MCP33151-10 Eval Board

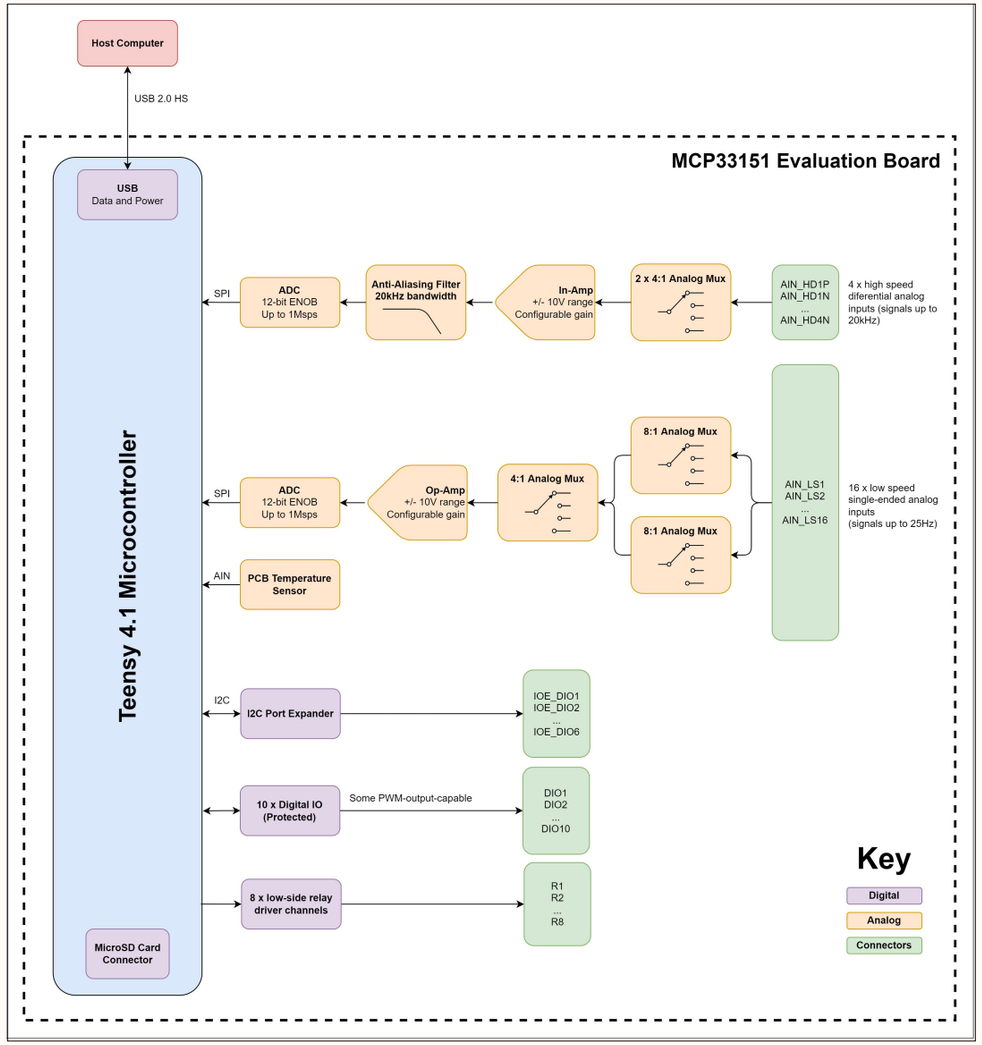
Table of Contents

1 Cover
2 Connectors
3 Power
4 Microcontroller
5 IO Expansion
6 Digital IO Protection
7 Analog - High Speed Differential
8 Analog - Low Speed Single-Ended
9 ADC
10 Relay Drivers
11 Debug

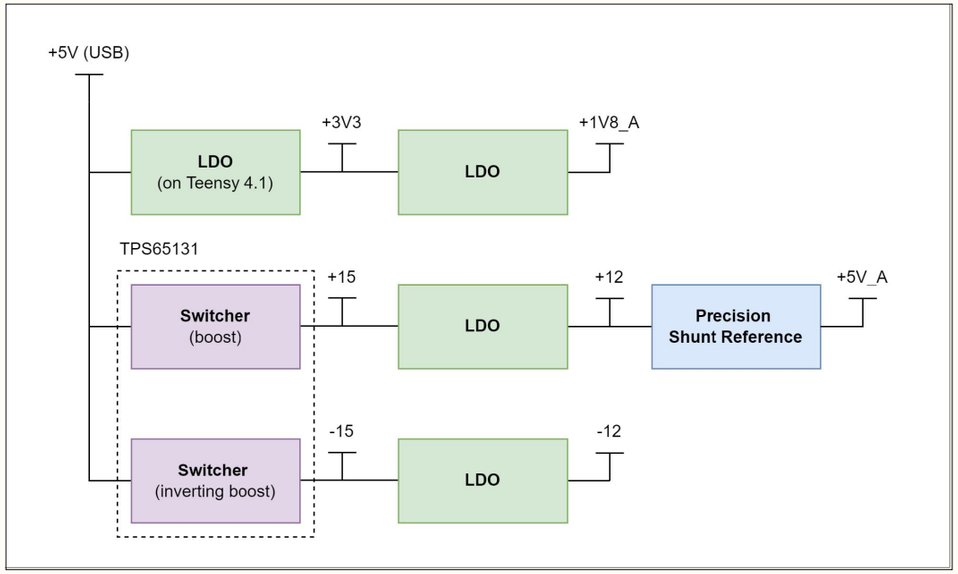
Port Colors

- Connector
- Digital
- Analog
- Communication

Main Block Diagram



Power Architecture



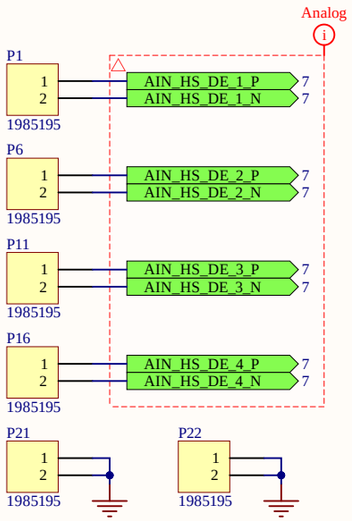
Title: *MCP33151-10 Eval Board*			*Avionics* *McGill Rocket Team* *McGill University* *Montreal, Quebec*
Size: B	Revision: *	Drawn By: Jasper Yun	
Date: 2022-11-07	Time: 8:42:25 PM	Sheet 1 of 11	
File: C:\Users\jaspe\Desktop\ecse478_honours_thesis\1 Hardware\MCP33151 Eval Board\Cover.SchDoc			

Connectors

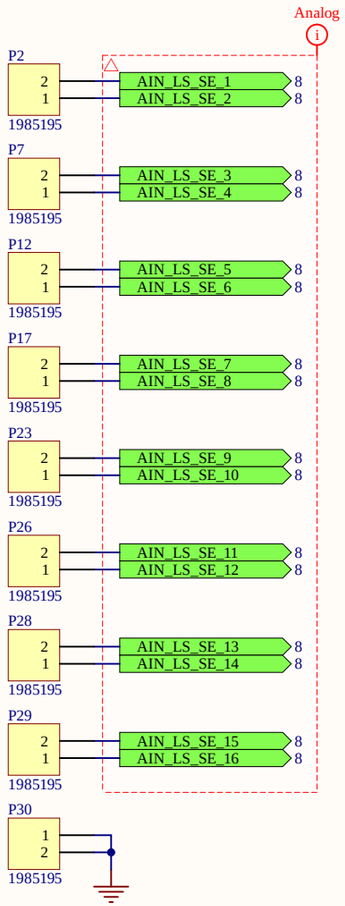
All terminal blocks for ease of prototyping.

DE = differential-ended
SE = single-ended

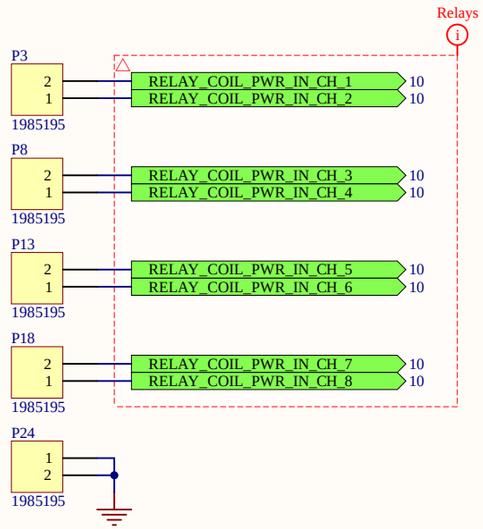
High Speed DE Analog



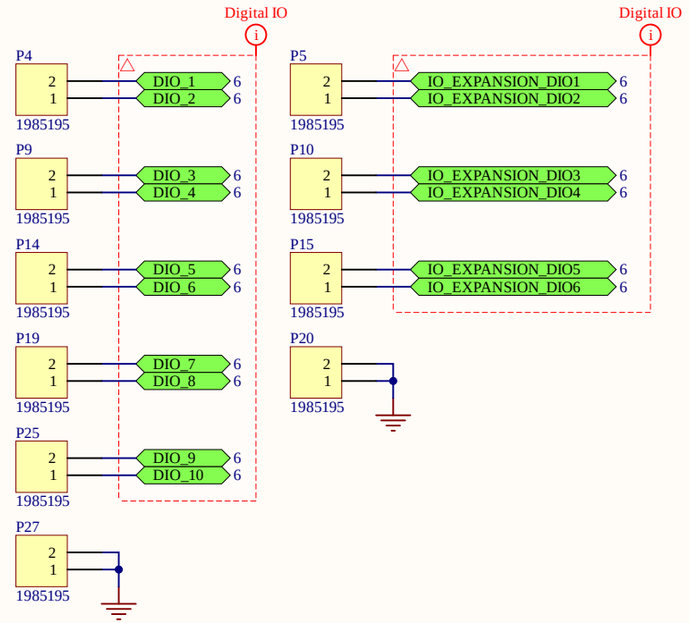
Low Speed SE Analog



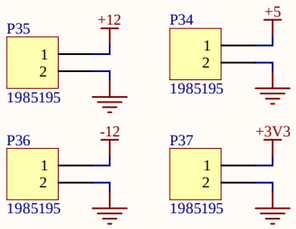
Relay Coils (Low Side)



Digital IO Pins



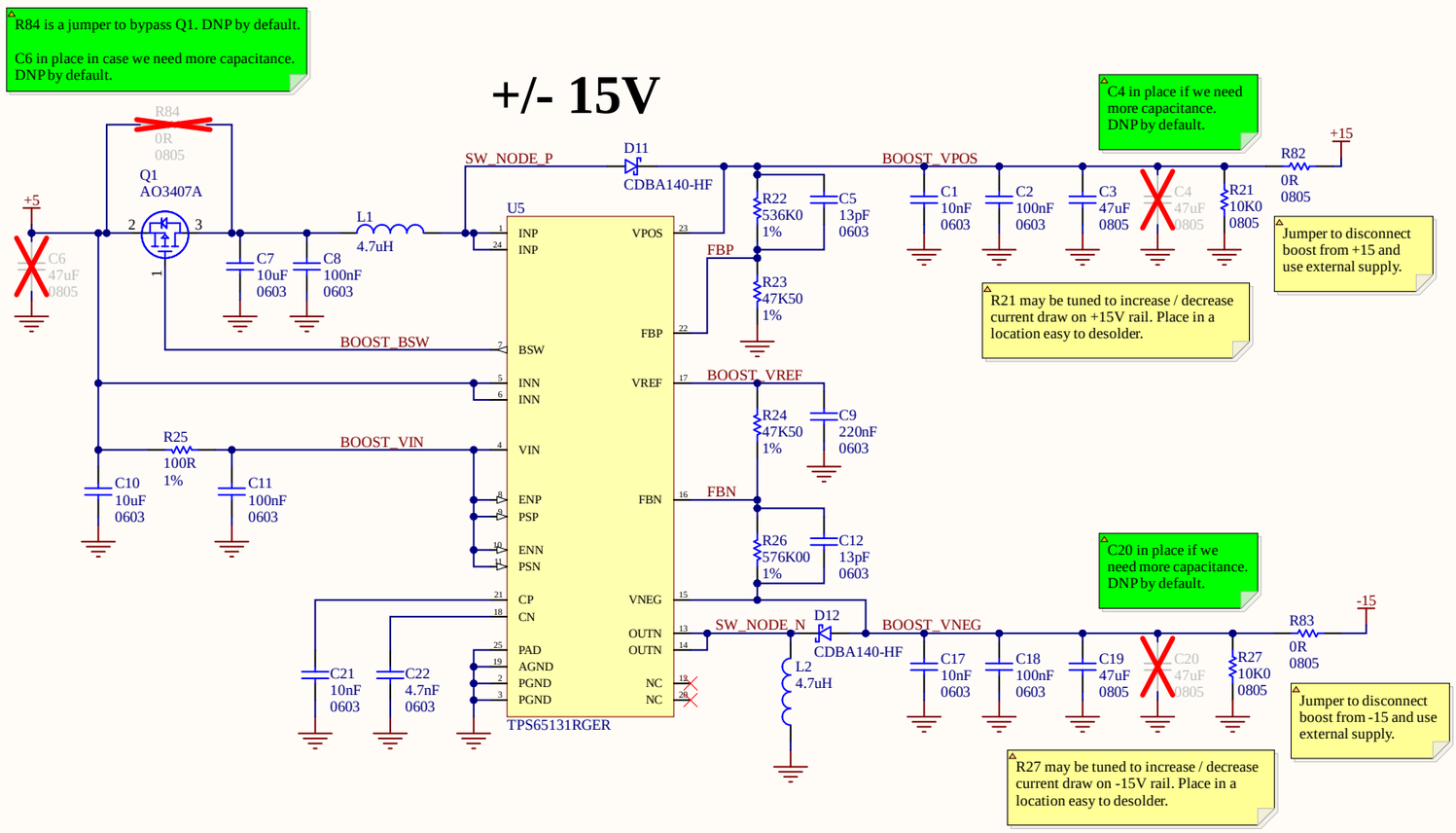
Power



Title: *Connectors*			*Avionics* *McGill Rocket Team* *McGill University* *Montreal, Quebec*
Size: B	Revision: *	Drawn By: Jasper Yun	
Date: 2022-11-07	Time: 8:42:25 PM	Sheet 2 of 11	
File: C:\Users\jaspe\Desktop\ecse478_honours_thesis\1 Hardware\MCP33151 Eval Board\Connectors.SchDoc			

Power

+/- 15V



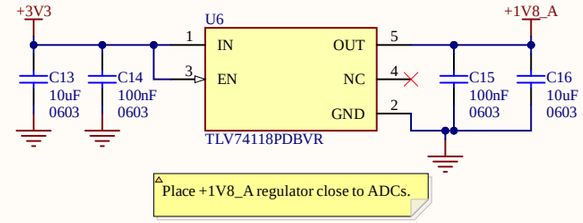
+5V (from USB port on Teensy :))

Nothing to be done.

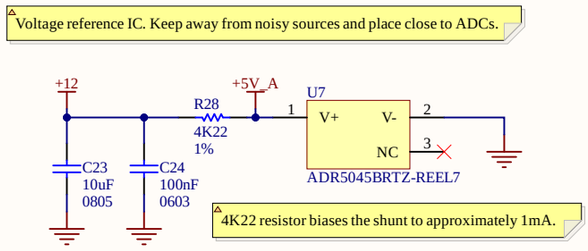
+3V3 (from Teensy :))

Nothing to be done.

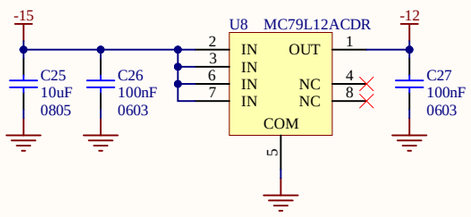
+1V8_A (ADC)



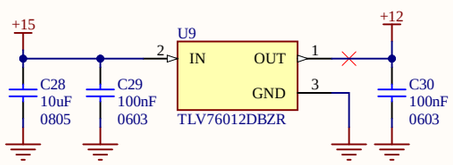
+5V_A (Analog Reference)



-12V



+12V



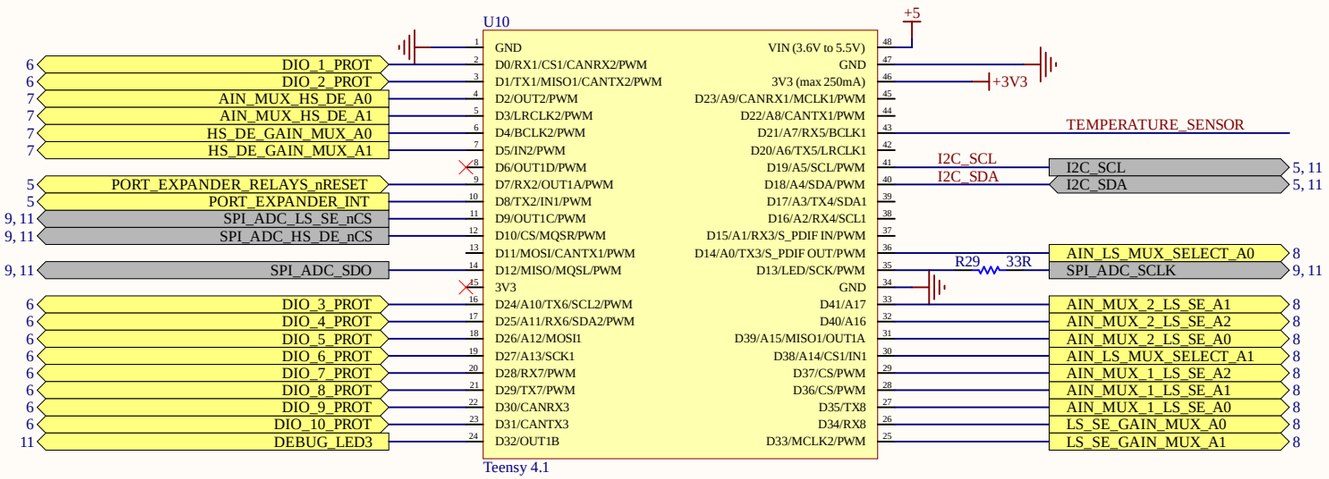
Title: *Power*			*Avionics* *McGill Rocket Team* *McGill University* *Montreal, Quebec*
Size: B	Revision: *	Drawn By: Jasper Yun	
Date: 2022-11-07	Time: 8:42:25 PM	Sheet 3 of 11	
File: C:\Users\jaspe\Desktop\ecse478_honours_thesis\1 Hardware\MCP33151 Eval Board\Power.SchDoc			

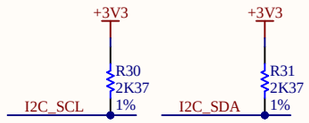
Microcontroller

Teensy will be interfaced by USB thus powered by USB. Board is thus limited to 500mA from the +5V rail.

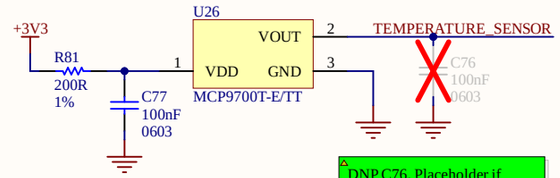
Use Teensy 4.1 Ethernet kit to add Ethernet capability to the board.

Teensy 4.1 has built-in SD card which interfaces using 4-bit SDIO. No need for SD card on this board.





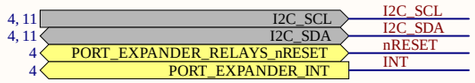
Temperature sensor outputs 500mV at 0C with 10mV/C slope. Place far from heat sources.

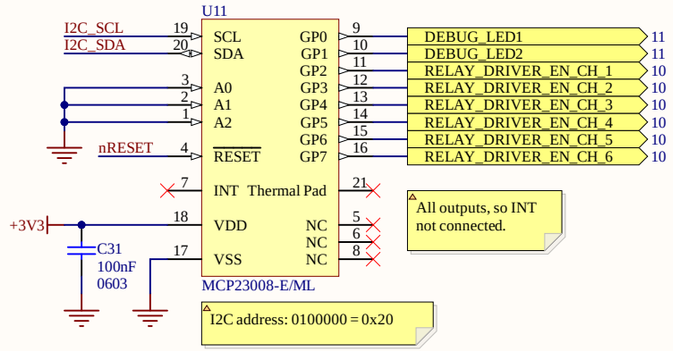


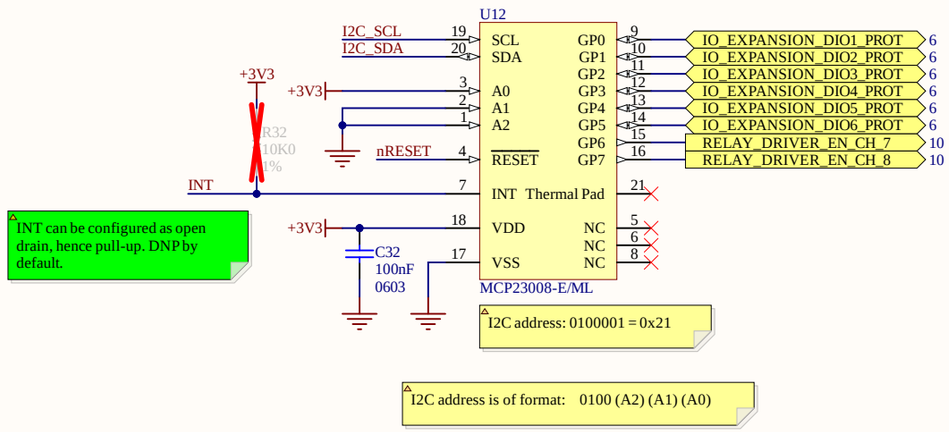
DNP C76. Placeholder if extra capacitance is required.

Title: *Microcontroller*			*Avionics* *McGill Rocket Team* *McGill University* *Montreal, Quebec*
Size: B	Revision: *	Drawn By: Jasper Yun	
Date: 2022-11-07	Time: 8:42:25 PM	Sheet 4 of 11	
File: C:\Users\jaspe\Desktop\ecse478_honours_thesis\1 Hardware\MCP33151 Eval Board\Microcontroller.SchDoc			

IO Expansion







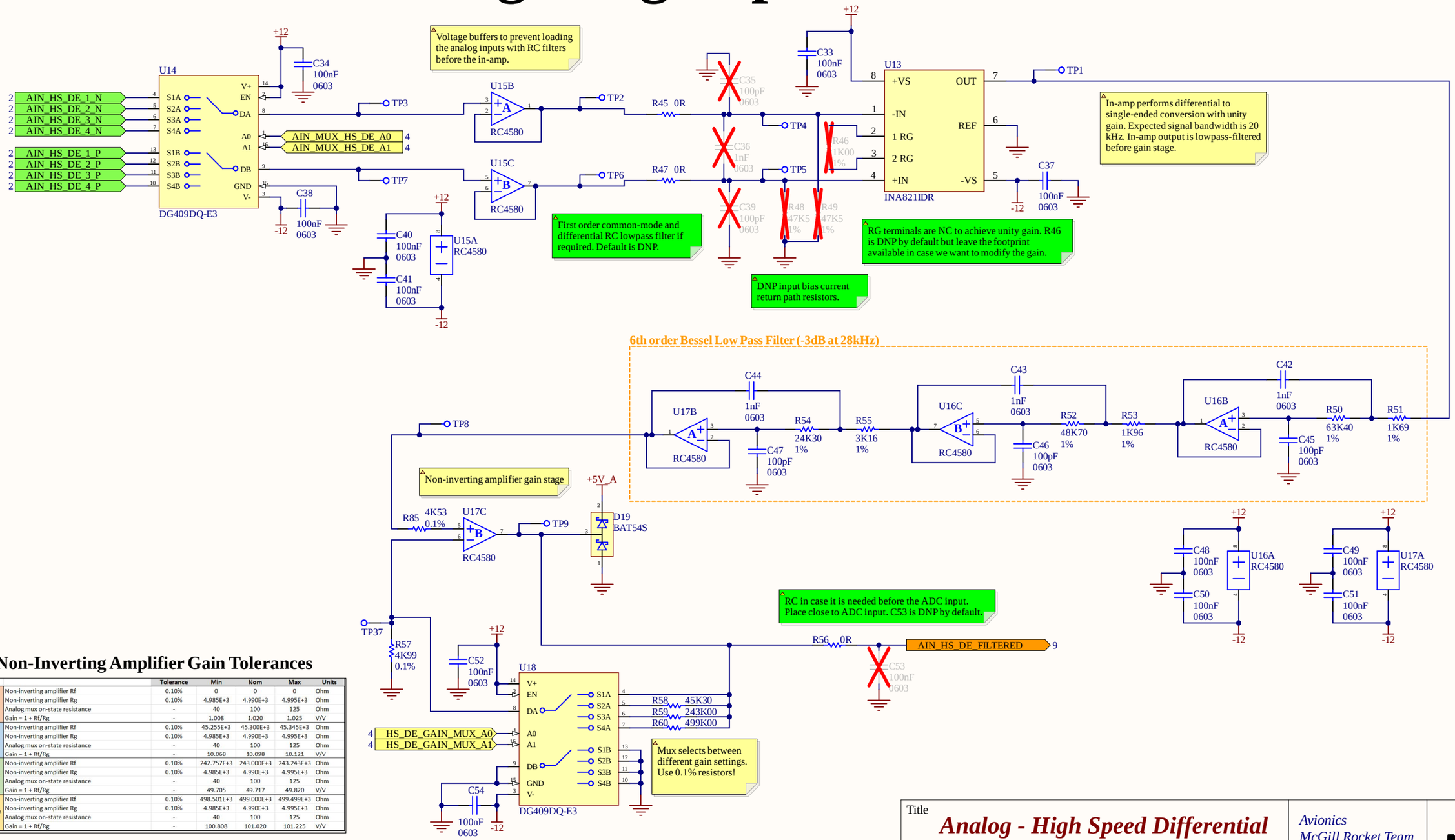
I2C address is of format: 0100 (A2) (A1) (A0)

Title: *IO Expansion*			*Avionics* *McGill Rocket Team* *McGill University* *Montreal, Quebec*
Size: B	Revision: *	Drawn By: Jasper Yun	
Date: 2022-11-07	Time: 8:42:26 PM	Sheet 5 of 11	
File: C:\Users\jaspe\Desktop\ecse478_honours_thesis\1 Hardware\MCP33151 Eval Board\IO Expansion.SchDoc			

Digital IO Protection

Title	***Digital IO Protection***		*Avionics* *McGill Rocket Team* *McGill University* *Montreal, Quebec*
Size: B	Revision: *	Drawn By: Jasper Yun	
Date: 2022-11-07	Time: 8:42:26 PM	Sheet 6 of 11	
File: C:\Users\jaspe\Desktop\ecse478_honours_thesis\1 Hardware\MCP33151 Eval Board\Digital IO Protection.SchDoc			

Analog - High Speed Differential



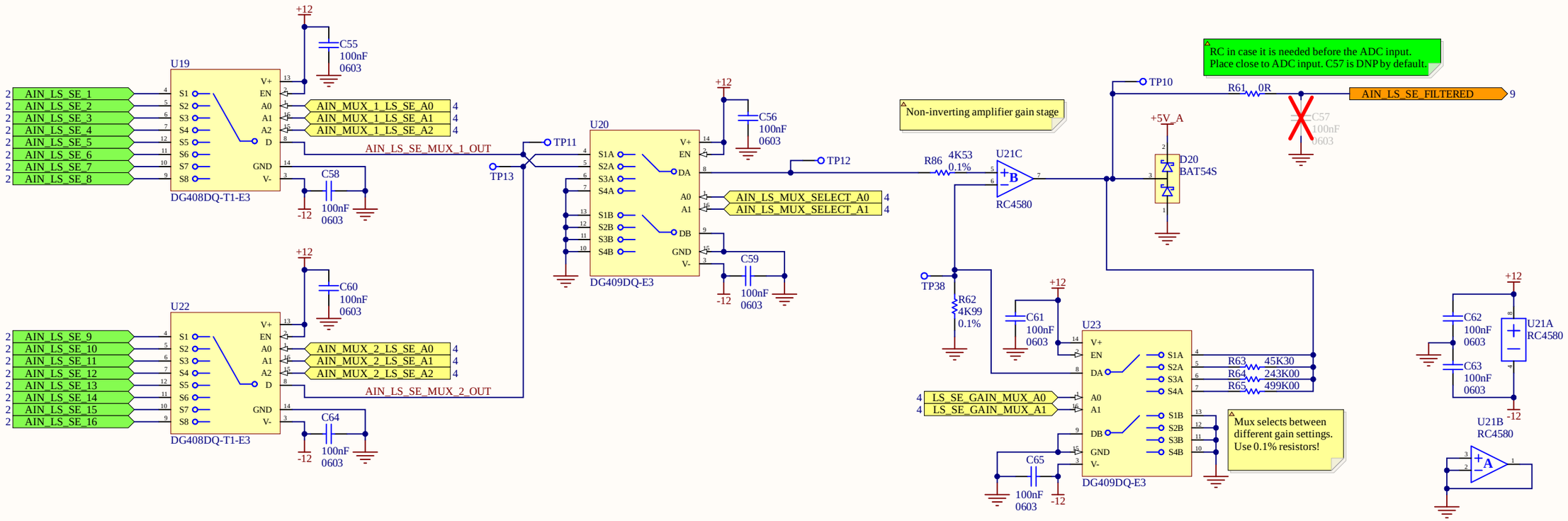
Non-Inverting Amplifier Gain Tolerances

		Tolerance	Min	Nom	Max	Units
G = 1 V/V	Non-inverting amplifier Rf	0.10%	0	0	0	Ohm
	Non-inverting amplifier Rg	0.10%	4.985E+3	4.990E+3	4.995E+3	Ohm
	Analog mux on-state resistance	-	40	100	125	Ohm
	Gain = 1 + Rf/Rg	-	1.008	1.020	1.025	V/V
G = 10 V/V	Non-inverting amplifier Rf	0.10%	45.255E+3	45.300E+3	45.345E+3	Ohm
	Non-inverting amplifier Rg	0.10%	4.985E+3	4.990E+3	4.995E+3	Ohm
	Analog mux on-state resistance	-	40	100	125	Ohm
	Gain = 1 + Rf/Rg	-	10.068	10.098	10.121	V/V
G = 50 V/V	Non-inverting amplifier Rf	0.10%	242.757E+3	243.000E+3	243.243E+3	Ohm
	Non-inverting amplifier Rg	0.10%	4.985E+3	4.990E+3	4.995E+3	Ohm
	Analog mux on-state resistance	-	40	100	125	Ohm
	Gain = 1 + Rf/Rg	-	49.705	49.717	49.820	V/V
G = 100 V/V	Non-inverting amplifier Rf	0.10%	498.501E+3	499.000E+3	499.499E+3	Ohm
	Non-inverting amplifier Rg	0.10%	4.985E+3	4.990E+3	4.995E+3	Ohm
	Analog mux on-state resistance	-	40	100	125	Ohm
	Gain = 1 + Rf/Rg	-	100.808	101.020	101.225	V/V

Title	*Analog - High Speed Differential*		
Size: B	Revision: *	Drawn By: Jasper Yun	
Date: 2022-11-07	Time: 8:42:26 PM	Sheet 7 of 11	
File: C:\Users\jaspe\Desktop\ecse478_honours_thesis\1 Hardware\MCP33151 Eval Board\Analog - High Speed DE.SchDoc			

Avionics
McGill Rocket Team
McGill University
Montreal, Quebec

Analog - Low Speed Single-Ended

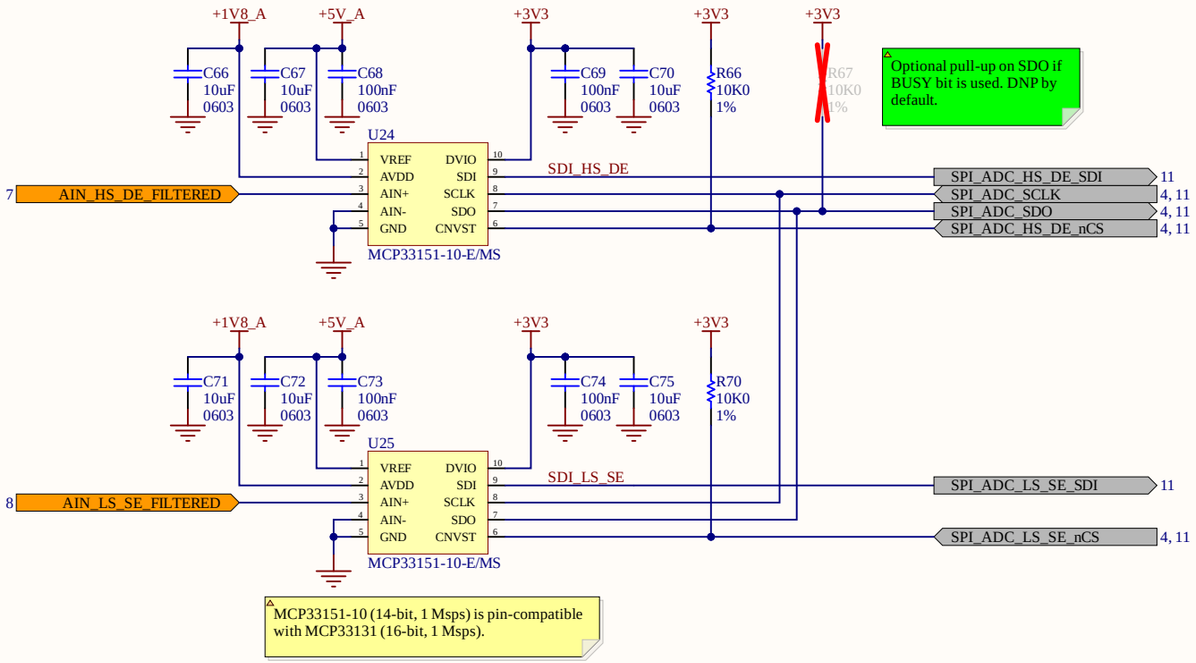


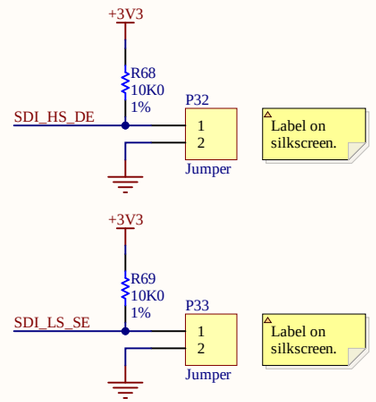
Non-Inverting Amplifier Gain Tolerances

		Tolerance	Min	Nom	Max	Units
G = 1 V/V	Non-inverting amplifier Rf	0.10%	0	0	0	Ohm
	Non-inverting amplifier Rg	0.10%	4.985E+3	4.990E+3	4.995E+3	Ohm
	Analog mux on-state resistance	-	40	100	125	Ohm
	Gain = 1 + Rf/Rg	-	1.008	1.020	1.025	V/V
G = 10 V/V	Non-inverting amplifier Rf	0.10%	45.255E+3	45.300E+3	45.345E+3	Ohm
	Non-inverting amplifier Rg	0.10%	4.985E+3	4.990E+3	4.995E+3	Ohm
	Analog mux on-state resistance	-	40	100	125	Ohm
	Gain = 1 + Rf/Rg	-	10.068	10.098	10.121	V/V
G = 50 V/V	Non-inverting amplifier Rf	0.10%	242.757E+3	243.000E+3	243.243E+3	Ohm
	Non-inverting amplifier Rg	0.10%	4.985E+3	4.990E+3	4.995E+3	Ohm
	Analog mux on-state resistance	-	40	100	125	Ohm
	Gain = 1 + Rf/Rg	-	49.705	49.717	49.820	V/V
G = 100 V/V	Non-inverting amplifier Rf	0.10%	498.501E+3	499.000E+3	499.499E+3	Ohm
	Non-inverting amplifier Rg	0.10%	4.985E+3	4.990E+3	4.995E+3	Ohm
	Analog mux on-state resistance	-	40	100	125	Ohm
	Gain = 1 + Rf/Rg	-	100.808	101.020	101.225	V/V

Title	***Analog - Low Speed Single-Ended***		*Avionics* *McGill Rocket Team* *McGill University* *Montreal, Quebec*
Size: B	Revision: *	Drawn By: Jasper Yun	
Date: 2022-11-07	Time: 8:42:26 PM	Sheet 8 of 11	
File: C:\Users\jaspe\Desktop\ecse478_honours_thesis\1 Hardware\MCP33151 Eval Board\Analog - Low Speed SE.SchDoc			

Analog to Digital Conversion

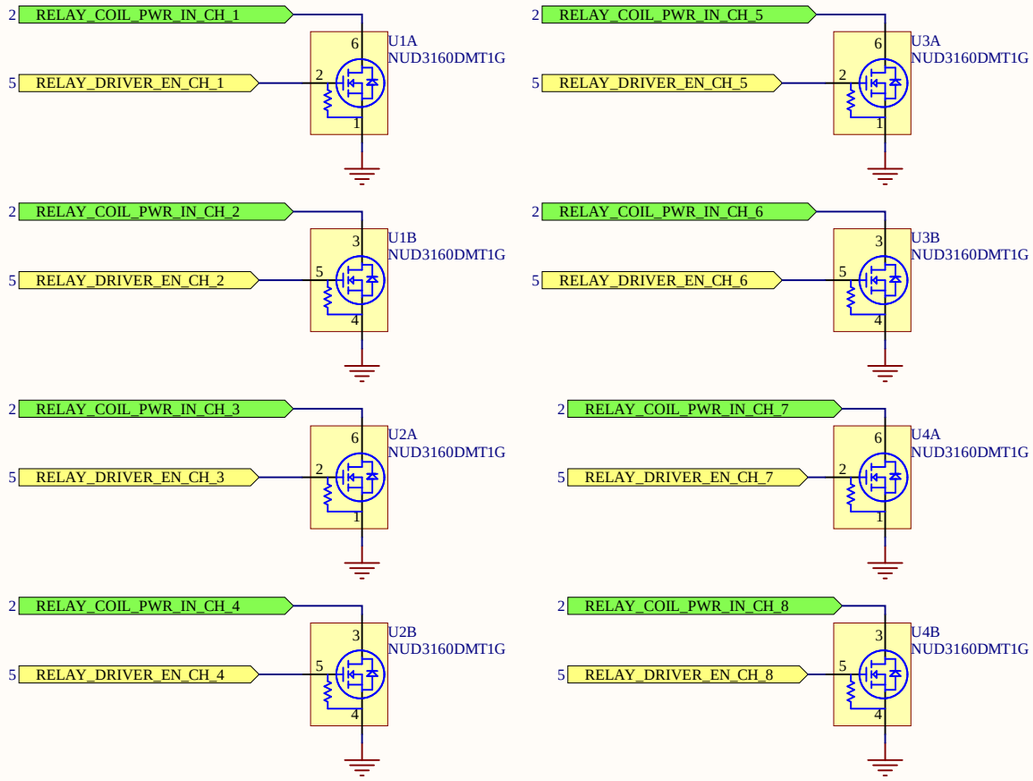




Title: *Analog to Digital Conversion*			*Avionics* *McGill Rocket Team* *McGill University* *Montreal, Quebec*
Size: B	Revision: *	Drawn By: Jasper Yun	
Date: 2022-11-07	Time: 8:42:26 PM	Sheet 9 of 11	
File: C:\Users\jaspe\Desktop\ecse478_honours_thesis\1 Hardware\MCP33151 Eval Board\ADC.SchDoc			

Relay Drivers

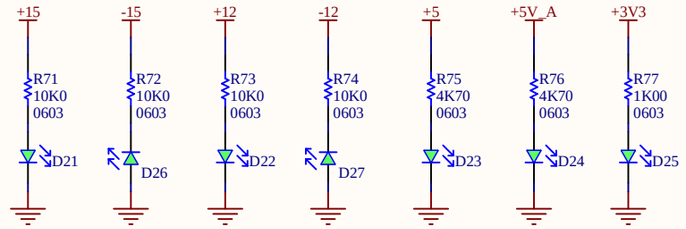
> Relay drivers are low-side nFETs which are rated to 60V drain-source. Relay coil outputs are connected to RELAY_COIL_PWR_IN_CH_XY.



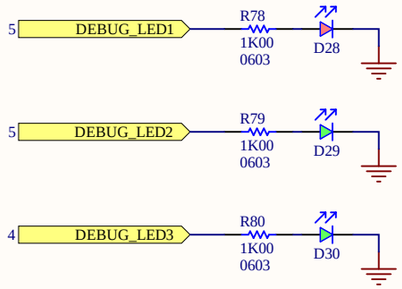
Title: ***Relay Drivers***			*Avionics* *McGill Rocket Team* *McGill University* *Montreal, Quebec*
Size: B	Revision: *	Drawn By: Jasper Yun	
Date: 2022-11-07	Time: 8:42:26 PM	Sheet 10 of 11	
File: C:\Users\jaspe\Desktop\ecse478_honours_thesis\1 Hardware\MCP33151 Eval Board\Relay Drivers.SchDoc			

Debug

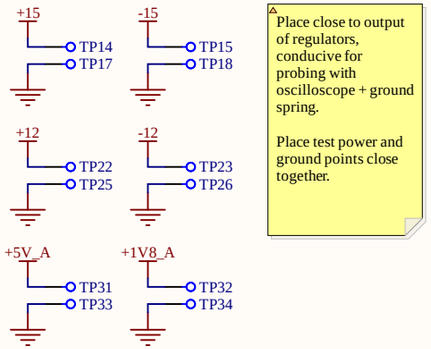
Power LEDs



Program Debug LEDs



Power Rails Test Points

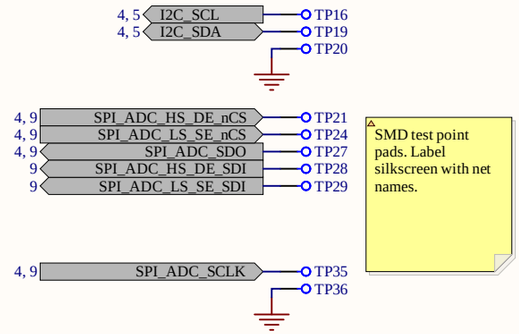


Place close to output of regulators, conducive for probing with oscilloscope + ground spring.

Place test power and ground points close together.

Analog Test Points

See analog sheets.



SMD test point pads. Label silkscreen with net names.

Title: ***Debug***			*Avionics* *McGill Rocket Team* *McGill University* *Montreal, Quebec*
Size: B	Revision: *	Drawn By: Jasper Yun	
Date: 2022-11-07	Time: 8:42:26 PM	Sheet 11 of 11	
File: C:\Users\jaspe\Desktop\ecse478_honours_thesis\1 Hardware\MCP33151 Eval Board\Debug.SchDoc			