

MCP33151-10 Eval Board

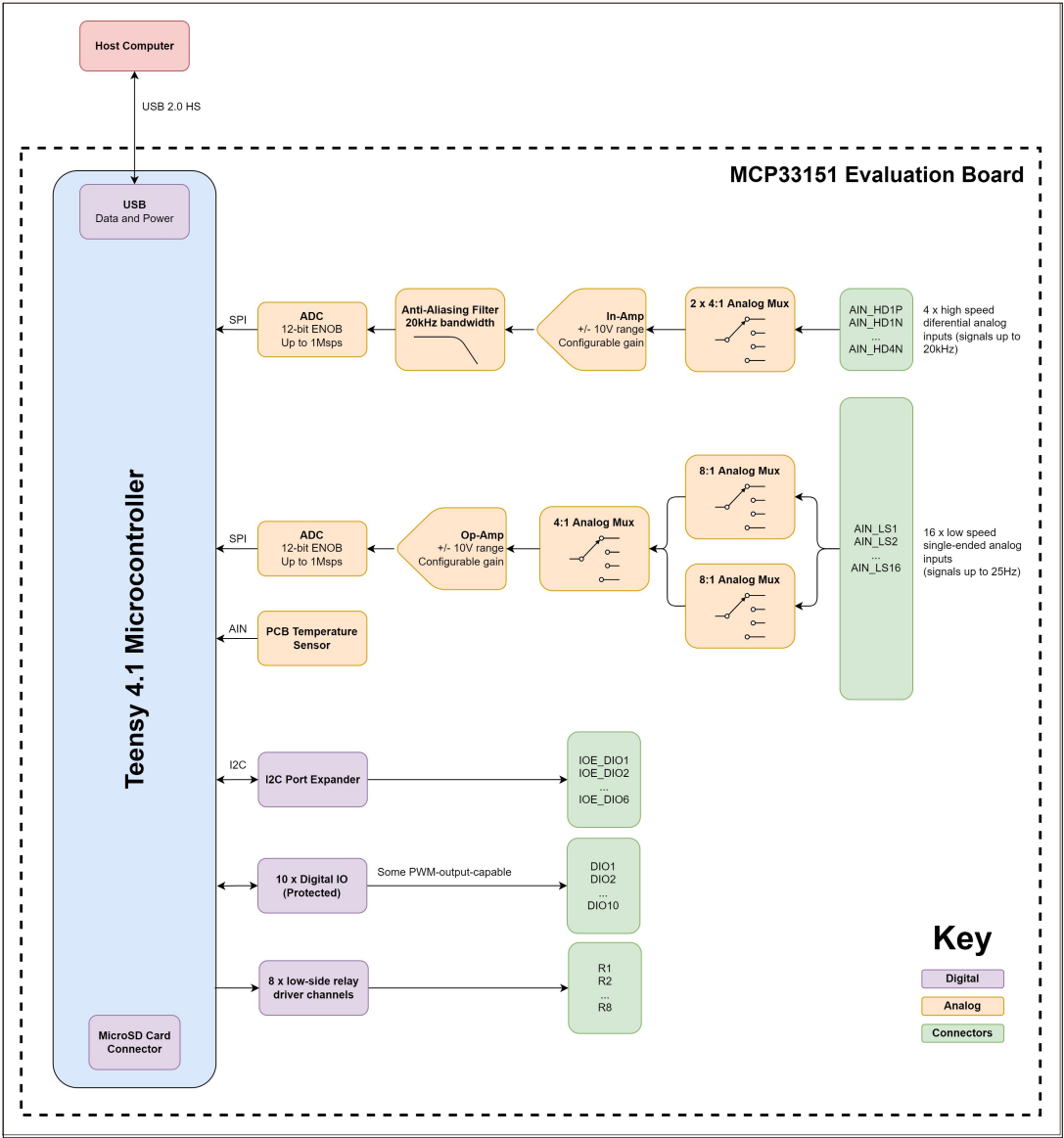
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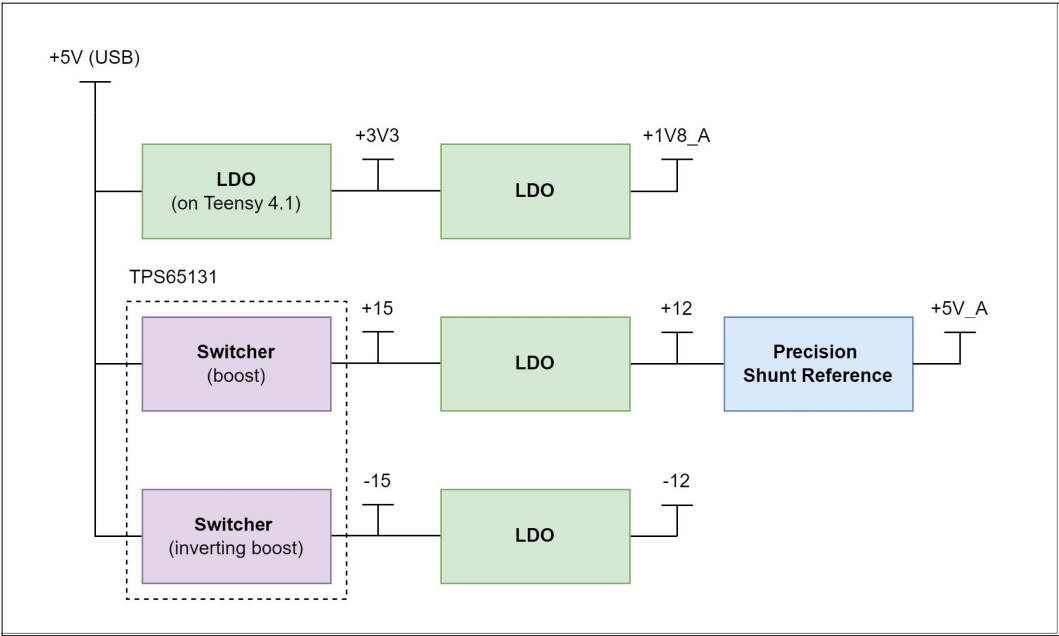
Port Colors

Connector
Digital
Analog
Communication


Main Block Diagram



Power Architecture



Revision: fe513d38ca26ea1f94add3fb0afb592a349a031f [Ahead of server]

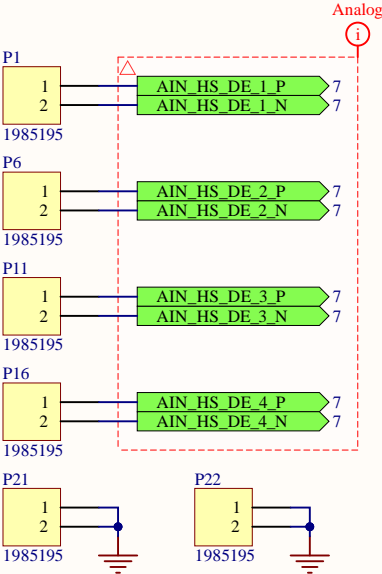
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Size: B	Revision: fe513	Drawn By: Jasper Yun		
Date: 2022-11-23	Time: 12:23:33 PM	Sheet 1 of 11		
File: C:\Users\jaspe\Desktop\ecse478_honours_thesis\1 Hardware\MCP33151 Eval Board\Cover.SchDoc				

Connectors

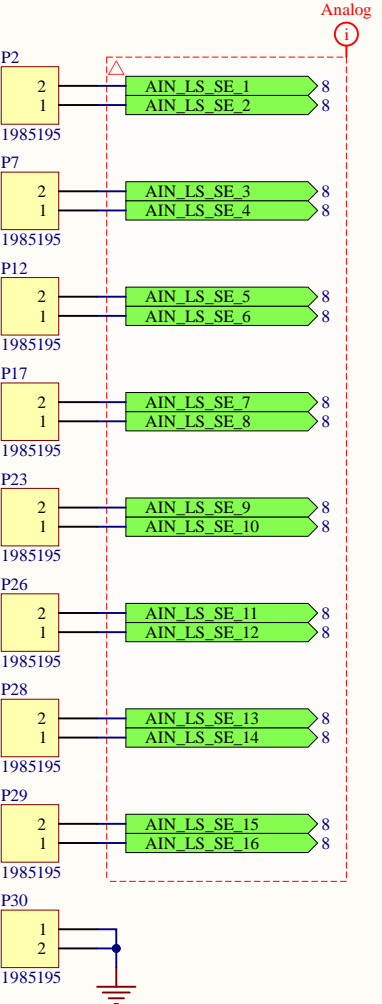
DE = differential-ended
SE = single-ended

All terminal blocks for ease of prototyping.

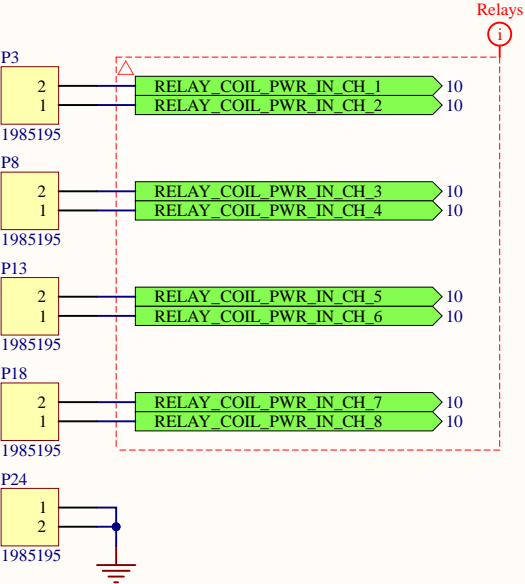
High Speed DE Analog



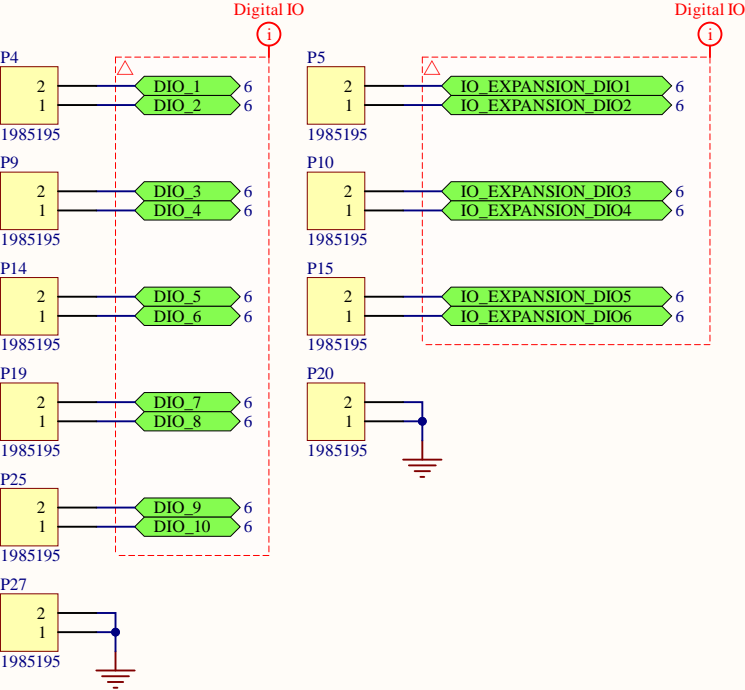
Low Speed SE Analog



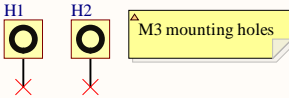
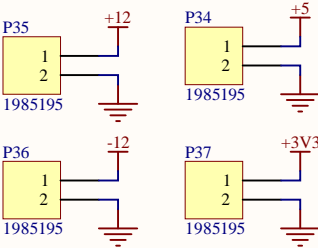
Relay Coils (Low Side)



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.

Vref = 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.

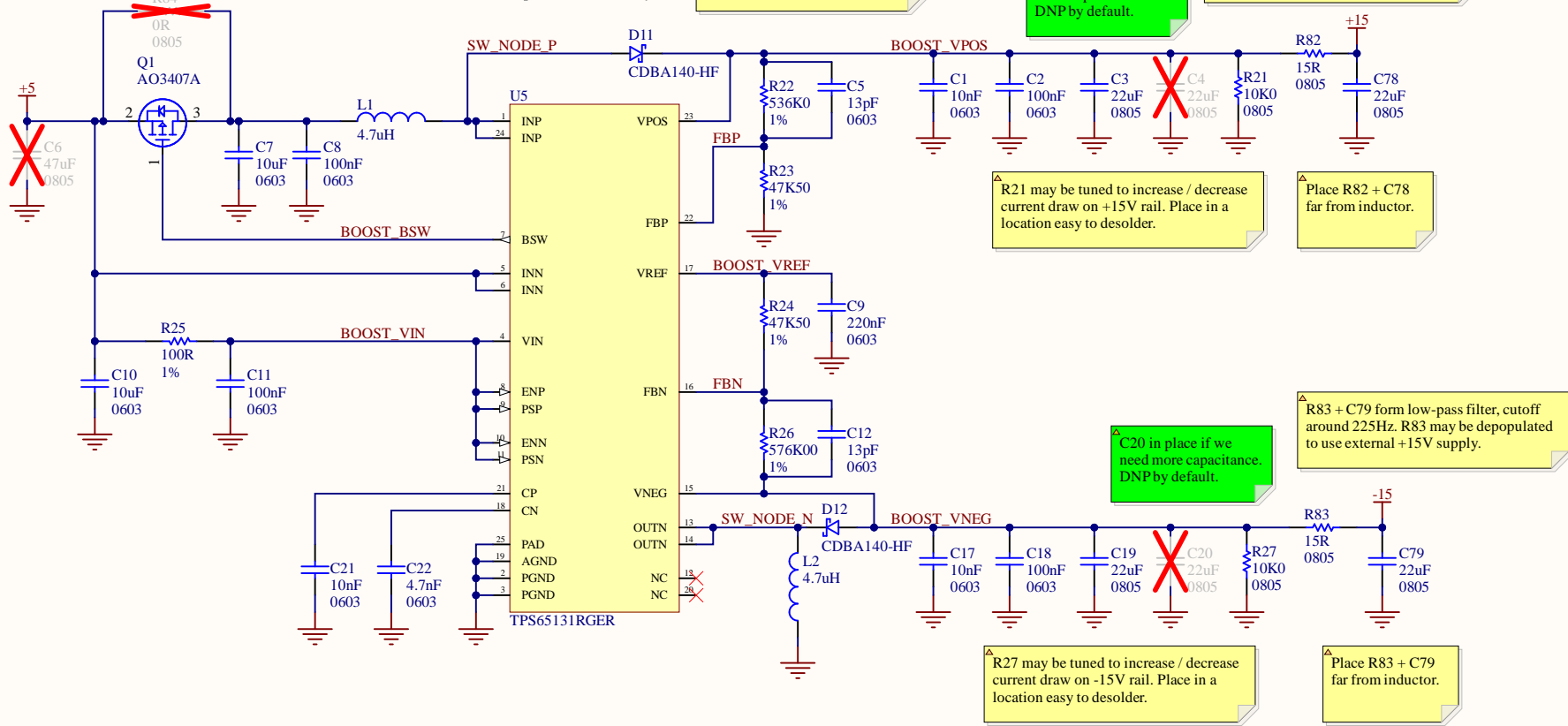
+1V8_A (ADC)

Place +1V8_A regulator close to ADCs.

+5V_A (Analog Reference)

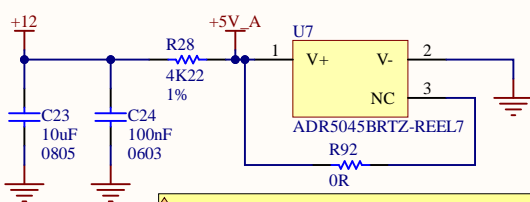
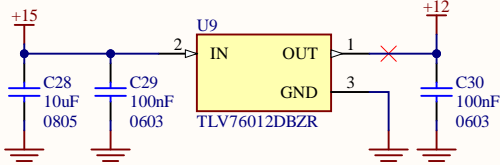
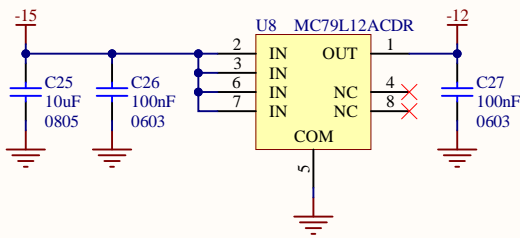
Voltage reference IC. Keep away from noisy sources and place close to ADCs.

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



Revision:

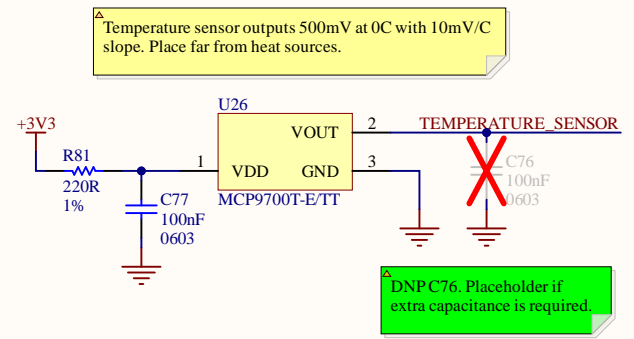
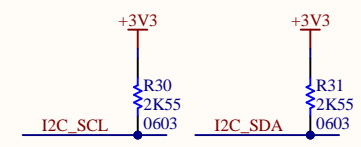
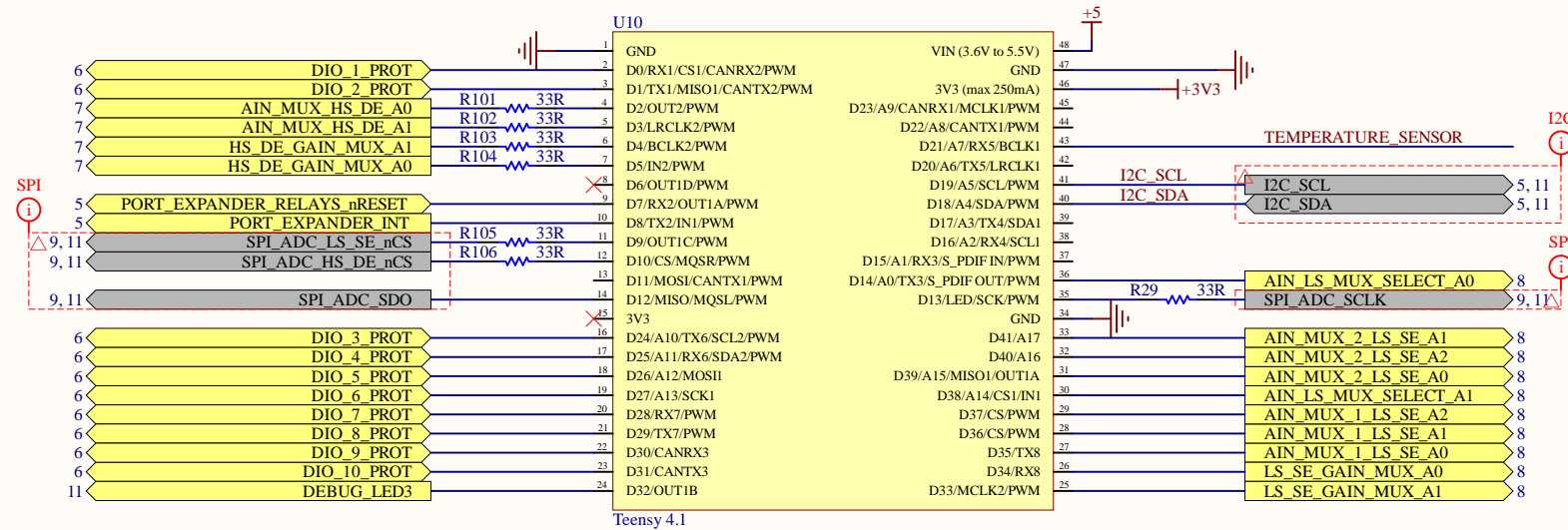
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Size: B	Revision:	Drawn By: Jasper Yun			
Date: 2022-11-23	Time: 12:23:34 PM	Sheet 3 of 11			
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Microcontroller

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.

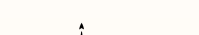
Teensy 4.1 has built-in SD card which interfaces using 4-bit SDIO. No need for SD card on this board.



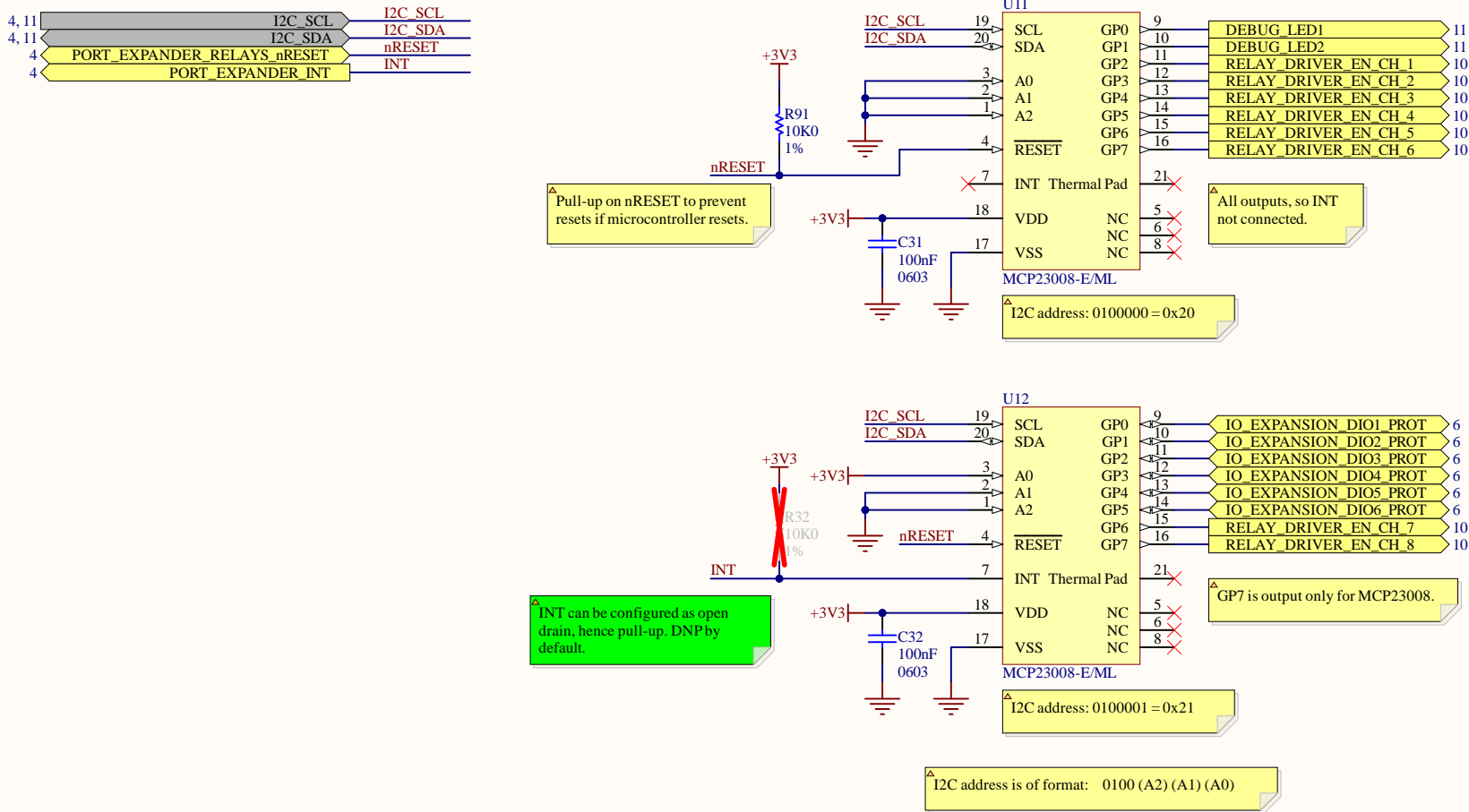
Temperature sensor outputs 500mV at 0C with 10mV/C slope. Place far from heat sources.

DNP C76. Placeholder if extra capacitance is required.


Revision:

Title <i>Microcontroller</i>			Avionics McGill Rocket Team McGill University Montreal, Quebec	
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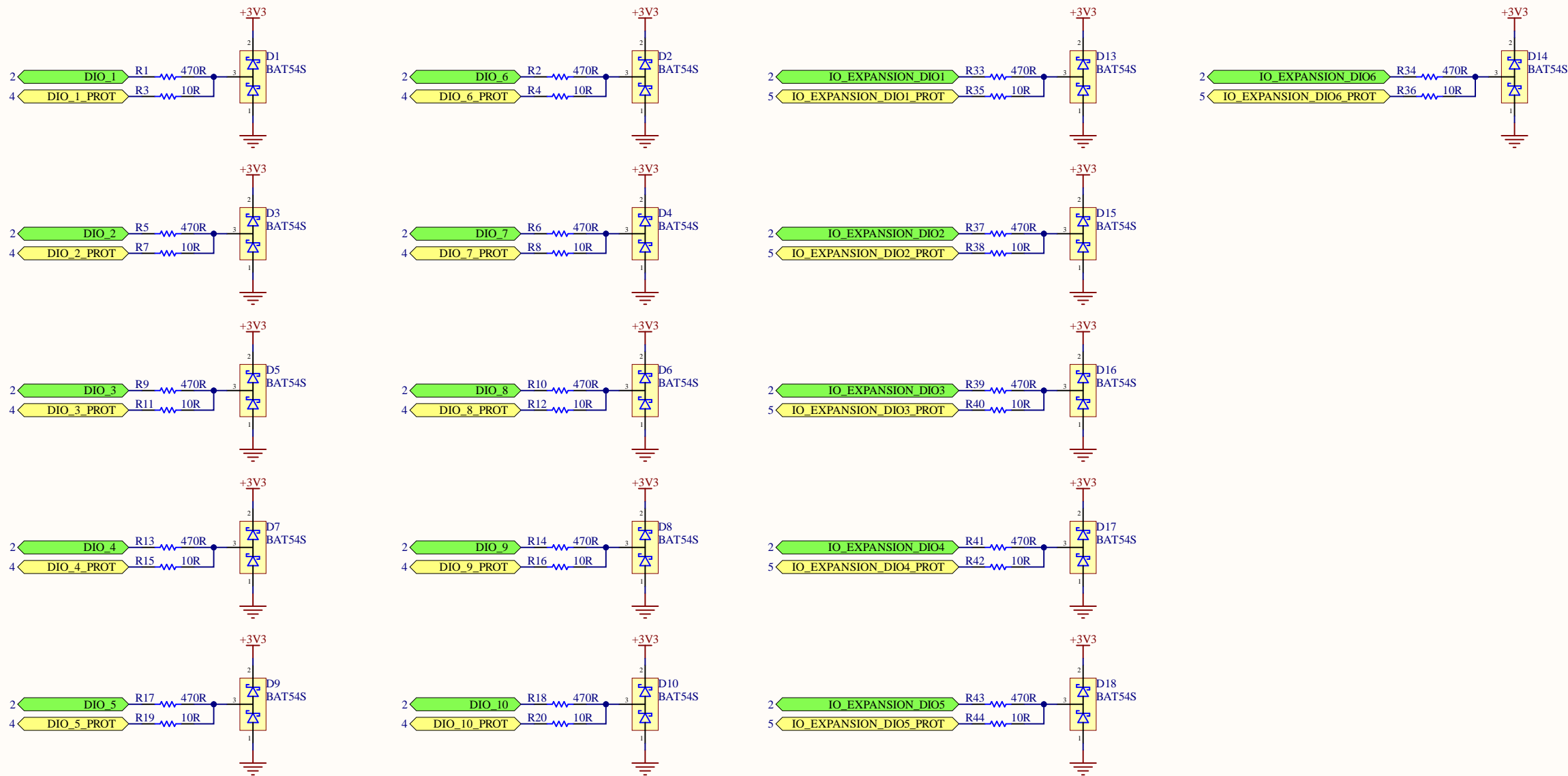
IO Expansion




Revision:

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Size: B	Revision:	Drawn By: Jasper Yun			
Date: 2022-11-23	Time: 12:23:34 PM	Sheet 5 of 11			
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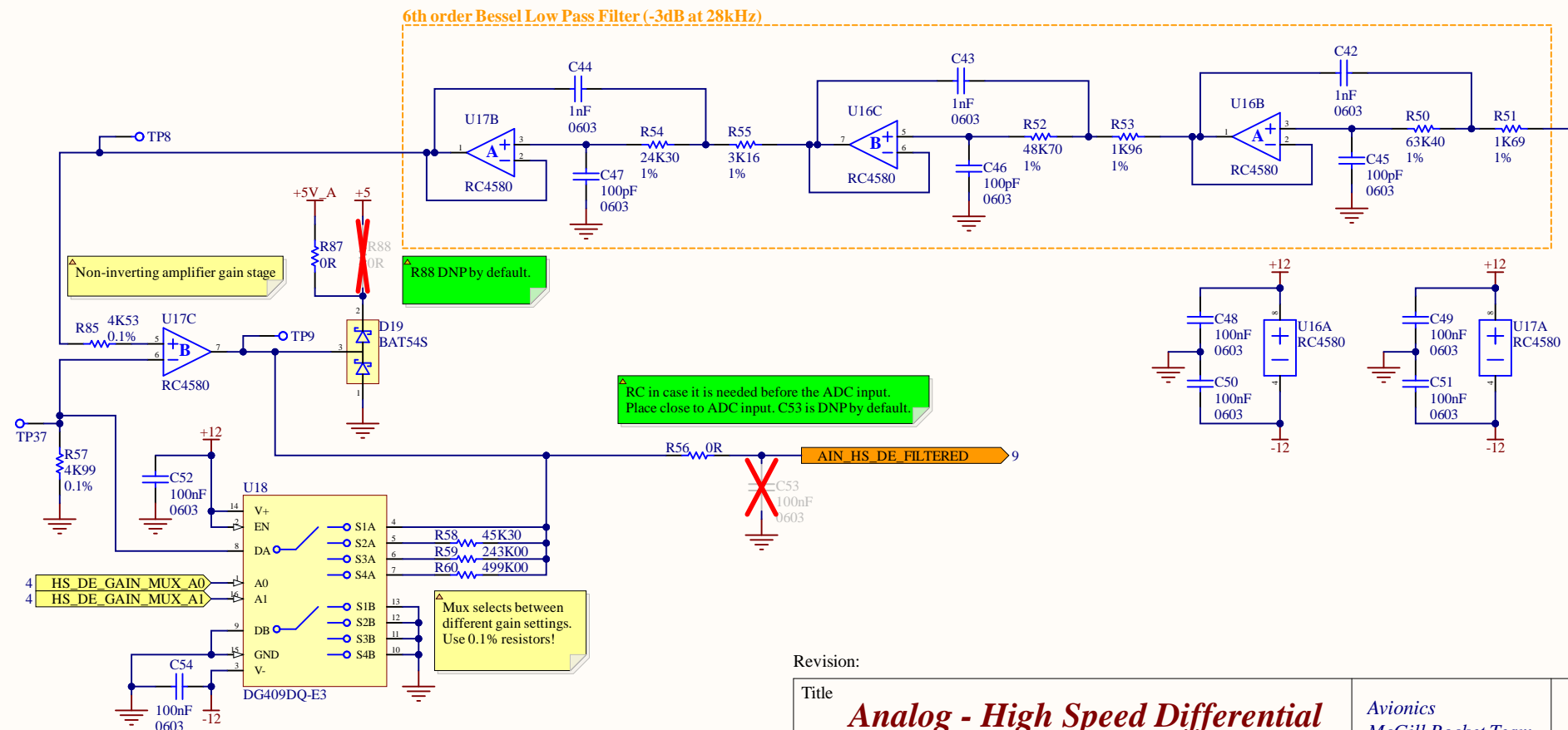
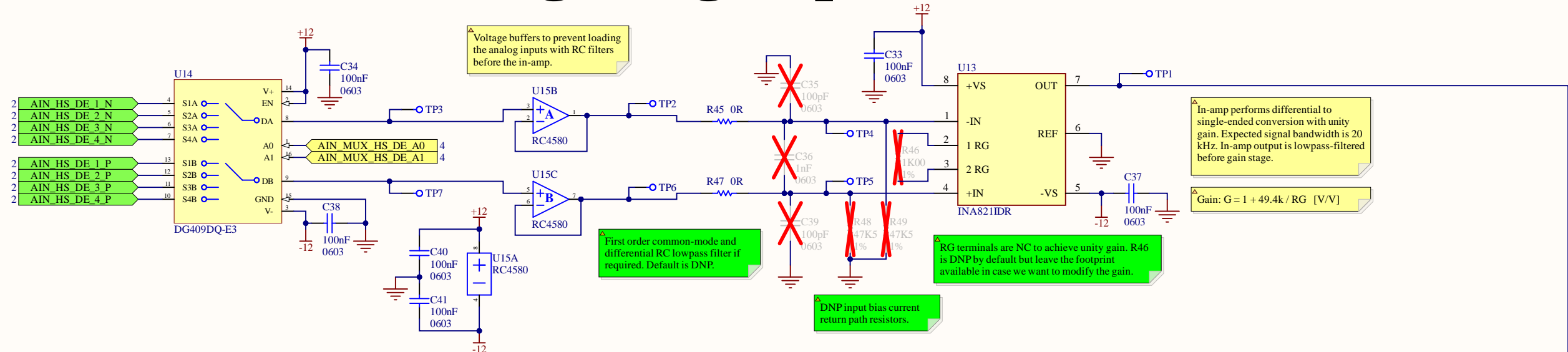
Digital IO Protection



Revision:

Title <i>Digital IO Protection</i>			Avionics McGill Rocket Team McGill University Montreal, Quebec	
Size: B	Revision:	Drawn By: Jasper Yun		
Date: 2022-11-23	Time: 12:23:35 PM	Sheet 6 of 11		
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Analog - High Speed Differential



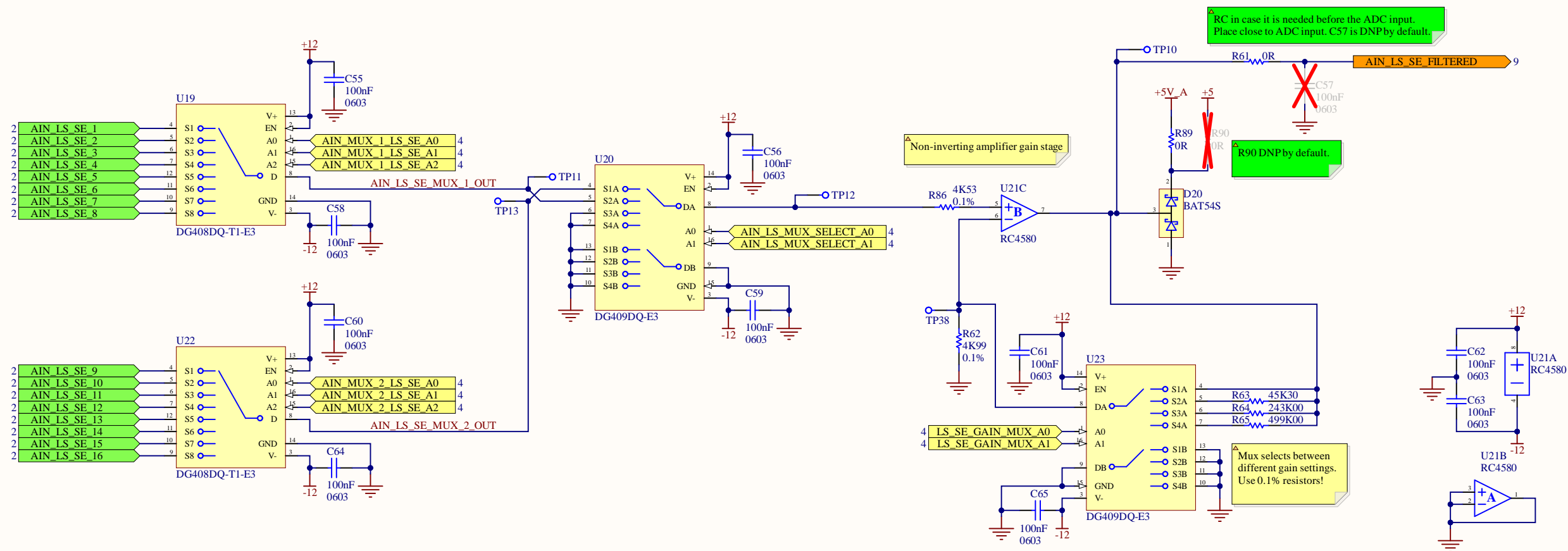
Non-Inverting Amplifier Gain Tolerances

		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
	Analogue 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
	Analogue 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
	Analogue 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
	Analogue mux on-state resistance	-	40	100	125	Ohm
	Gain = 1 + Rf/Rg	-	100.808	101.020	101.225	V/V

Revision:

Title <i>Analog - High Speed Differential</i>				Avionics McGill Rocket Team McGill University Montreal, Quebec		
Size: B	Revision:	Drawn By: Jasper Yun				
Date: 2022-11-23	Time: 12:23:35 PM	Sheet 7 of 11				
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Analog - Low Speed Single-Ended



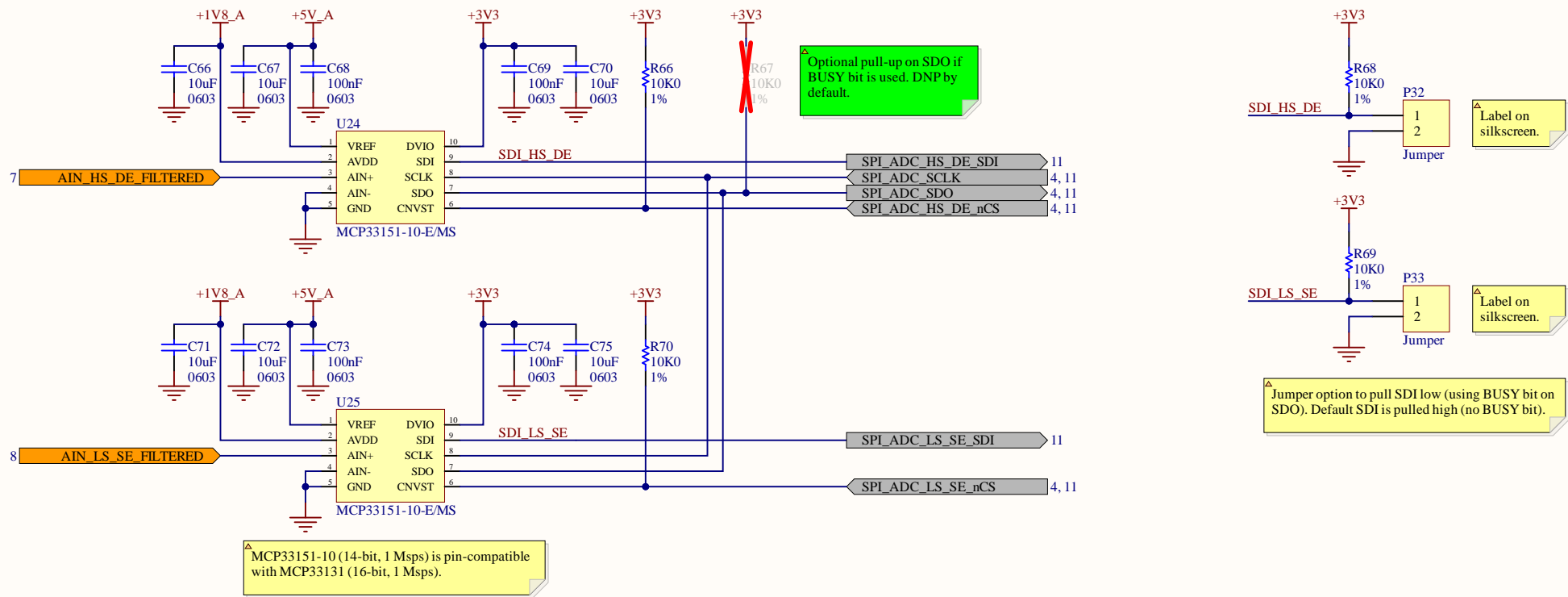
Non-Inverting Amplifier Gain Tolerances

		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

Revision:

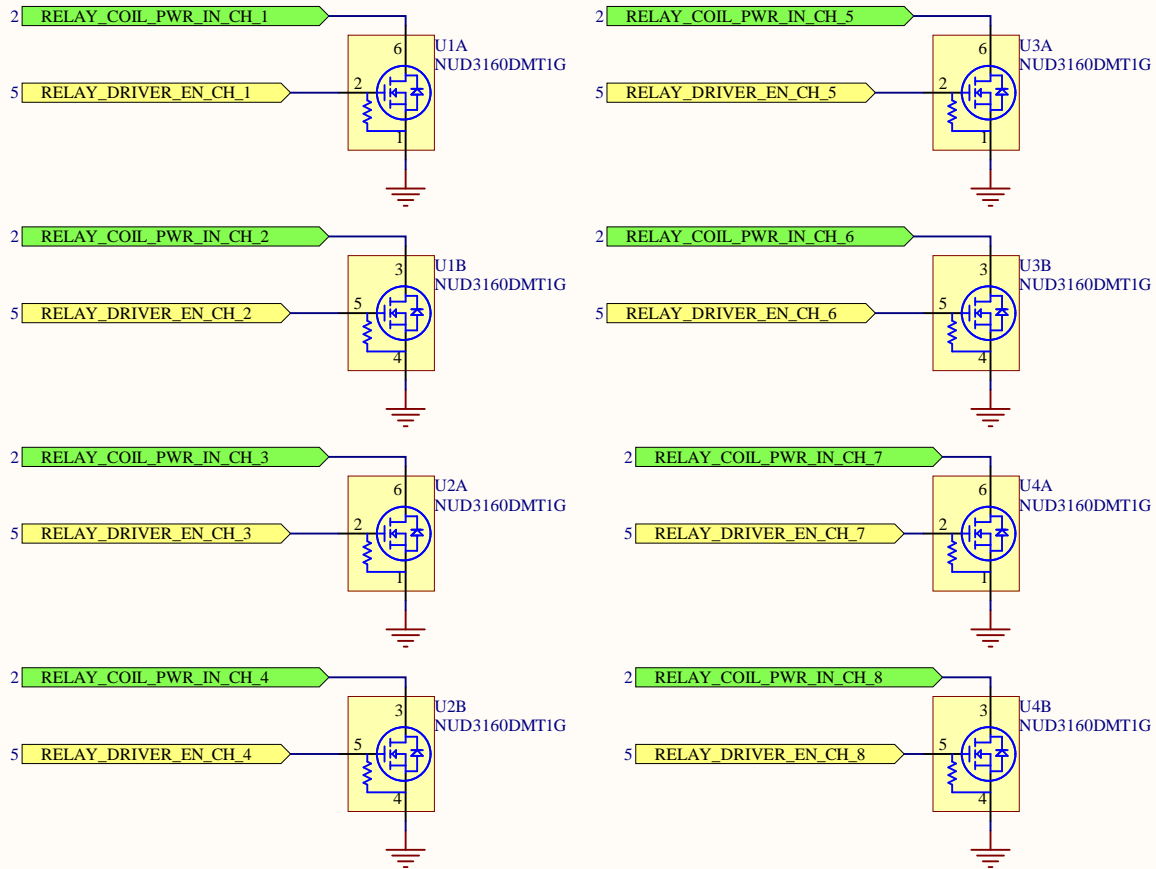
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File: C:\Users\jaspe\Desktop\ecse478_honours_thesis\1 Hardware\MCP3315 Eval Board\Analog - Low Speed SE.SchDoc				

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.

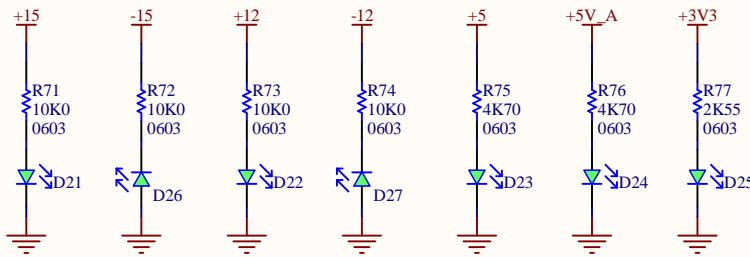


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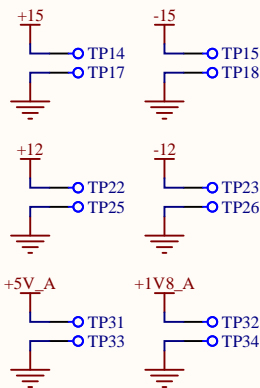
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Debug

Power LEDs

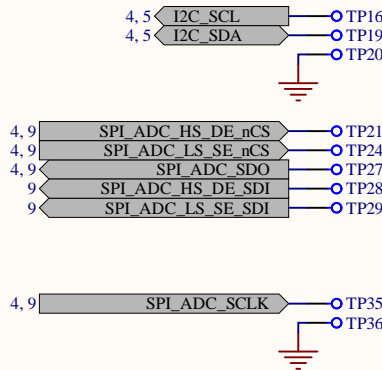


Power Rails Test Points



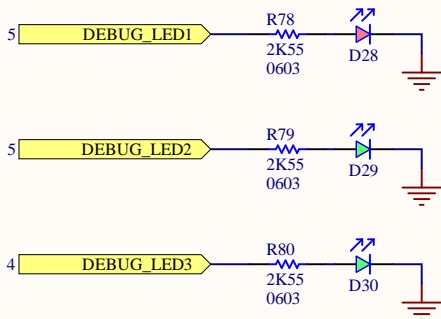
Place close to output of regulators, conducive for probing with oscilloscope + ground spring.

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.

Revision:

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