॥ सा विद्या या विमुक्तये ॥

भारतीय प्रौद्योगिकी संस्थान धारवाड़

Indian Institute of Technology Dharwad

High Voltage Isolated Differential Probe

EE314: EDL Project Evaluation 3

Team Members:

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Project Supervisor

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Project Timeline

A. First Evaluation

1. Study of existing solutions ✅
2. Requirement Building / Spec freeze ✅
3. High-level system Design by 27/Jan 2023 ✅

B. Second Evaluation

4. Simulation ✅
5. Prototyping ☑️
6. PCB design by 17/Feb 2023 ✅

C. Third Evaluation

7. Prototyping and Assembling ☑️
8. Integration 17/March 2023 ✅

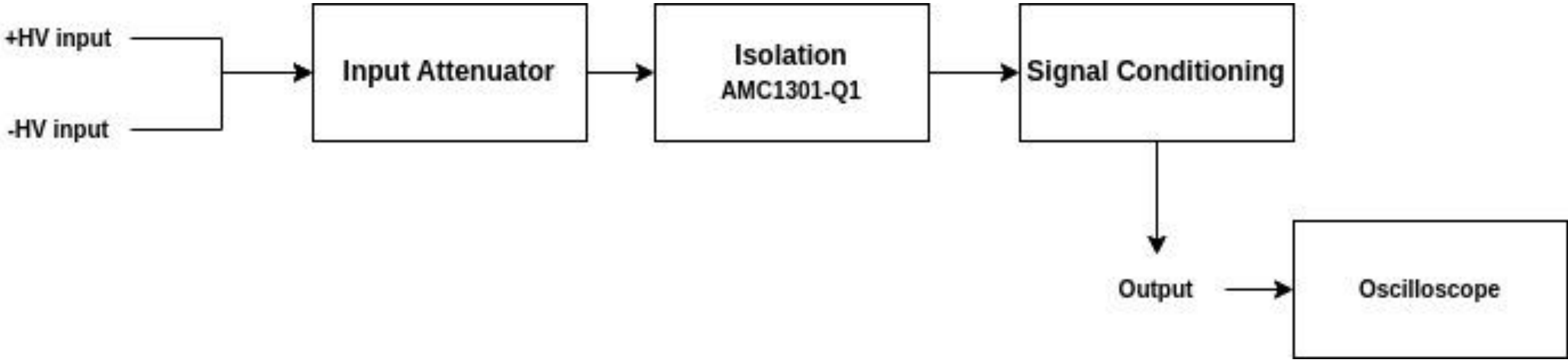
D. Final Evaluation

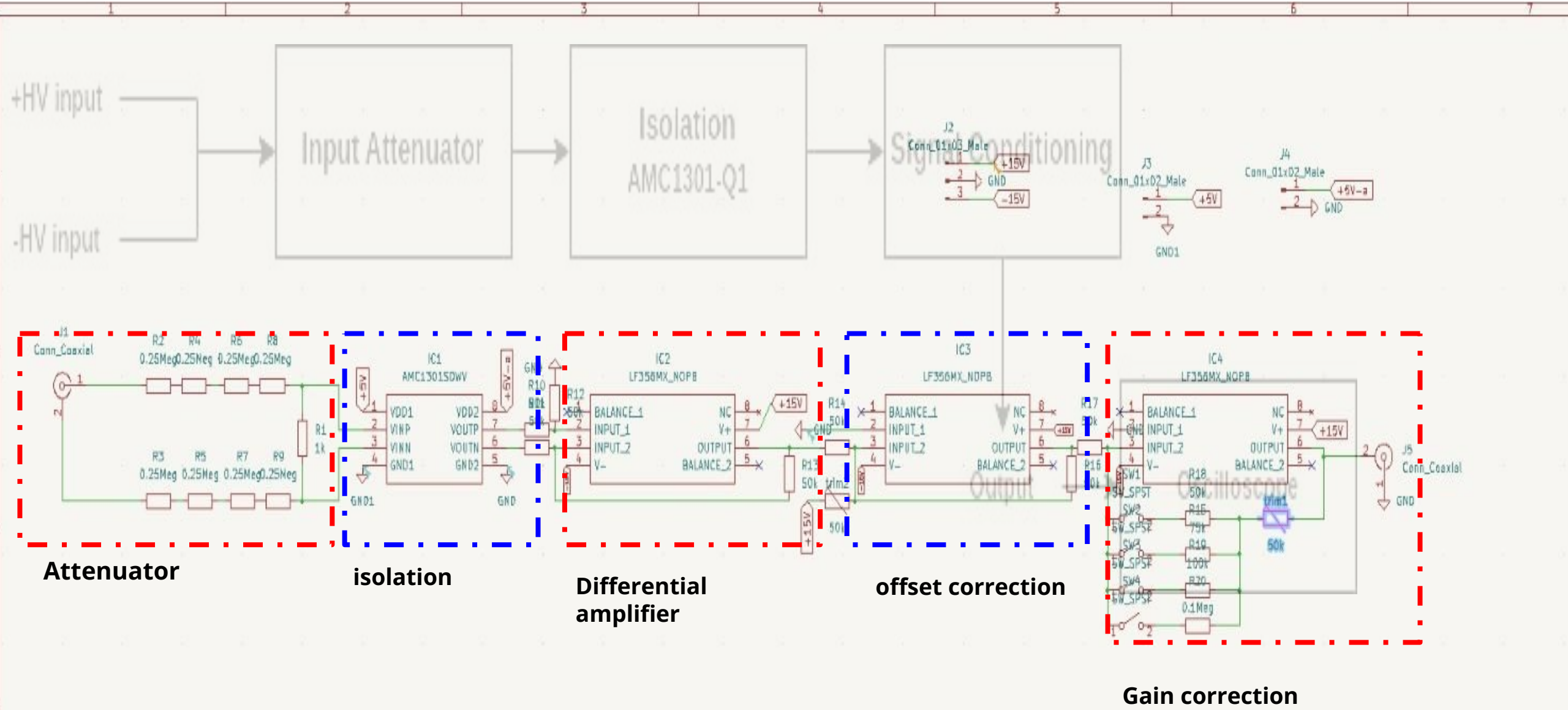
9. Testing and Calibration
10. Bugs and Fixing
11. Final PoC System Demonstration 10/April 2023

Wish specifications:

- Voltage Range: **0-600V**
- Impedance: **10MΩ**
- Bandwidth: **DC-5MHz**
- Common Mode Rejection Ratio (CMRR): **> 65dB**
- Signal Noise Ratio (SNR): **> 65dB**
- Isolation Voltage Rating: **1000V**
- Input Connector: **Banana jack type**
- Output Connector: **BNC**
- Operating Temperature: **10°C to 50°C**
- Power Source: **External**

System Block diagram




+HV input
-HV input
Input Attenuator
Isolation
AMC1301-Q1
Signal Conditioning
Conn_01x03_Male
+15V
GND
-15V
Conn_01x02_Male
+5V
GND1
Conn_01x02_Male
+5V-a
GND
Conn_Coaxial
R2 R4 R6 R8
0.25Meg 0.25Meg 0.25Meg 0.25Meg
R1
1k
R3 R5 R7 R9
0.25Meg 0.25Meg 0.25Meg 0.25Meg
IC1
AMC1301SDWV
VDD1
VINP
VINN
GND1
VDD2
VOUTP
VOUTN
GND2
+5V
+5V-a
GND
R10
50k
IC2
LF356MX_NOPB
BALANCE_1
INPUT_1
INPUT_2
V-
NC
V+
OUTPUT
BALANCE_2
+15V
R12
50k
R13
50k
trim2
-15V
IC3
LF356MX_NOPB
R14
50k
R16
50k
R17
50k
IC4
LF356MX_NOPB
SW1
SW2
SW3
SW4
SW_SPST
R15
75k
R18
50k
R19
100k
R20
0.1Meg
trim1
50k
J5
Conn_Coaxial
Attenuator
isolation
Differential amplifier
offset correction
Gain correction

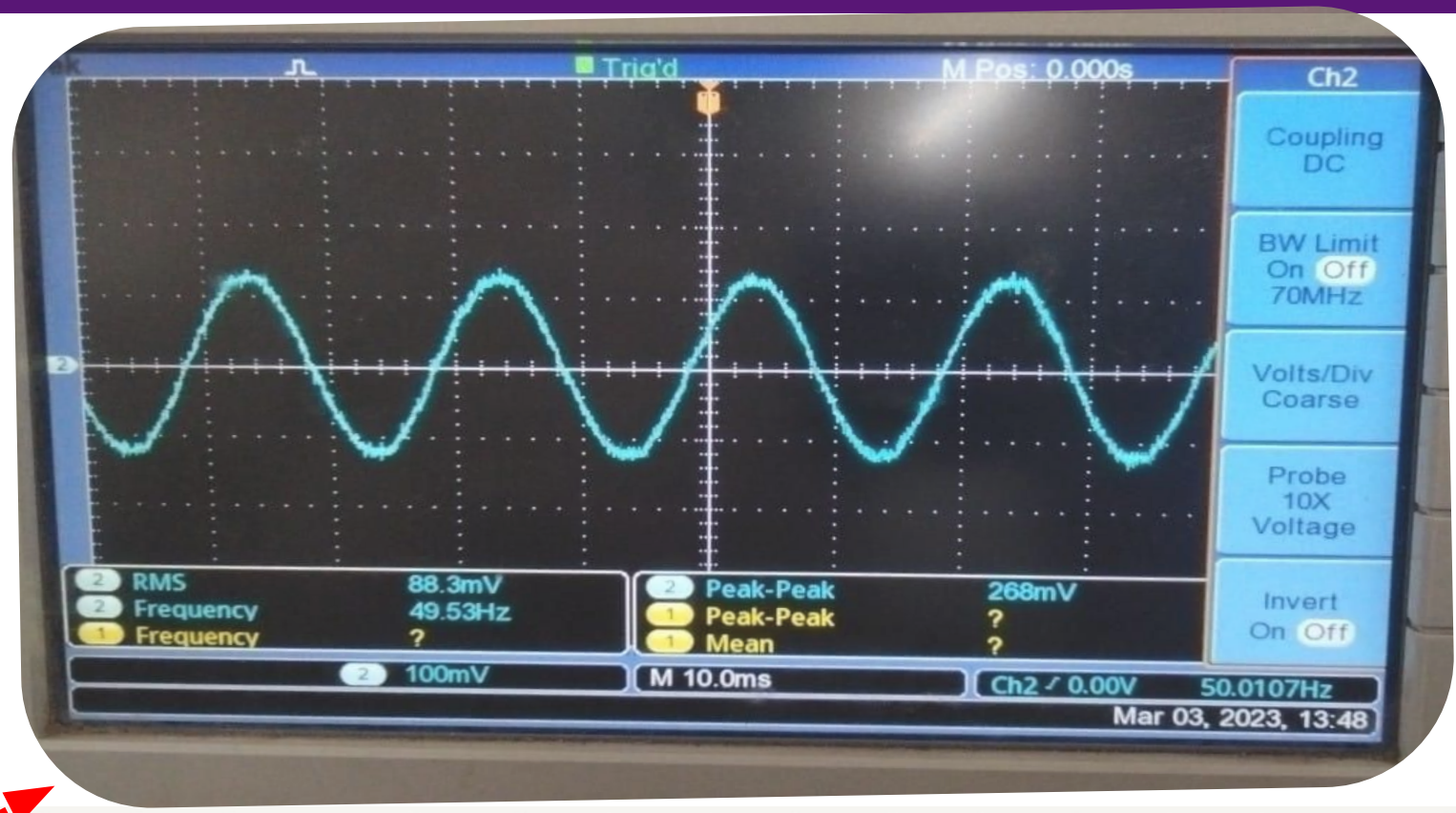
Test plan

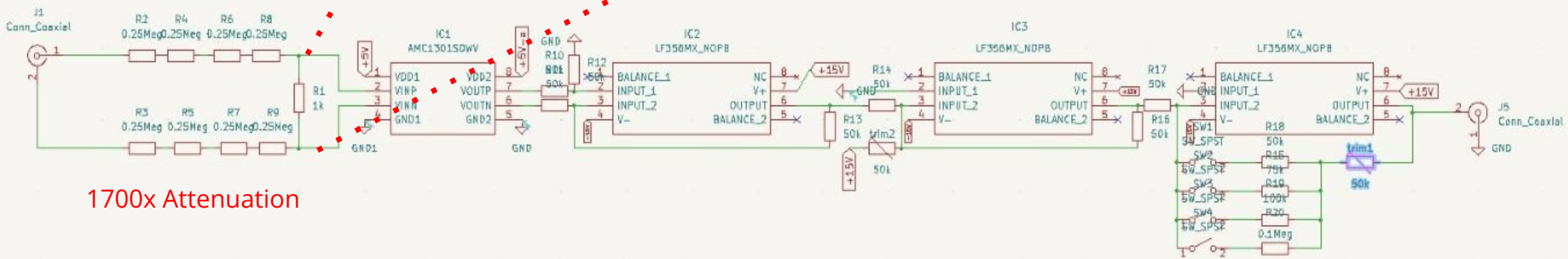
	A	B	C	D
1		Dc	low frequency (linearity)	high frequency
2	Identify 3 power sources	☑		
3	Checking attenuator stage	☑	☑	☑
4	Checking isolated amplifier (gain,offset)	☑	☑	☑
5	check diffrential amplifier	☑	☑	☑
6	Checking Offset correction	☑		☑
7	at low voltage	☑	☑	☑
8	at moderate voltage	☑	☑	☑
9	at high voltage (60V max applied)	☑	☑	☐
10	checking gain correction	☑	☑	☑

Checking attenuator stage:
since at the starting stage we can't deal with 600V so we start with
1) One stage attenuator
2) two stage attenuator
3)three stage attenuator
4) four stage attenuator

At an input of 480V pp

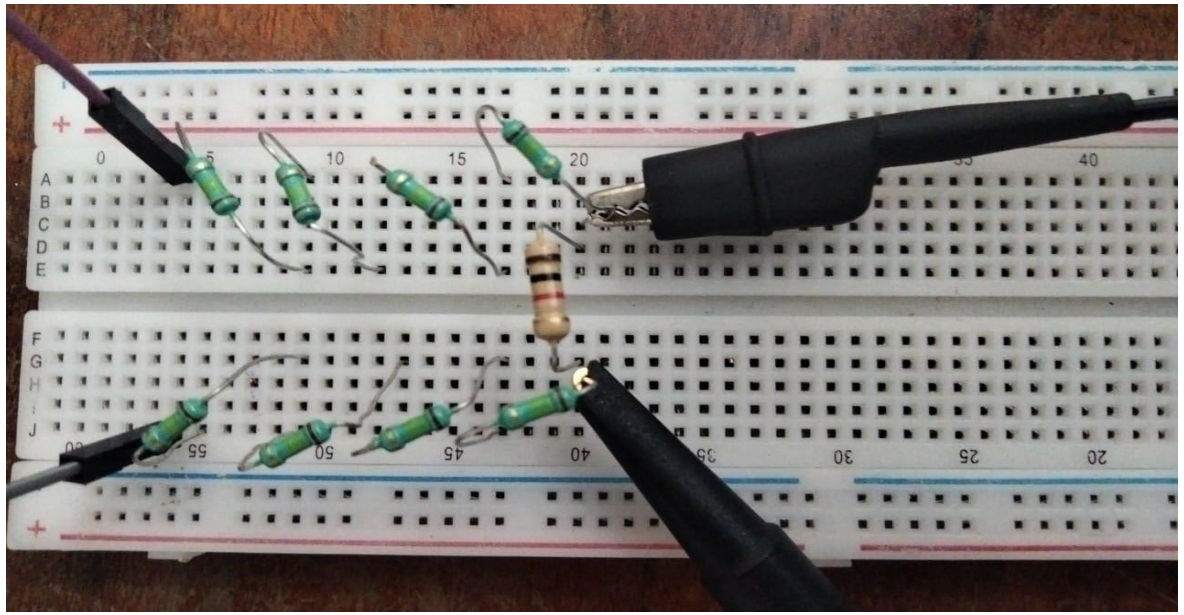
Expected = 480V / 1760 =272mV
Obtained = 268mV





1700x Attenuation

Attenuator



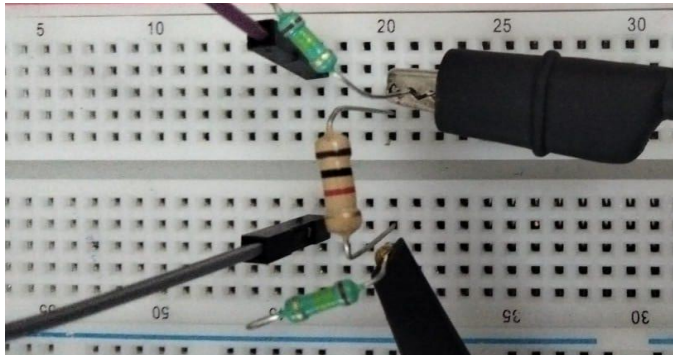
60V DC four stage attenuator

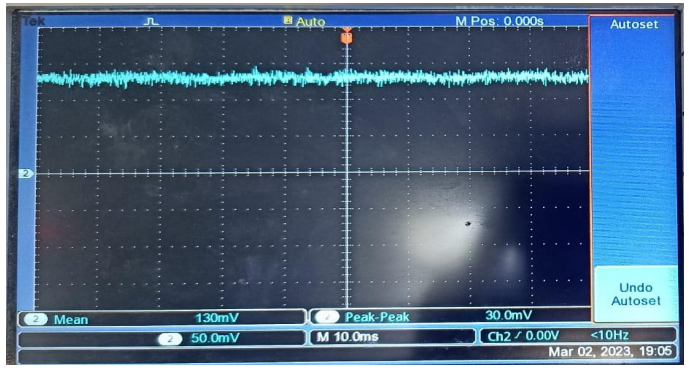
Calculations

Expected = 60V/1760 =34mV
Obtained = 42mV

60V DC one stage attenuator

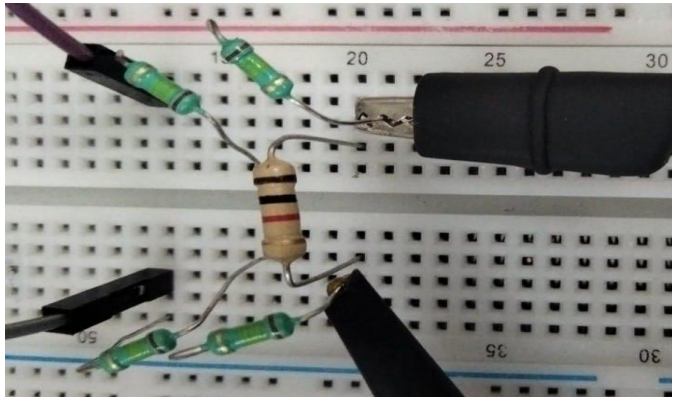
attenuation = 1/440
expected output = 136mV
obtained = 130 mV

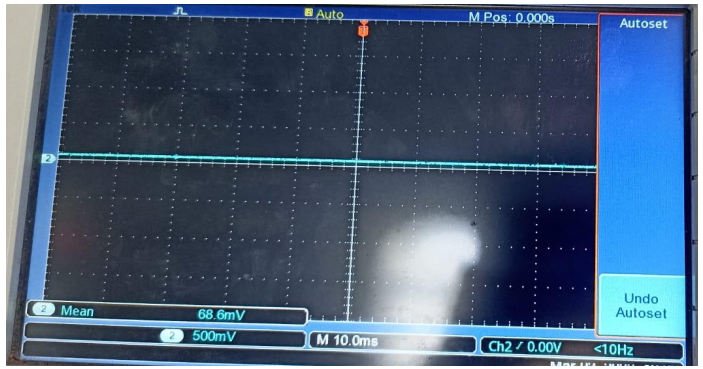




60V DC two stage attenuator

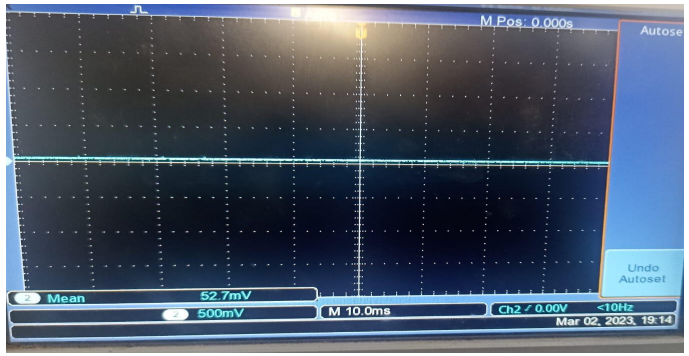
attenuation = 1/880
expected output = 68.1mV
obtained = 68.5 mV





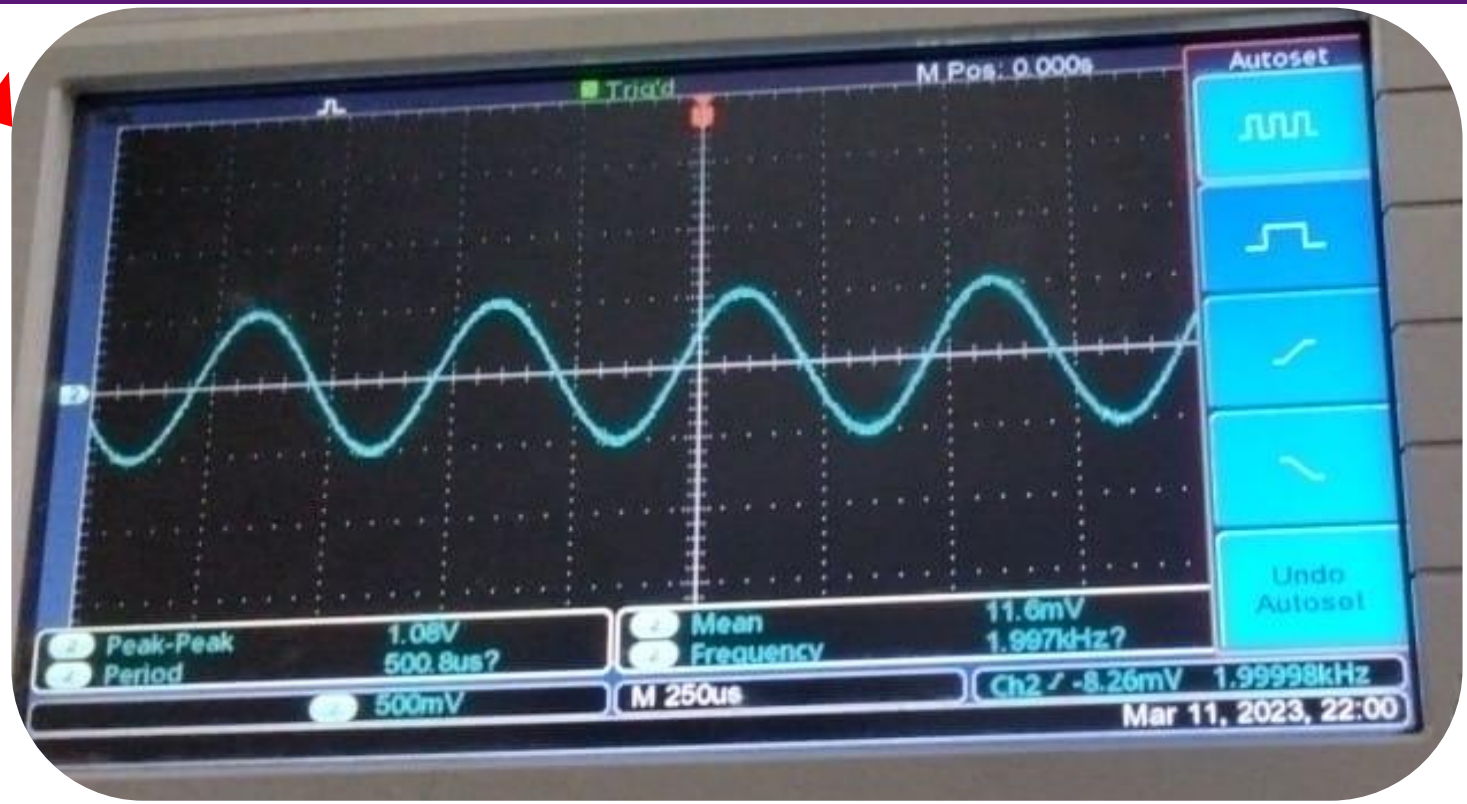
60V DC three stage attenuator

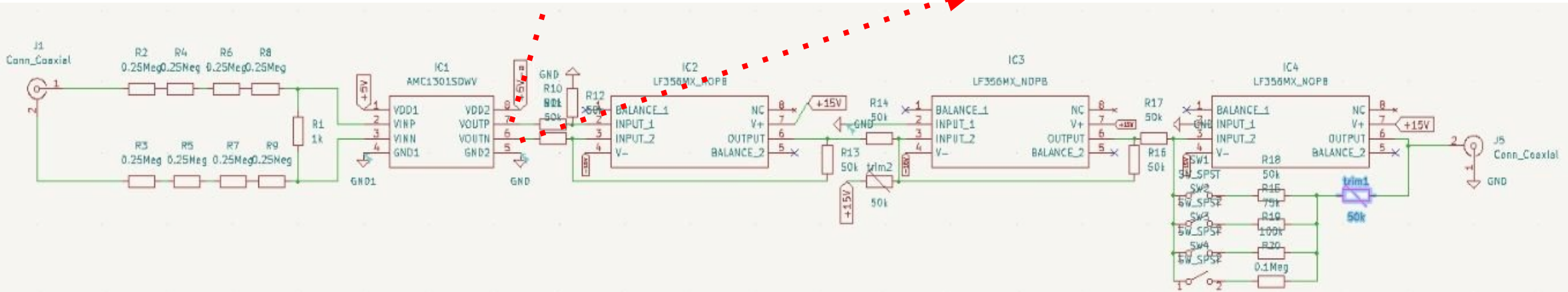
attenuation = 1/1320
expected output = 45.45mV
obtained = 52.7 mV

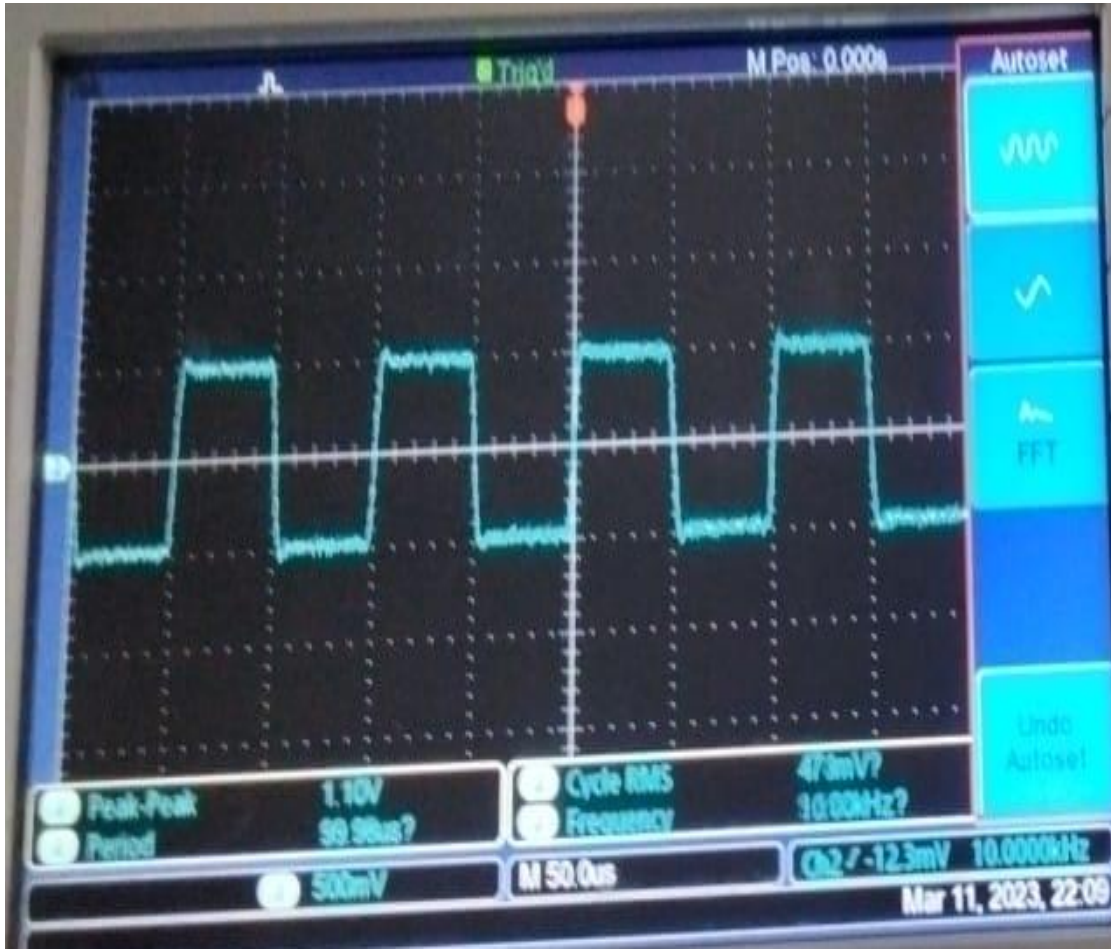


At an input of 200 mv pp to isolation amplifier at 2kHz

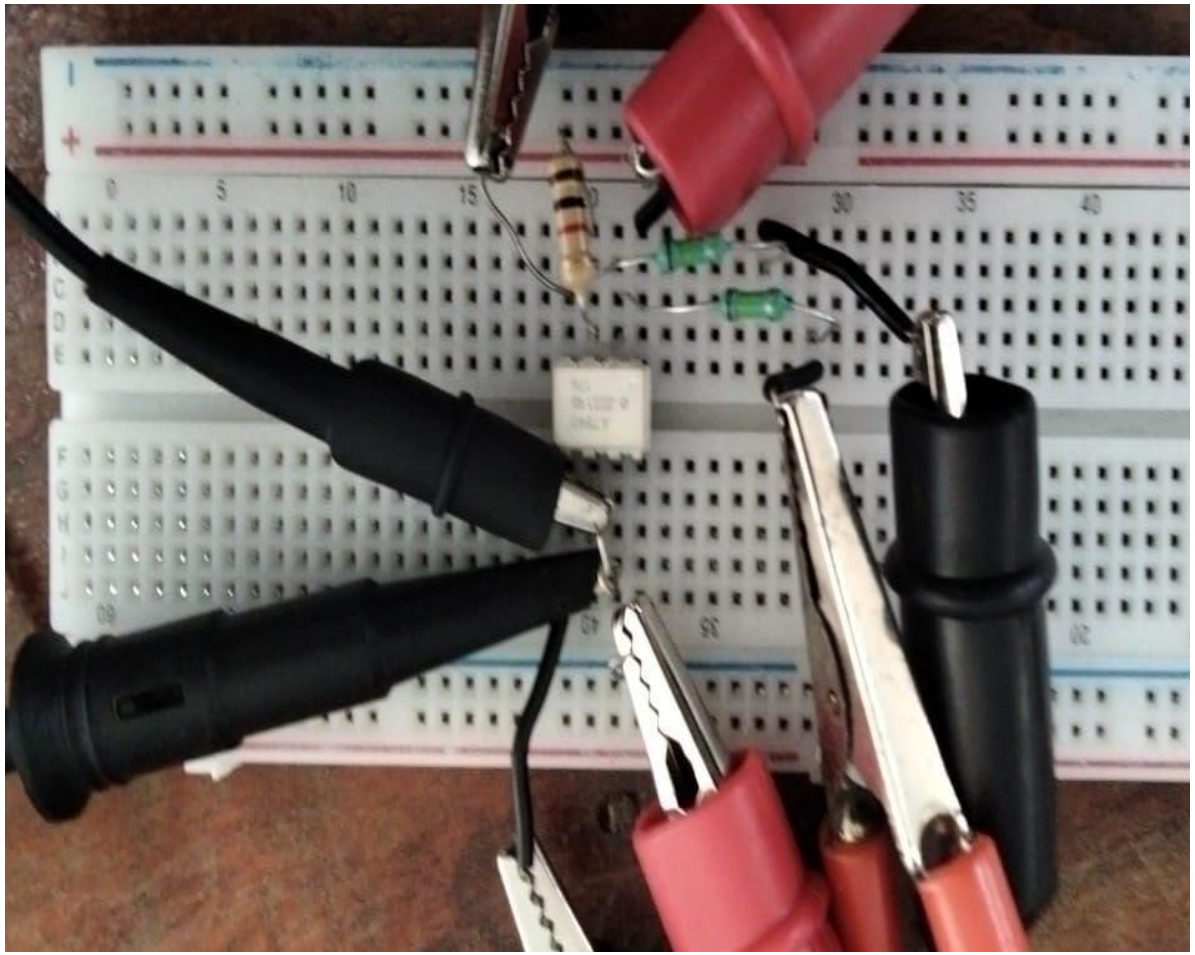
Expected gain = 8
expected output = 2V
obtained output = 1.08V
obtained gain = around (5-6)







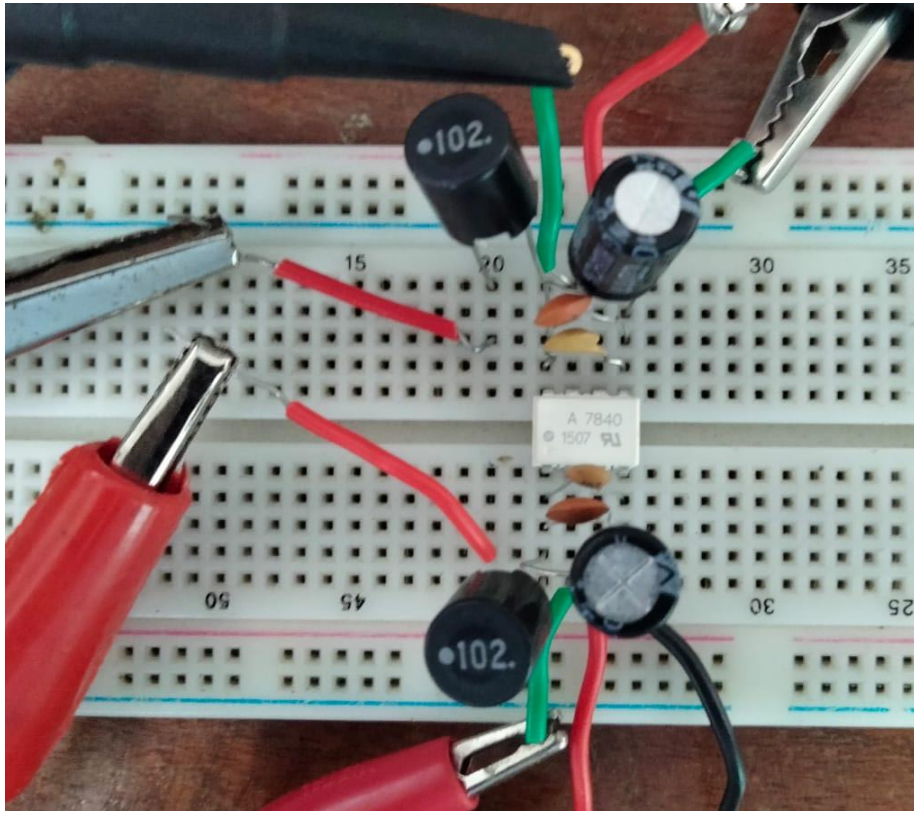
Output of isolation amplifier at 10kHz

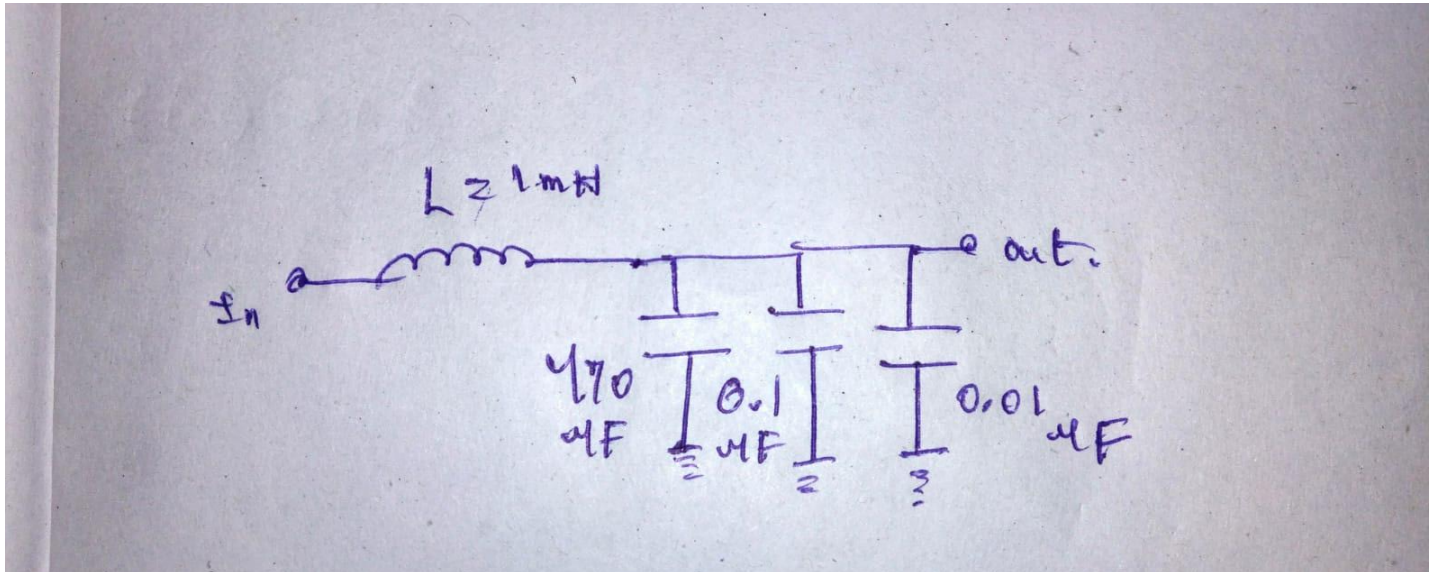


Circuit of isolation amplifier with one stage attenuator

POWER SOURCE for isolation amplifier

1) Input side and output side with RPS
2) Both side RPS through isolation transformer
3) Input side with battery and output side with RPS
4) Input side with RPS and output side with battery
5) used LC filter for cancellation of noise
6) Input side and output side with battery

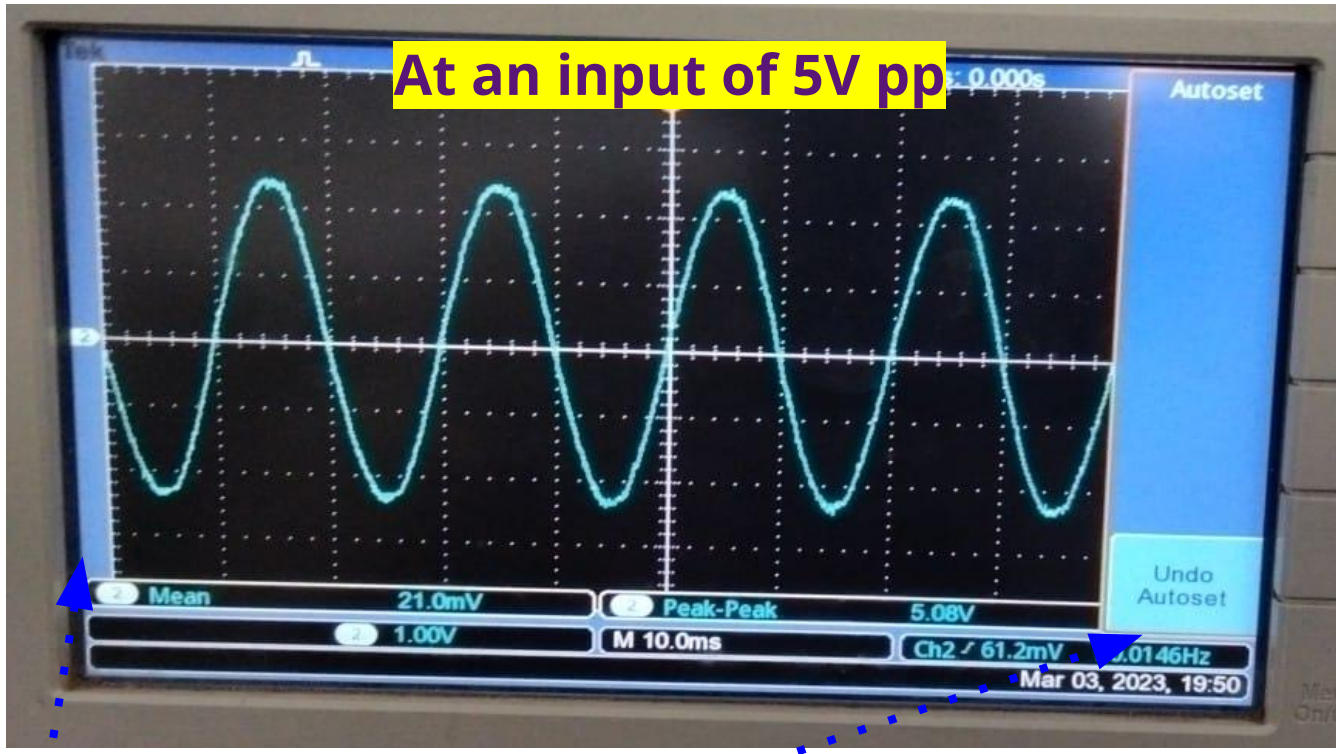


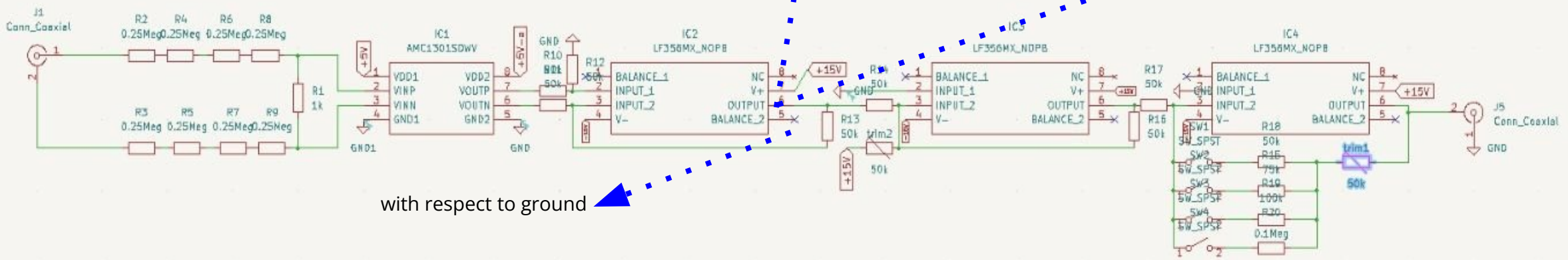


LC Filter Circuit

used for noise correction

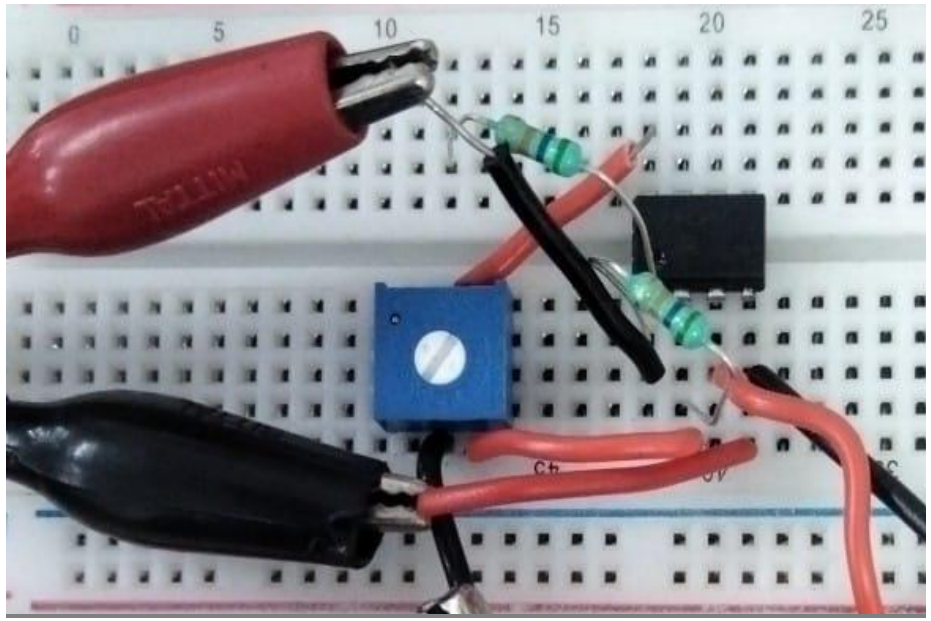
Differential Amplifier



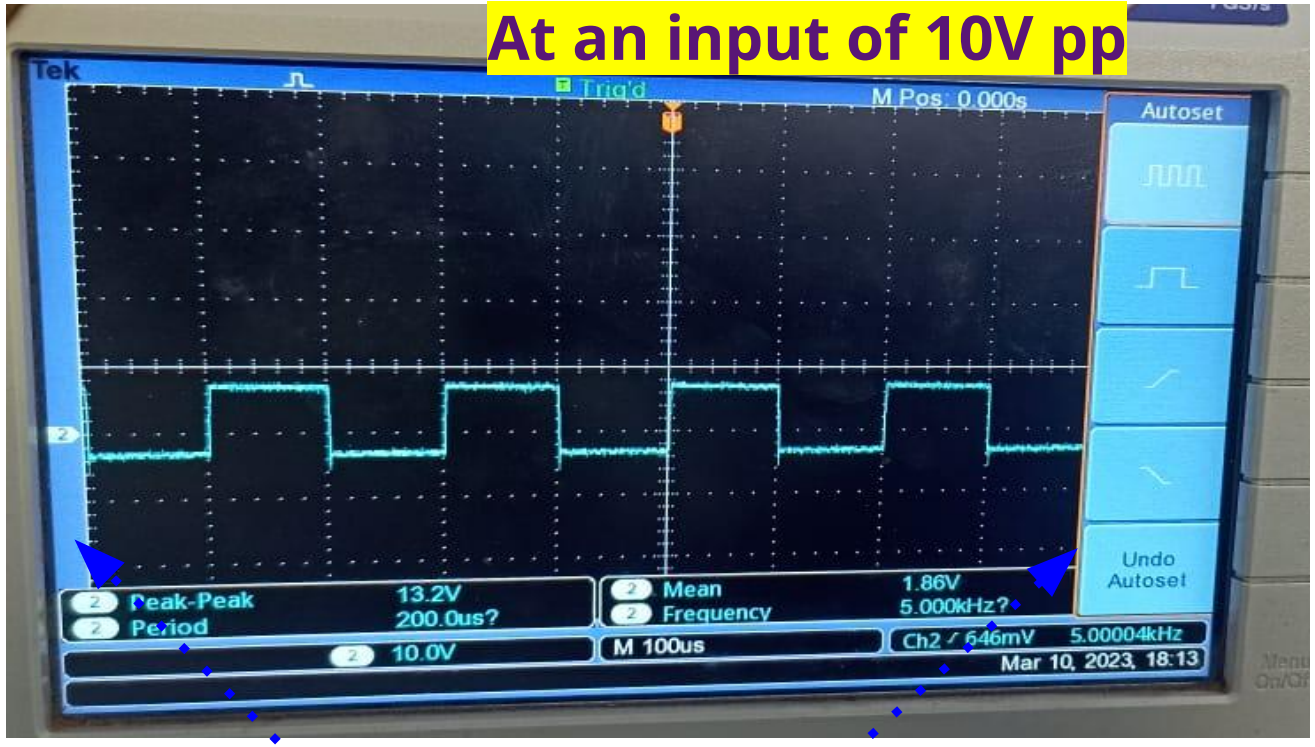


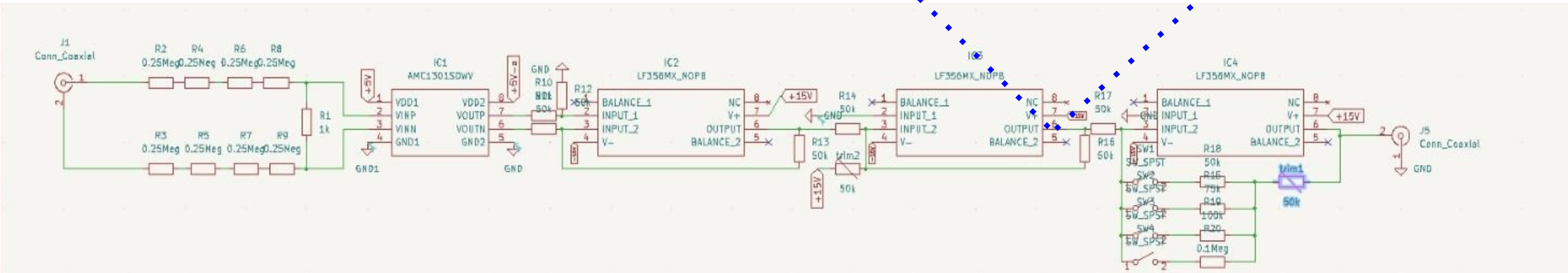
with respect to ground

Summing amplifier(offset correction)

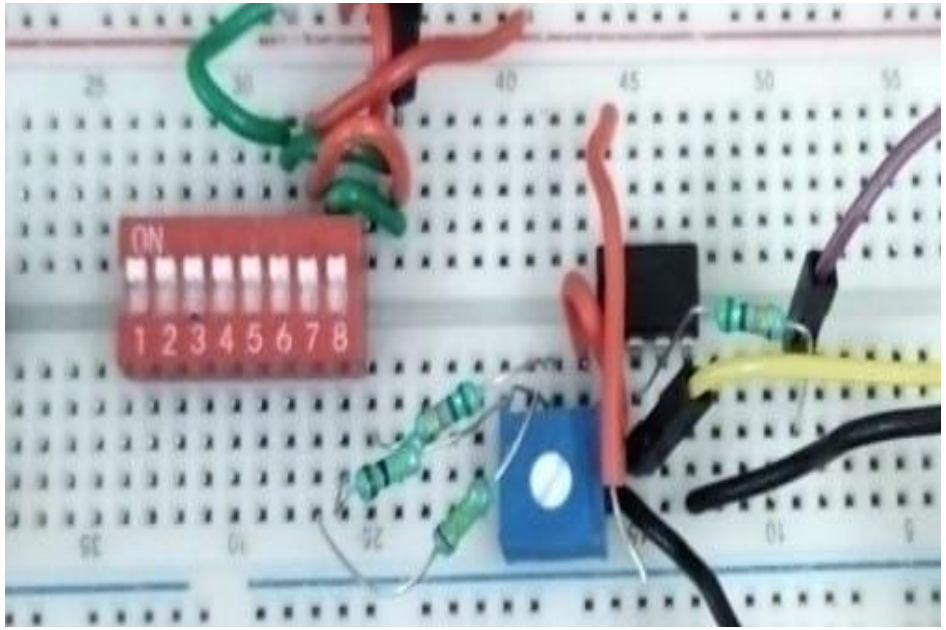


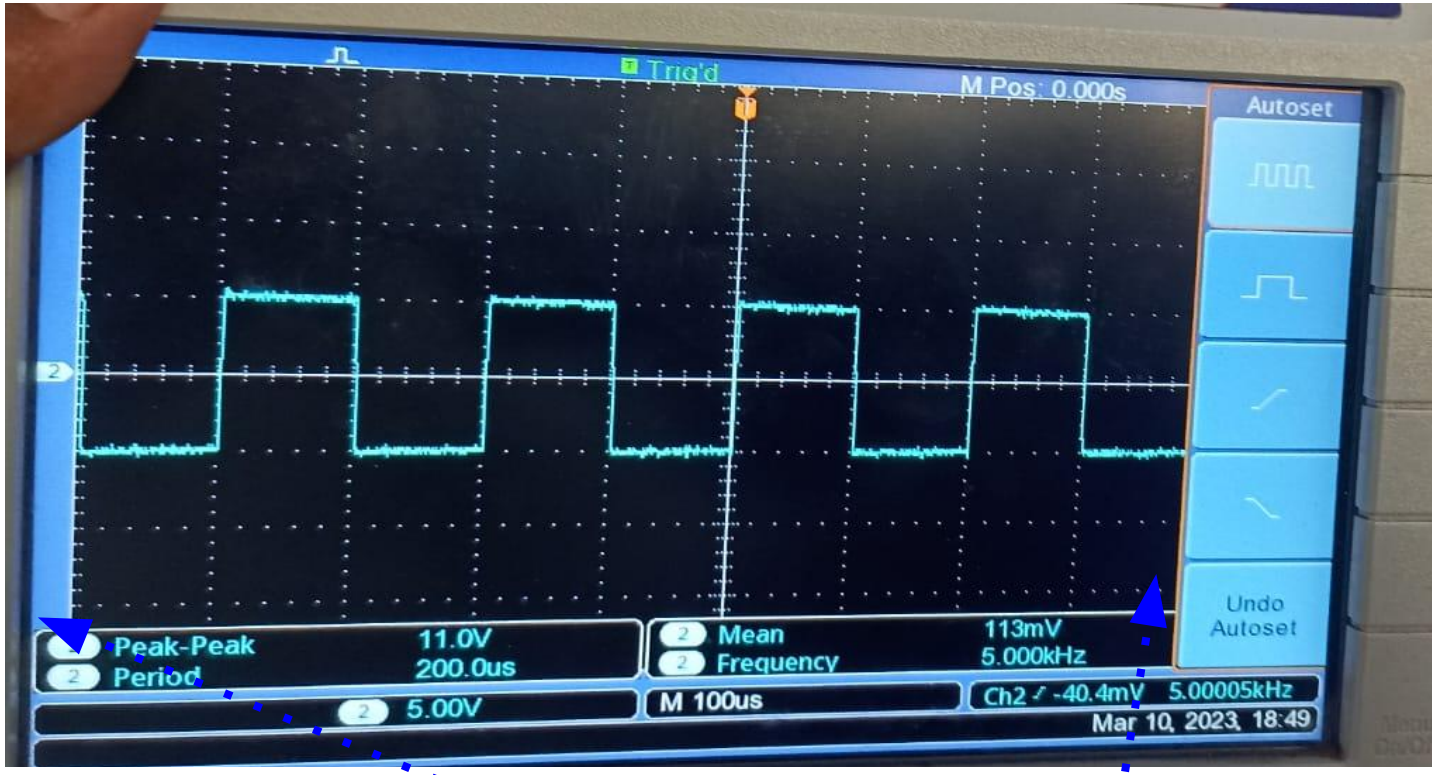
At an input of 10V pp

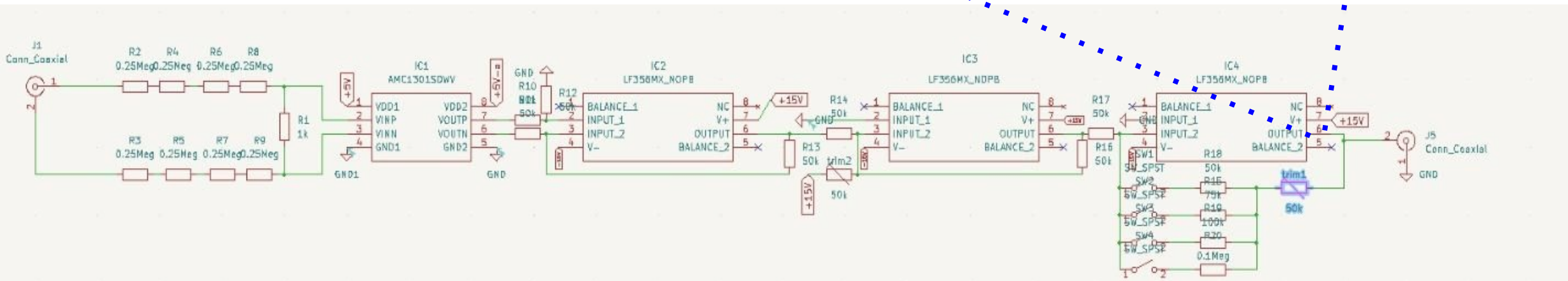




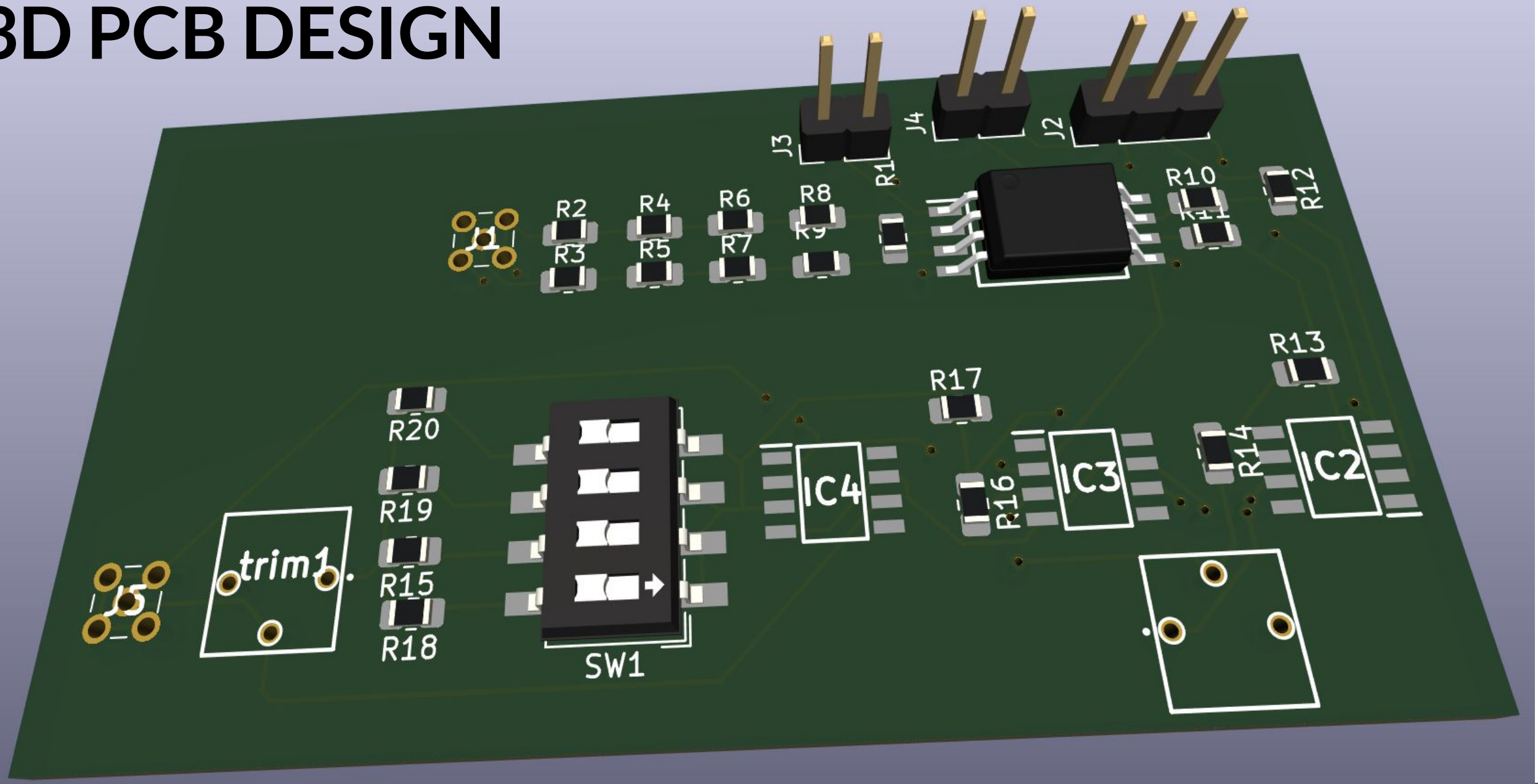
Inverting amplifier (Gain Correction)







3D PCB DESIGN



Future work / path to completion

Final Evaluation

1. Testing and Calibration
2. Bugs and Fixing
3. Final PoC System Demonstration 10/April 2023

Final demo plan

We will show our working design for 600V DC which will display voltage value in DSO.