

MCP33151-10 Eval Board

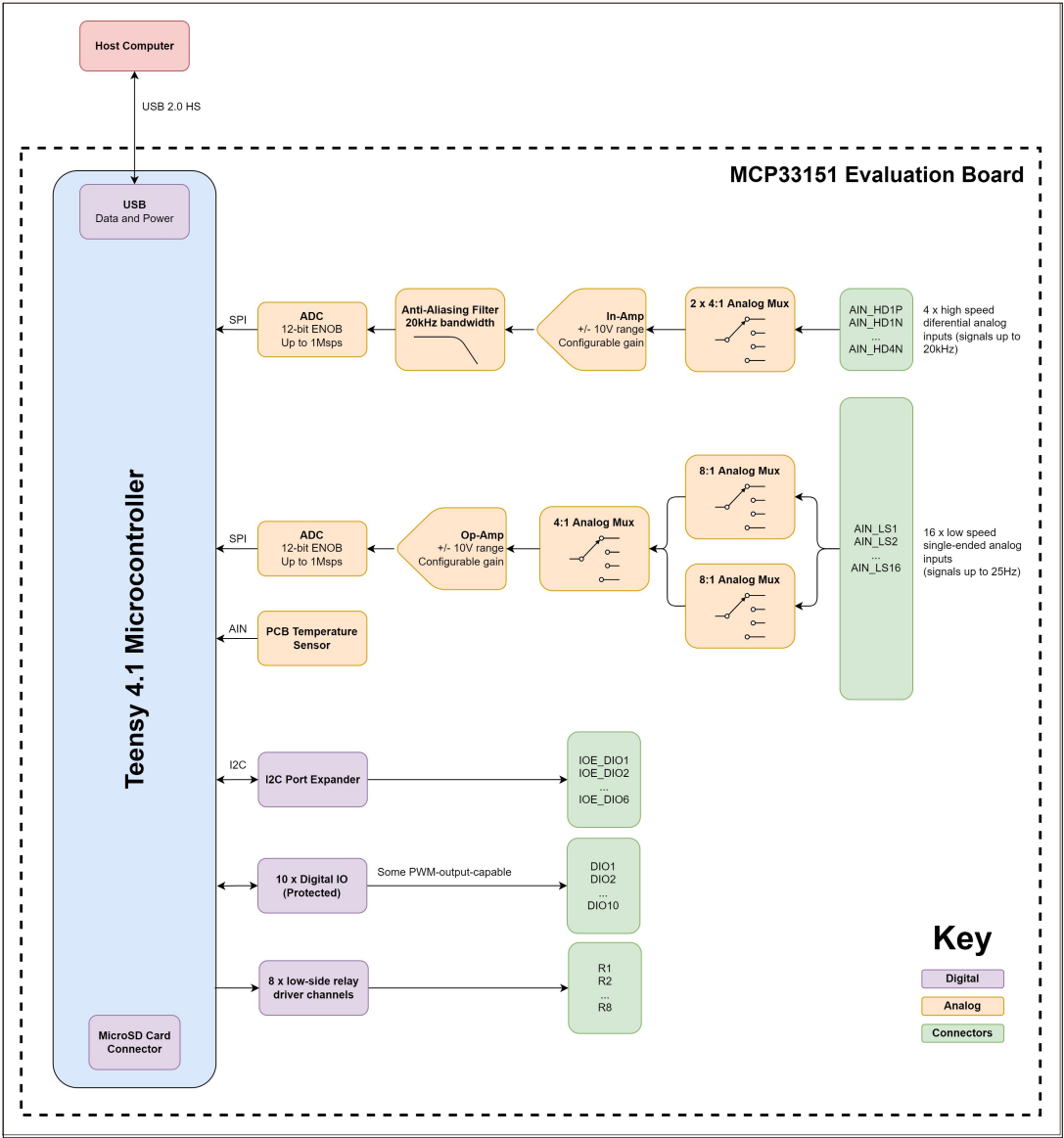
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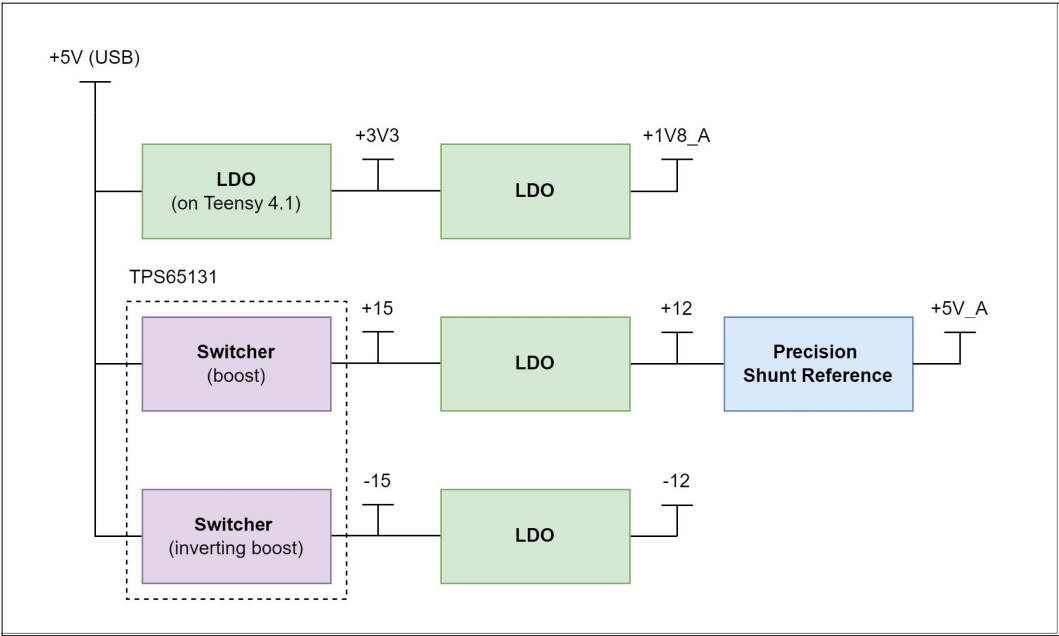
Port Colors

Connector
Digital
Analog
Communication

Main Block Diagram



Power Architecture

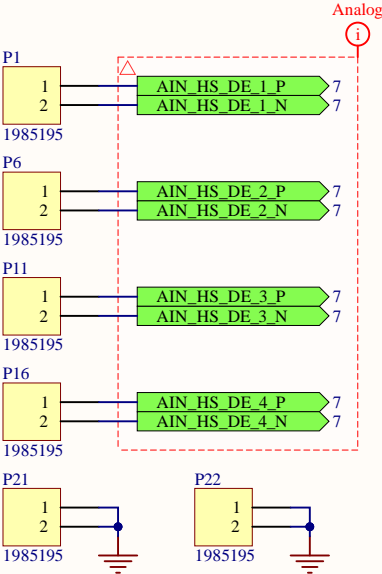


Connectors

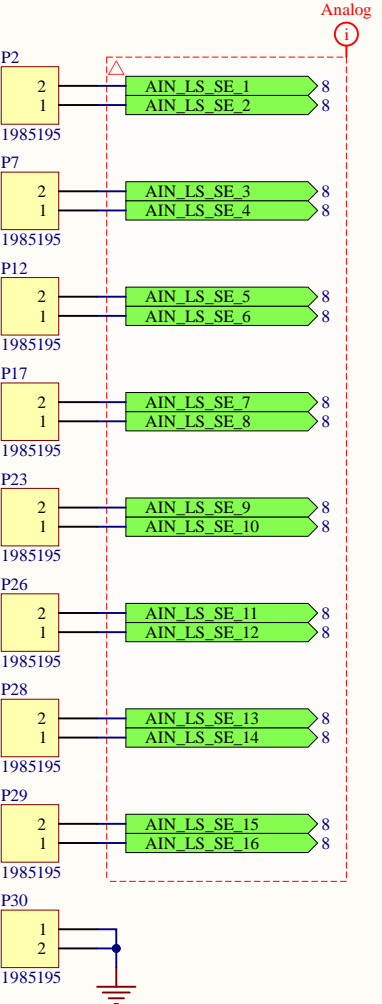
DE = differential-ended
SE = single-ended

All terminal blocks for ease of prototyping.

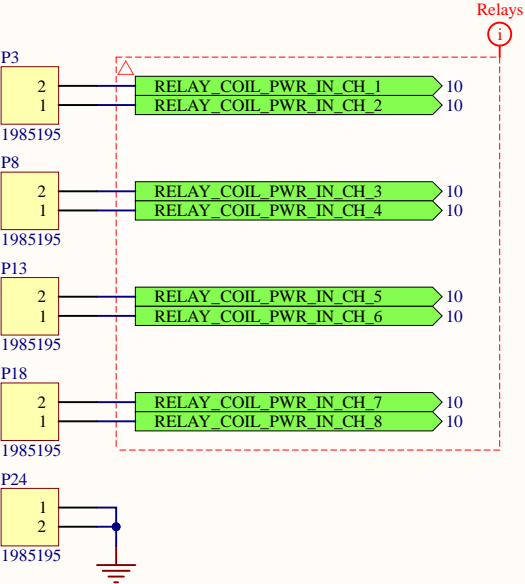
High Speed DE Analog



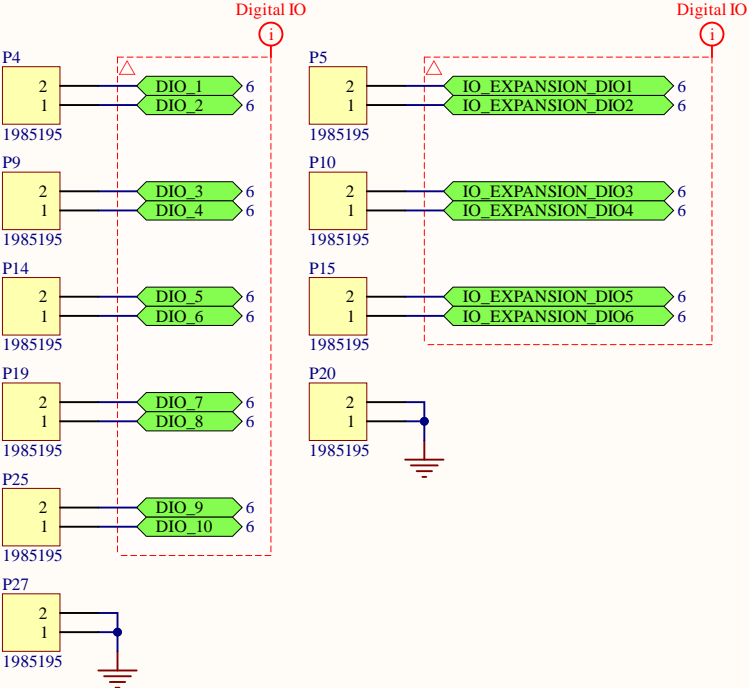
Low Speed SE Analog



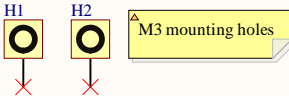
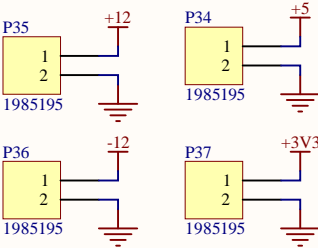
Relay Coils (Low Side)



Digital IO Pins



Power



Power

⚠ R84 is a jumper to bypass Q1. DNP by default.
C6 in place in case we need more capacitance. DNP by default.

⚠ $V_{ref} = 1.213V$
 $R22 = R23 * (V_{pos} / V_{ref} - 1)$
 $R26 = -R24 * (V_{neg} / V_{ref})$

⚠ C4 in place if we need more capacitance. DNP by default.

⚠ R82 + C78 form low-pass filter, cutoff around 225Hz. R82 may be depopulated to use external +15V supply.

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

⚠ Nothing to be done.

+3V3 (from Teensy :))

⚠ Nothing to be done.

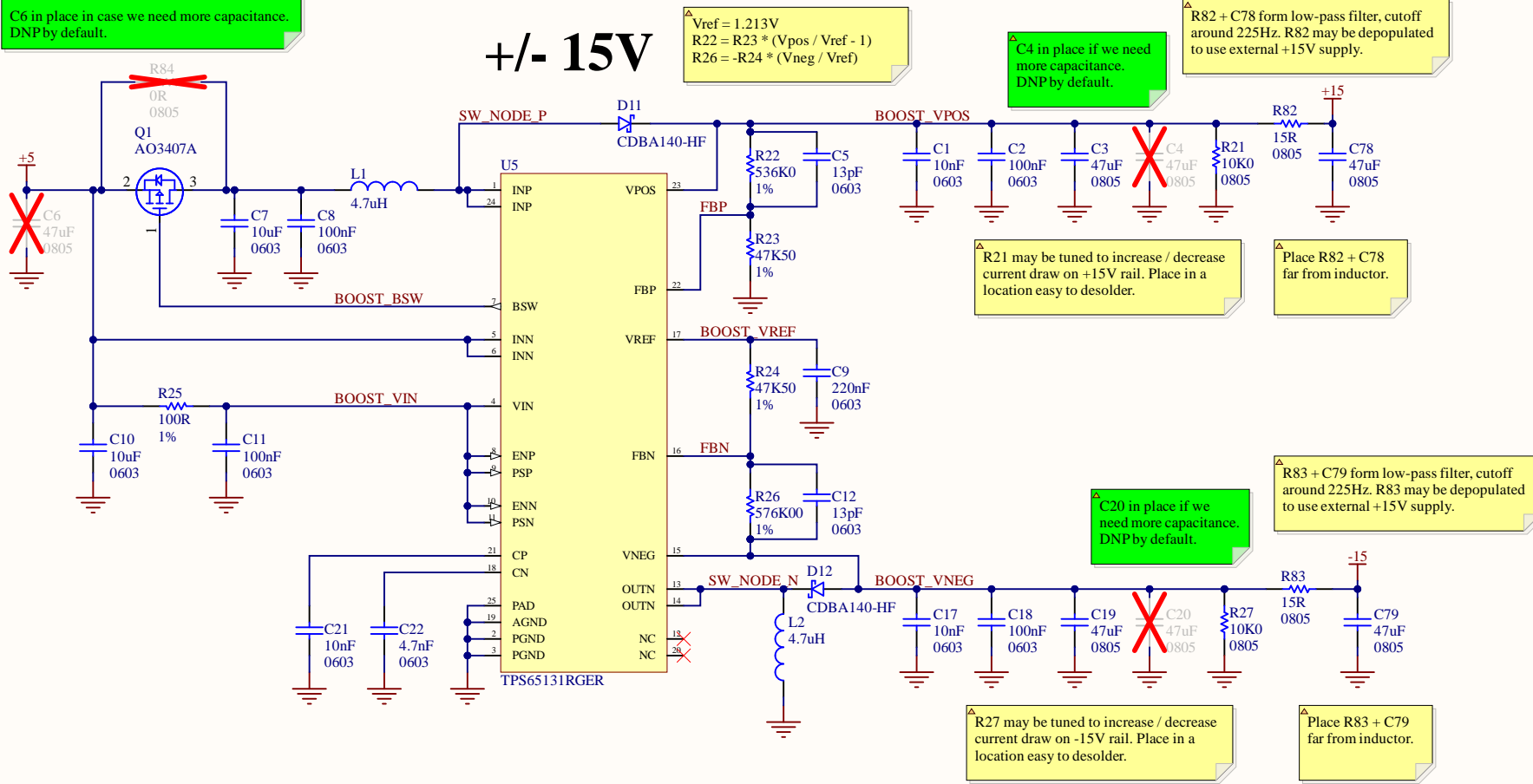
+1V8_A (ADC)

⚠ Place +1V8_A regulator close to ADCs.

+5V_A (Analog Reference)

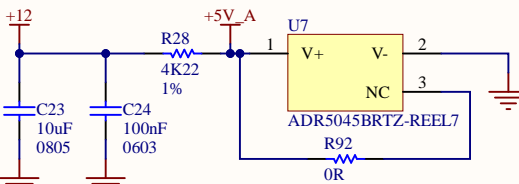
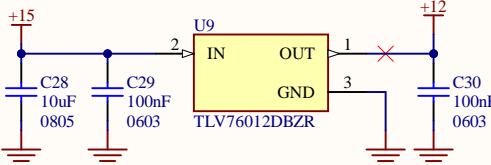
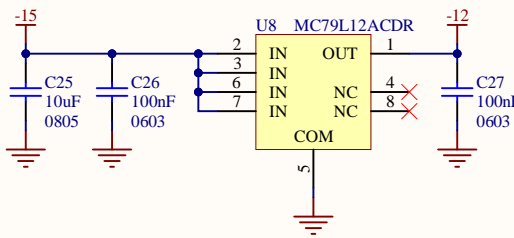
⚠ Voltage reference IC. Keep away from noisy sources and place close to ADCs.

⚠ 4K22 resistor biases the shunt to approximately 1mA. R92 is a jumper to connect pin 3 to pin 1. Option to remove if using other pin-compatible shunt references.



-12V

+12V

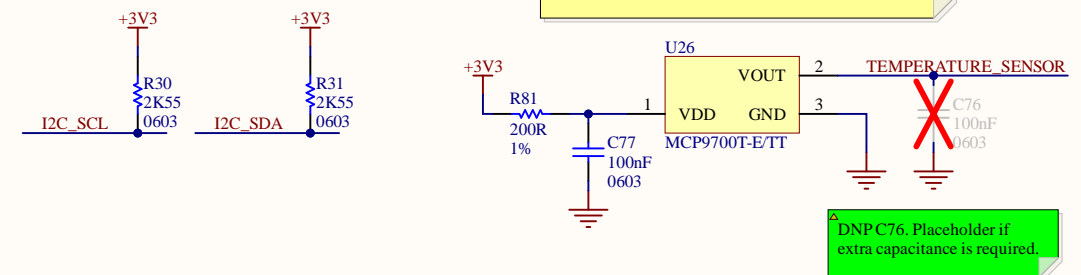
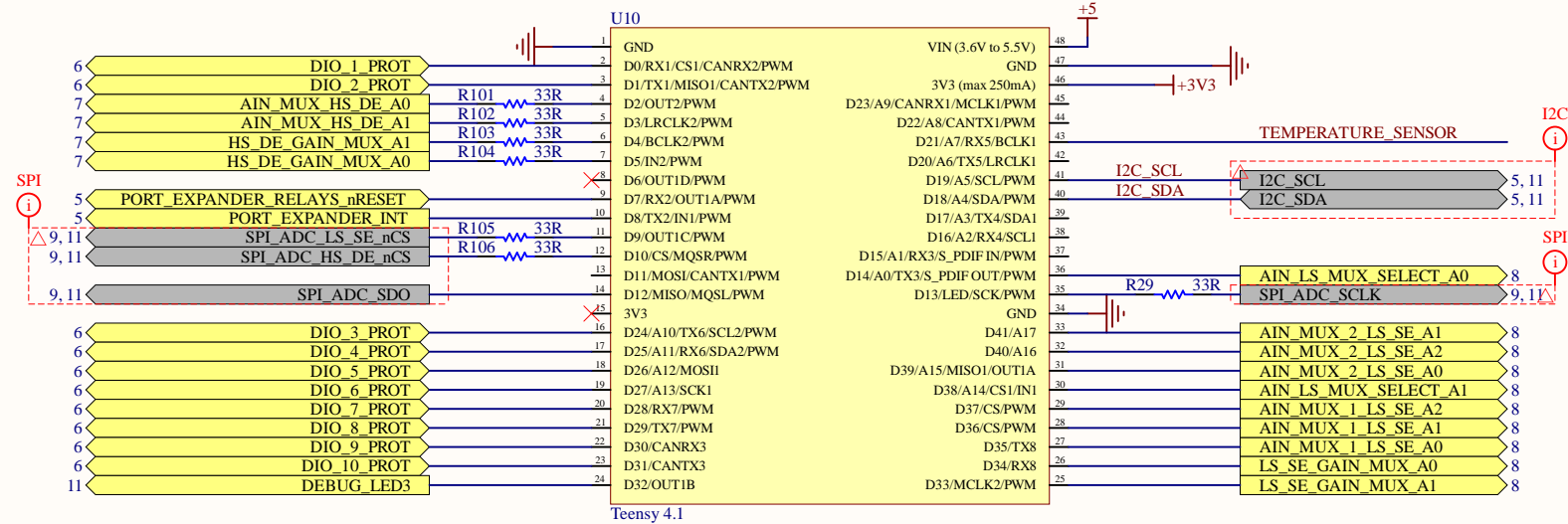



Microcontroller

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

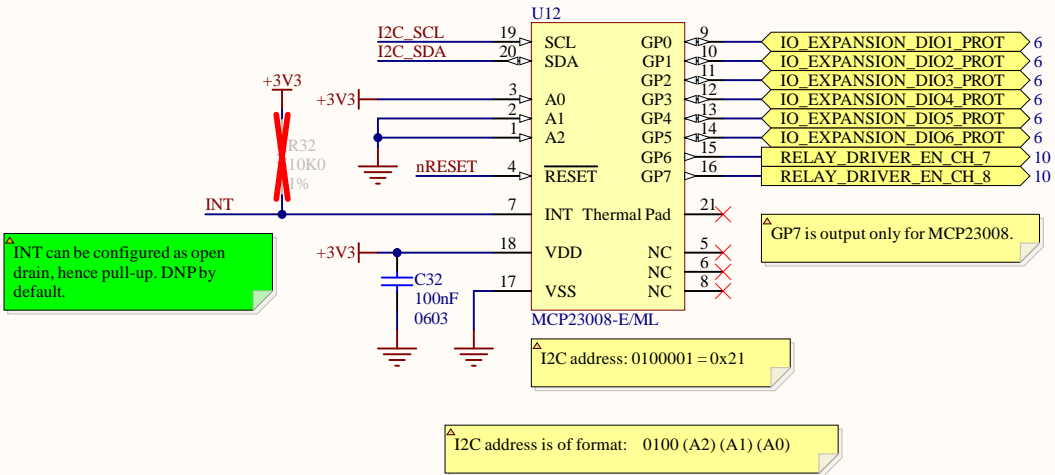
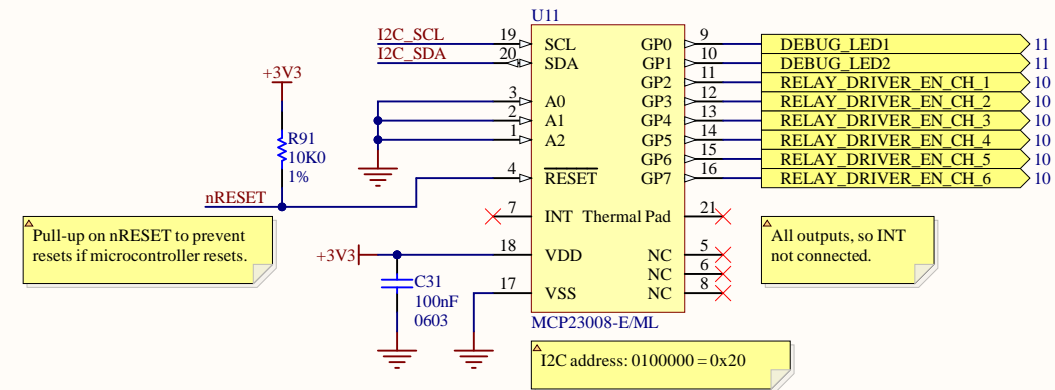
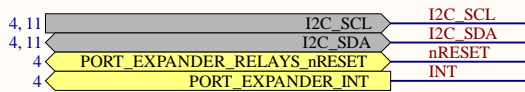
Use Teensy 4.1 Ethernet kit to add Ethernet capability to the board.

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

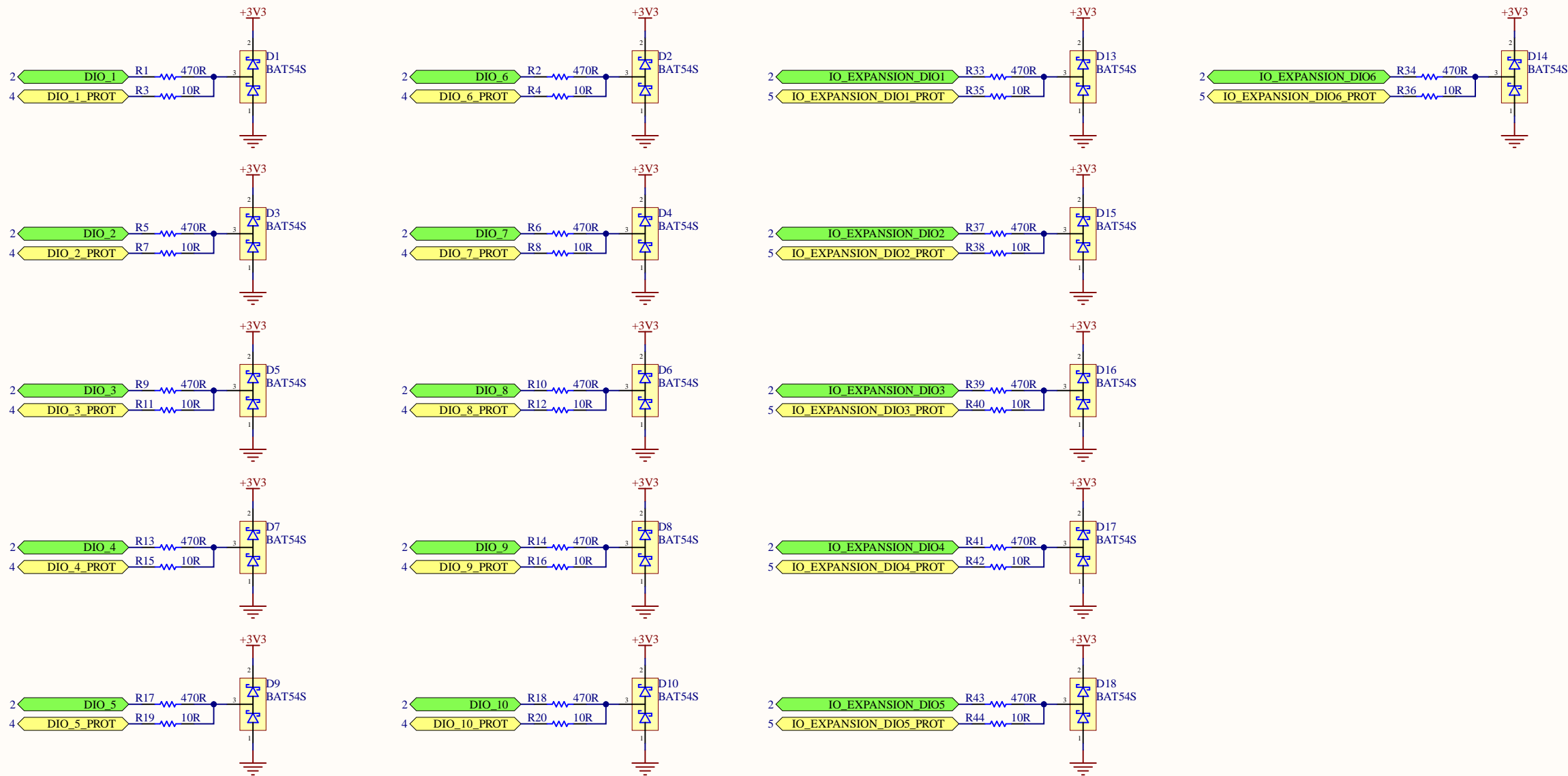



Title			<i>Avionics</i> <i>McGill Rocket Team</i> <i>McGill University</i> <i>Montreal, Quebec</i>	
<i>Microcontroller</i>				
Size: B	Revision: *	Drawn By: Jasper Yun		
Date: 2022-11-10	Time: 11:02:29 PM	Sheet 4 of 11		
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IO Expansion

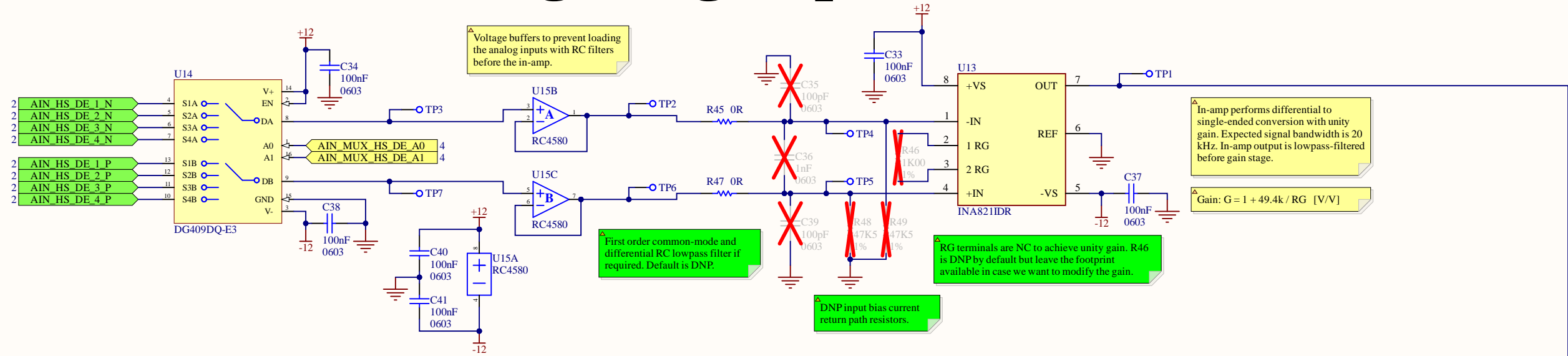


Digital IO Protection

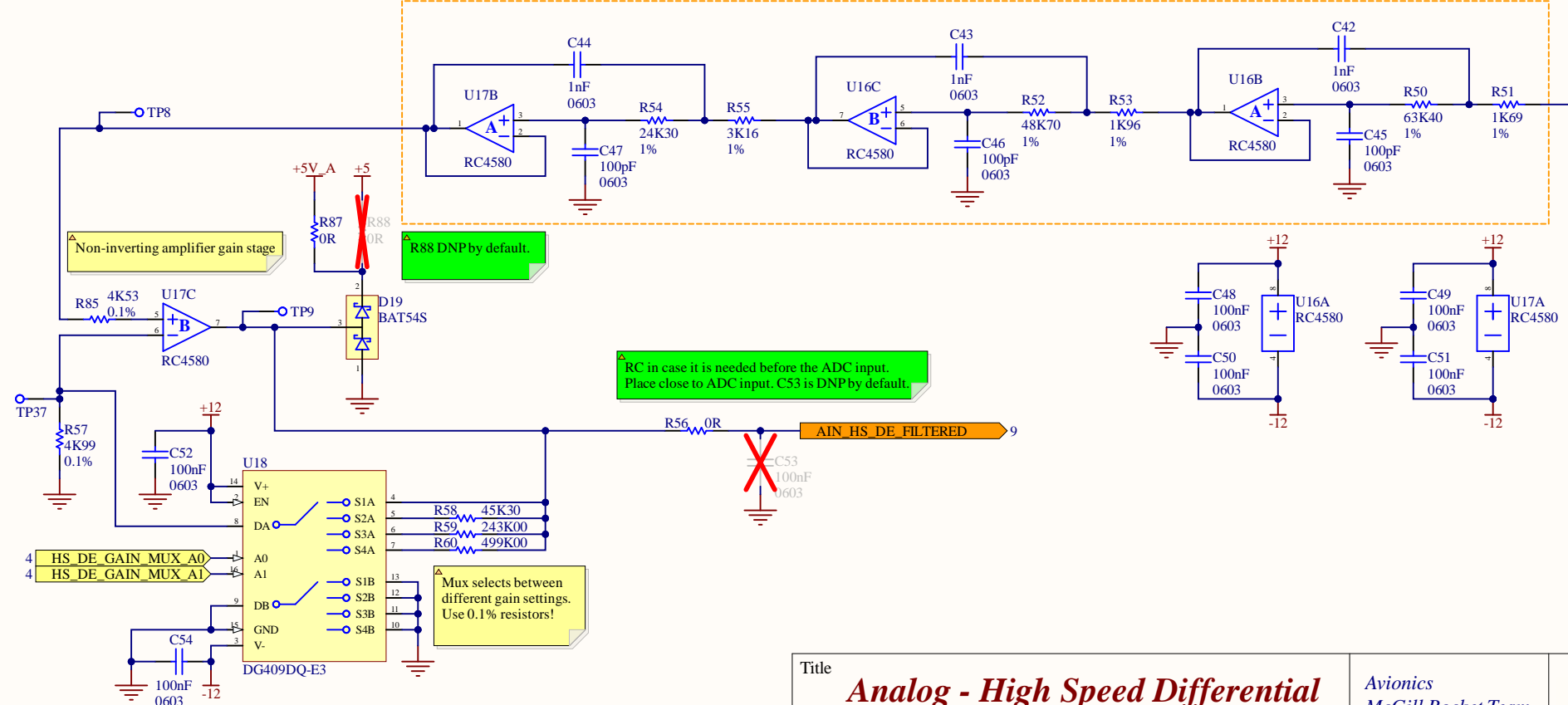


Title			<i>Digital IO Protection</i>	Avionics McGill Rocket Team McGill University Montreal, Quebec	
Size: B	Revision: *	Drawn By: Jasper Yun			
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Analog - High Speed Differential



6th order Bessel Low Pass Filter (-3dB at 28kHz)



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: 2022-11-10

Time: 11:02:30 PM

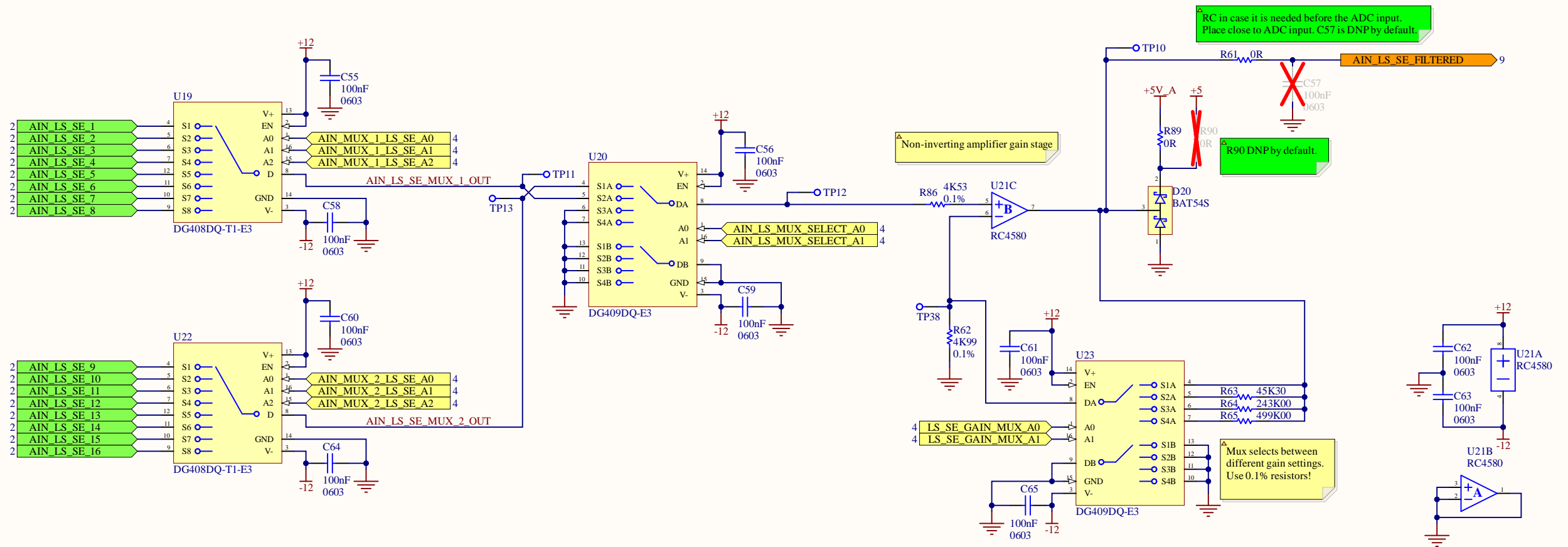
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Avionics
McGill Rocket Team
McGill University
Montreal, Quebec




Analog - Low Speed Single-Ended

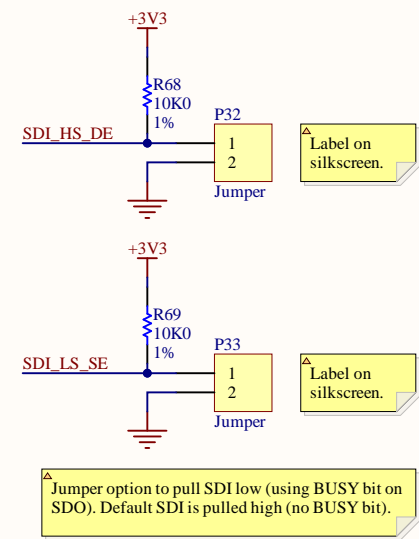
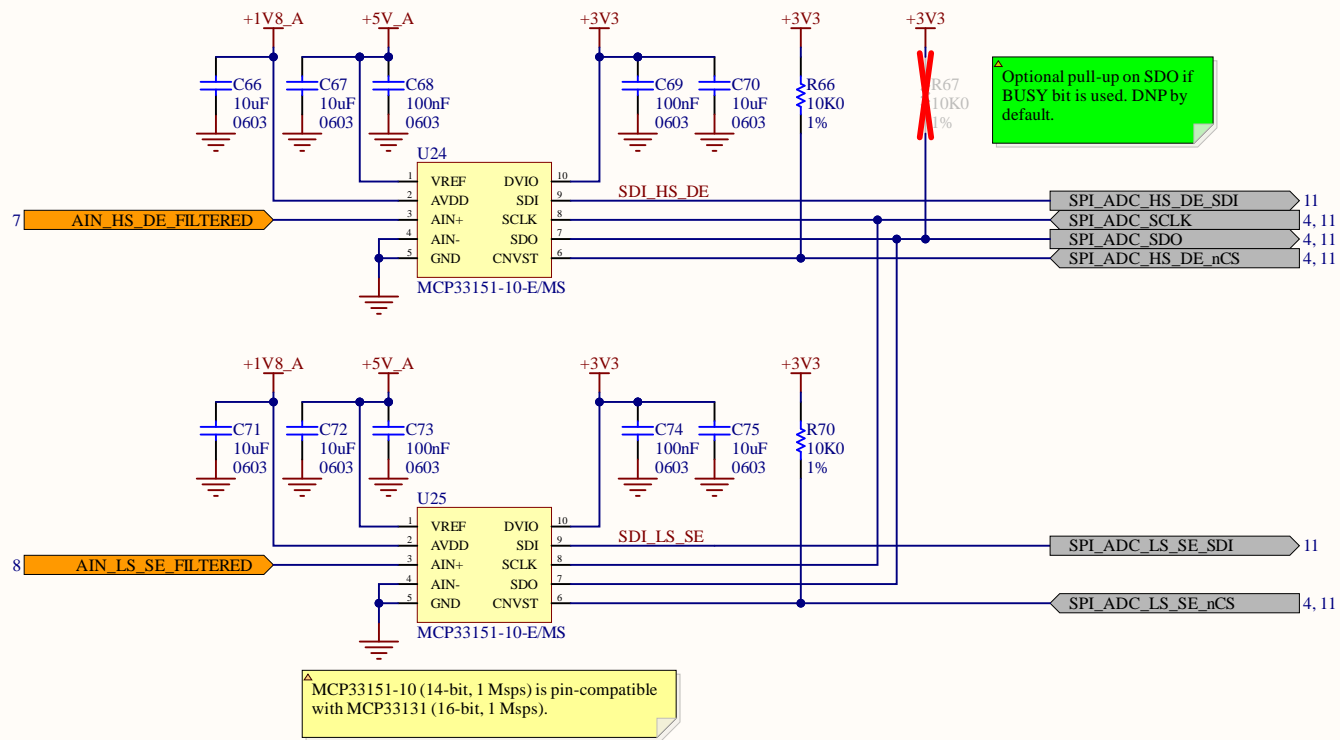


Non-Inverting Amplifier Gain Tolerances

		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

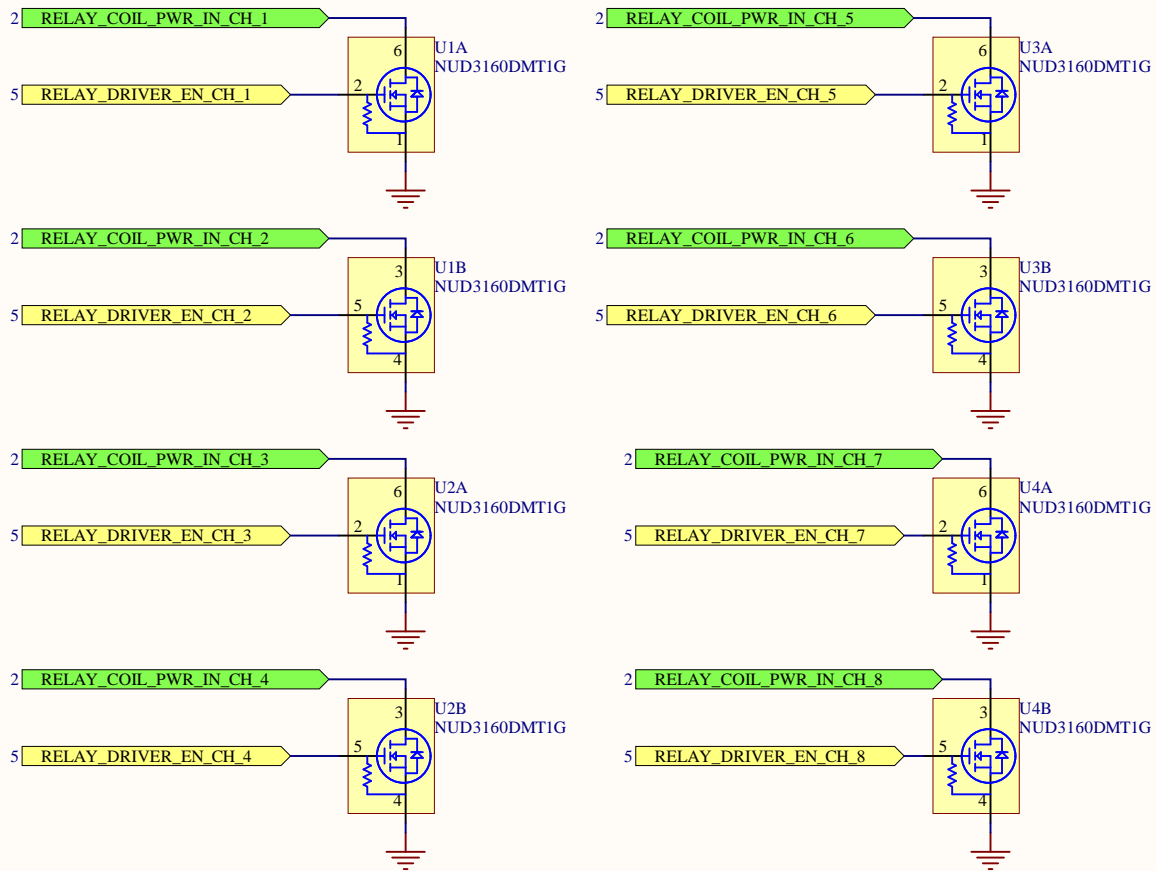
Title			Avionics McGill Rocket Team McGill University Montreal, Quebec		
<i>Analog - Low Speed Single-Ended</i>					
Size: B	Revision: *	Drawn By: Jasper Yun			
Date: 2022-11-10	Time: 11:02:30 PM	Sheet 8 of 11			
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Analog to Digital Conversion



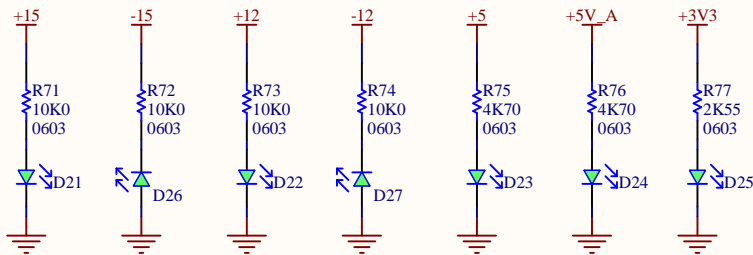
Relay Drivers

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.

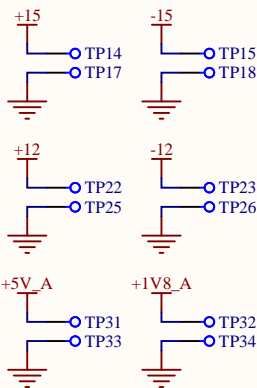


Debug

Power LEDs

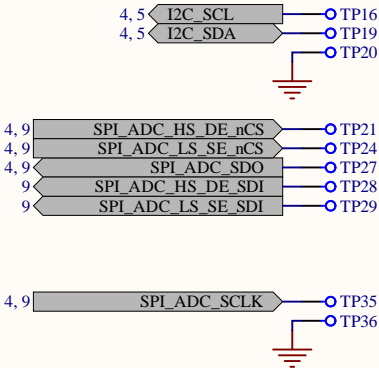


Power Rails Test Points



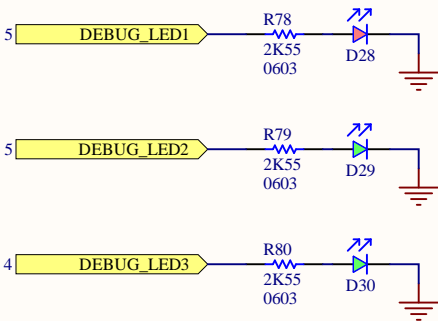
Place close to output of regulators, conducive for probing with oscilloscope + ground spring.

Place test power and ground points close together.



SMD test point pads. Label silkscreen with net names.

Program Debug LEDs



Analog Test Points

See analog sheets.