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Experiment I

AIM:

Design a Voltage Divider Circuit with:

1. R1 = R2
2. R1 variable and R2 fixed.

Theory:

Voltage Divider:

In electronics, a voltage divider (also known as a potential divider) is a passive linear circuit that produces an output voltage (V_{out}) that is a fraction of its input voltage (V_{in}). Voltage division is the result of distributing the input voltage among the components of the divider. A simple example of a voltage divider is two resistors connected in series, with the input voltage applied across the resistor pair and the output voltage emerging from the connection between them.

Circuit Analysis:

Let input AC voltage be V_{in} with frequency v, Phase 0 degrees and RMS voltage V_{rms}

$$V_{in} = V_{rms}\sqrt{2}\sin(2\pi vt + 0)\,V = V_{rms}\sqrt{2}\sin(2\pi vt)\,V$$

Current in the circuit,

$$i = \frac{V_{in}}{R_1+R_2}\ A$$

Voltage across R_1,

$$V_{R_1} = \frac{R_1 V_{in}}{R_1+R_2}\ V$$

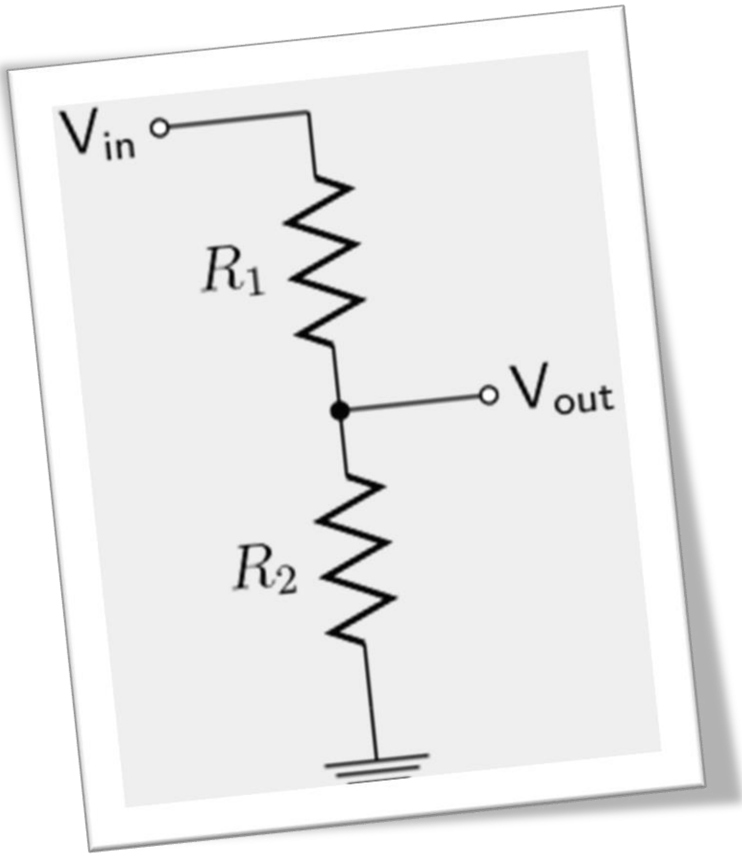
Voltage across R_2,

$$V_{R_2} = \frac{R_2 V_{in}}{R_1+R_2}\ V$$

Output Voltage V_{out},

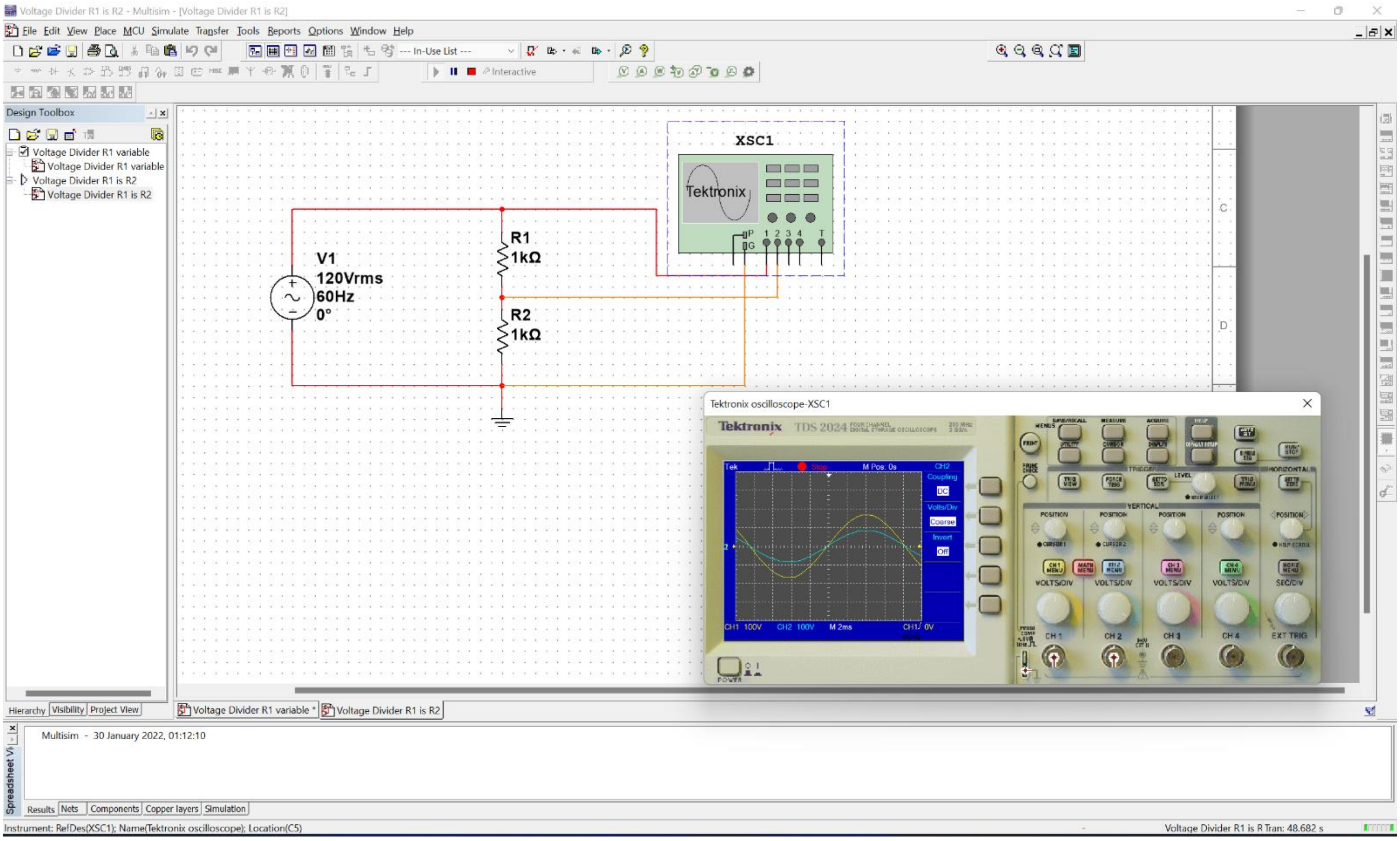
$$V_{out} = V_{R_2} = \frac{R_2 V_{in}}{R_1+R_2}\ V$$

We can see that,
We can get the output Voltage according to what we want by adjusting the values of Resistances.



Observations:

Voltage Divider Circuit with R1 = R2 (Both Resistance Equal):



Using Tektronix oscilloscope, we will find out the voltage difference between R2 and R1+R2. The 2 waves at output corresponds the same.

To get the 2 waves we make the -ve terminal of the AC battery source as ground that is at Zero Volts (which is reference voltage).

As R1 = R2, so we get the 2nd wave with peak magnitude as half of the 1st one.

Equation for voltage here,

$$V = 120\sqrt{2}\sin(120\pi t)\,V$$

$$R1 = 1k\ ohm$$

$$R2 = 1k\ ohm$$

Equation for the current in the circuit,

$$i = 60\sqrt{2}\sin(120\pi t)\,X10^{-3}A$$

Equation for the Yellow Wave,

$$V_Y = i\ X\ R = 120\sqrt{2}\sin(120\pi t)\,V$$

Equation for the Blue Wave,

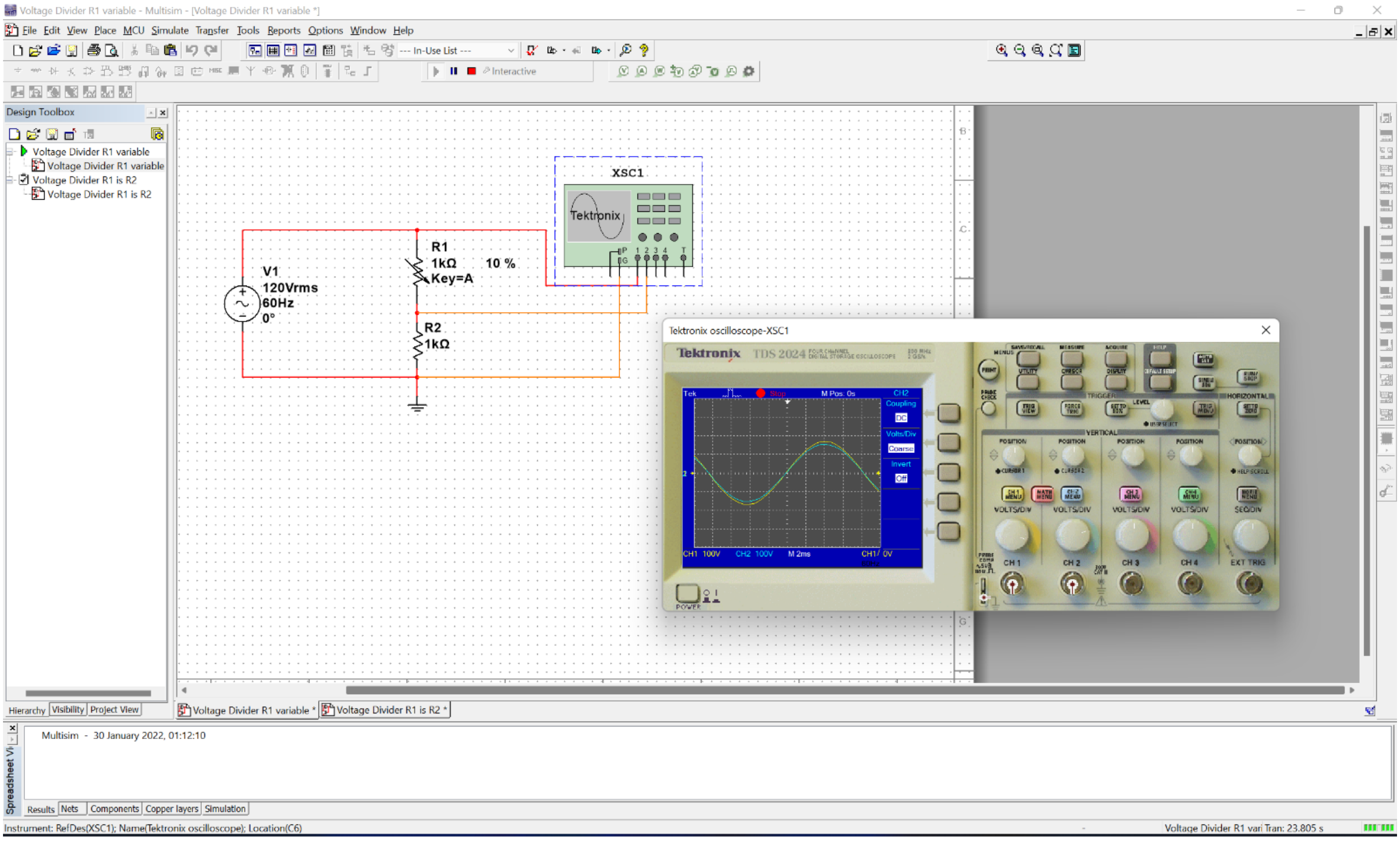
$$V_B = i\ X\ R = 60\sqrt{2}\sin(120\pi t)\,V$$

Voltage Divider Circuit with R1 Variable and R2 Fixed:

Using Tektronix oscilloscope, we will find out the voltage difference between R2 and R1+R2. The 2 waves at output corresponds the same.

To get the 2 waves we make the -ve terminal of the AC battery source as ground that is at Zero Volts (which is reference voltage).

Case I (R1 = 10% R2):



As R1 = 10% of R2, so we get the 2nd wave with peak magnitude closer to 1st wave as value of resistance is much low.

Equation for voltage here,

$V = 120\sqrt{2}\sin(120\pi t)\,V$

$R2 = 1k\ ohm$

$R1 = 10\%\ of\ 1k = 100\ ohm$

Equation for the current in the circuit,

$i = (10.91)\sqrt{2}\sin(120\pi t)\,X10^{-2}A$

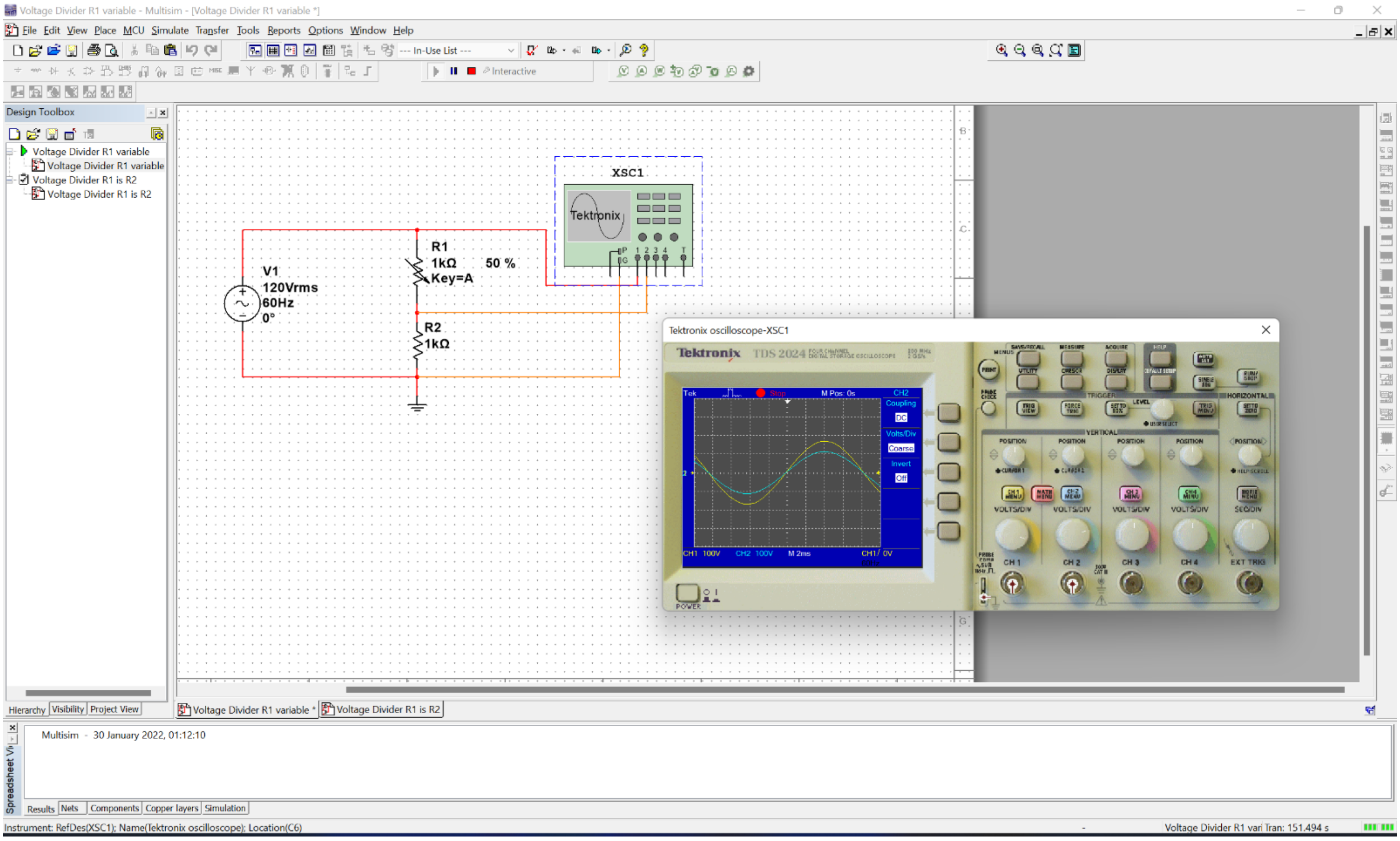
Equation for the Yellow Wave,

$V_Y = i\ X\ R = 120\sqrt{2}\sin(120\pi t)\,V$

Equation for the Blue Wave,

$V_B = i\ X\ R = (109.1)\sqrt{2}\sin(120\pi t)\,V$

Case II (R1 = 50% R2):



As R1 = 50% of R2, so we get the 2nd wave with peak magnitude away from 1st wave as compared to case I because value of resistance is increases.

Equation for voltage here,

$V = 120\sqrt{2}\sin(120\pi t)\,V$

$R2 = 1k\ ohm$

$R1 = 50\%\ of\ 1k = 500\ ohm$

Equation for the current in the circuit,

$i = 8\sqrt{2}\sin(120\pi t)\,X10^{-2}A$

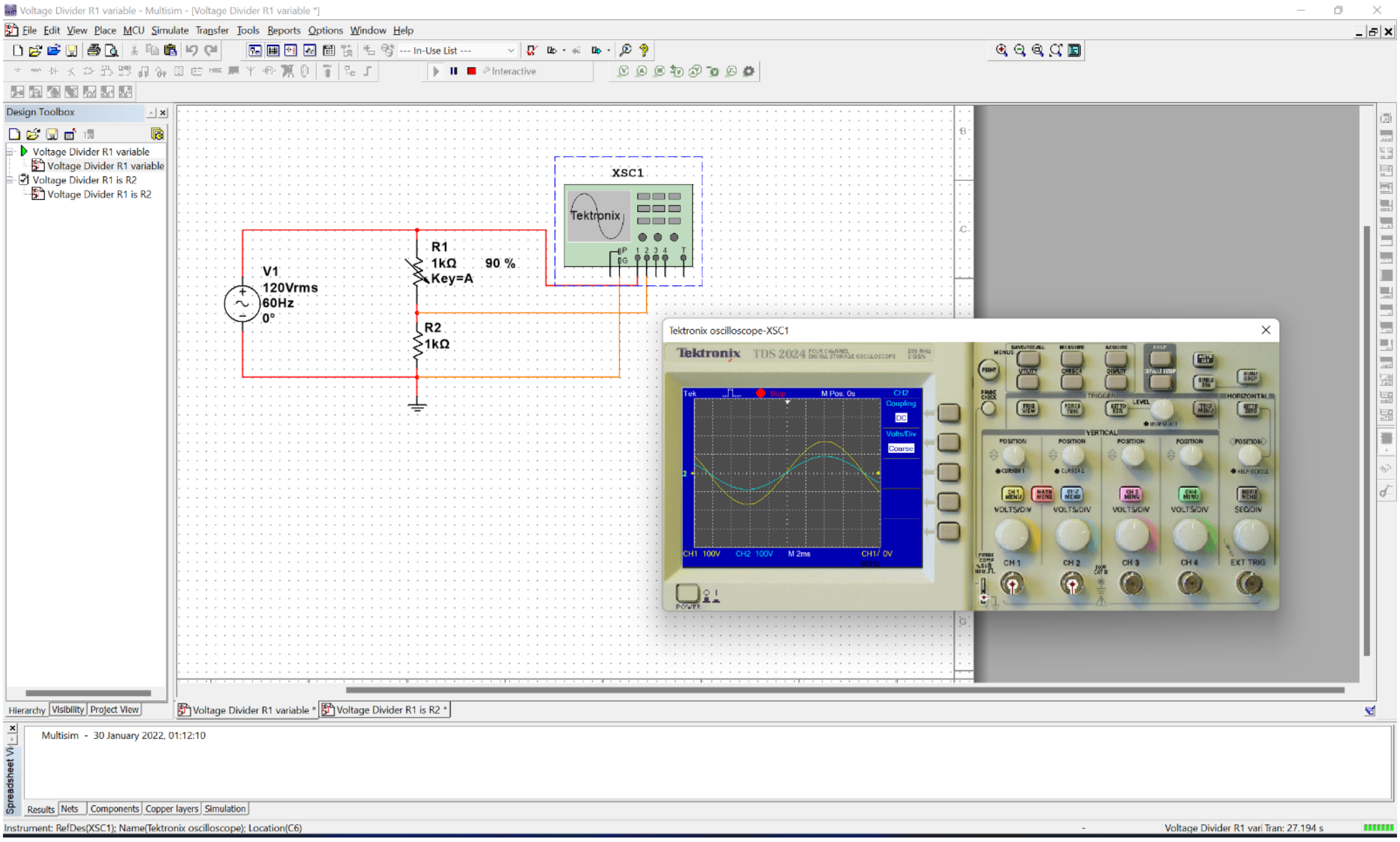
Equation for the Yellow Wave,

$V_Y = i\ X\ R = 120\sqrt{2}\sin(120\pi t)\,V$

Equation for the Blue Wave,

$V_B = i\ X\ R = 80\sqrt{2}\sin(120\pi t)\,V$

Case III (R1 = 90% R2):



As R1 = 50% of R2, so we get the 2nd wave with peak magnitude away from 1st wave as compared to case II because value of resistance is increases.

Equation for voltage here,

$$V = 120\sqrt{2}\sin(120\pi t)\,V$$

$$R2 = 1k\ ohm$$

$$R1 = 90\%\ of\ 1k = 900\ ohm$$

Equation for the current in the circuit,

$$i = (6.31579)\sqrt{2}\sin(120\pi t)\,X10^{-2}A$$

Equation for the Yellow Wave,

$$V_Y = i\ X\ R = 120\sqrt{2}\sin(120\pi t)\,V$$

Equation for the Blue Wave,

$$V_B = i\ X\ R = (63.1579)\sqrt{2}\sin(120\pi t)\,V$$