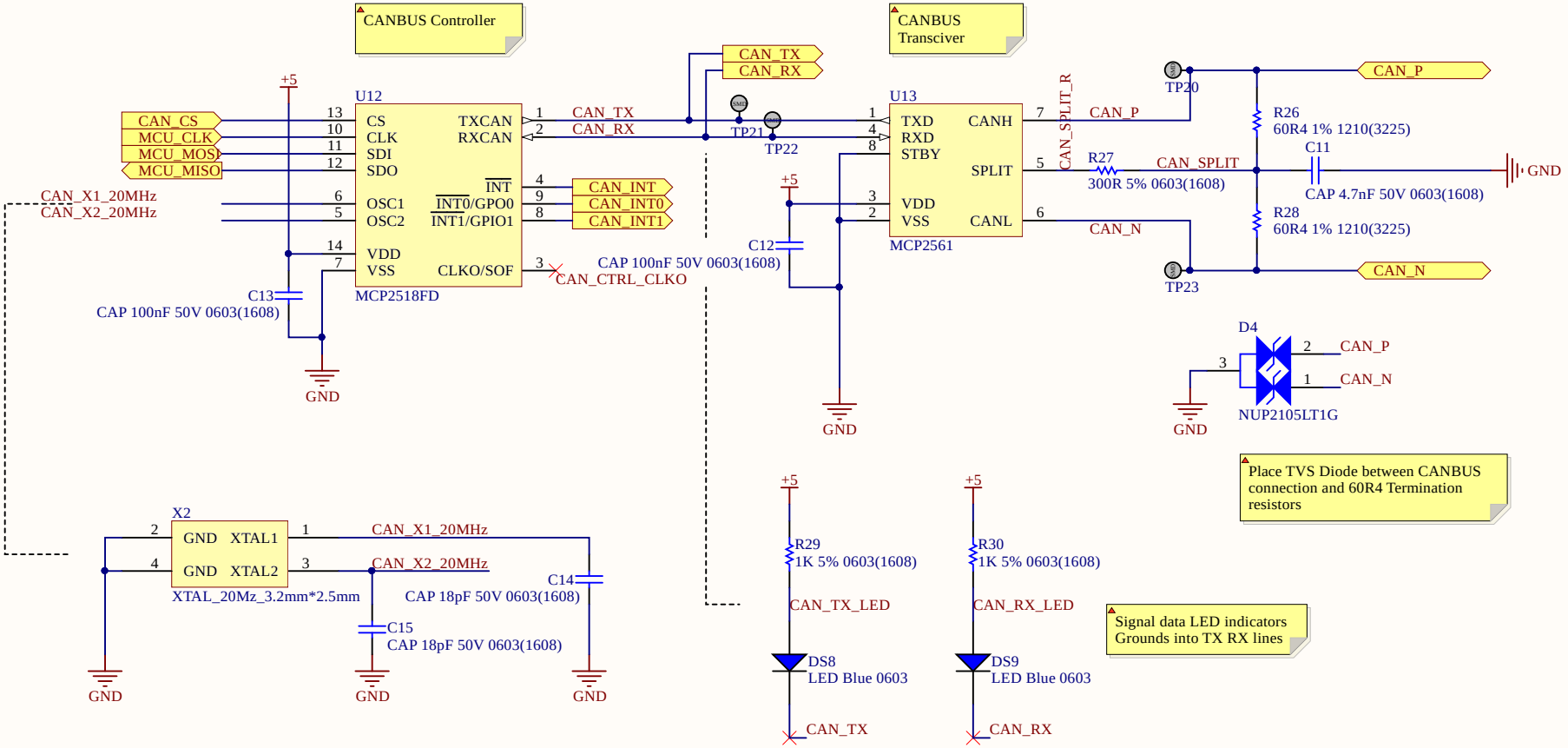
LEM Sensor HASS-200S https://www.lem.com/en/hass-200s
LEM Sensor HASS-400S https://www.lem.com/en/hass-400s
Datasheet https://www.lem.com/sites/default/files/products_datasheets/hass_50_600-s.pdf

Title	QUTMS - HVBoard V1.1 - LEM		
Size: A4	Number:3	Revision3	QUT Motorsport, O-120 O Block, QUT Gardens Point Brisbane, QLD, Australia
Date: 8/04/2020	Time: 12:07:02 PM	Sheet3 of 8	


HV 90-110V
R13
9K1 5% 1210(3225)
TP14
HV_SPLIT
R15
1K 5% 1210(3225)
C2
CAP 100nF 50V
HV_GND
HV Split
HV / 10 => 0 - 9/11V
+12_ISO
R14
1K 5% 1210(3225)
TP15
HV_REF_ACTIVE
R16
1K 5% 1210(3225)
C3
CAP 100nF 50V
HV_GND
HV Split Ref
6V
+5
U6B
NC
VCC GND
SN74LVC1G17DBVR
C18
CAP 100nF 50V
GND
U7B
NC
VCC GND
SN74LVC1G17DBVR
C19
CAP 100nF 50V
GND
TSAL_SIG
U6A
SN74LVC1G17DBVR
TSAL_ACTIVE
U7A
SN74LVC1G17DBVR
TSAL_INACTIVE
TP16
TSAL_ACTIVE
TSAL Signal Buffering and Inverting
+12_ISO
U8A
LM358AM
HV_REF_ACTIVE
HV_SPLIT
TP17
HV_ISO_ACTIVE
R20
1K 5% 0603(1608)
DS4
LED Red 0603
HV_GND
Tractive System Active Comparator
Op Amp Compartor Guide
If VIN (+) > VREF (-) ? 5V
If VIN (+) < VREF (-) ? 0V
HV Active Light
If HV is on (+60V), then ISO_ACTIVE line is high
R19
2K2 5% 0603(1608)
C4
CAP 100nF 50V
U9
TCLT1000
+5
R17
1K 5% 0603(1608)
TSAL_SIG
TP18
GND
Isolation Barrier
TSAL_ACTIVE
Either
Open Drain
Push Pull
TSAL_HV
R18
1K 5% 0603(1608)
DS3
LED Red 0603
GND
Still waiting for the new members group who is designing the TSAL
HV 90-110V
R22
1K 5% 1210(3225)
+18_ISO
U10
LM3480IM3-12
IN OUT
GND
TP19
D3
18V Zener SMA
C5
CAP 100nF 50V
C6
CAP 100nF 50V
HV_GND
Isolated High Voltage Power Suply
+12_ISO
U8B
LM358AM
HV_GND
Tractive System Spare Comparitor
TSAL_INACTIVE
Either
Open Drain
Push Pull
TSAL_LV
R21
1K 5% 0603(1608)
DS5
LED Red 0603
GND
Title QUTMS - HVBoard V1.1- TSAL
Size: A4
Number:4
Revision2
Date: 8/04/2020
Time: 12:07:03 PM
Sheet4 of 8
QUT Motorsport, O-120
O Block, QUT Gardens Point
Brisbane, QLD, Australia

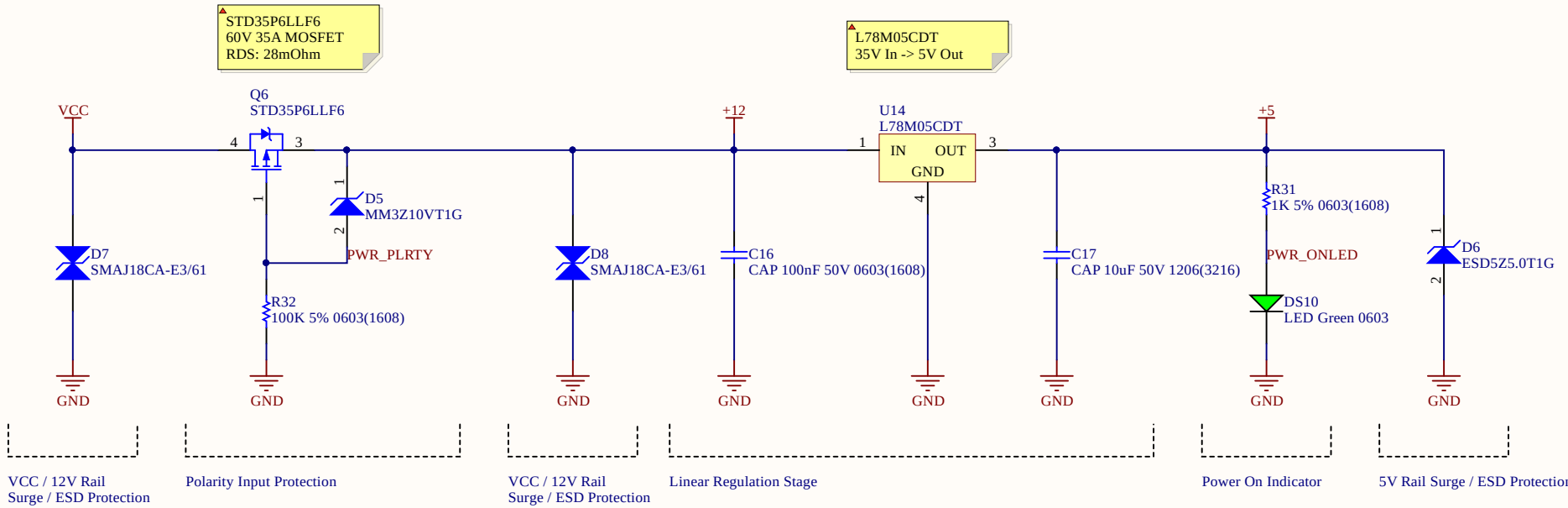


Title	***QUTMS HVBoard V1.1 - MCU***		
Size: A4	Number: 5	Revision: *	*QUT Motorsport, O-120*
Date: 8/04/2020	Time: 12:07:03 PM	Sheet 5 of 8	*O Block, QUT Gardens Point*
			Brisbane, QLD, Australia



20Mhz XTAL		https://lcsc.com/product-detail/SMD-Crystal-Resonators_Yangxing-Tech-X322520MSB4SI_C9004.html
CANBUS Controller	MCP2518FD	https://www.digikey.com.au/product-detail/en/microchip-technology/MCP2518FDT-H-SL/MCP2518FDT-H-SLCT-ND/10231406 Check at time of order if these parts exist on LCSC
	MCP2517FD	https://www.digikey.com.au/product-detail/en/microchip-technology/MCP2517FDT-H-SL/MCP2517FDT-H-SLCT-ND/7801975
CANBUS Transciver	MCP2561	https://lcsc.com/product-detail/CAN-ICs_Microchip-Tech_MCP2561T-E-SN_Microchip-Tech-MCP2561T-E-SN_C87081.html
CANBUS TVS Diode	NUP2105L	https://lcsc.com/product-detail/TVS_ON-Semicon_NUP2105LT1G_ON-Semicon-ON-NUP2105LT1G_C14486.html Text
Paper on CANBUS TVS Diode:		https://www.onsemi.com/pub/Collateral/AND8181-D.PDF
CANBUS Protection		https://www.onsemi.com/pub/Collateral/AND8169-D.PDF

Title	QUTMS - HVBoard V1.1 - CANBUS		
Size: A4	Number: 6	Revision: *	QUT Motorsport, O-120 O Block, QUT Gardens Point Brisbane, QLD, Australia
Date: 8/04/2020	Time: 12:07:03 PM	Sheet 6 of 8	



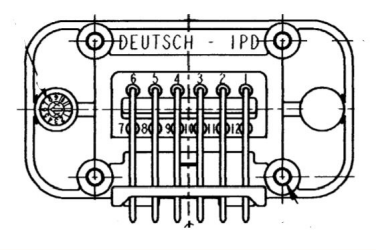
Input power stage needs to be built for:
- 1 Lead Acid Battery -> 14.4V Max
- 4s#p Li-ion Battery -> 16.8V Max

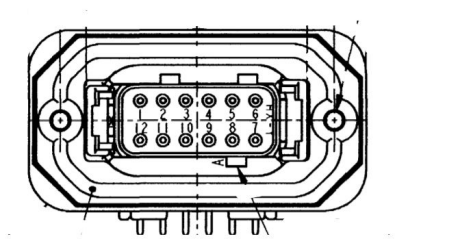
Polarity Protection MOSFET	https://lcsc.com/product-detail/MOSFET_STMicroelectronics_STD35P6LLF6_STMicroelectronics-STD35P6LLF6_C165929.html	1st Choice
	https://lcsc.com/product-detail/MOSFET_International-Rectifier_IRFR5305TRPBF_International-Rectifier-IR-IRFR5305TRPBF_C2624.html	2nd Choice
Polarity Protection Zener	https://lcsc.com/product-detail/Zener-Diodes_ON-Semicon_MM3Z10VT1G_ON-Semicon-ON-MM3Z10VT1G_C39057.html	
5V Rail TVS	https://lcsc.com/product-detail/Diodes-ESD_ON-Semicon_ESD5Z5-0T1G_ON-Semicon-ON-ESD5Z5-0T1G_C82044.html	
VCC / 12V Rail TVS	https://lcsc.com/product-detail/TVS_Littelfuse_SMAJ18CA_SMAJ18CA_C151240.html	
Output Cap	https://lcsc.com/product-detail/Multilayer-Ceramic-Capacitors-MLCC-SMD-SMT_SAMSUNG_CL31A106KBHNNNE_10uF-106-10-50V_C13585.html	
Linear Reg Actual	https://lcsc.com/product-detail/Linear-Voltage-Regulators_ON-Semicon_MC7805BDTRKG_ON-Semicon-ON-MC7805BDTRKG_C110908.html	
Listed	https://lcsc.com/product-detail/Others_STMicroelectronics_L78M05CDT-1_STMicroelectronics-L78M05CDT-1_C262914.html	

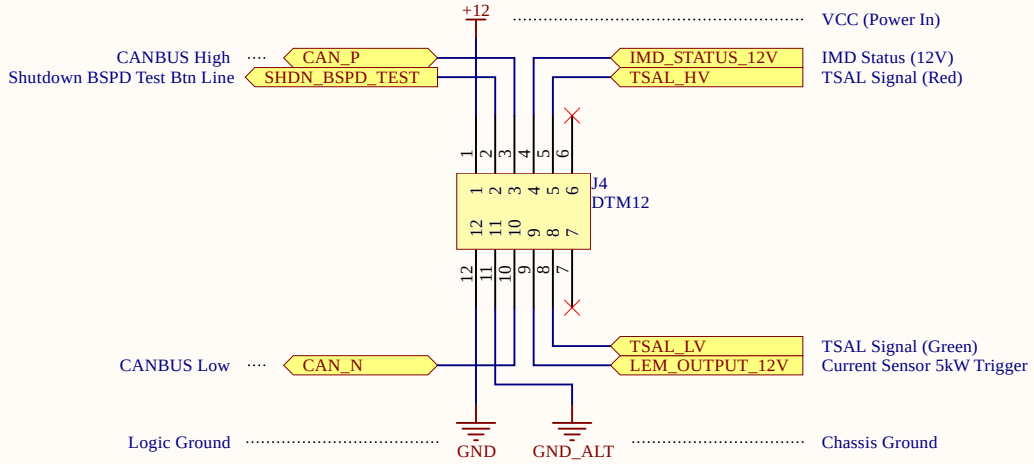
Any DPak package linear reg (not low dropout!) will be sufficent, Just check the pinout just in case

Title	***QUTMS - HV Board V1.1 - Power***		
Size: A4	Number: 7	Revision: 2	*QUT Motorsport, O-120*
Date: 8/04/2020	Time: 12:07:03 PM	Sheet 7 of 8	*O Block, QUT Gardens Point*
			Brisbane, QLD, Australia

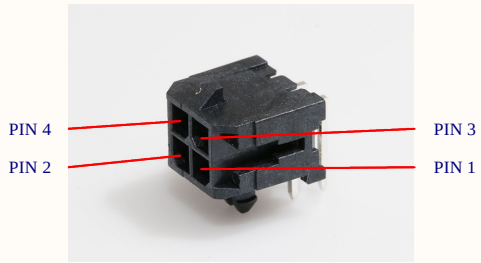
TE DTM12 PCB Right Angle







Microfit 3.0 2x2 Pinout



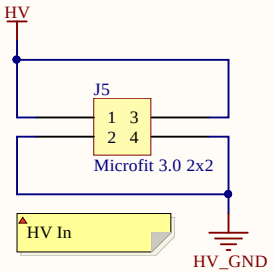
Microfit 3.0 Voltage Rating

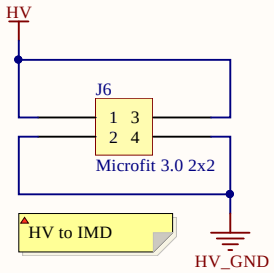
4.0 RATINGS

4.1 SAFETY AGENCY RATINGS

Series	Agency Voltage Rating (AC RMS or DC)			Agency Current Rating (Single Circuit) (Amps)		
	UL	CSA	IEC	UL	CSA	IEC
43640	250	600	250	5	7	5
200875	250	600	250	5	7	5
43645	600	600	250	8	8	5
43650	600	600	250	8	8	5
171850	600	600	250	5	7	5

(Current ratings are maximum and may vary depending on wire size, circuit count, and end-use application. Further testing may be required in the end-use application.)





Title	**QUTMS HVBoard V1.1 - Offboard**		QUT Motorsport O-120 O Block QUT Gardens Point Brisbane, 4000
Size: A4	Number: 8	Revision: *	
Date: 8/04/2020	Time: 12:07:03 PM	Sheet 8 of 8	
File: R:\Users\Jonn\Documents\git\qutms\QUTMS_HVBoard\hardware\QUTMS_HVBoard_V1_1\Offboard.Sch			