

Experiment #8: Troubleshooting

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# Experiment #8

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# Objective

 The objective of this experiment is to use the knowledge of circuit theory from the previous experiments to determine the probable cause of failure in given circuits.

# Materials Required.

* Digital multimeter
* Circuits boards provided by the CLT.

# Procedure

* Calculate the resistance values you would expect to get for the first schematic.
* Build the schematic on the breadboard and the measure the values, compare it to the values calculated
* Then obtain circuit boards from the CLT. Using the multimeter measure and record the values of the resistors thereby finding the faults in it using the calculated values from what you would expect to get.

# Data



|  |  |  |  |
| --- | --- | --- | --- |
| Open Input | No FaultCalculate Measure | B-C ShortCalculate Measure | B-E OpenCalculate Measure |
| RAB | 220Ω | 219Ω | 220Ω | 219Ω | 220Ω | 219Ω |
| RAC | 468.12Ω | 462Ω | 220Ω | 219Ω | 1.22kΩ | 1.204kΩ |
| RAH | 468.12Ω | 462Ω | 220Ω | 219Ω | 1.22kΩ | 1.204kΩ |
| RAG | 515.12Ω | 509Ω | 267Ω | 266Ω | 1.267Ω | 1.251kΩ |
| RGH | 47Ω | 43Ω | 47Ω | 43Ω | 47Ω | 43Ω |
| RBH | 330Ω | 245Ω | 0Ω | 0Ω | 968Ω | 968Ω |
| Shorted Input(AG) |  |  |  |  |  |  |
| RAB | 220Ω | 125Ω |  |  |  |  |
| RAC |  | 43Ω |  |  |  |  |
| RAH |  | 43Ω |  |  |  |  |
| RAG | 0Ω | 0.01Ω |  |  |  |  |
| RGH | 47Ω | 43Ω |  |  |  |  |
| RBH | 330Ω | 128Ω |  |  |  |  |

# Experiment # 9B Troubleshooting Test Circuit # S9

# Original Circuit



|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Points | No faultΩ | MeasuredΩ | DifferenceΩ | Fault |
| A-B | 0Ω | 0.01Ω | 0.01Ω | No fault |
| B-c | 39Ω | 4oΩ | 1Ω | No fault |
| D-E | 0Ω | 0.01Ω | 0.01Ω | No fault |
| E-F | 56Ω | 28Ω | 28Ω | Hidden resistor |
| F-G | 0Ω | 0Ω | 0Ω | No fault |
| G-H | 0Ω | 0Ω | 0Ω | No fault |
| I-H | 27Ω | 31Ω | 4Ω | No fault |
| J-I | 0Ω | 6Ω | 6Ω | Hidden resistor |
| A-j | 122Ω | 104Ω | 18Ω | Hidden resistors |



# Experiment # 9B Troubleshooting Test Circuit # P8

# Original Circuit



|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Points | No fault | Measured | Difference | Fault |
| A-B | 0Ω | 0Ω | 0Ω | No fault |
| C-D | 13kΩ | 0Ω | 13kΩ | Short circuit |
| H-I | 6.24kΩ | 9.45kΩ | 3.21kΩ | Short circuit |
| K-N | 17.88kΩ | 0Ω | 17.88kΩ | Short circuit |
| J-K | 0Ω | 0Ω | 0Ω | Open circuit |
| J-L | 9.18KΩ | 9.45kΩ | 0.27kΩ | No fault |

#

# Experiment # 9B Troubleshooting Test Circuit # SP12

# Original Circuit



|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Points | No fault | Measured | Difference | Fault |
| A-B | 6.8kΩ | 6.9kΩ | 0.1kΩ | No fault |
| C-D | 9.1kΩ | 0Ω | 9.1KΩ | Short circuit |
| G-H | 0Ω | 0Ω | 0Ω | Open circuit |
| D-J | 0Ω | 0Ω | 0Ω | Open circuit |
| J-H | 0Ω | 0Ω | 0Ω | Open circuit |
| J-K | 3.3kΩ | 3.3kΩ | 0Ω | No fault |
| B-K | 13.57kΩ | 0Ω | 13.57kΩ | Open circuit |
| B-H | 10.27kΩ | 12.7kΩ | 2.43kΩ | Short circuit |



# Definition of terms

***Definition of terms***

Short Circuit

It is defined as A short circuit is simply a low resistance connection between the two conductors supplying electrical power to any circuit. This is caused when current travels an unintended path with little to no resistance. This causes too much current to flow within the circuit. Example: When the positive and negative terminals of a battery are connected together with a low resistant material like a wire excessive current passes through the battery which causes overheating and possibly an explosion.

Open Circuit

 An open circuit is when a circuit lacks a complete path between the terminals of its power source. For current to flow, which basically is flow of electrons, we need a path of low resistance. If the opposition to electrons is very high, to the extent that current flow is not possible, that is an open circuit.

Shorted Resistor

This is when a wire is placed across a resistor causing the electrons to flow through the wire instead of the resistor due to the nature of resistors. i.e. Electrons choose the path with the least resistance. Therefore, the resistor present will have a resistance of 0Ω.

Resistor in parallel

 Two elements, branches or circuits are in parallel if they have two points of intersection. In a parallel circuit voltage is constant and the resistance decreases when more resistors are added. Current is divided according to the value of the resistor the higher the magnitude of resistance the lower the current through that particular resistor.

Resistors in series.

 Two elements, branches are in series if they are connected once. In a series resistor the total resistance is the summation of all the individual resistors. Current remains constant and the voltages drop along the resistors. The total of the voltage drops equals that of the total voltage.

## Formulas Used

## series connection

RT = R1 + R2 + R3 …... + RN

## PARALLEL CONNECTION

# $R\_{T}=\frac{1}{\frac{1}{R\_{1}}+\frac{1}{R\_{2}}+\frac{1}{R\_{3}}∙∙∙∙∙\frac{1}{R\_{N}}}$

# Summary and Conclusion

## First box

## series circuit

First the nominal values of the resistors were calculated using the color code system. Once that was done the total resistance assuming there was no faults in the circuit was calculated to be 122Ω. But when it was measured the total resistance was 104Ω indicating that there were faults in the circuit. Using the digital multimeter the points were measured and the values were compared to the calculated values to try and find the faults. After measuring the points, it was discovered that there was a hidden resistor connected in parallel to the 56Ω resistor since the value dropped from 56Ω to 28Ω and that there was a hidden resistor between points I and J measured at 6 Ω. After identifying all this faults the reason the total valued measured was less than the calculated value was clear.

## second box

## parallel circuit

 Same as with the first box the nominal values of the resistors were calculated. Once that was done the individual values of the resistors were measured to see if the resistors were in parallel. After measure two of the resistors measured 0Ω even though the nominal values were 13kΩ and 33kΩ indicating that a wire was placed across it to short the resistors. The wires were also checked using the multimeter to check for an open circuit after measuring the points an open circuit point was found between the 39kΩ and the 33kΩ resistors. After all the faults were found the total resistance was measured and the values corresponded to that of the calculated resistance taking the faults into account.

## third box

## series-parallel connection.

 The nominal values of the resistors were calculated using the color code system. Then the total resistance and resistance across each point was calculated using the formulae for calculating total resistance in a series circuit and that of total resistance in a parallel circuit. The total voltage was measured and the value measured was 0Ω meaning there was a break in the circuit upon further measuring and comparing with the total resistance the faults identified was a short between the 100kΩ resistor and the 10kΩ resistor. The short was found to between point D-J and point J-H. after these faults were recorded the total resistance and individual resistance calculated taking into account all the faults matched.

# Summary

 In this experiment, it can be observed that a given circuit can have many faults and that not all the faults may prevent the circuit from working. That’s why it is in the best interest of everyone to test circuits before using it calculate the values you are supposed to get using the series and parallel knowledge and then compare your results to the measured values to know if the circuit is working properly to prevent any future problems.