॥ सा विद्या या विमुक्तये ॥

भारतीय प्रौद्योगिकी संस्थान धारवाड़

Indian Institute of Technology Dharwad

High Voltage Isolated Differential Probe

EE314: EDL Project Evaluation 2

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

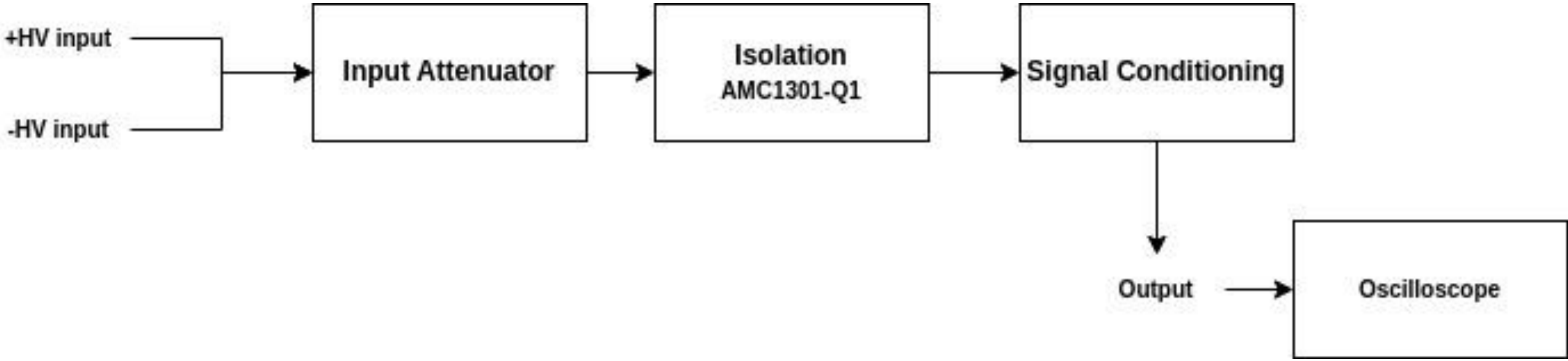
D. Final Evaluation

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

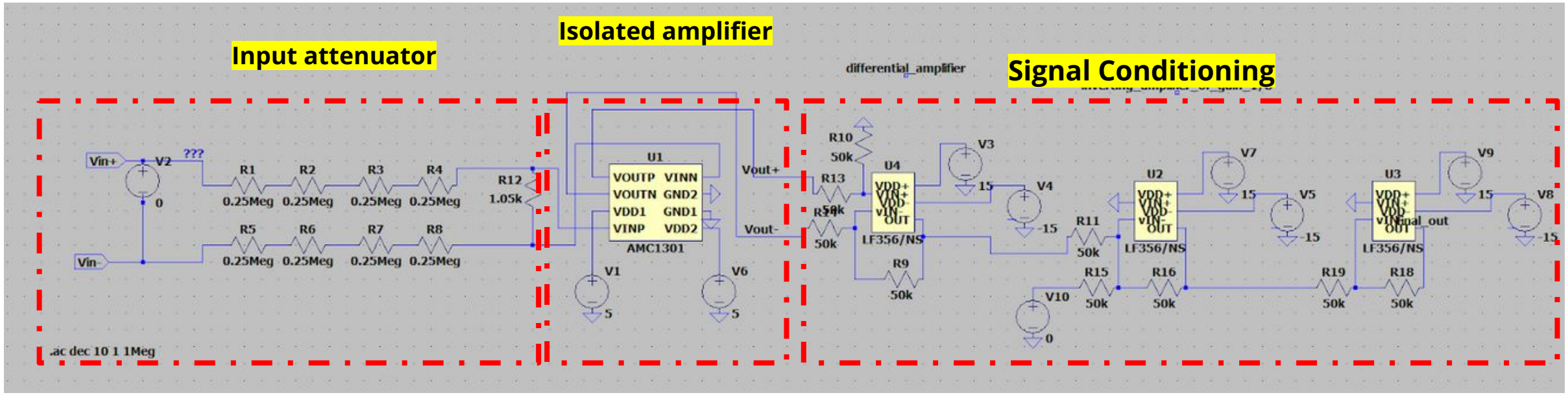
Wish specifications:

- 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



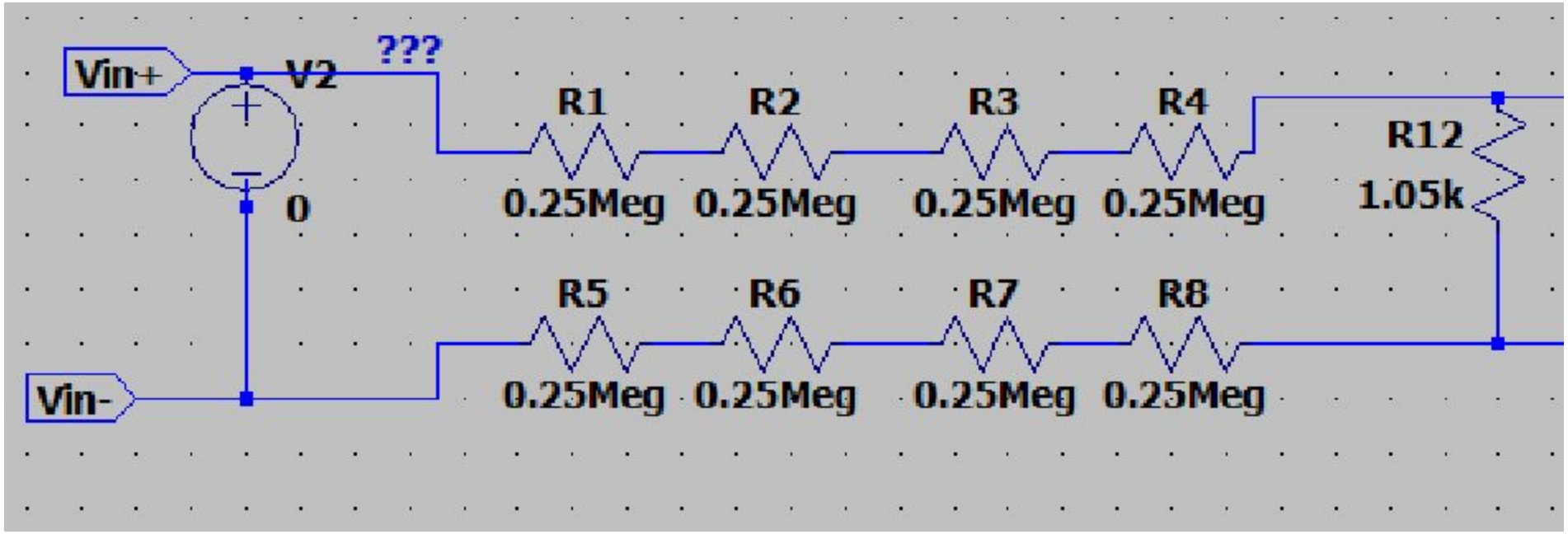
Circuit Schematic



Stages:

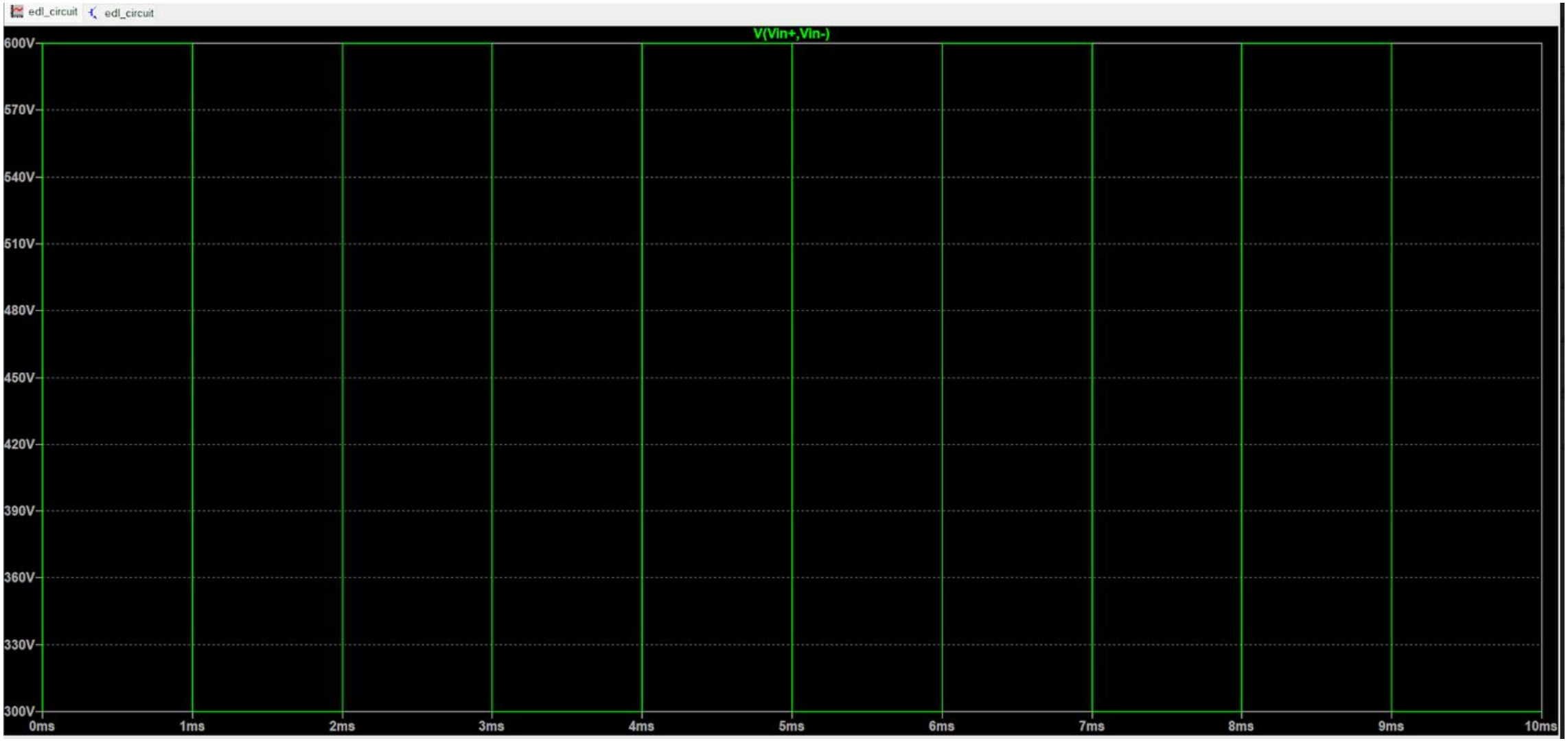
Input attenuator(voltage divider)(attenuation 1/2000)
isolation amplifier (AMC1301 IC) (bandwidth=1MHz)
differential amplifier
inverting amplifier (for gain correction)
inverting amplifier (for offset correction)

Input Attenuator Stage

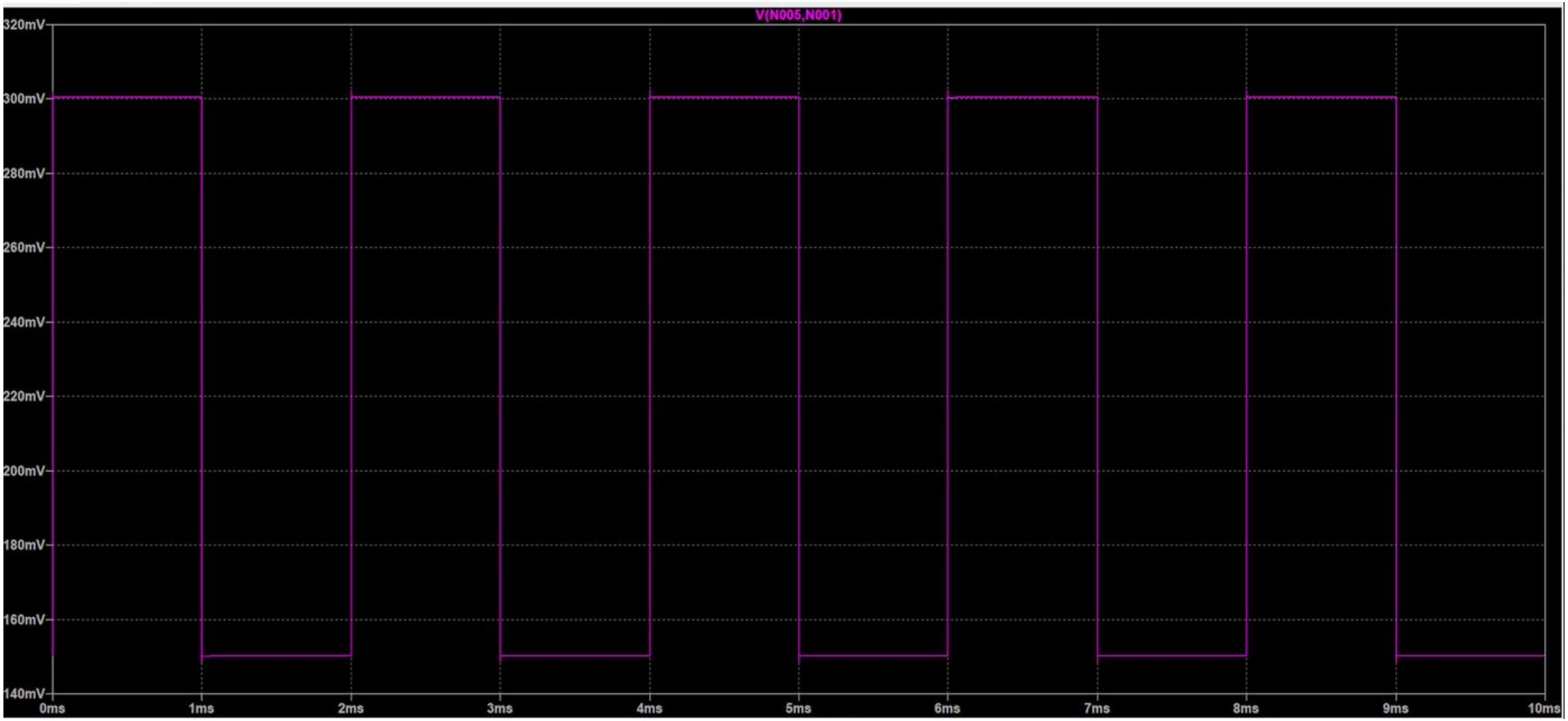


Attenuation: 1/2000

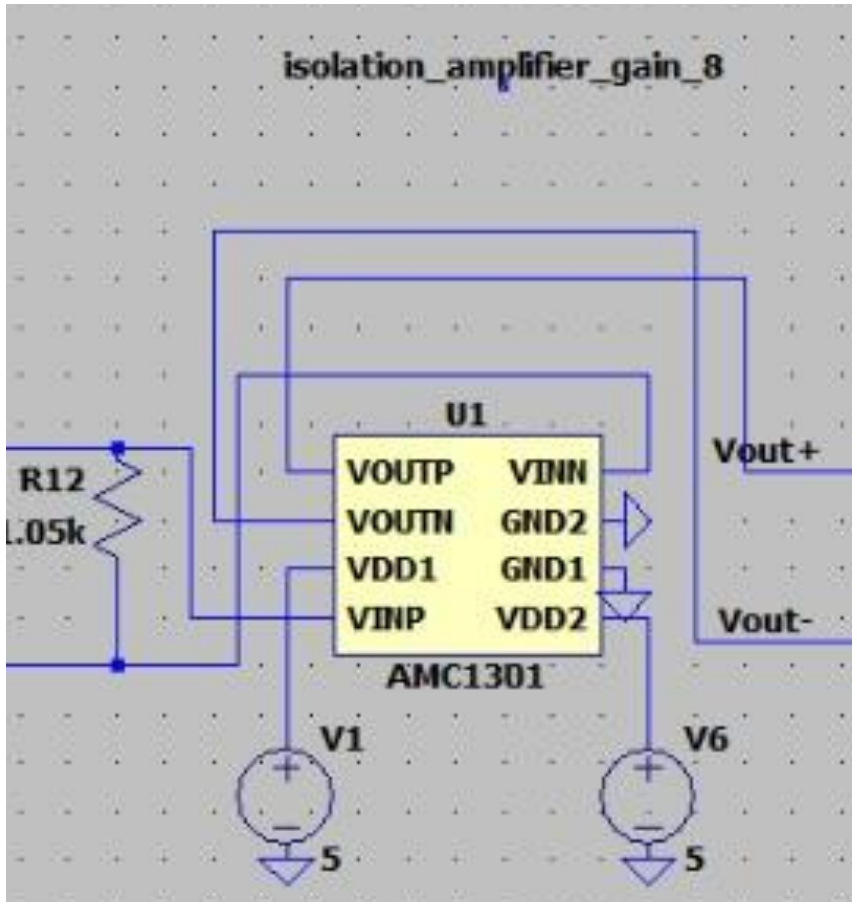
High voltage Input

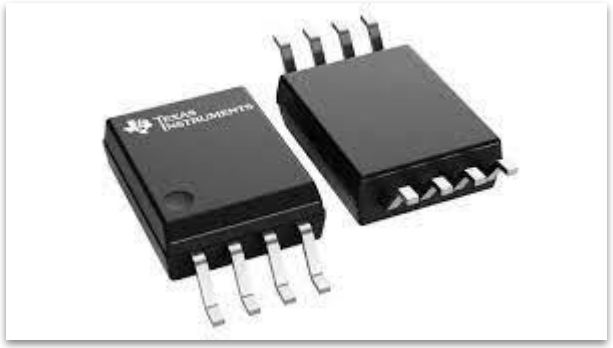


Output after Attenuator



Isolated Amplifier Stage
AMC1301



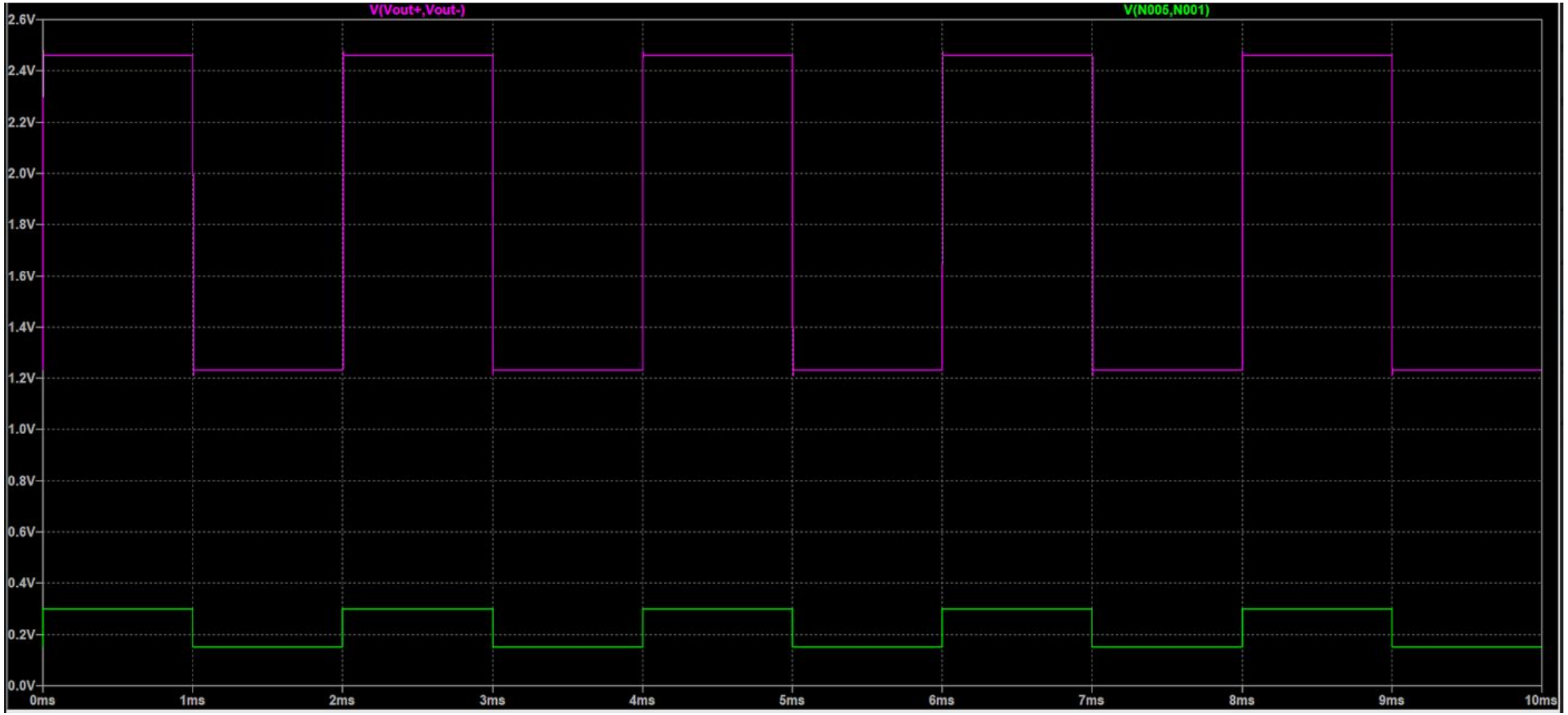


Bandwidth: 1MHz
gain: 8
Vdd: -0.3 to 7V
Input voltage range : 330mV (calculated by simulations)

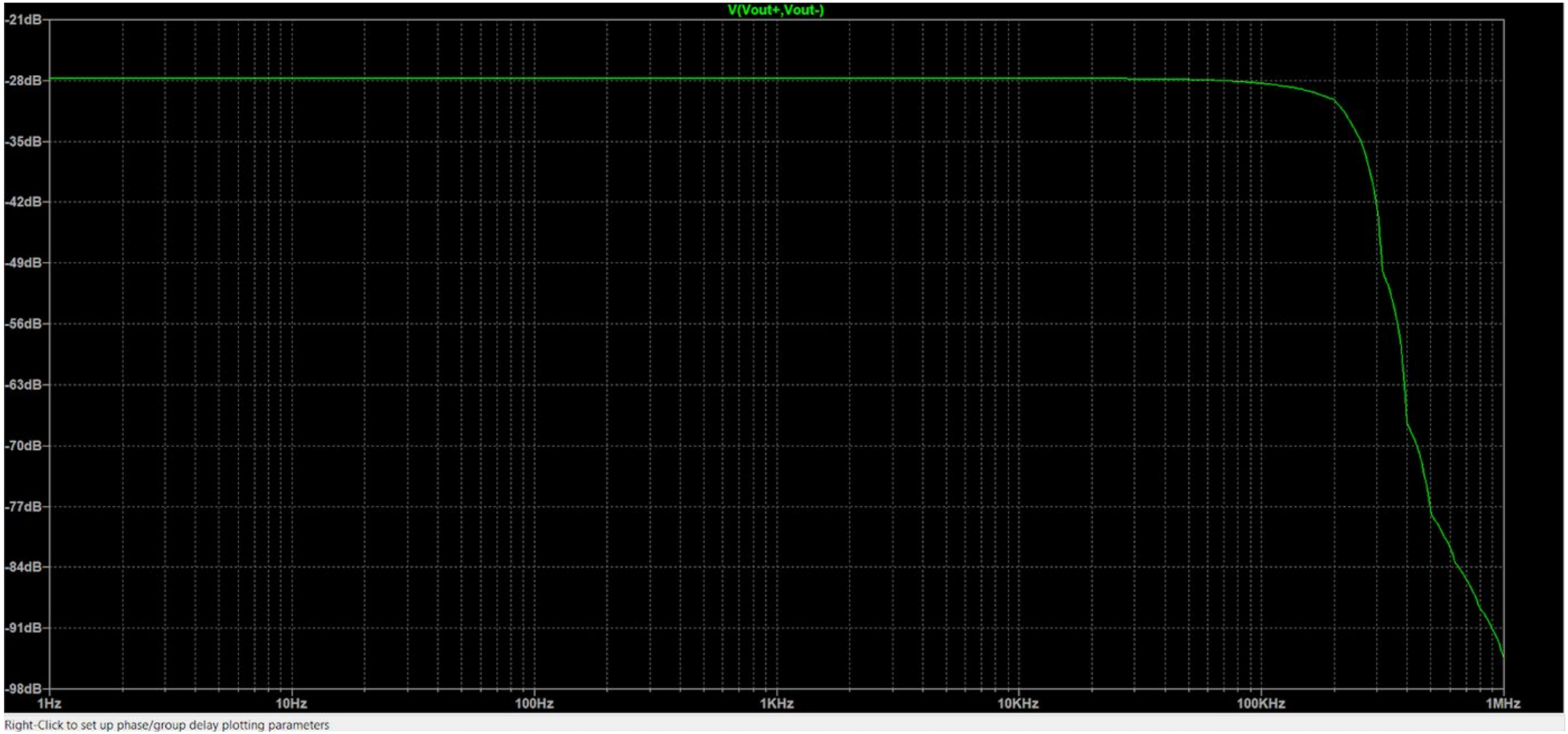
- **Specs**

GBWP	—1000 kHz
CMRR	-— 92 dB
Operating Temperature	—(-40 to 125 c)
VDD	— (–0.3 to 7) V
Input Voltage Range	— (GND1 – 6) to (VDD+ 0.5)

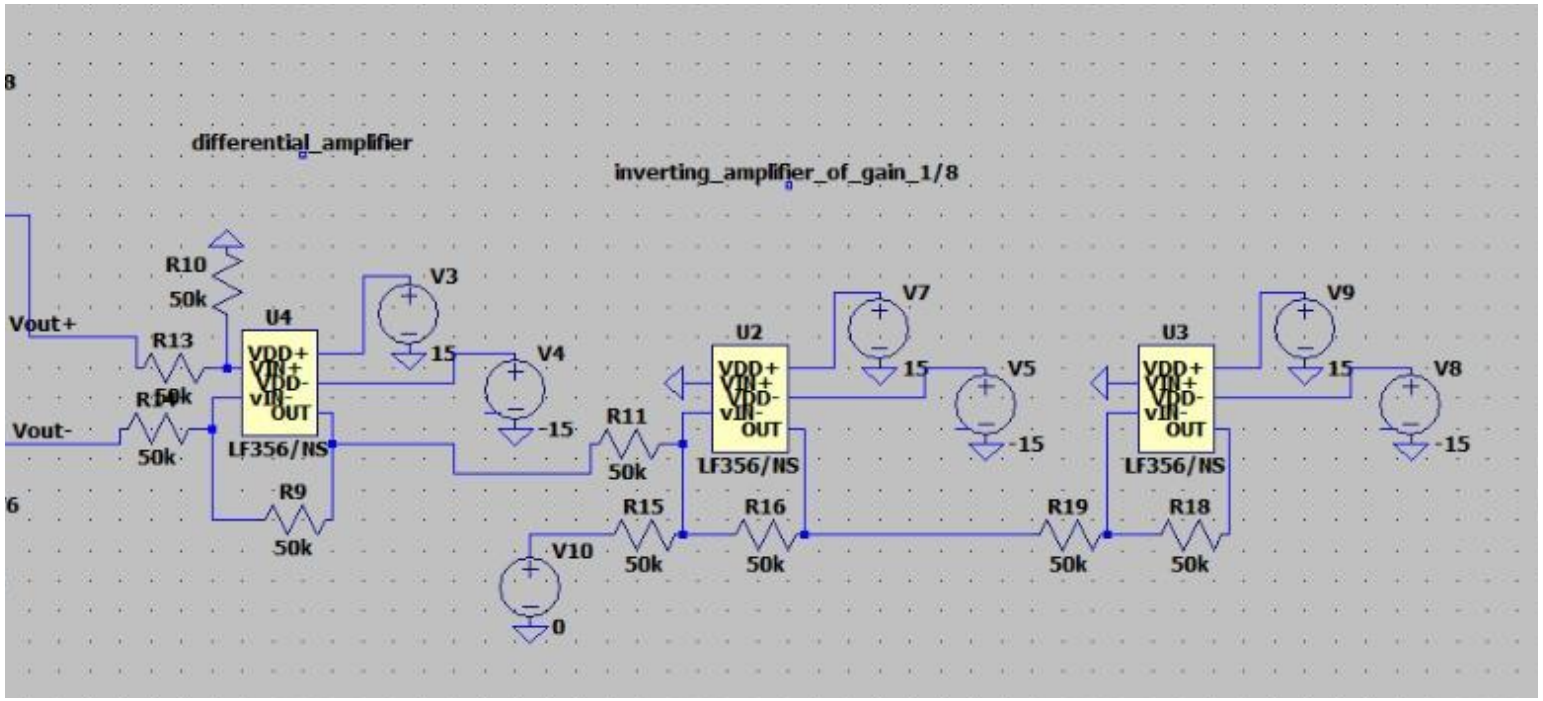
Input and Output of Isolation amplifier



AC analysis for Sinusoidal



Signal Conditioning



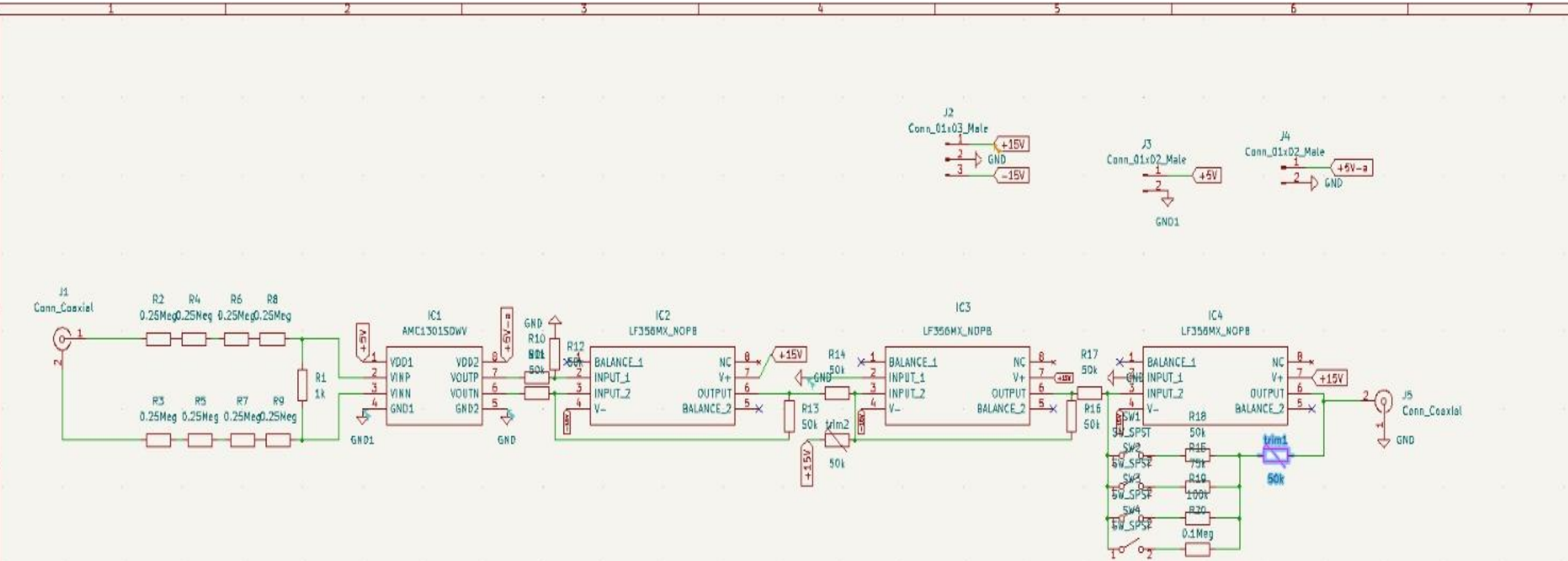
IC (LF356)
Differential amplifier : making output single ended
Inverting amplifier : used for trimming of gain and offset correction

Output after differential amplifier vs output after Isolated amplifier

Trimming Values Required for gain and offset correction

Frequency (Hz)	Gain (dB)	Trimming Values (Ohm)
1-1000	-48.14	51k (+75)
1000-10k	-48.14	51k (+75 to +107)
10k-50k	-48.15 - -48.71	51k(+107 to 900)
50k-63k	-48.15 - -48.71	52k (+403)
63k-80k	-48.15 - -48.71	53k (+203)
80k-100k	-48.15 - -48.71	54k (+544)
100k-126k	-49	56k (+777)
126k -158k	-49	60k (+654)
158k- 200k	-50	68k (+300)
200k-250k	-50 to -54	1M (+9k)
250k-500k	-54 to -90	6M (+57k to +542k)
500k-1M	-98 to -114	31M (+494k to 323k)

PCB schematic diagram

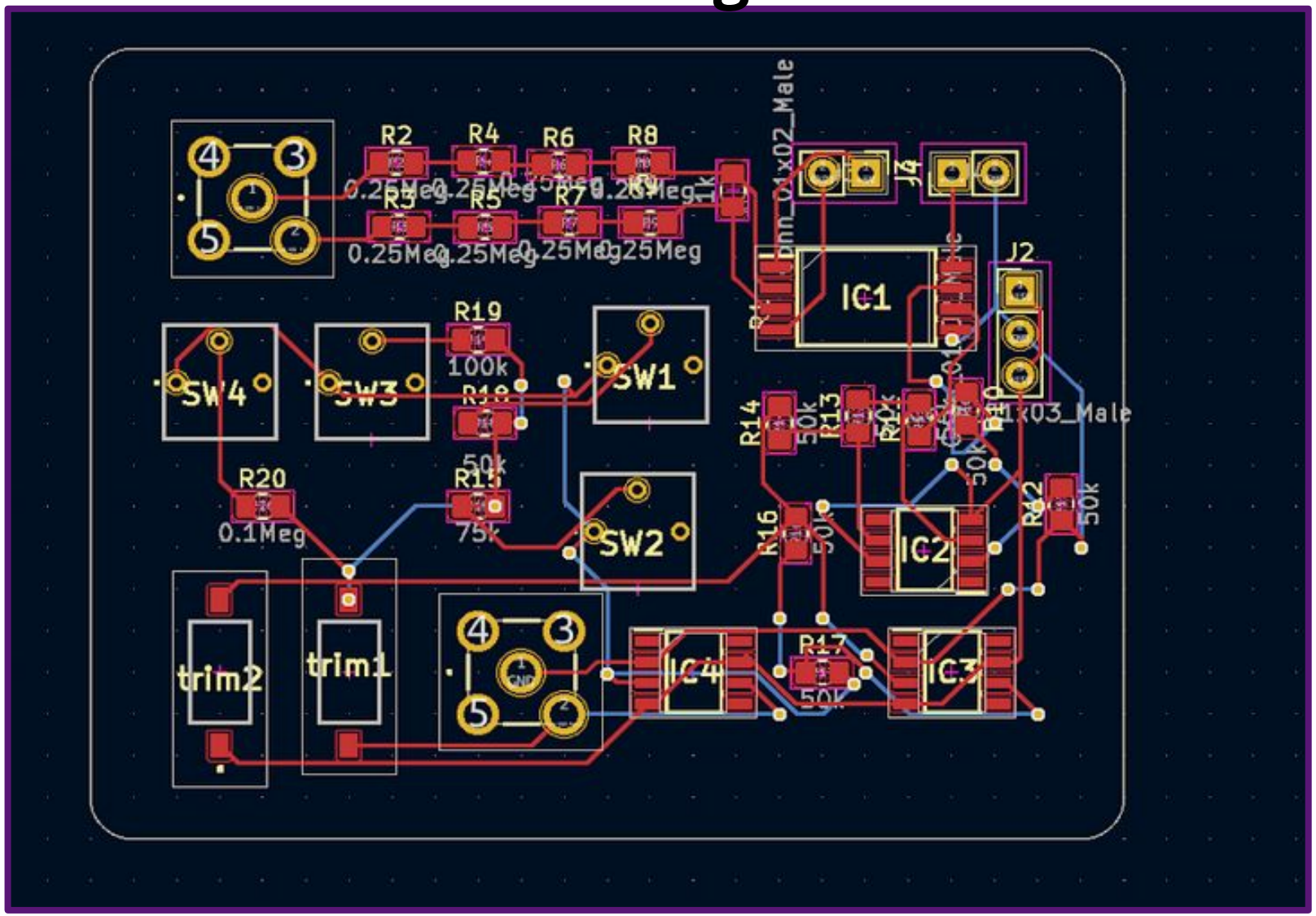


Footprints used in PCB Design

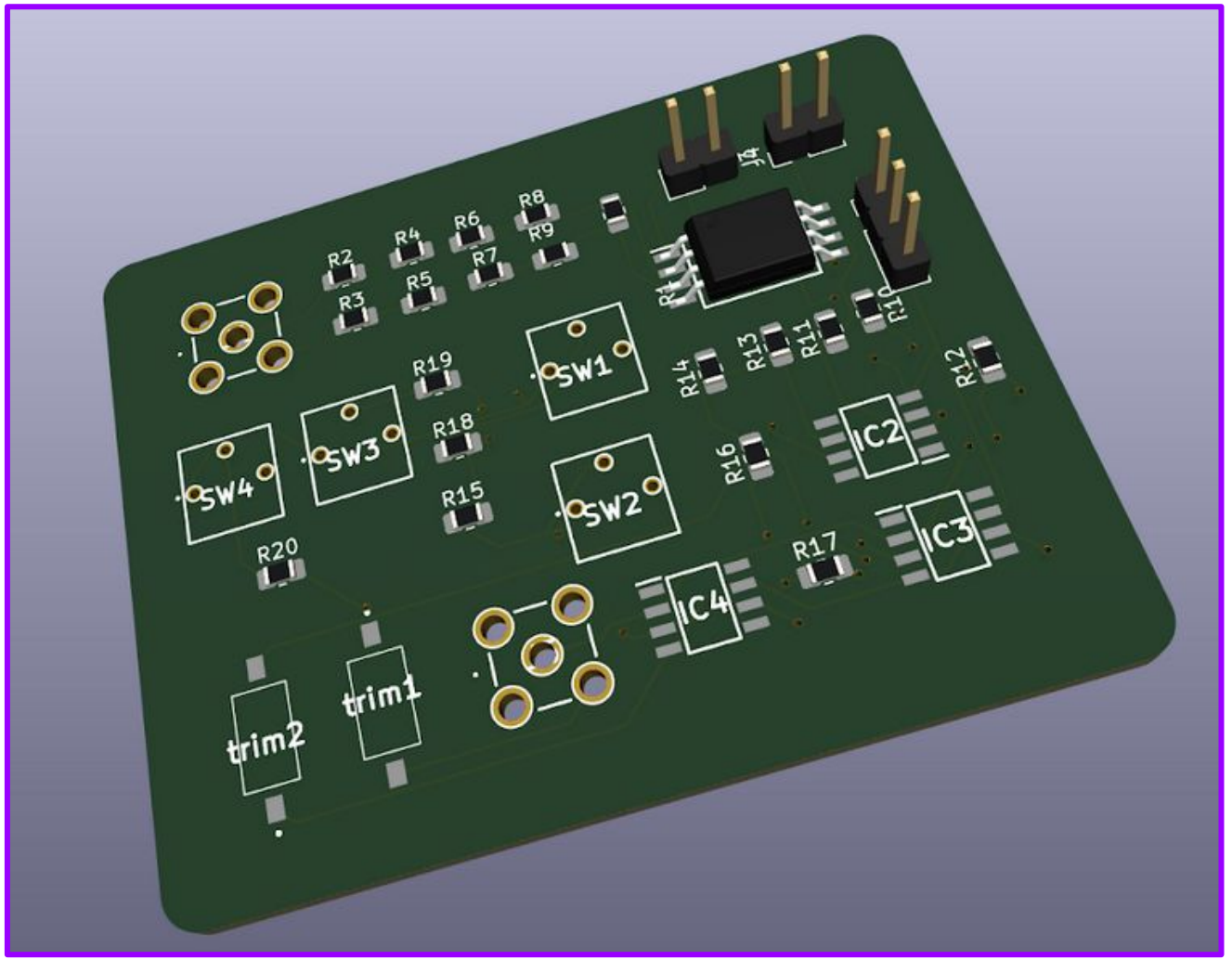
Symbol : Footprint Assignments

1	IC1	AMC1301SDWV	AMC1301SDWV:SOIC127P1150X280-8N
2	IC2	LF356MX_NOPB	LF356MX_NOPB:SOIC127P600X175-8N
3	IC3	LF356MX_NOPB	LF356MX_NOPB:SOIC127P600X175-8N
4	IC4	LF356MX_NOPB	LF356MX_NOPB:SOIC127P600X175-8N
5	J1	Conn_Coaxial	R124426123:R124426123
6	J2	Conn_01x03_Male	Connector_PinHeader_2.54mm:PinHeader_1x03_P2.54mm_Vertical
7	J3	Conn_01x02_Male	Connector_PinHeader_2.54mm:PinHeader_1x02_P2.54mm_Vertical
8	J4	Conn_01x02_Male	Connector_PinHeader_2.54mm:PinHeader_1x02_P2.54mm_Vertical
9	J5	Conn_Coaxial	R124426123:R124426123
10	R1	1k	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder
11	R2	0.25Meg	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder
12	R3	0.25Meg	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder
13	R4	0.25Meg	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder
14	R5	0.25Meg	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder
15	R6	0.25Meg	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder
16	R7	0.25Meg	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder
17	R8	0.25Meg	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder
18	R9	0.25Meg	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder
19	R10	50k	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder
20	R11	50k	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder
21	R12	50k	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder
22	R13	50k	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder
23	R14	50k	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder
24	R15	75k	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder
25	R16	50k	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder
26	R17	50k	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder
27	R18	50k	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder
28	R19	100k	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder
29	R20	0.1Meg	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder
30	SW1	SW_SPST	3362P-1-102LF:3362P_1
31	SW2	SW_SPST	3362P-1-102LF:3362P_1
32	SW3	SW_SPST	3362P-1-102LF:3362P_1
33	SW4	SW_SPST	3362P-1-102LF:3362P_1
34	trim1	50k	DS04-254-2-01BK-SMT:DS04254201BKSMT
35	trim2	50k	DS04-254-2-01BK-SMT:DS04254201BKSMT

PCB Design


R2
R4
R6
R8
R3
R5
R7
0.25Meg
J4
Conn_01x02_Male
IC1
J2
R19
100k
SW4
SW3
SW1
R14
50k
R13
R20
0.1Meg
75k
SW2
R16
IC2
R12
trim2
trim1
IC4
R17
IC3
Conn_01x03_Male

3D model of PCB Design



Future Work

Third Evaluation

Prototyping and Assembling
Integration 17/March 2023