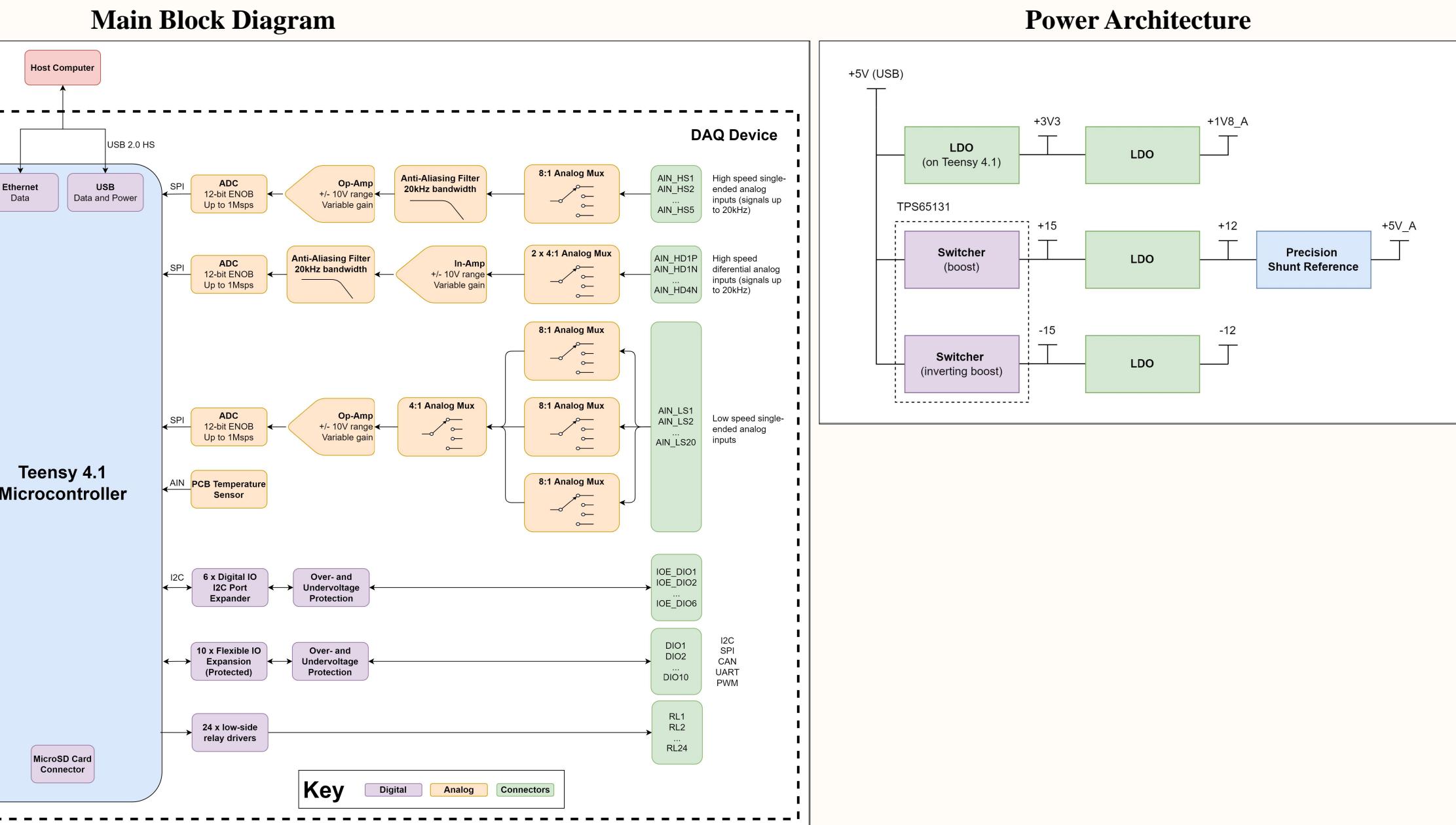
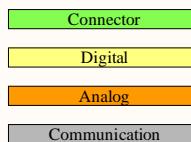


# ECSE478 - DAQ Device

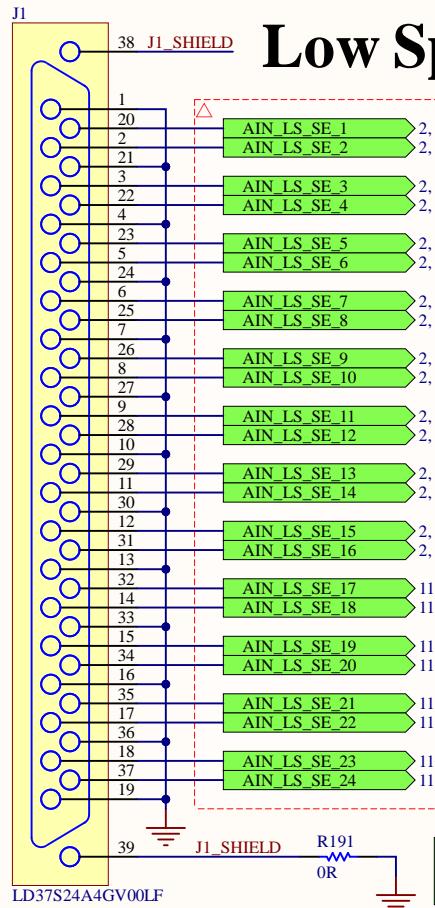
## Table of Contents

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

## Port Colors



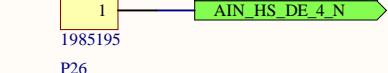
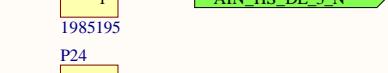
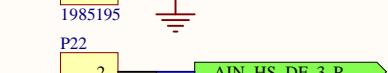
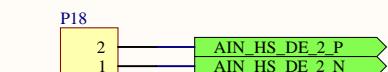
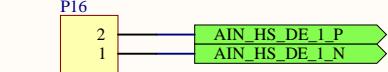
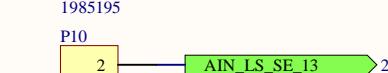
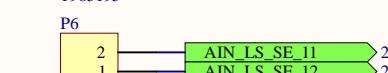
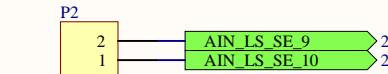
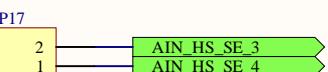
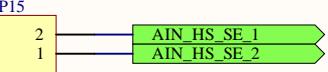
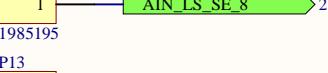
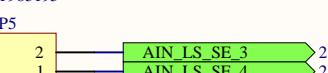
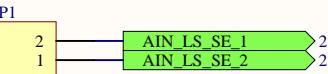
DE = differential-ended  
SE = single-ended



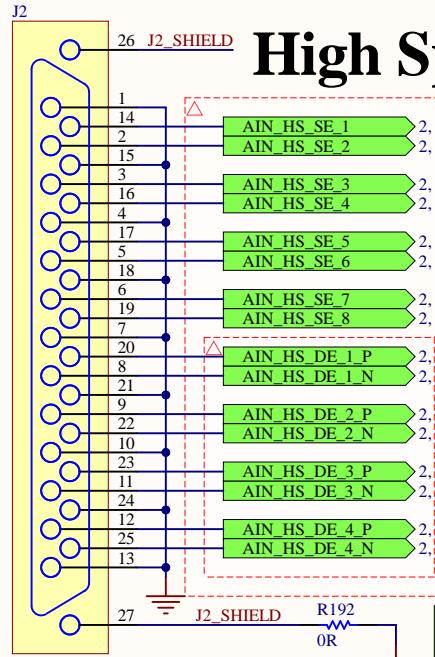
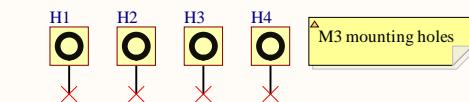
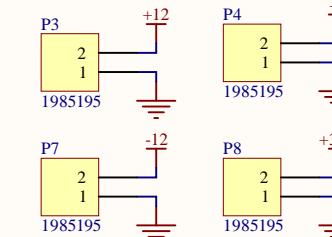
## Low Speed Analog

# Connectors - Analog

Terminal blocks are used alongside DB25 and DB37 connectors to allow quick connections, e.g. during prototyping, and full expansion use.



## Power



## High Speed Analog

### Connectors - Analog

Title: Connectors - Analog

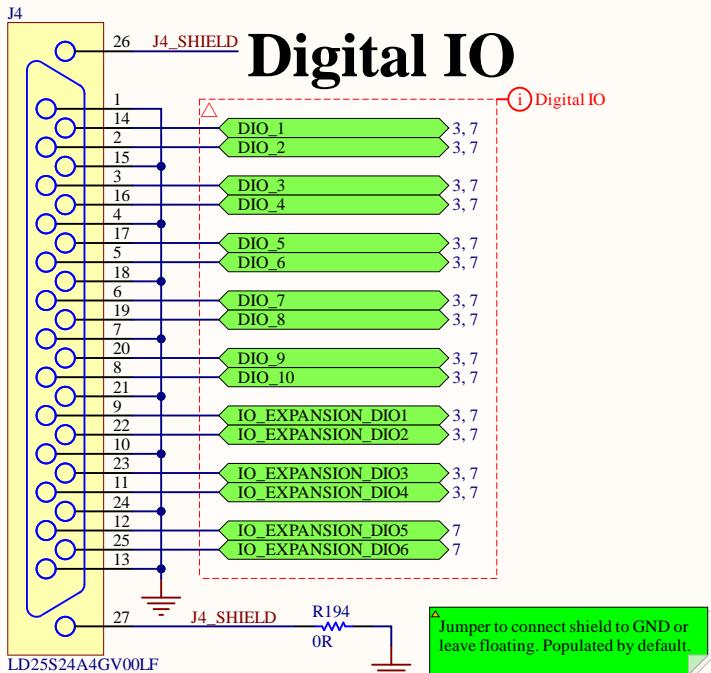
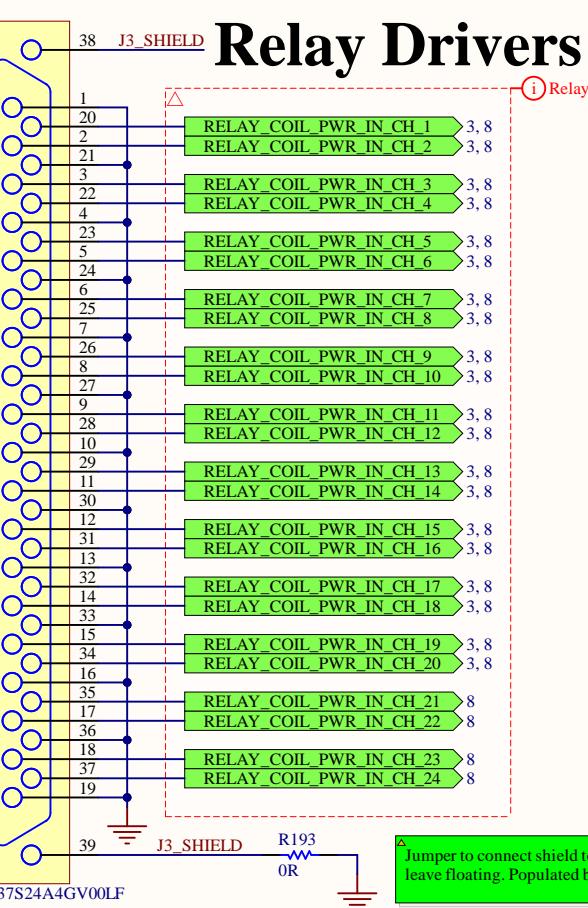
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Date: 2023-01-07 Time: 6:53:58 PM Sheet 2 of 13

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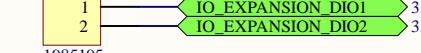
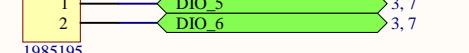
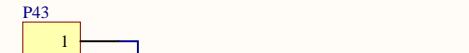
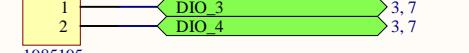
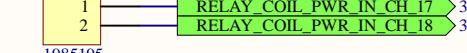
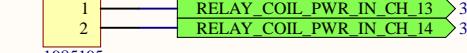
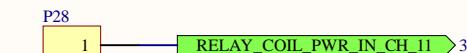
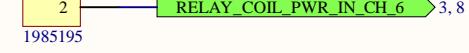
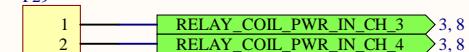
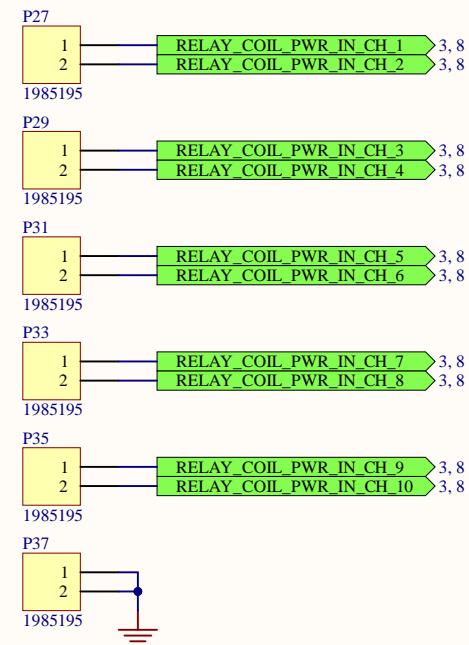
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McGill University  
Montreal, Quebec





# Connectors - Digital

Terminal blocks are used alongside DB25 and DB37 connectors to allow quick connections, e.g. during prototyping, and full expansion use.



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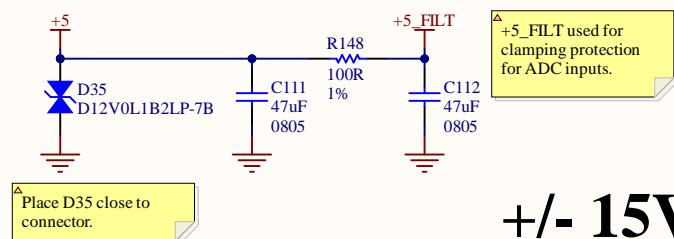
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File: C:\Users\jaspe\Desktop\ecse478\_honours\_thesis\1 Hardware\ECSE478 - DAQ Device\Connectors - Digital.SchDoc

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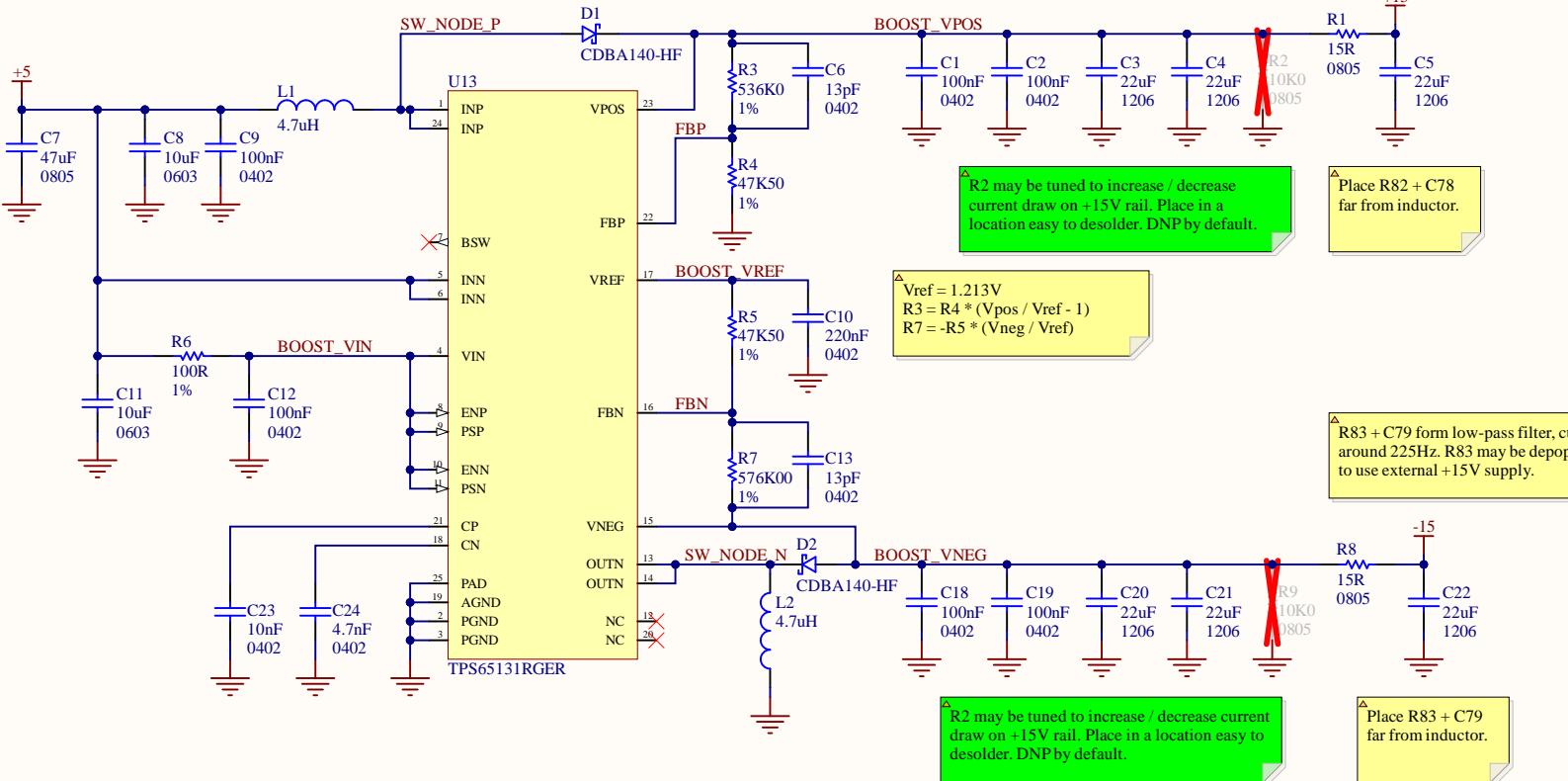


# Power



**+/- 15V**

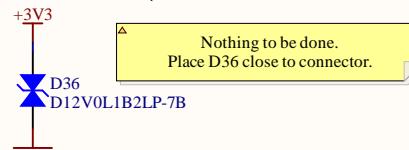
Rail	Min	Nom	Max
+15 V	14.47 V	14.90 V	15.33 V
-15 V	-15.15 V	-14.71 V	-14.26 V



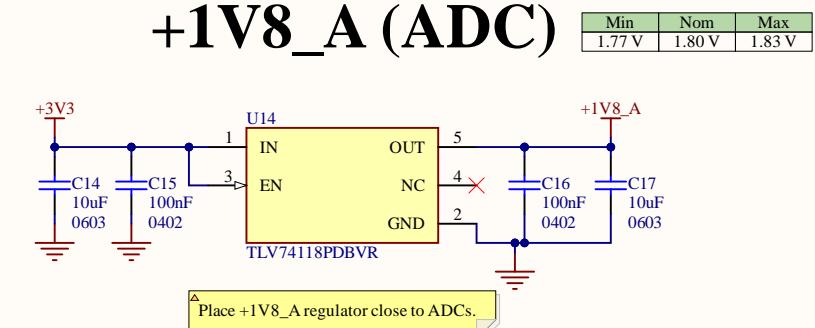
**+5V (from USB port on Teensy :))**

Nothing to be done.

**+3V3 (from Teensy :))**

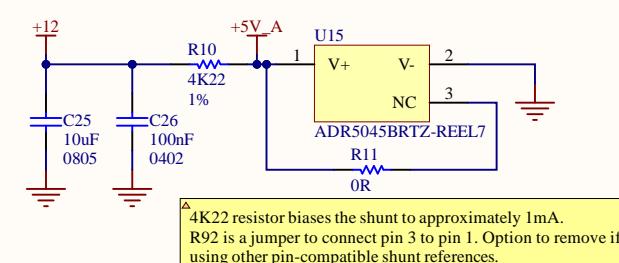
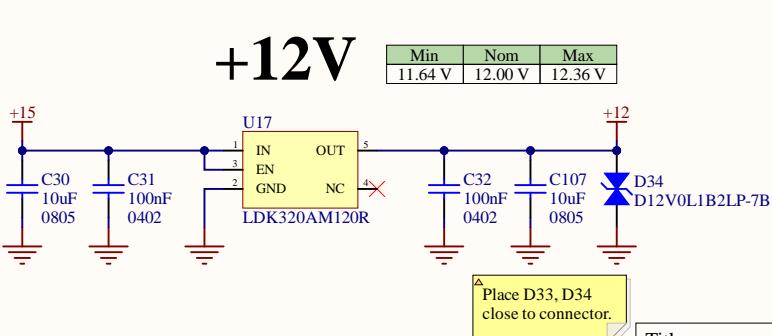
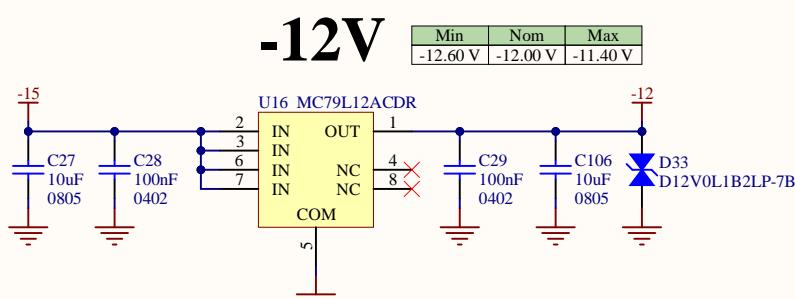


**+1V8\_A (ADC)**



**+5V\_A (Analog Reference)**

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



Title **Power**

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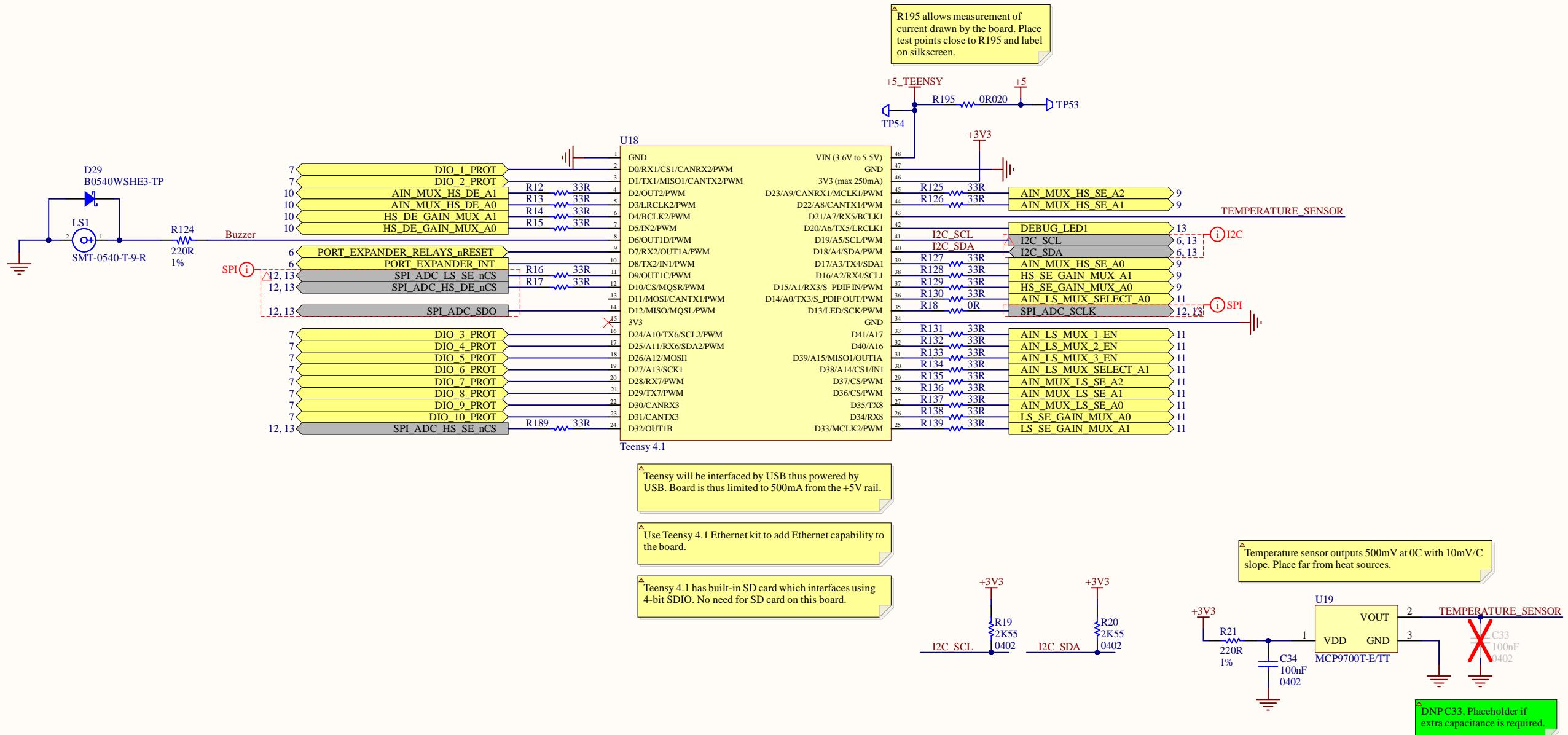
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# Microcontroller



Title

## Microcontroller

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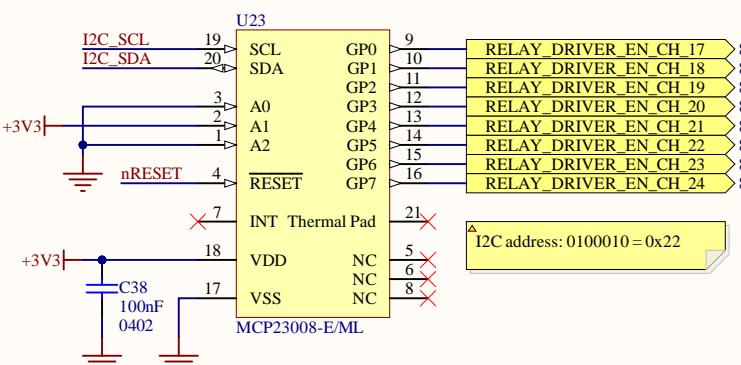
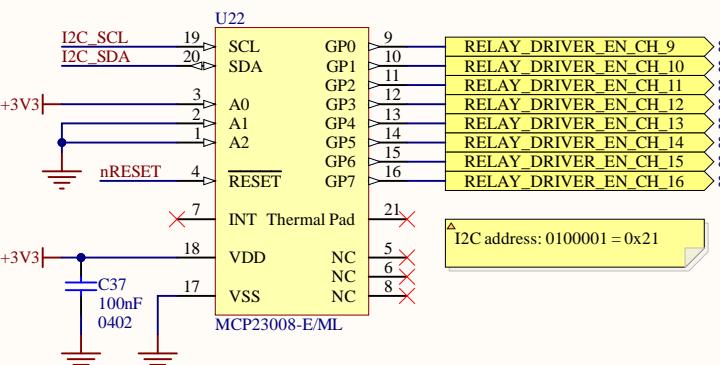
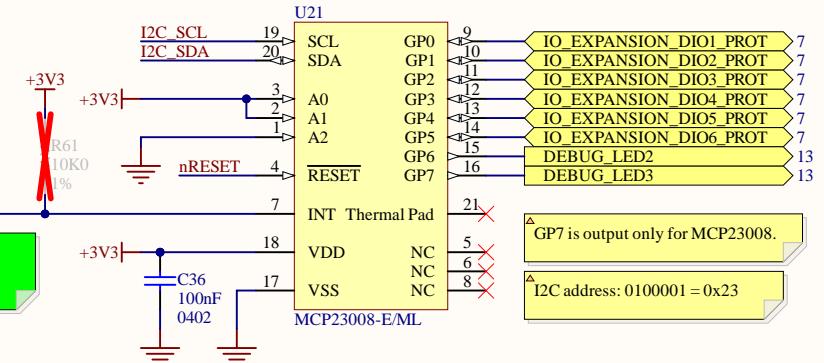
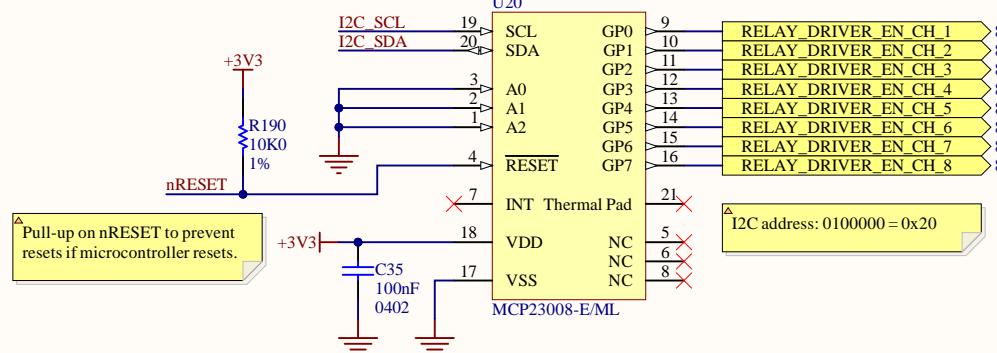
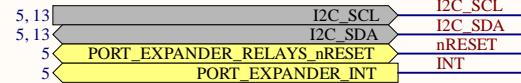
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File: C:\Users\jaspe\Desktop\ecse478\_honours\_thesis\1 Hardware\ECSE478 - DAQ Device\Microcontroller.SchDoc

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# IO Expansion



These 24 IO expansion pins can be set as inputs or outputs. They will be configured as outputs only for relay driver control, as relay actuation does not require high speed actuation from microcontroller pins. Interrupts not needed.

GP7 is output-only on MCP23008.

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

## Title *IO Expansion*

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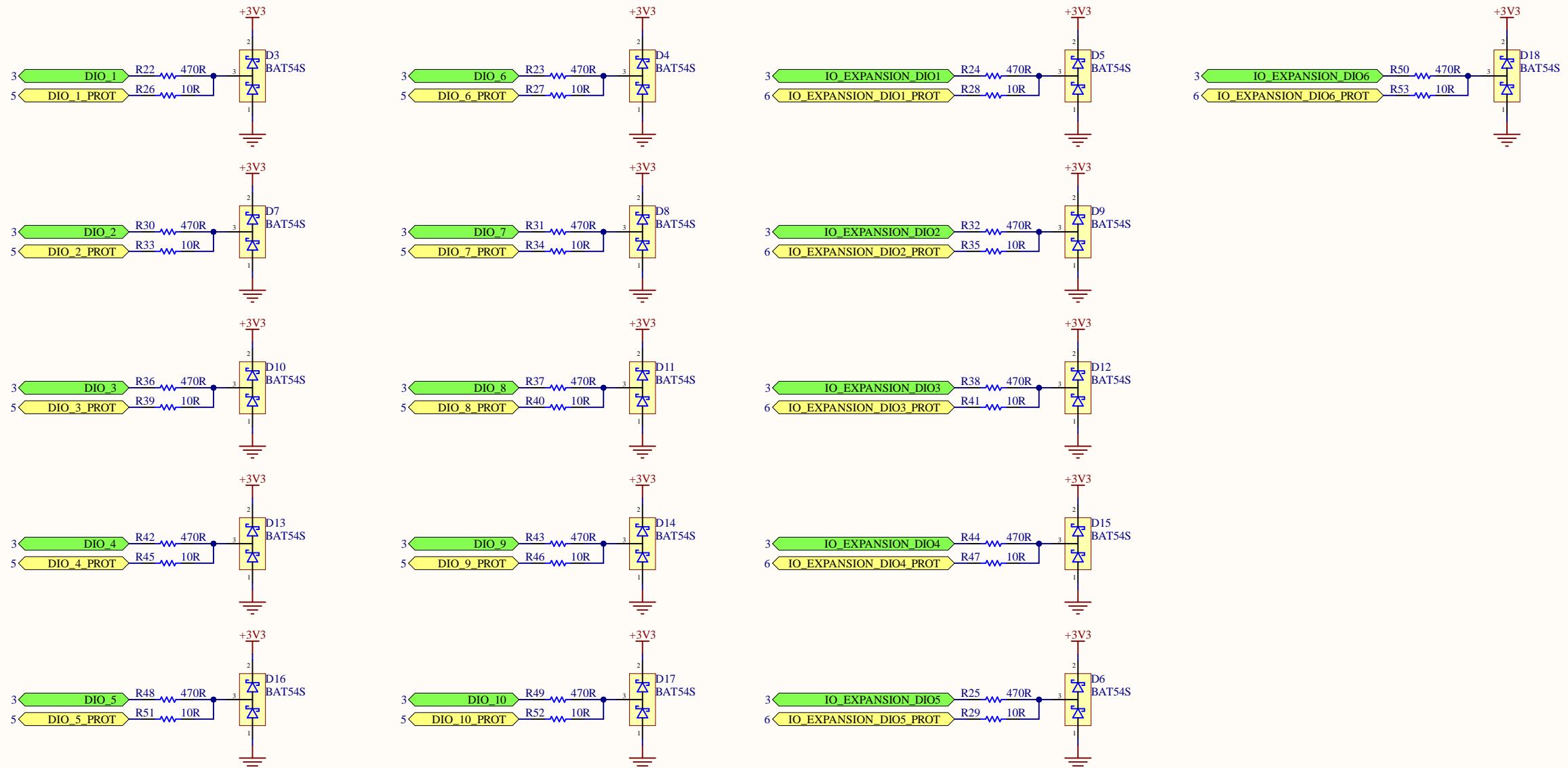
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# Digital IO Protection



Title

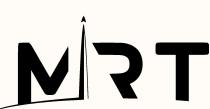
**Digital IO Protection**

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Date: 2023-01-07 | Time: 6:53:59 PM | Sheet 7 of 13

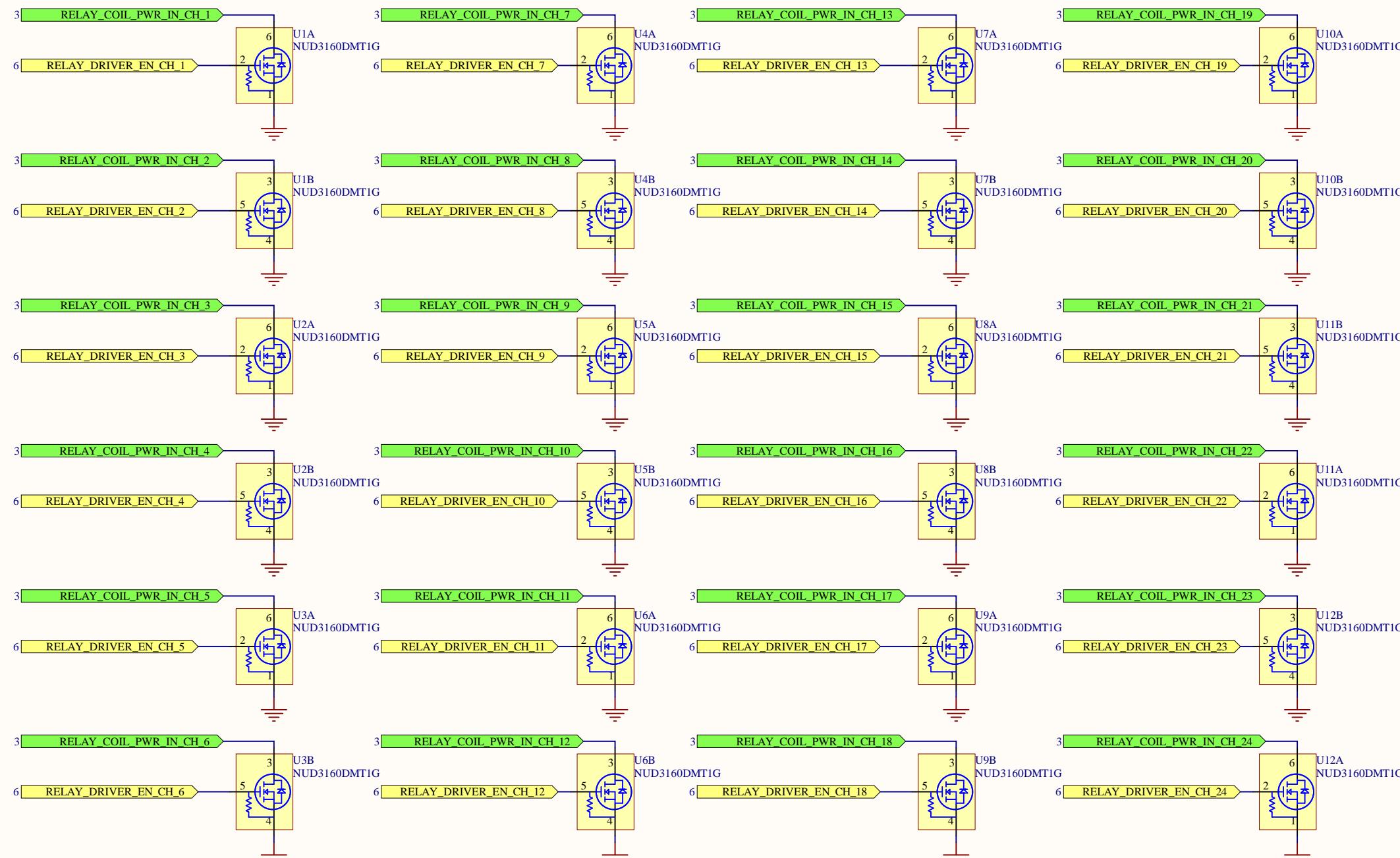
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# Relay Drivers

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**

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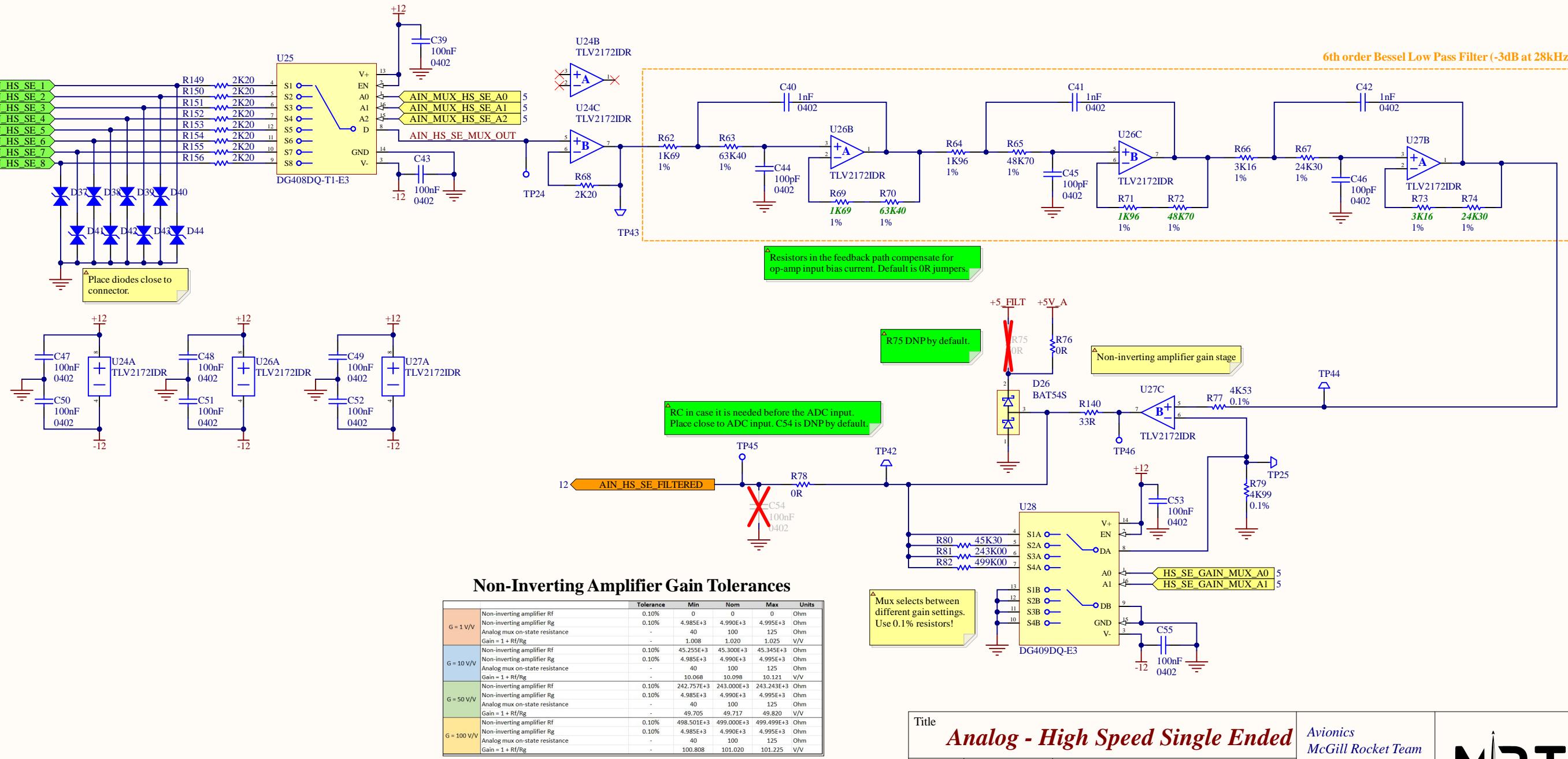
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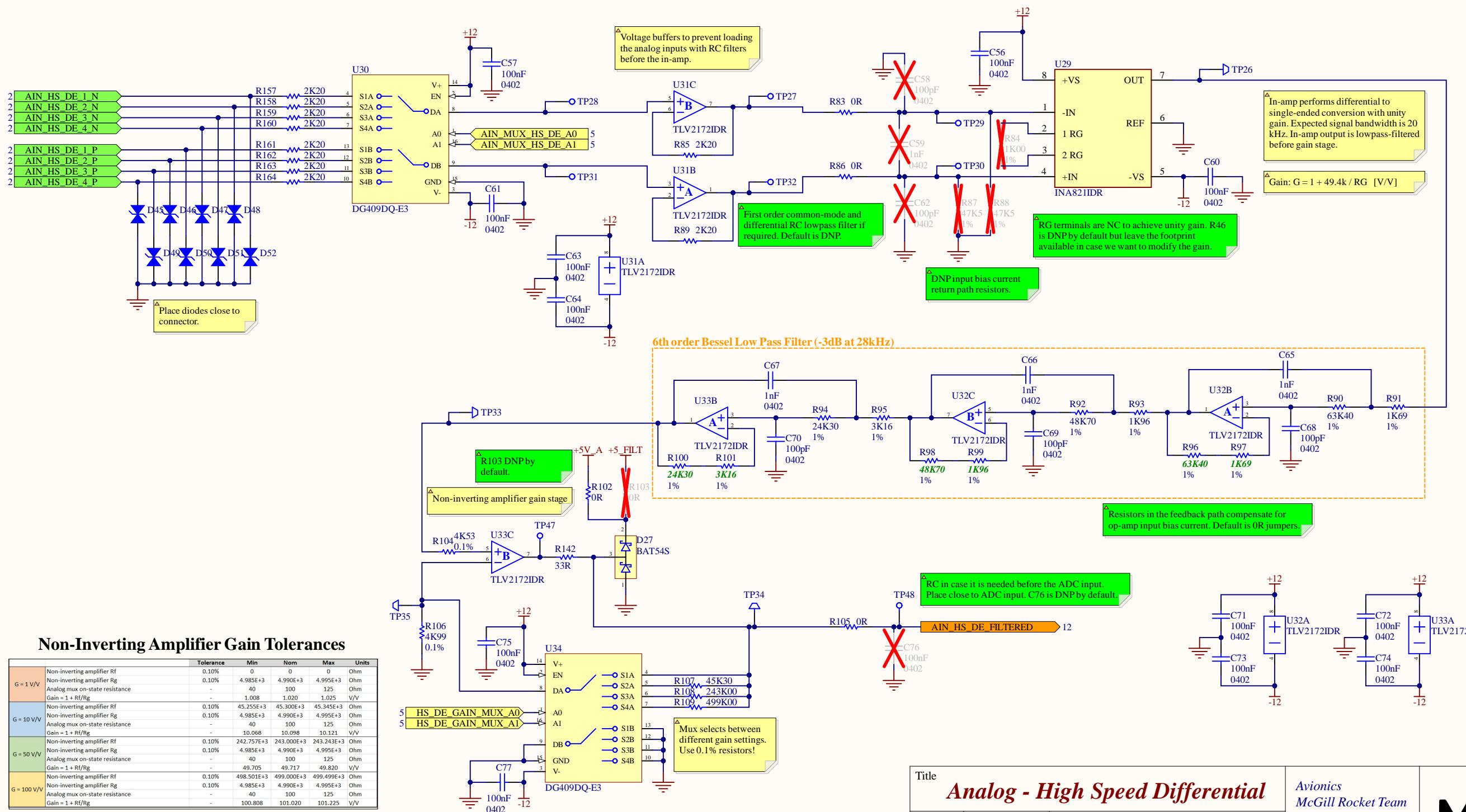
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# Analog - High Speed Single Ended



# Analog - High Speed Differential



Title  
**Analog - High Speed Differential**

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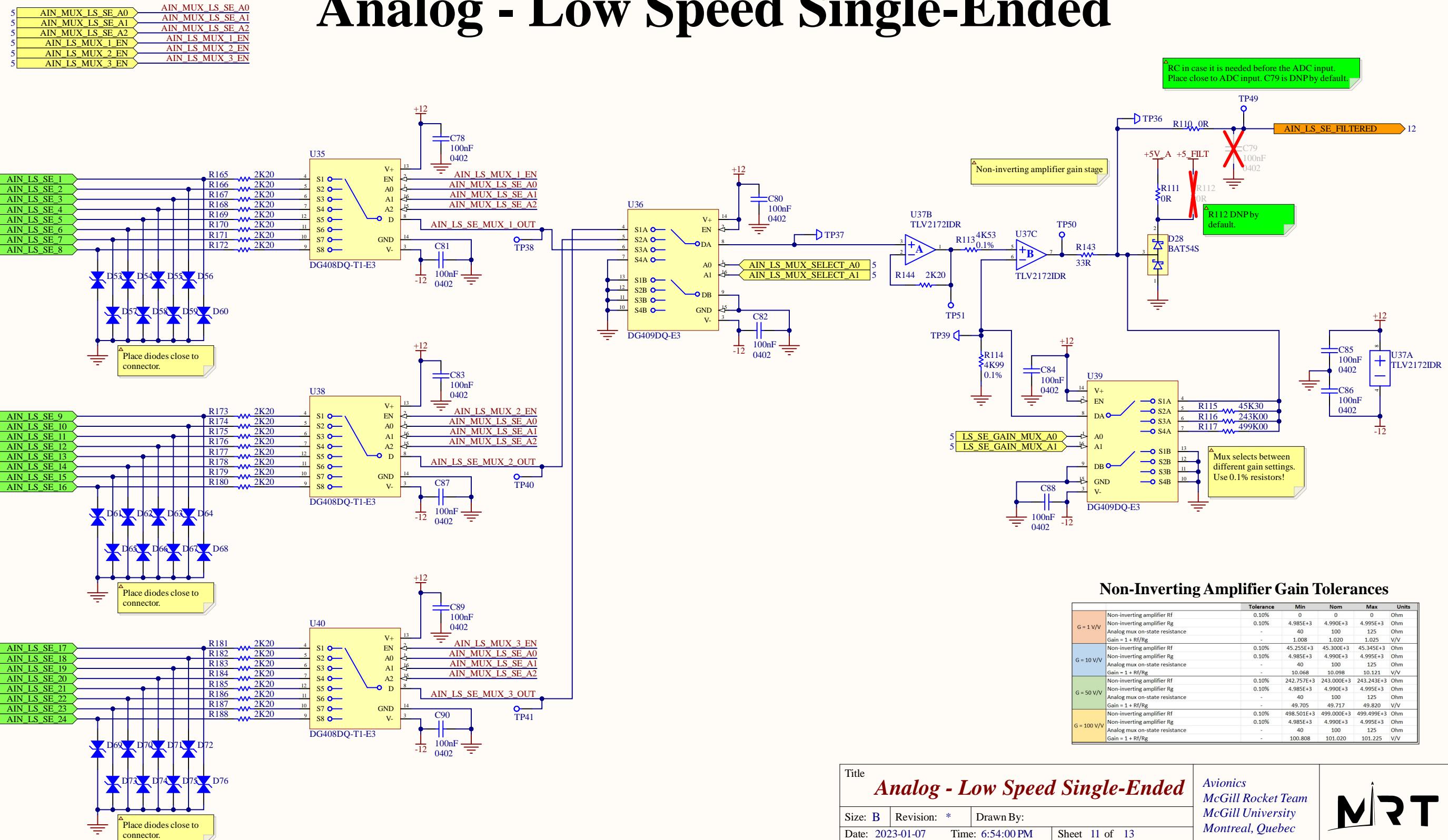
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# Analog - Low Speed Single-Ended



## Non-Inverting Amplifier Gain Tolerances

		Tolerance	Min	Nom	Max	Units
G = 1 V/V	Non-inverting amplifier Rf	0.10%	0	9.00	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*

Size: B Revision: \* Drawn By:

Date: 2023-01-07 Time: 6:54:00 PM Sheet 11 of 13

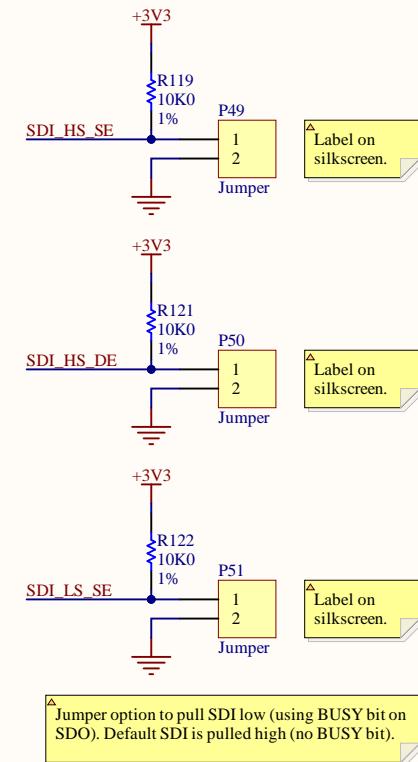
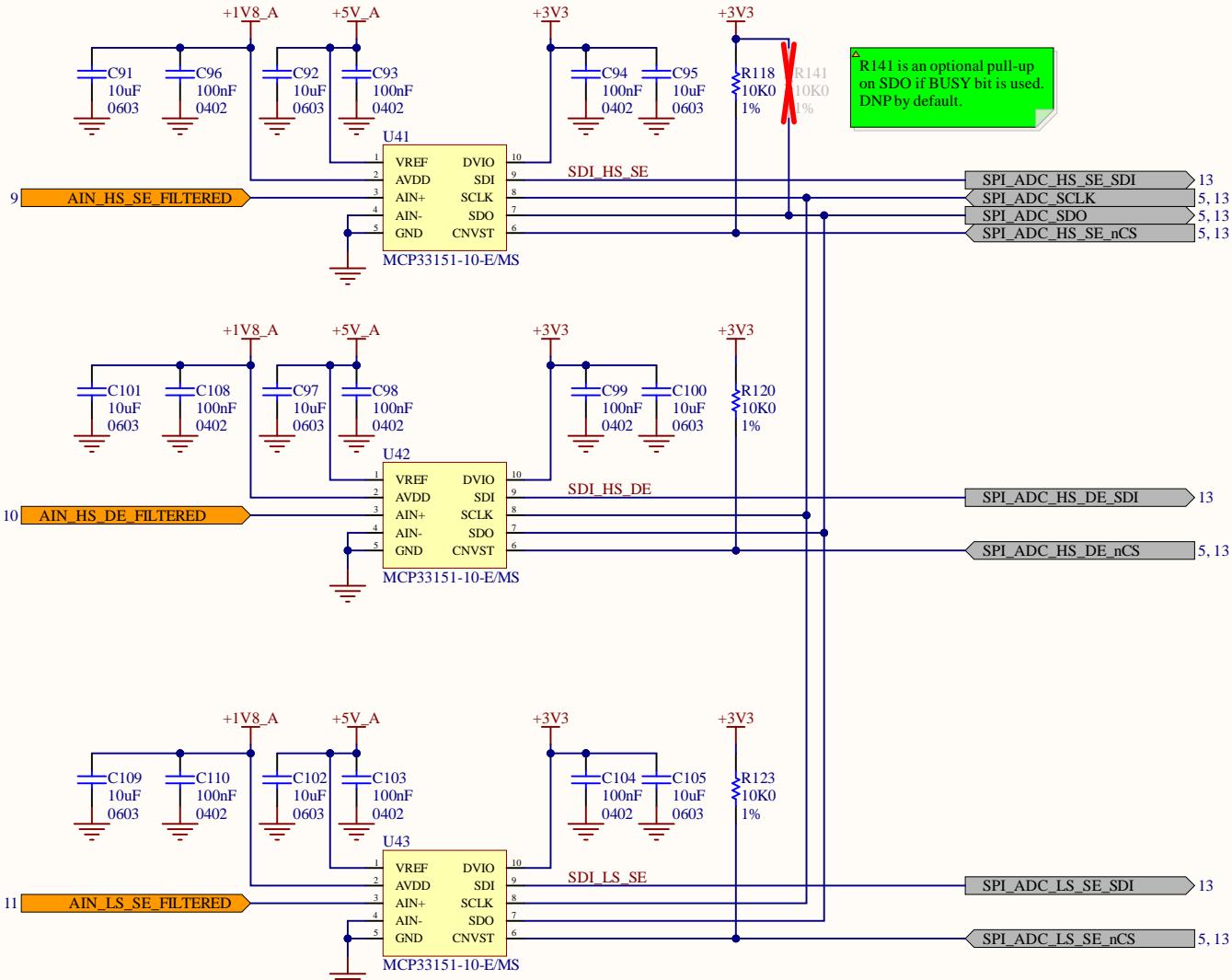
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4 \_\_\_\_\_ 5 \_\_\_\_\_ 6 \_\_\_\_\_

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Montreal, Quebec*



# Analog to Digital Conversion



Title

**Analog to Digital Conversion**

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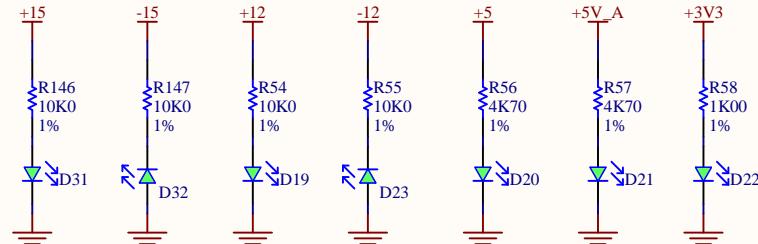
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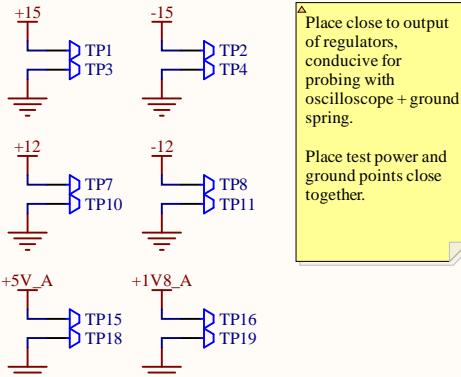
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# Debug

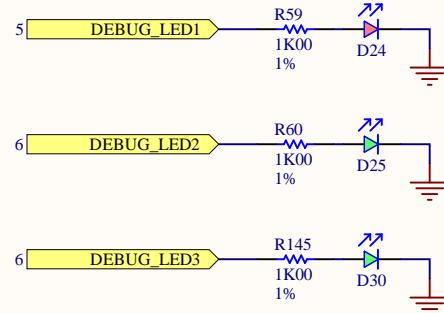
## Power LEDs



## Power Rails Test Points



## Program Debug LEDs



## Analog Test Points

See analog sheets.

