Lab 29- Single Reference Point Level III

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Experiment 29: Oscilloscope: Single Reference Point Measurements; Level III

Objectives: Upon completion of this lab, we learned to:

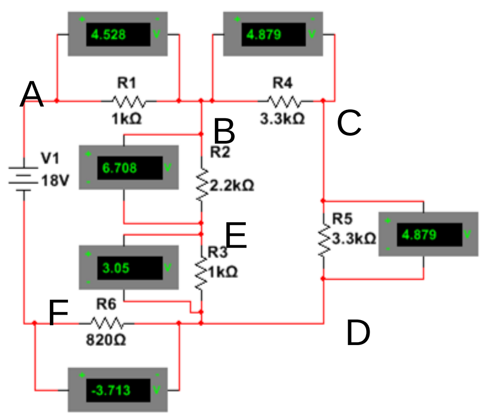
- Measure dc voltages with the oscilloscope in a complex circuit, with a single common reference point.
- Review resistive series-parallel concepts, including Kirchhoff's Voltage Law

Procedure:

First, we collected the following materials:

- Variable power supply; 0 to 20 volts dc
- Dual-trace oscilloscope
- 820Ω resistor
- 1kΩ resistors (2)
- 2.2kΩ resistors (2)
- 3.3kΩ resistors (2)
- Various test leads

First we construct the circuit shown in Circuit 3-1.



Circuit 3-1

In order to figure out the voltage drop for each resistor we added the resistance of all of the resistors that were in series with each other. Then we pugged the resistance of BE with the resistance of CD into equation 3-1 because they are parallel to each other. Then the resistance of the two branches and added it to the resistance of A and F.

$$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \cdots\cdots$$

Equation 29-1

We then added the resistance of R1 and total resistance of the two branches. The total resistance was then recorded down below in table 1-3. We also removed V1 or the 7V power supply and connected the circuit in parallel to the ohmmeter to find the total resistance of the circuit, we then recorded it in table 1-3. After this, we reinserted the power supply back into the circuit.

Calculated Total Resistance	Measured Total Resistance
3155.1Ω	3162Ω

Table 29-1

V1 was then divided by the total resistance in table 3-1 to get the total current. Then the total current was multiplied by the resistance of VF and VA to find their voltage drop which was recorded in table 3-2 and find the voltage going through the branches. The voltage of the branches was then divided by the resistance of the total resistance of each branch to find the current going through each branch. After the current for each resistor was figured out we multiplied it by the resistance of each resistor to find its voltage drop which was recorded in table 3-2.

Resistor	Resistor Voltage (Multisim)	Resistor Voltage (Calculation)
R1	4.528V	4.53V
R2	6.708V	6.6V
R3	3.05V	3V
R4	4.879V	4.95V
R5	4.879V	4.95V
R6	3.713V	3.71V

Table 29-2

After we calculated the voltages across each resistor, we created the circuit itself with a voltage source of 18V. We connected the ground lead of the oscilloscope to Point F in the circuit and used it as our ground for the rest of the lab. We then turned on the oscilloscope and adjusted the zero-volt reference line so that it was in the direct center of the screen. We also set the volts/division control to 5. The AC/GND/DC switch was set to GND for this, but when we put the line at the center, we changed this to the DC position.
We then used our probe to find the voltages at points A, B, C, D, E, and F . We did this by inserting our probe into the channel 1 section of the oscilloscope and by inserting the other end of the probe on the point. All of these values are shown in Table 3-2.

Point	Voltage
V_F	0V
V_D	+3.6V
V_C	+8V
V_E	+6.6V
V_B	+13V
V_A	+18V

Table 29-2

With these two tables, we used Kirchhoff's Voltage Law (Vt=V1+V2+V3…) to check our answers and see if our voltage readings were correct. We did this by having VR1+VR2+VR3+VR6=VT and VR1+VR4+VR5+VR6=VT which became 4.53+6.6+3+3.71=17.84V and 4.53+4.95+4.95+3.71=18.14V, and both 17.84V and 18.14V are close to the total voltage of 18V.

Discussion:

During this lab, we just had one major problem, where our voltage values were not the ones that were written in the book. We compared with other groups to see what we did wrong and it turned out that we didn't do anything wrong.

Conclusion:

Kirchoff's law states that the voltage drops of all the components in the circuit will added up together to get the total voltage as shown in table 29-2. Setting the AC/GND/DC select switch to GND or zero-volts position will set the ground position of the trace. The X10 probe has a switch that allow it to switch from X1 to X10. The X10 setting reads 10x the magnitude of the measured value. The volts/div select switch controls the amount of volts per division as shown in figure 1-8. In order to measure the voltage drop between points in a circuit, the X10 probe connects to one end of the listed point while the ground wire connects to the other. If the polarity of the circuit is opposite to that of the probes then the reading would be negative as shown in table 29-2.