CSE 251
Electronic Devices and CIRCUITS

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Group: 1

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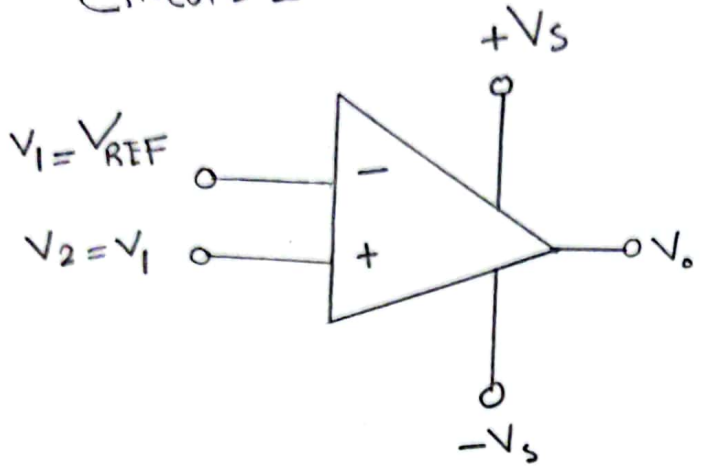
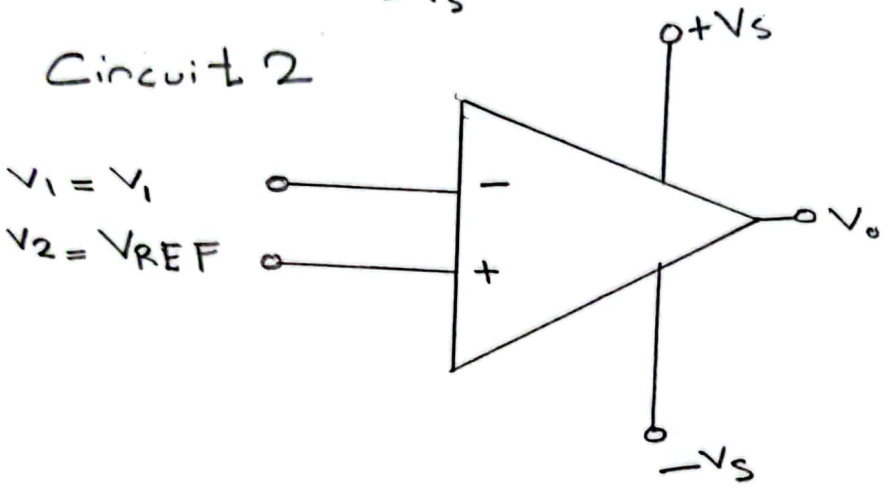
Task 1: Op-Amp Comparator Circuits

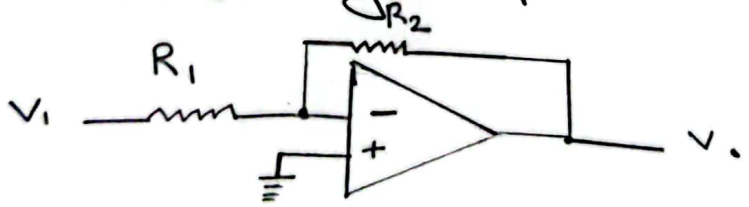
Circuit 1



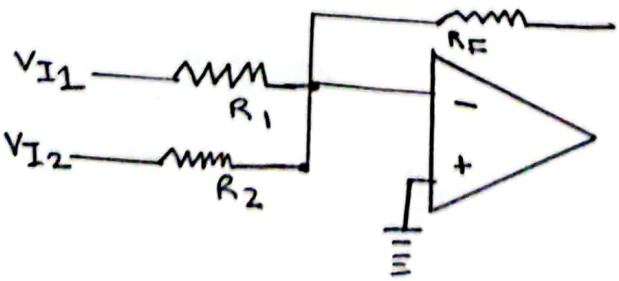
Circuit 2



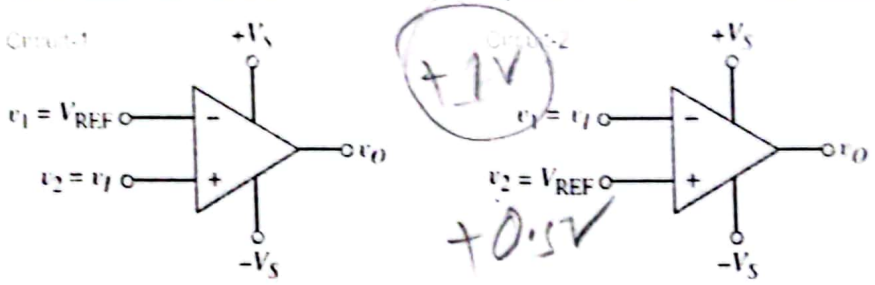
Task 2: Inverting Amplifier Circuits



Task 3: Inverting Summing Amplifier



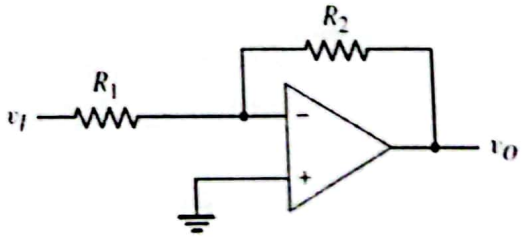
Task-01: Op-Amp Comparator



Procedure

1. Construct Circuit-1 with v_I = 2 V (p-p), 1 kHz sine wave and V_{REF} = 0.5 V. The supply voltage $+V_S$ and $-V_S$ should be +10 V and -10 V respectively which can be taken from the trainer board. **Use this supply voltage throughout the experiment.** The input voltage v_I can be taken from the oscilloscope.
2. Connect the Ch1 and Ch2 of the oscilloscope to v_I and v_O respectively. Observe the input and output waveform and capture them using a camera.
3. Now, construct Circuit-2 and repeat the experiment with same values given above. Observe the input and output waveform and capture them using a camera.

Task-02: Inverting Amplifier



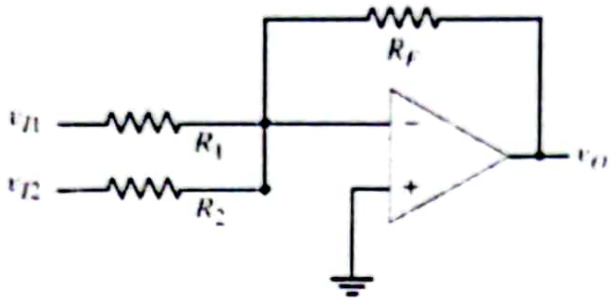
Procedure

1. Construct the circuit with v_I = 2 V (p-p), 1 kHz sine wave. Use R_1 = 1 kΩ, R_2 = 2.7 kΩ.
2. Connect the Ch1 and Ch2 of the oscilloscope to v_I and v_O respectively. Observe the input and output waveform and capture them using a camera.

Observation and Calculation

The output waveform should be amplified and inverted compared to the input waveform.
Input Amplitude from oscilloscope, v_I = 1.88
Output Amplitude from equation, $v_O = -(\frac{R_2}{R_1}) \times v_I$ = $-\left(\frac{2.62}{0.982}\right) \times 1.88 = -5.154$
Output Amplitude from oscilloscope, v_O = − 5.20 V

Task-03: Inverting Summing Amplifier



Procedure

Part-01

1. Construct the circuit with $v_{I1} = 2$ V, $v_{I2} = 1$ V. Use $R_1 = 1$ kΩ, $R_2 = 2.7$ kΩ, $R_F = 2.7$ kΩ.
2. Use the digital multimeter to measure the output voltage.

Part-02

1. Construct the circuit with $v_{I1} = 2$ V (from the DC Supply) and $v_{I2} = 2$ V (p-p), 1 kHz sine wave. Use $R_1 = 1$ kΩ, $R_2 = 2.7$ kΩ, $R_F = 2.7$ kΩ.
2. Connect the Ch1 and Ch2 of the oscilloscope to v_I and v_O respectively and observe the waveforms.

Observation and Calculation

For Part-01,
from multimeter, $v_{I1} = 1.98$ V
from multimeter, $v_{I2} = 5.02$ V
Output Amplitude from equation, $v_O = -(\frac{R_F}{R_1} \times v_{I1} + \frac{R_F}{R_2} \times v_{I2}) = \frac{2.7}{0.982} \times 1.98 + \frac{2.7}{2.692} \times 5.02 = -10.51$ V
Output Amplitude from multimeter, $v_O = -9.11$ V

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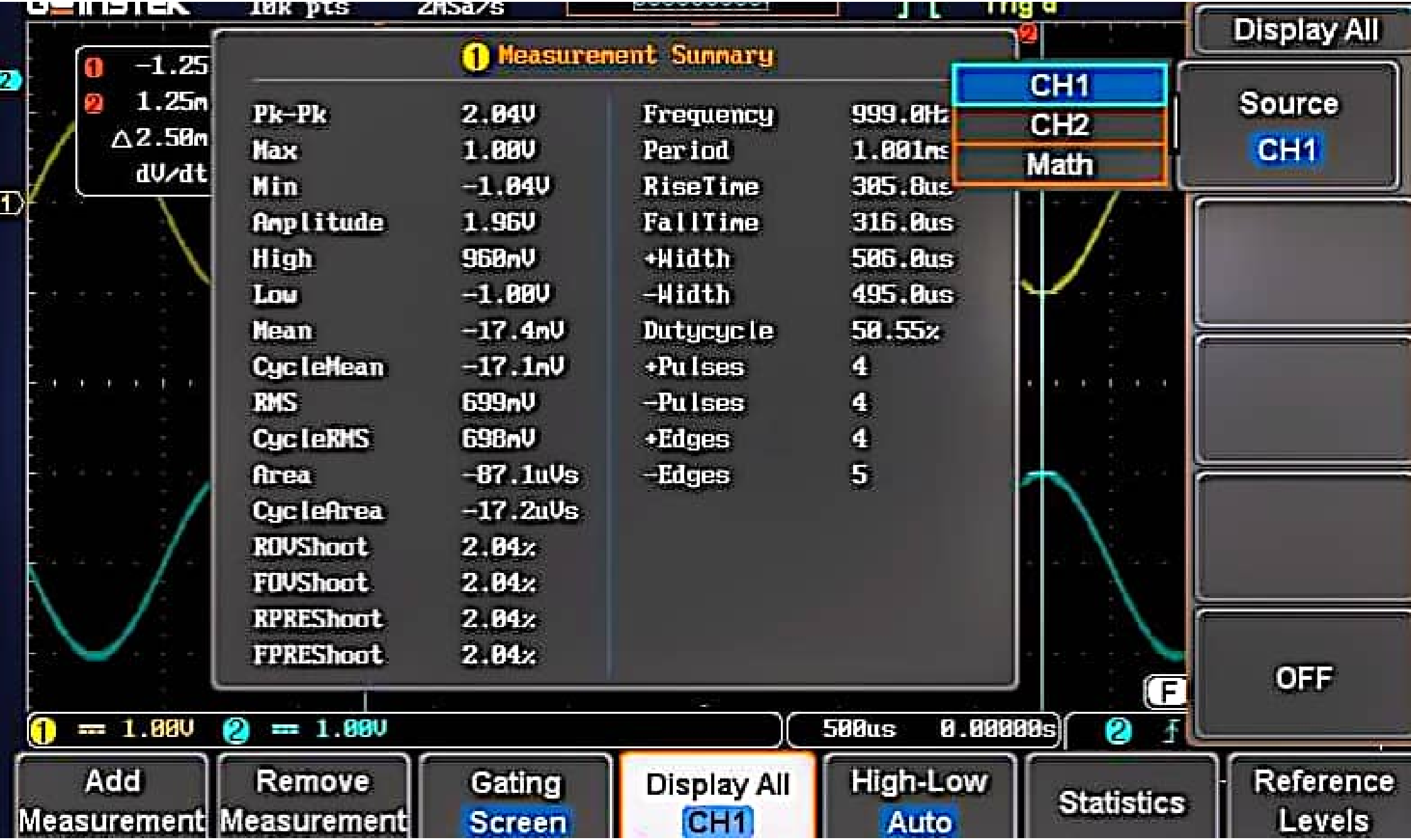
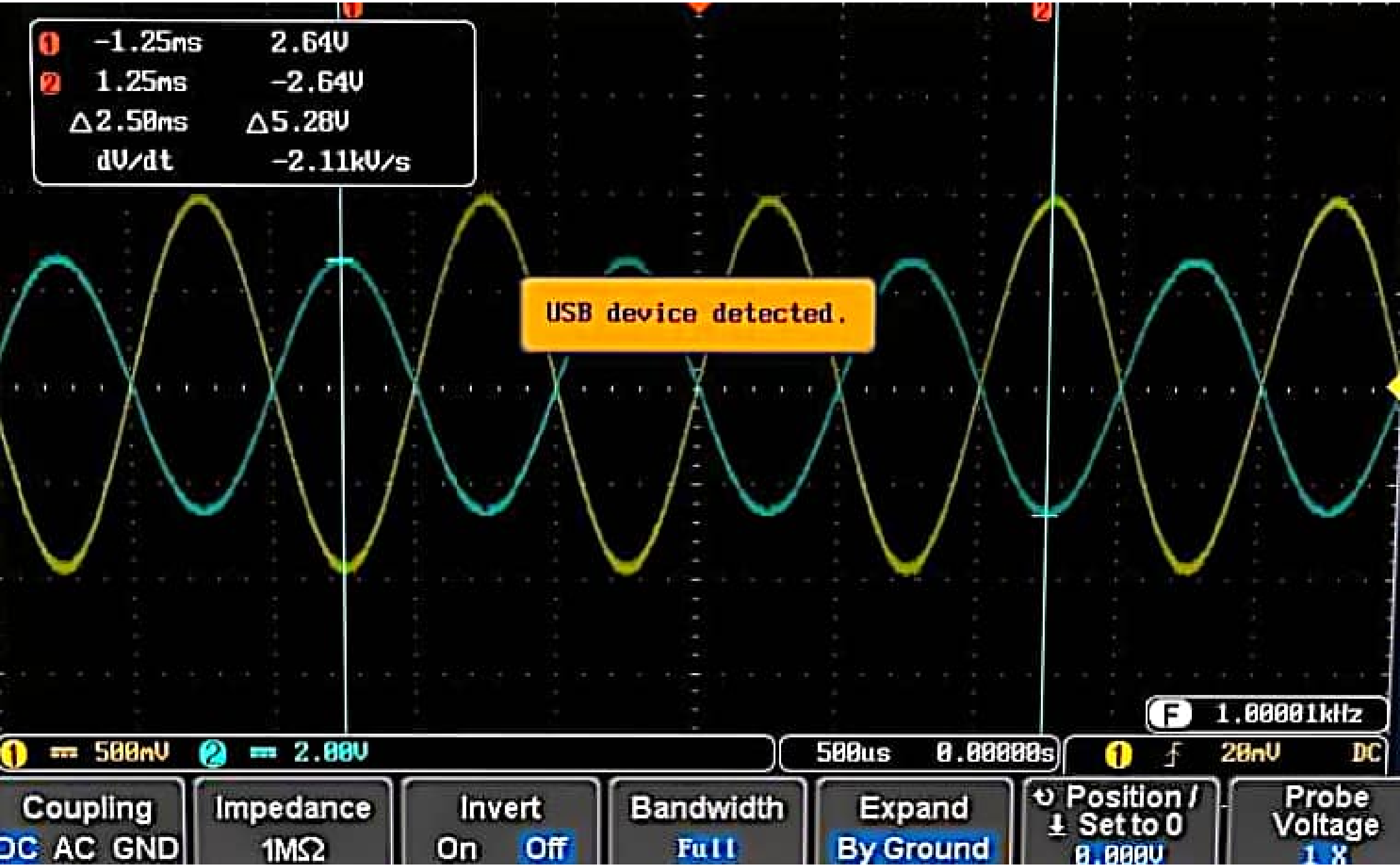
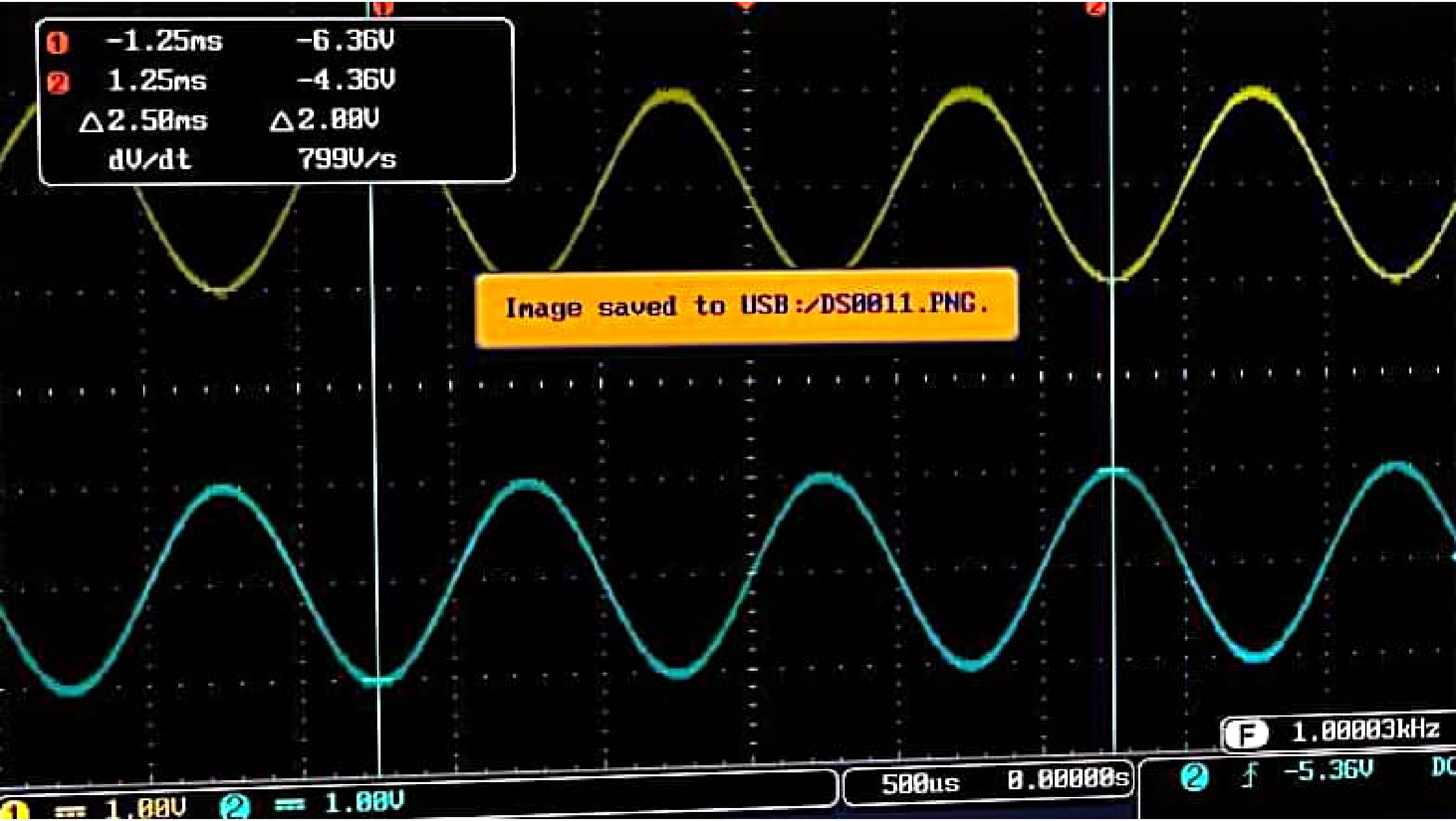
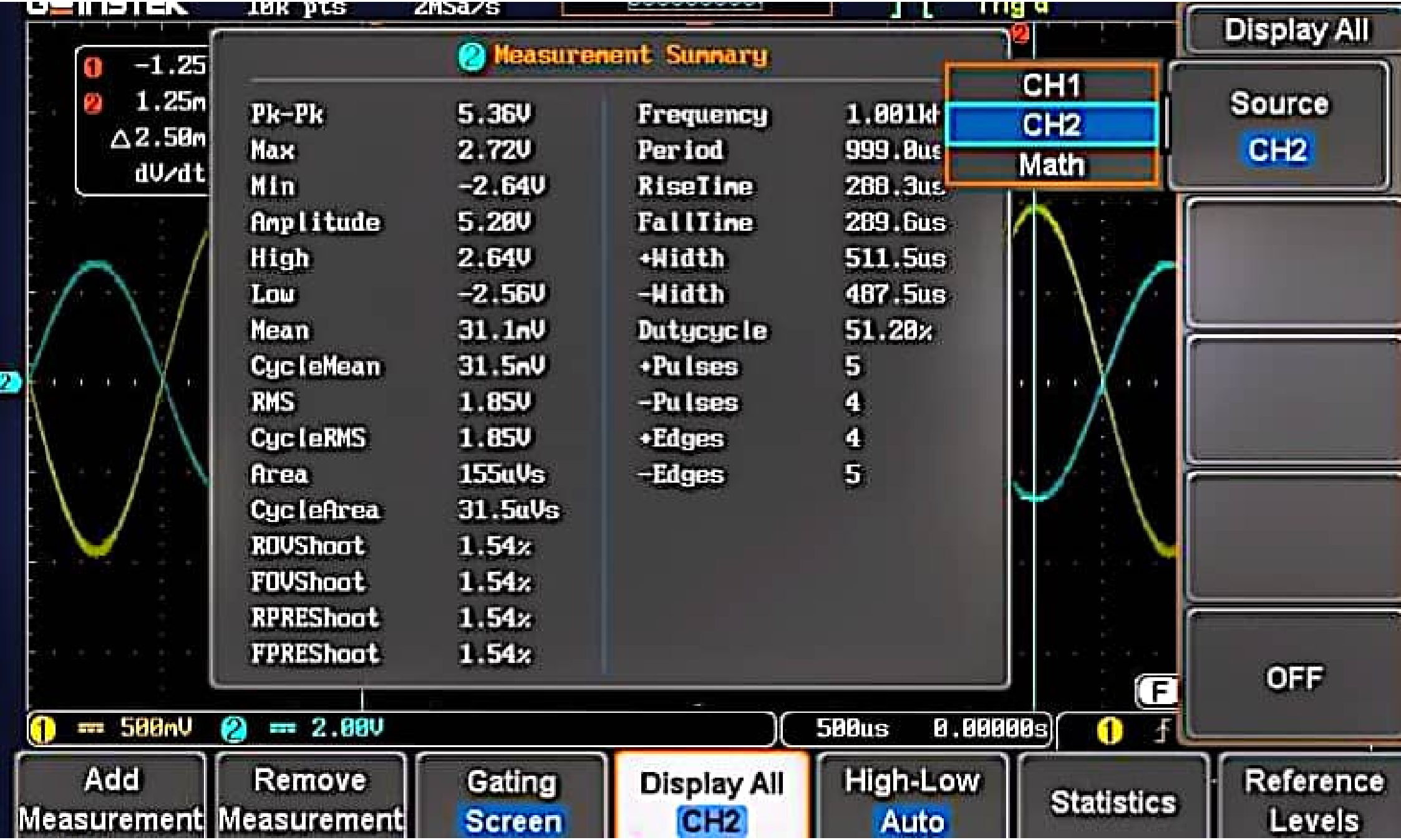
For Part-02.
The output waveform should be amplified and inverted compared to the input waveform. Observe the input and output waveform and capture them using a camera.

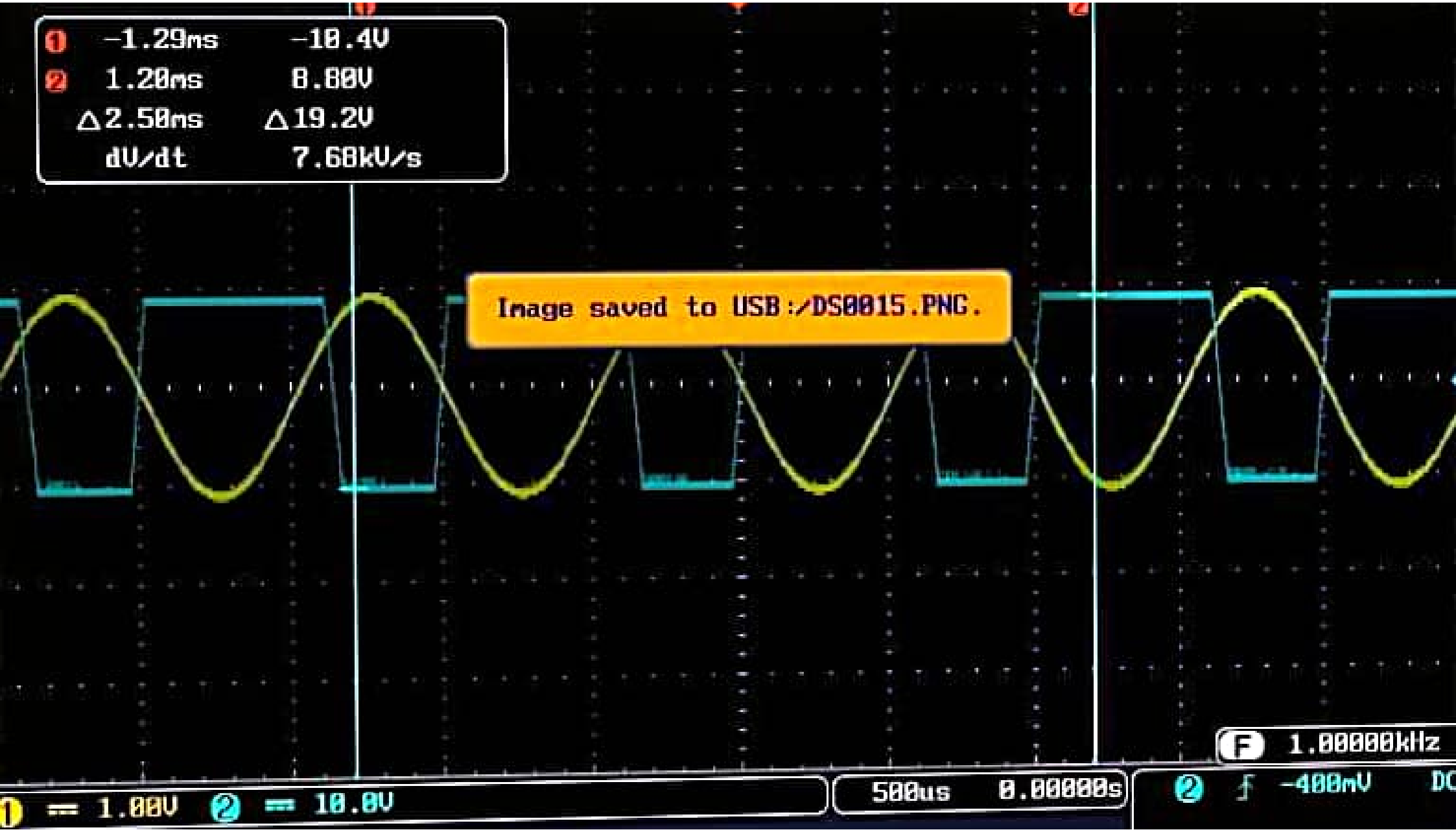

10k pts
1 -1.25
2 1.25m
Δ2.50m
dV/dt
1 Measurement Summary
Pk-Pk 2.04V
Max 1.00V
Min -1.04V
Amplitude 1.96V
High 960mV
Low -1.00V
Mean -17.4mV
CycleMean -17.1mV
RMS 699mV
CycleRMS 698mV
Area -87.1uVs
CycleArea -17.2uVs
ROVShoot 2.04%
FOVShoot 2.04%
RPREShoot 2.04%
FPREShoot 2.04%
Frequency 999.0Hz
Period 1.001ms
RiseTime 305.8us
FallTime 316.0us
+Width 506.0us
-Width 495.0us
Dutycycle 50.55%
+Pulses 4
-Pulses 4
+Edges 4
-Edges 5
CH1
CH2
Math
Display All
Source
CH1
OFF
1 1.00V 2 1.00V
500us 0.00000s
Add Measurement
Remove Measurement
Gating Screen
Display All CH1
High-Low Auto
Statistics
Reference Levels

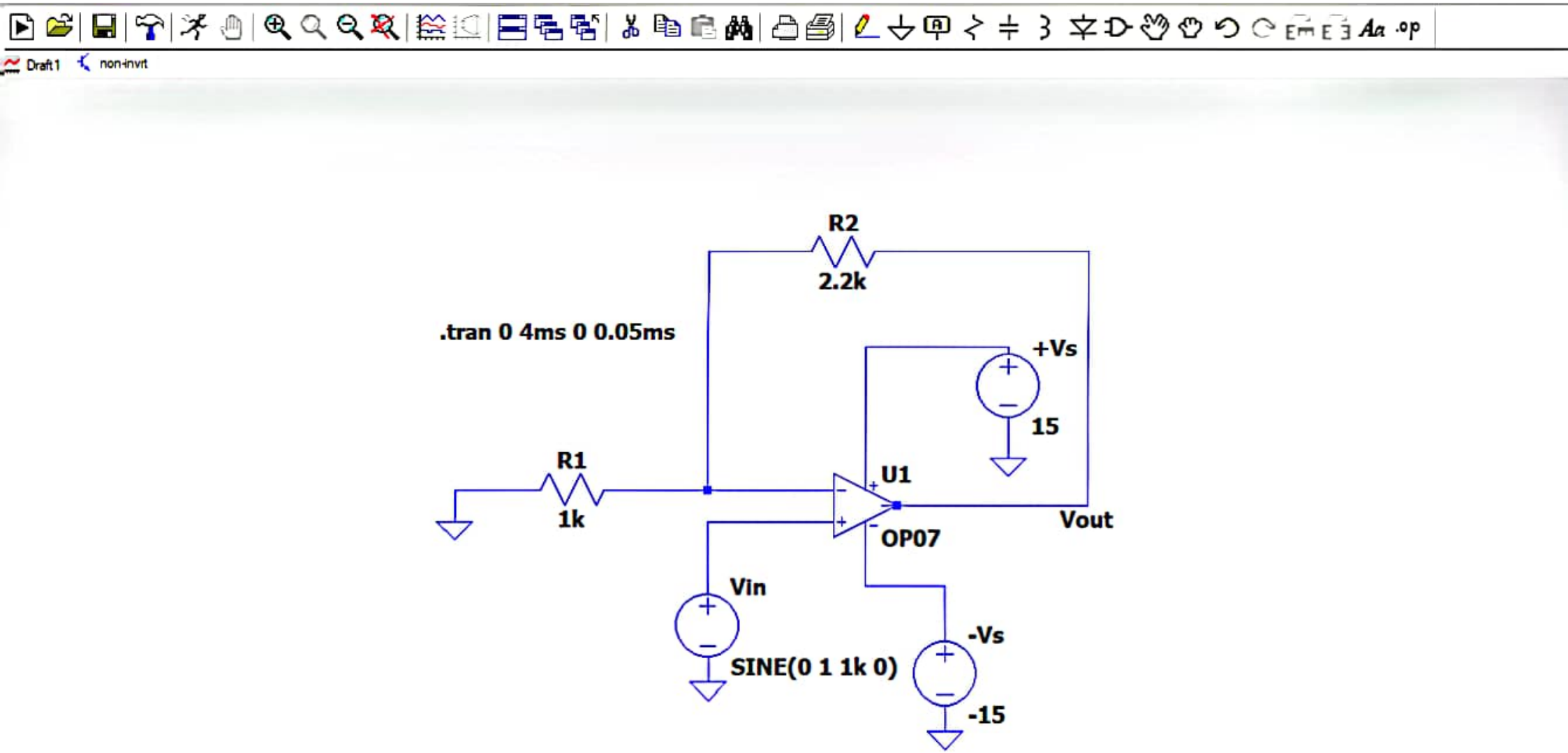

1 -1.25ms 2.64V
2 1.25ms -2.64V
Δ2.50ms Δ5.28V
dV/dt -2.11kV/s
USB device detected.
F 1.00001kHz
1 500mV 2 2.00V
500us 0.00000s
1 20mV DC
Coupling
DC AC GND
Impedance
1MΩ
Invert
On Off
Bandwidth
Full
Expand
By Ground
Position /
Set to 0
0.000V
Probe
Voltage
1 X


10k pts
500kSa/s
Measurement Summary
Pk-Pk 3.52V
Max 2.00V
Min -1.52V
Amplitude 80.0mV
High 240mV
Low 160mV
Mean 110mV
CycleMean ?
RMS 300mV
CycleRMS ?
Area 2.21mVs
CycleArea ?
ROVShoot ?
FOVShoot ?
RPREShoot ?
FPREShoot ?
Frequency ?
Period ?
RiseTime ?
FallTime ?
+Width ?
-Width ?
Dutycycle ?
+Pulses ?
-Pulses ?
+Edges ?
-Edges ?
CH1
CH2
Math
Display All
Source
CH2
F
OFF
Phase
Phase
500mV
2.00V
2ms
0.00000s
Add Measurement
Remove Measurement
Gating
Screen
Display All
CH2
High-Low
Auto
Statistics
Reference Levels


1 -1.25ms -6.36V
2 1.25ms -4.36V
Δ2.50ms Δ2.00V
dV/dt 799V/s
Image saved to USB:/DS0011.PNG.
F 1.00003kHz
500us 0.00000s
2 ∫ -5.36V
1.00V 2 1.00V


Measurement Summary
Pk-Pk 5.36V
Max 2.72V
Min -2.64V
Amplitude 5.20V
High 2.64V
Low -2.56V
Mean 31.1mV
CycleMean 31.5mV
RMS 1.85V
CycleRMS 1.85V
Area 155uVs
CycleArea 31.5uVs
ROVShoot 1.54%
FOVShoot 1.54%
RPREShoot 1.54%
FPREShoot 1.54%
Frequency 1.001kH
Period 999.0us
RiseTime 288.3us
FallTime 289.6us
+Width 511.5us
-Width 487.5us
Dutycycle 51.20%
+Pulses 5
-Pulses 4
+Edges 4
-Edges 5
CH1
CH2
Math
Display All
Source
CH2
OFF
-1.25
1.25m
Δ2.50m
dV/dt
500mV
2.00V
500us
0.00000s
Add Measurement
Remove Measurement
Gating Screen
Display All CH2
High-Low Auto
Statistics
Reference Levels

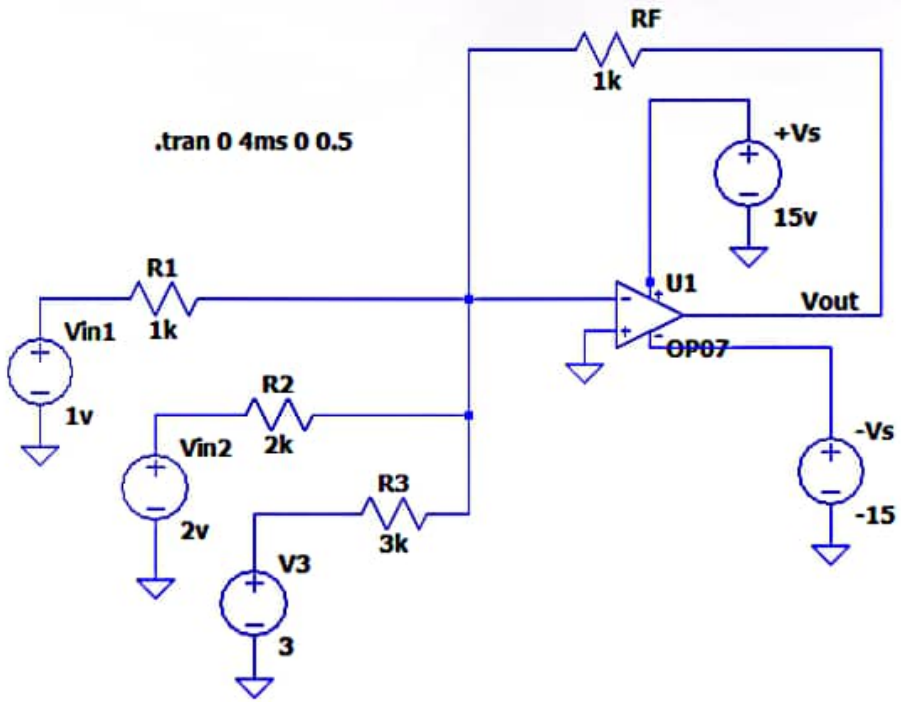

1 -1.29ms -10.4V
2 1.20ms 8.80V
Δ2.50ms ΔV19.2V
dV/dt 7.68kV/s
Image saved to USB:/DS0015.PNG.
F 1.00000kHz
1 ⎓ 1.00V 2 ⎓ 10.0V
500us 0.00000s
2 ∫ -400mV DC

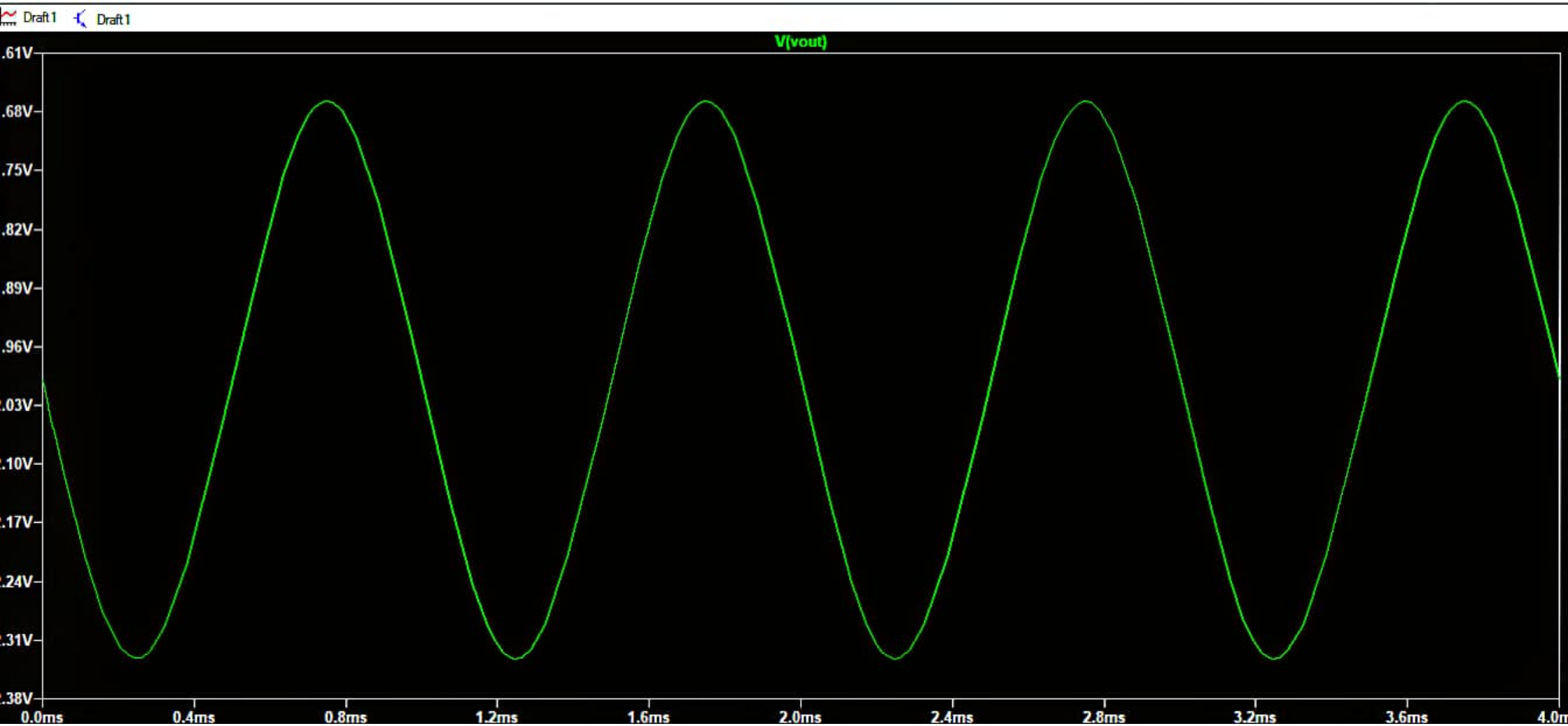

Draft1
non-invrt
R2
2.2k
.tran 0 4ms 0 0.05ms
+Vs
15
R1
1k
U1
OP07
Vout
Vin
SINE(0 1 1k 0)
-Vs
-15

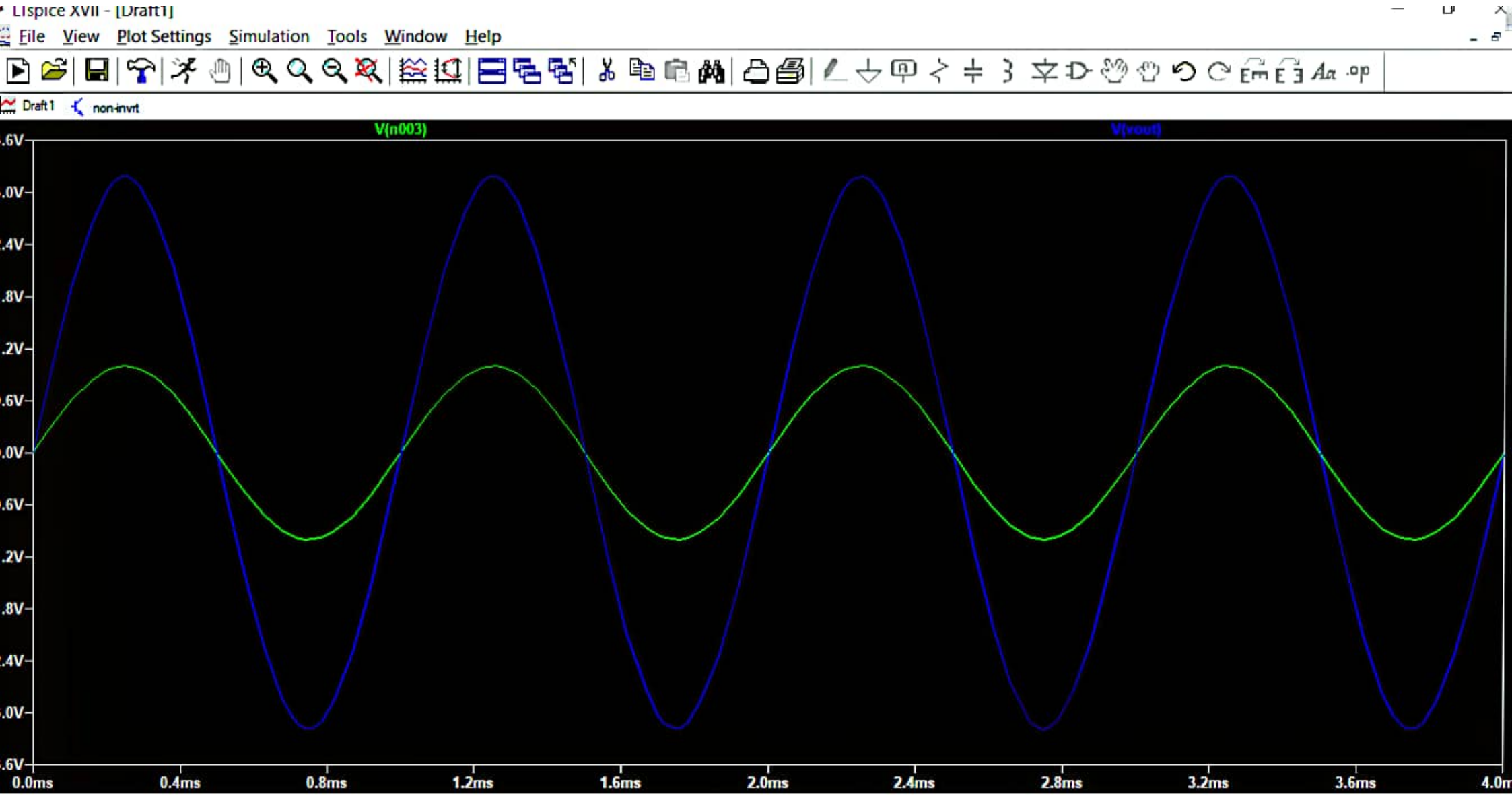
LTspice XVII - [Draft2]

File Edit Hierarchy View Simulate Tools Window Help

Draft1 Draft2 Draft2 non-invrt




Draft1
Draft1
V(vout)
.61V
.68V
.75V
.82V
.89V
.96V
.03V
.10V
.17V
.24V
.31V
.38V
0.0ms
0.4ms
0.8ms
1.2ms
1.6ms
2.0ms
2.4ms
2.8ms
3.2ms
3.6ms
4.0m


LTspice XVII - [Draft1]
File View Plot Settings Simulation Tools Window Help
Draft1
non-invrt
V(n003)
V(vout)
.6V
.0V
.4V
.8V
.2V
.6V
.0V
.6V
.2V
.8V
.4V
.0V
.6V
0.0ms
0.4ms
0.8ms
1.2ms
1.6ms
2.0ms
2.4ms
2.8ms
3.2ms
3.6ms
4.0m

Inverting amplifier : (From sheet)

→ Theoritically

$V_1 = 2\,V$
$R_1 = 1K\Omega$
$R_2 = 2.7K\Omega$

$$V_o = -\left(\frac{R_2}{R_1}\right) \times V_1$$
$$= -\frac{2.7}{1} \times 2$$
$$= -5.4\,V$$

Inverting Summing Amplifier :

(From equation)

Part 1 : $V_{I1} = V_{I2} = 1V$

$R_L = 1K\Omega$
$R_2 = 2.7K\Omega$
$R_F = 2.7K\Omega$

$$\therefore V_o = -\left(\frac{R_F}{R_1} \times V_{I1} + \frac{R_F}{R_2} \times V_{I_2}\right)$$
$$= -\left(\frac{2.7}{1} \times 1 + \frac{2.7}{2.7} \times 1\right)$$
$$= -(2.7 + 1)$$
$$= -3.7$$

Part 2 : $V_{I1} = 2V$, $V_{I2} = 2V$

$R_1 = 1K\Omega$, $R_2 = 2.7K\Omega$, $R_F = 2.7K\Omega$

$$\therefore V_o = -\left(\frac{2.7}{1} + \frac{2.7}{2.7}\right) \times 2$$
$$= -(2.7 + 1) \times 2$$
$$= -(3.7) \times 2$$
$$= -7.4\,V$$

Discussion: While doing the experiment there was a fluctuation of the voltage source. We also faced problem in the voltage meter. There were also problem when implementing the circuit in breaboard.