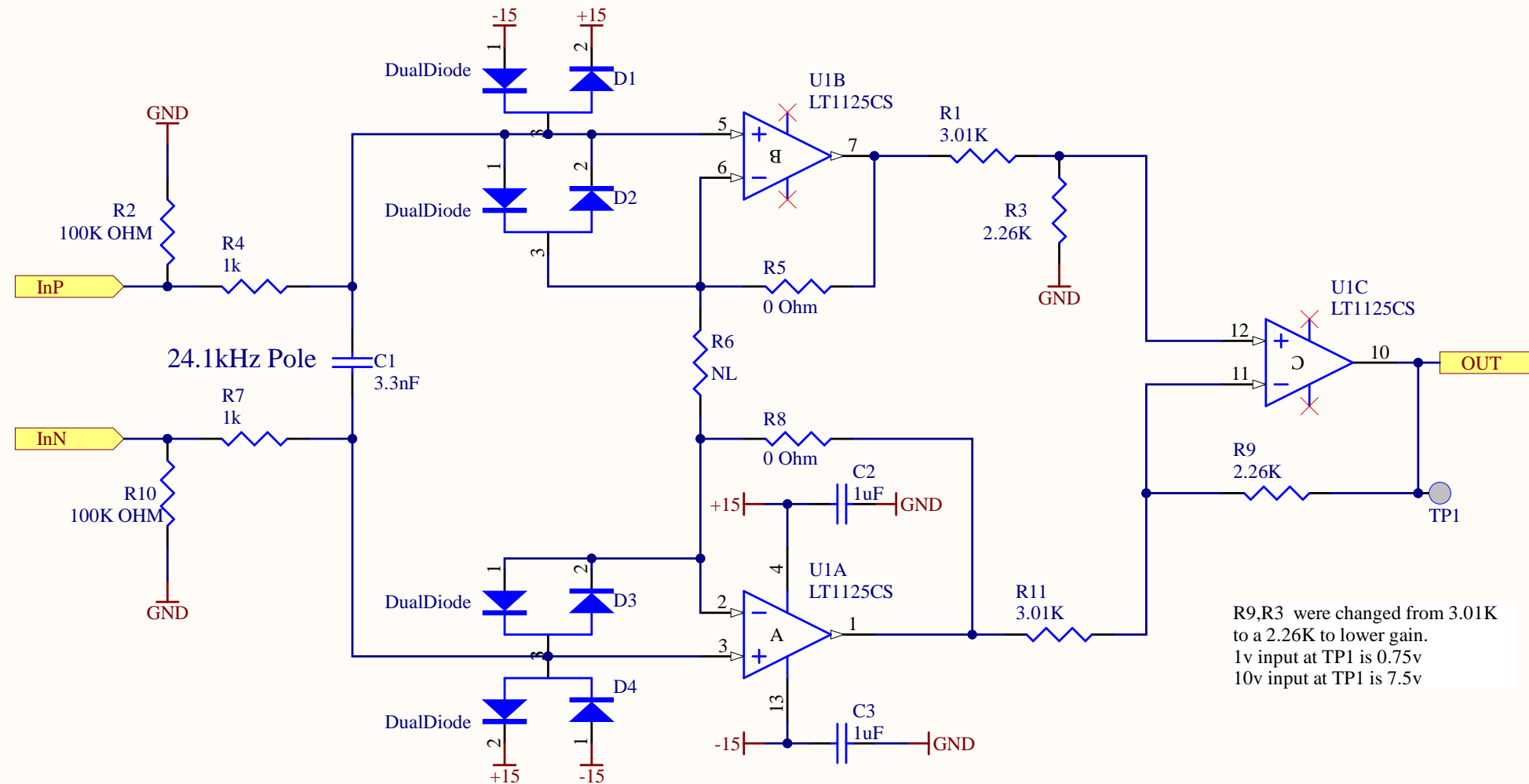


Overall Gain = 1 from InP-InN to Out

Ex. 10V battery across input = 7.5V from Out to GND

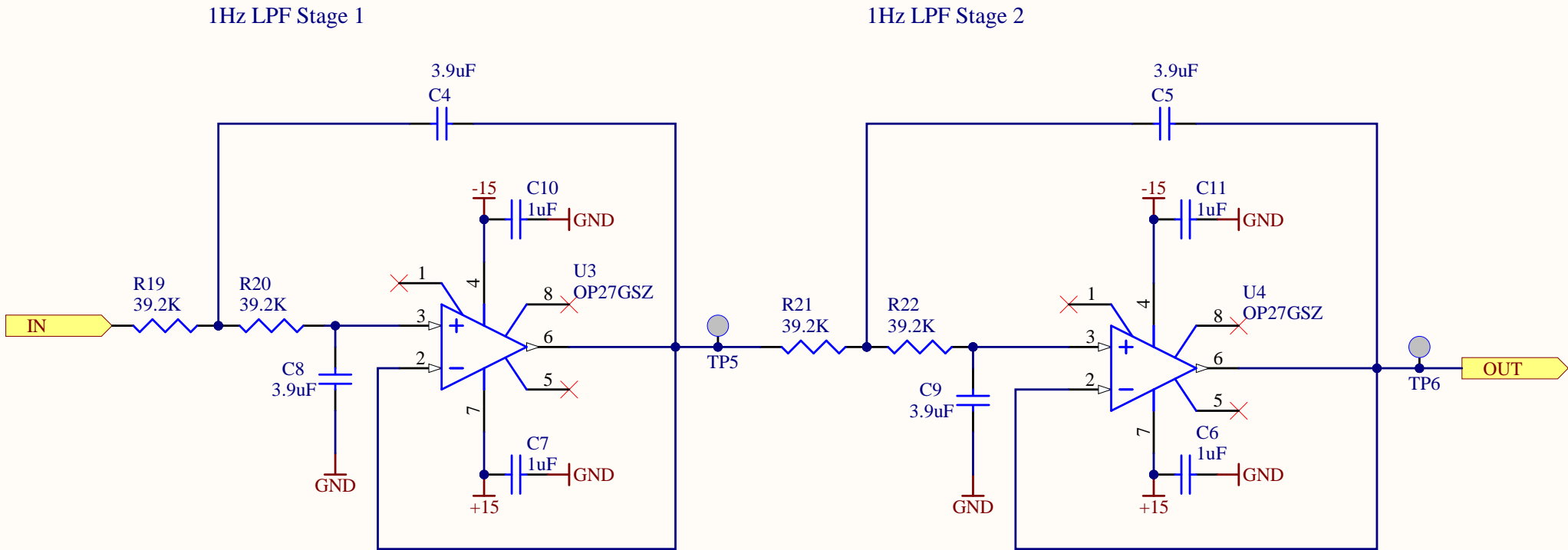
Input Protection



R9,R3 were changed from 3.01K to a 2.26K to lower gain.
1v input at TP1 is 0.75v
10v input at TP1 is 7.5v

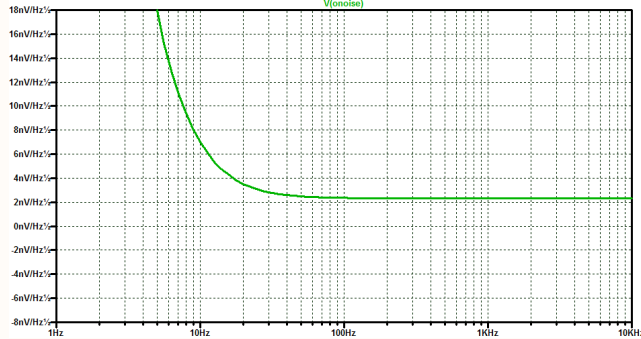
Input Protection

The 24.1kHz RC filter is there to cut high frequency noise to prevent slew rate limiting. Overall gain is 1 such that 10 volts peak from DAC yields 10v wrt ground at output

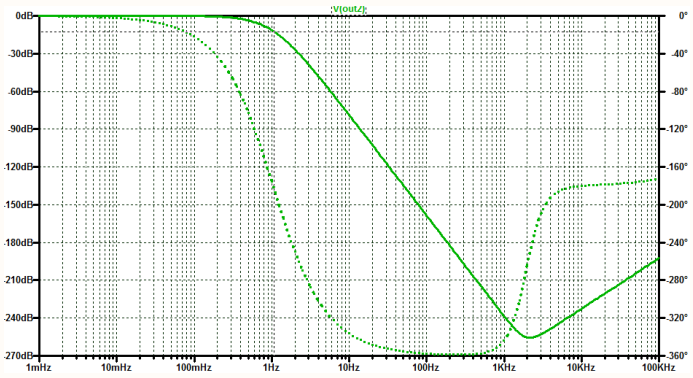


R1=R2, C1=C2		OUTPUT VOLT NOISE	
		SINE(5v,1KHz)	DAC NOISE(300nV/√Hz)
		@ TP6	@ TP6
@10Hz	3.9μF 39.2K	7.007nV/√Hz	7.007nV/√Hz
@30Hz	3.9μF 39.2K	2.817nV/√Hz	2.817nV/√Hz
@60Hz	3.9μF 39.2K	2.42nV/√Hz	2.425nV/√Hz
@100Hz	3.9μF 39.2K	2.35nV/√Hz	2.35nV/√Hz
fc= 1.04107Hz			
Pole(s)			
p = 1.04107Hz			

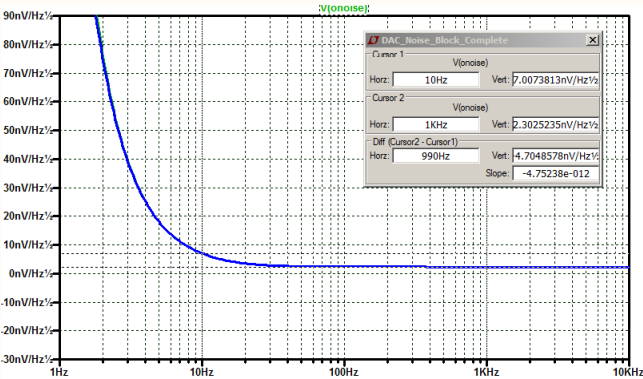
Volt Noise at TP6 from a sin signal



Filter transfer function



Volt Noise at TP6 from a DAC signal



Last Edited: 7/8/2025

Title
Low Pass Filter

LIGO Laboratory
California Institute of Technology
Massachusetts Institute of Technology

LIGO

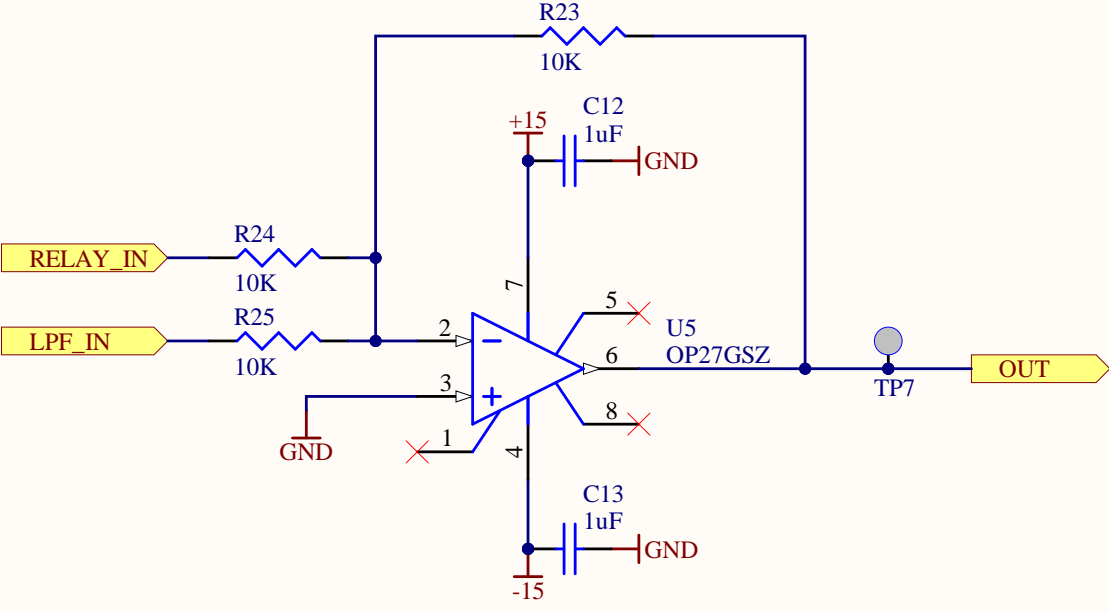
Size: A DCC Number: D1600454

Revision: 3

Engineer: L.Sánchez

Date: 7/8/2025
Time: 4:54:24 PM
Sheet 4 of 8

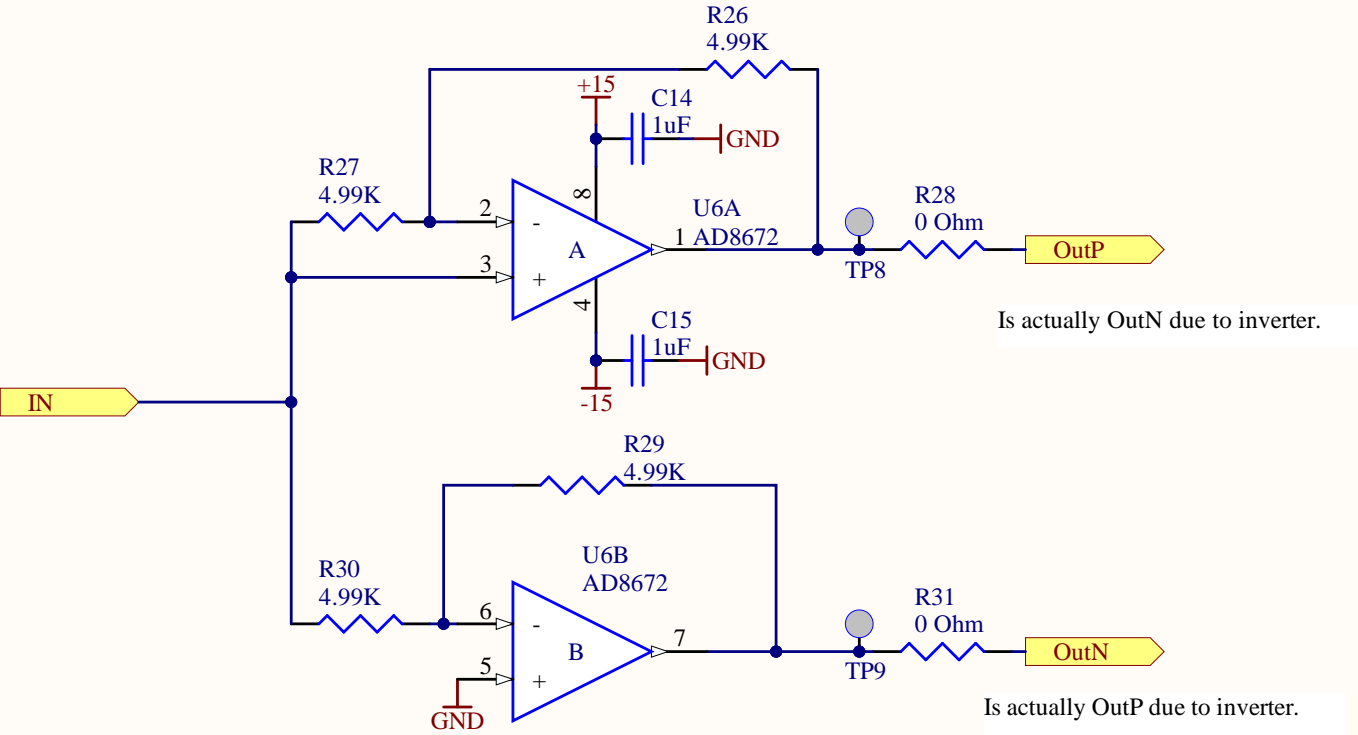
File: C:\Users\daniel.sigg\Documents\Protel\Analog\Heater\HeaterDriver\LowPassFilter.SchDoc



Title		LIGO Laboratory California Institute of Technology Massachusetts Institute of Technology		Last Edited: 7/3/2025	
Size: A		DCC Number: D1600454		Revision: 3	
File: C:\Users\daniel.sigg\Documents\Protel\Analog\Heater\HeaterDriver\OPAMP_SUM.SchDoc		Engineer: L.Sánchez		Date: 7/8/2025	
				Time: 4:54:24 PM	
				Sheet 5 of 8	

OP AMP SUM





Is actually OutN due to inverter.

Is actually OutP due to inverter.

Typical LIGO differential driver circuit for the monitor signals.

Title		LIGO Laboratory California Institute of Technology Massachusetts Institute of Technology		Last Edited: 7/3/2025	
Size: A		DCC Number: D1600454		Revision: 3	
File: C:\Users\daniel.sigg\Documents\Protel\Analog\Heater\HeaterDriver\DifferentialDriver.SchDoc		Engineer: L.Sanchez		Date: 7/8/2025 Time: 4:54:24 PM	
				Sheet 6 of 8	

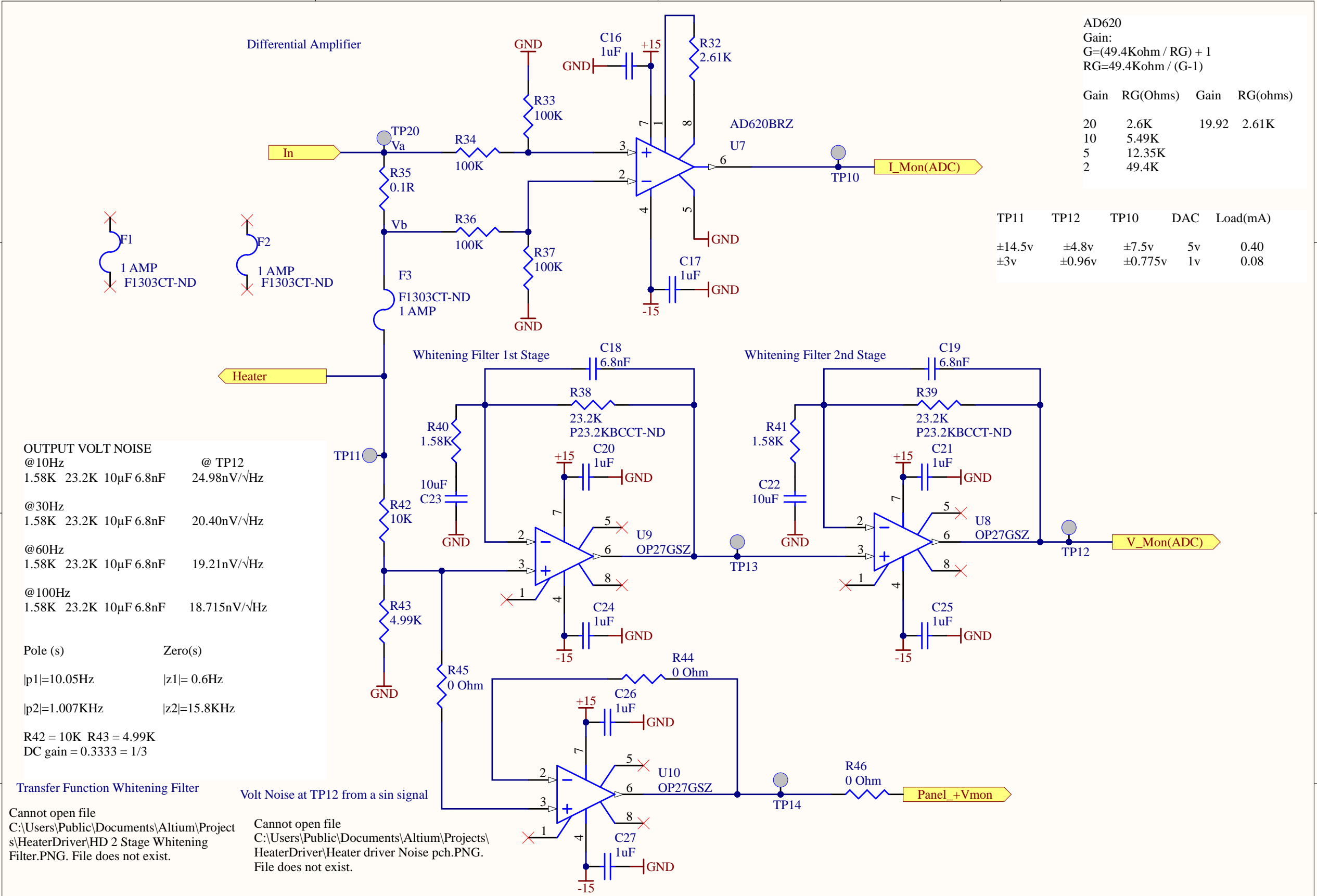


A

B

C

D



Last Edited: 7/3/2025

Title
Heater Driver Circuit

LIGO Laboratory
California Institute of Technology
Massachusetts Institute of Technology

LIGO

Size: A

DCC Number: D1600454

Revision: 3

Engineer: L.Sánchez

Date: 7/8/2025

Time: 4:54:24 PM

Sheet 7 of 8

File: C:\Users\daniel.sigg\Documents\Protel\Analog\Heater\HeaterDriver\HeaterDriverCircuit.SchDoc

P_LED12
LED GREEN 1/4" HOLE PANEL MOUNT
L10005-ND

P_LED13
LED GREEN 1/4" HOLE PANEL MOUNT
L10005-ND

P16
2 Position Receptacle 0.156" (3.96mm)
A24111-ND

P35
Contact Crimp Non-Gendered 18-24 AWG Gold
23-0008560105CT-ND

TP20 TP21 TP22 TP23
GND GND GND GND

Part8
Heat Sink TO-220 Aluminum Board Level
AE10852-ND

D10 protects againts C44 (input shorts)
D9 protects againts C43 (output shorts)

P15
2 Position Receptacle 0.156" (3.96mm)
A24111-ND

P36
Contact Crimp Non-Gendered 18-24 AWG Gold
23-0008560105CT-ND

P37
Contact Crimp Non-Gendered 18-24 AWG Gold
23-0008560105CT-ND

P38
Contact Crimp Non-Gendered 18-24 AWG Gold
23-0008560105CT-ND

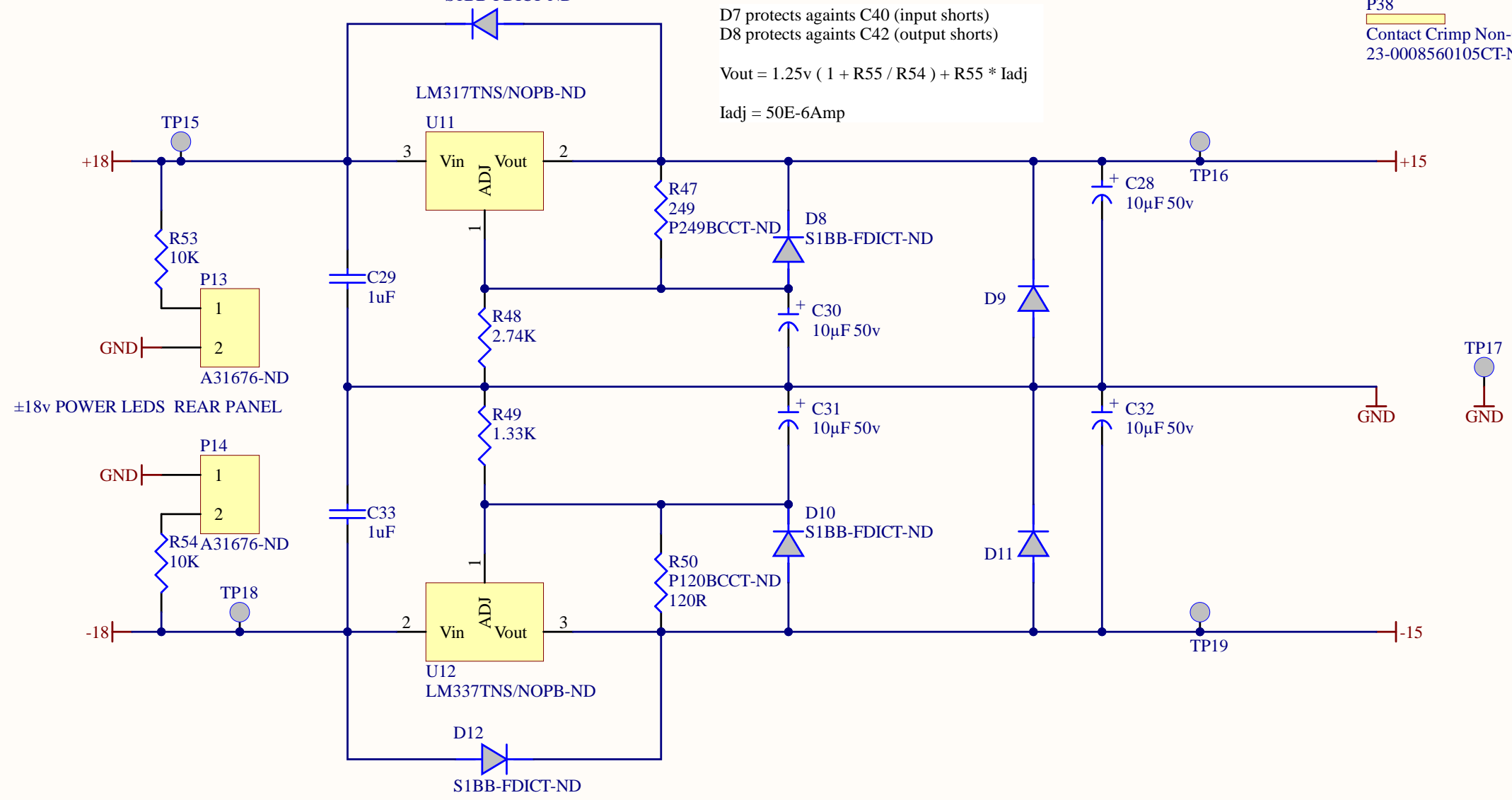
$$-V_{out} = 1.25v (1 + R56 / R57) + R56 * (- I_{adj})$$

$$I_{adj} = 50E-6Amp$$

D7 protects againts C40 (input shorts)
D8 protects againts C42 (output shorts)

$$V_{out} = 1.25v (1 + R55 / R54) + R55 * I_{adj}$$

$$I_{adj} = 50E-6Amp$$



Part9
Heat Sink TO-220 Aluminum Board Level
AE10852-ND

Last Edited: 7/3/2025

Title		LIGO Laboratory California Institute of Technology Massachusetts Institute of Technology		Date: 7/8/2025	
Size: A		DCC Number: D1600454		Revision: 3	
File: C:\Users\daniel.sigg\Documents\Protel\Analog\Heater\HeaterDriver\Voltage Regulator.SchDoc		Engineer: L.Sánchez		Time: 4:54:24 PM	
				Sheet 8 of 8	



