

# TASK 2

## CIRCUIT TECHNOLOGY

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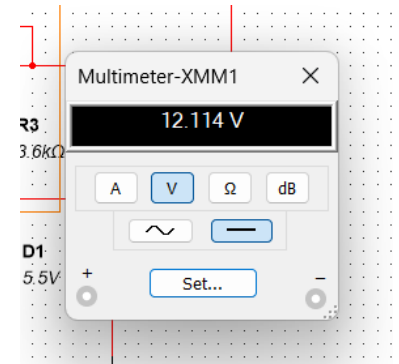
### 1. What is our Uout?

First of all, I calculated the ideal gain by using  $G_i = 1 + \frac{R_1}{R_2} = 2.2$ .

Next, by using Multimeter I measured Uout to be 12.114V, which is slightly higher than the calculated theoretical value of Uout:

$$U_{out} = U_{in} \times G_i = 5.5 V \times 2.2 = 12.1 V$$

This confirms that our setup and the components were correctly connected.



### 2. Input voltage offsets of U2 where the circuit fails

Since we know that the amplifier has a fixed gain  $G = 2.2$ , we can therefore calculate the max input voltage U2 can handle before hitting 20V limit from the voltage source:

$$U_{in(max)} = \frac{20 V}{2.2} = 9.09 V$$

Since our baseline voltage is 5.5 V, the positive offset that causes failure is:

$$\text{Offset} = 9.09 V - 5.5 V = +3.59V$$

The lowest voltage the op-amp can output is 0 V. So again, with baseline voltage being 5.5V, the negative offset required to pull the input down to zero is:

$$\text{Offset} = 0 V - 5.5 V = -5.5 V$$

### 3. Monte Carlo

By changing R3 by  $\pm 3k\Omega$ , we are drastically changing resistor's value at  $3.6k\Omega$ , from **0.6k $\Omega$**  to **6.6k $\Omega$** . Theoretically, low resistance should allow higher current, where Zener voltage will rise above its nominal value causing max Uout, whereas high resistance chokes the current down, so the Zener voltage will decrease, causing min Uout:

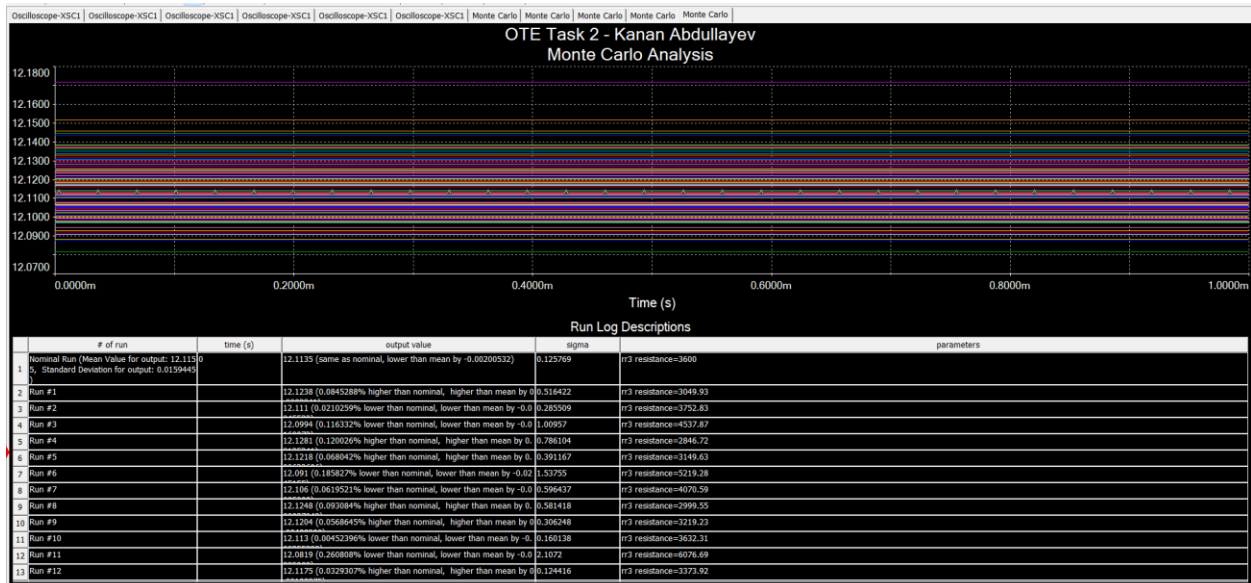


Figure 1. Monte Carlo, Transient simulation with 100 runs.

As shown above, the resulting output voltages fluctuate within a very narrow band, specifically between **12.06V** and **12.21V**. This demonstrates that despite a massive  $3k\Omega$  variation in the resistor R3, the Zener diode D1 remains stable, effectively isolating the output from significant changes in supply resistance.