CSE251- Electronic Devices and Circuits

Study of Op-Amp: Inverting Summing Amplifier, Schmitt Trigger

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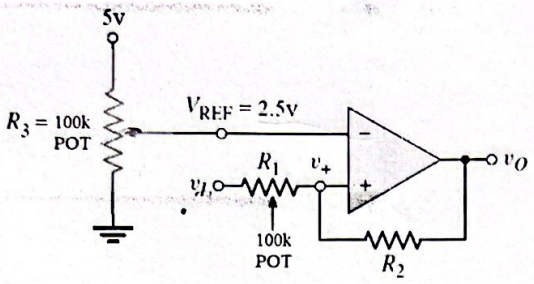
Task-03: Schmitt Trigger with Applied Reference Voltage



$R_1 \rightarrow$ Highest (100)

Procedure

1. Construct the circuit where the supply voltage $+V_S$ and $-V_S$ should be +5 V and 0 V respectively. Use the Trainer board for the supply voltages. Use a 100 kΩ POT for R_1 and R_3. Use R_2 = 100 kΩ.
2. Use the Function Generator to generate v_I = 8 V (p-p) 1 KHz and connect the Ch-1 and Ch-2 of the oscilloscope to v_I and v_O respectively.
3. Change the value of R_3 (as it is a POT) so that V_{REF} = 2.5 V (use multimeter).
4. Change the value of R_1 (as it is a POT) and observe the output voltage and write down the values according to the data sheet.

Task-04: Report

1. Cover page [include course code, course title, name, student ID, group, semester, date of performance, date of submission]
2. Attach the signed Data Sheet.
3. Add a brief Discussion at the end of the report.

Data Sheet

Task-01:

R_F = 93

from multimeter, v_{I1} = 0·502
from multimeter, v_{I2} = 1·032
from multimeter, v_{I3} = 4·98
Output Amplitude from equation, $v_O = -(\frac{R_F}{R_1} \times v_{I1} + \frac{R_F}{R_2} \times v_{I2} + \frac{R_F}{R_3} \times v_{I3})$ = -6·5412247
Output Amplitude from multimeter, v_O = -6·53

12.29

Task-02:

V_{S-} = -5·08 V_{S+} = 4·09

R_1	From Equation, $V_{TH} = -\left(\frac{R_1}{R_2}\right) V_S^-$	From Oscilloscope, V_{TH}	From Equation, $V_{TL} = -\left(\frac{R_1}{R_2}\right) V_S^+$	From Oscilloscope, V_{TL}
25 kΩ	1·4573	1·52	-1·4314	-1·44
50 kΩ	2·9053	2·88	-2·8538	-2·80

25.33
50.5

Task-03:

V_{TH} R_2 = 88·3

R_1	$p = R_2/R_1$	From Equation, $V_{TH} = 2.5 + \frac{2.5}{p}$	From Oscilloscope, V_{TH}	From Equation, $V_{TL} = 2.5 - \frac{2.5}{p}$	From Oscilloscope, V_{TL}
25 kΩ	3·486	3·217	3·20	1·7229	1·76
50 kΩ	1·7485	3·9297	4·00	1·84	1·8638

25.33
50.5

6/12/23

Task 02: Schmitt Trigger

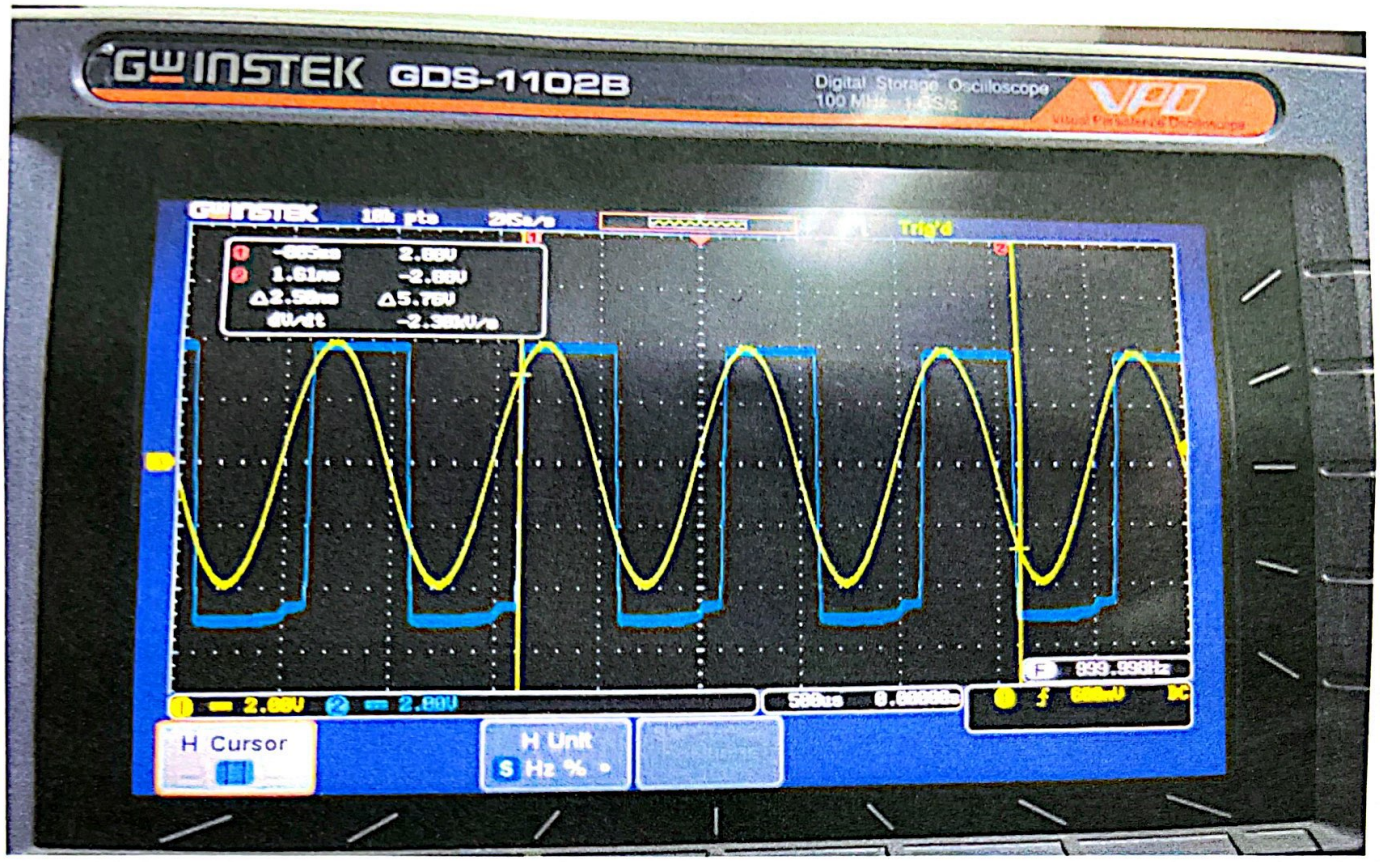


Figure 1: For 50.5K Ohm.

Figure 2: For 25.33K Ohm.

Task 03: Schmitt Trigger with Applied Reference Voltage

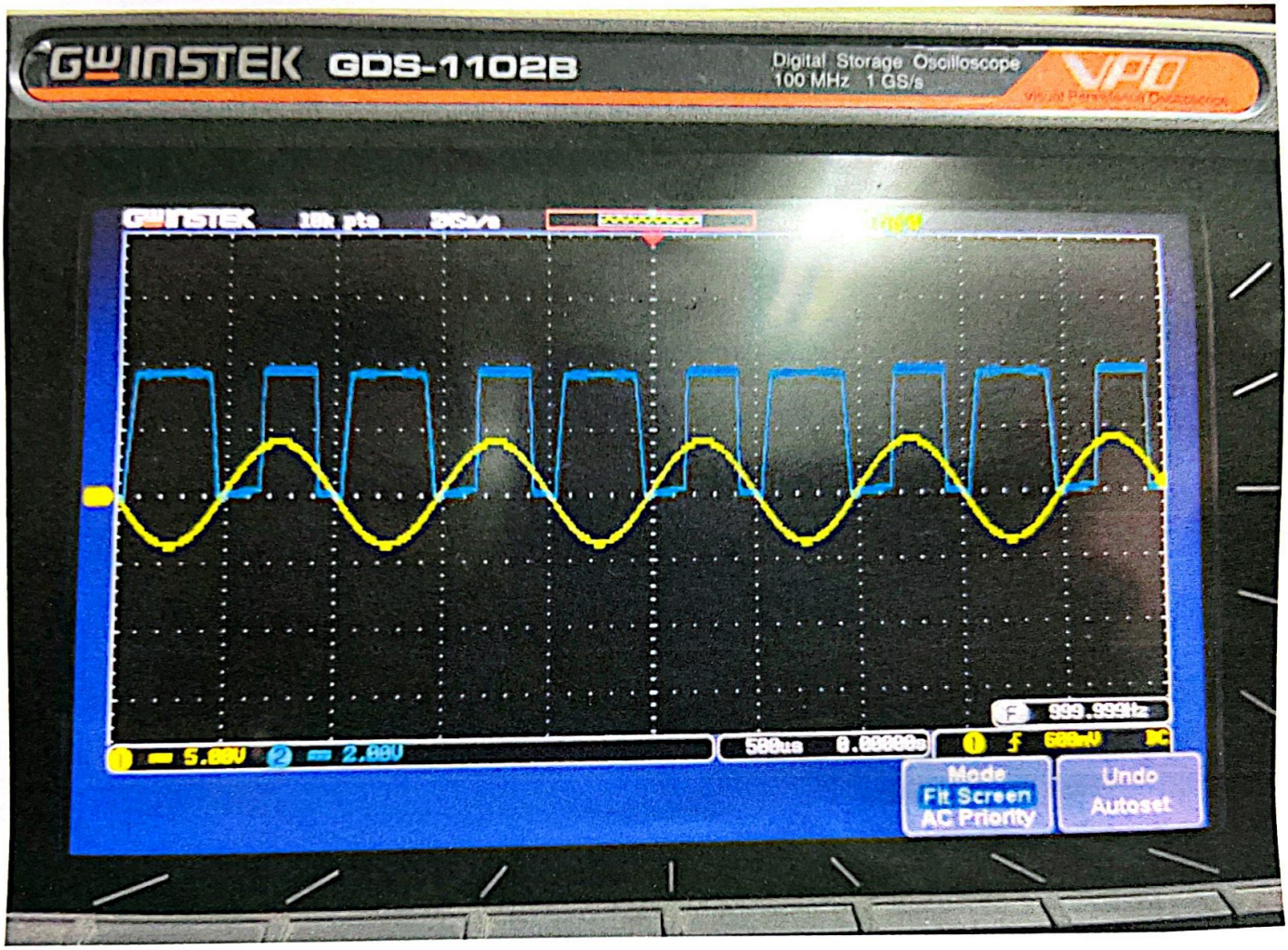


Figure 3: Schmitt trigger with 2.5V reference voltage.

Discussion:

Inverting Summing Amplifier:

An inverting summing amplifier is an operential amplifier (Op-Amp) circuit that combines multiple input signals and produces a output signal. The input signals are connected to the inverting terminal of the Op-Amp through individual resistors with the resistors serving to weight the input signals are determined the contribution of each input singal to the final output

The output of the inverting summing amplifier is given by the equation $V_{out} = \left(-\frac{R_f}{R_1} \times V_{I1}\right) - \left(\frac{R_f}{R_2} \times V_{I2}\right) - \left(\frac{R_f}{R_3} \times V_{I3}\right)$, where R_f is the feedback resistor. R_1, R_2, R_3 are the resistors connecting each input signal to the non-inverting terminal, V_{I1}, V_{I2}, V_{I3} are the input signals. Inverting summing amplifier combines multiple signals into a single output signal, allowing for easy signal processing.

$$I = I_{R1} + I_{R2} + I_{R3}$$

$$\frac{V^- - V_0}{R_f} = \frac{V_1 - V^-}{R_1} + \frac{V_2 - V^-}{R_2} + \frac{V_3 - V^-}{R_3}$$

$$\Rightarrow \frac{-V_0}{R_f} = \frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3}$$

$$V_0 = -\frac{R_f}{R_1} \cdot V_{I1} - \frac{R_f}{R_2} \cdot V_{I2} - \frac{R_f}{R_3} \cdot V_{I3}$$

Schmitt Trigger:

A schmitt Trigger with an applied reference voltage of 2·5 V and supply voltages of +5V and 0V is a type of comparator circuit that uses two different threshold voltages, V_{th^+} and V_{th^-} to compare an input voltage and switches its output between high or low states. The reference voltage of 2·5 V sets the threshold voltages in the circuit based on the supply voltages. In task ~~1 and 2~~ and 3, if the input voltage exceeds 2·5 V the output will switch to a high state, which is defined as a voltage close to the positive supply voltage of +5V. If the input voltage falls below 2·5V, the output will switch to a

low state, which is defined as a voltage close to the ground voltage of 0V. This makes Schmitt trigger immune to noise. The reference voltage of 2.5 V sets the threshold voltage levels, determining the input voltage range that triggers the switch.

We used a potentiometer to set the constant reference voltage of 2.5V and another potentiometer to set the resistance to 25.33K Ohm and 50.5 K Ohm and Vi was a sinusoidal wave of 8V (P-P) of 1 KHz.