Power Dissipation in Resistors

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1. You have at your lab station a bunch of different resistors. Use the color table below to help you read the “nominal” value of each resistor. Then measure the actual resistance of each resistor using your digital multimeter (DMM). (Set the DMM to “Ω” and put the two leads in the jacks labeled “COM” and “V-Ω”.)

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| |  |  |  |  |  | | --- | --- | --- | --- | --- | | Color | First-band Digit | Second-band Digit | Third-band  Multiplier | Fourth-band  Tolerance | | Black | 0 | 0 | 100 = 1 |  | | Brown | 1 | 1 | 101 = 10 | 1% | | Red | 2 | 2 | 102 = 100 | 2% | | Orange | 3 | 3 | 103 = 1000 | 3% | | Yellow | 4 | 4 | 104 = 10000 | 4% | | Green | 5 | 5 | 105 = 100000 |  | | Blue | 6 | 6 | 106 = 1000000 |  | | Violet | 7 | 7 | 107 = 10000000 |  | | Gray | 8 | 8 | 108 = 100000000 |  | | White | 9 | 9 | 109 = 1000000000 |  | | Gold |  |  |  | 5% | | Silver |  |  |  | 10% | | None |  |  |  | 20% | |
|  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Colors (if applicable) and physical description** | **Rated Power** | **Nominal R** | **Measured R** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

2. What is the relationship between the physical size of the resistors and their resistance?

3. Connect the physically largest resistor to the power supply as shown in the circuit diagram to the right. For each resistor, use two multimeters to precisely measure both the current and the voltage drop across the resistor. As you increase the voltage across the resistor, calculate both the power dissipated in it, and its resistance as calculated by . At each value, feel the resistor *carefully* to see if it is getting hot. (To get accurate current readings, use the smallest current range you can, but **do not exceed the maximum current** of that range, or you may blow a fuse.)



|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Resistor: (describe value, physical size and appearance): | | | | | |
| ΔV(nominal) | ΔV(measured) | I | P | ΔV/I | How hot? |
| 0.3 volts |  |  |  |  |  |
| 1 volt |  |  |  |  |  |
| 3 volts |  |  |  |  |  |
| 10 volts |  |  |  |  |  |
| 30 volts |  |  |  |  |  |

4. Based on your measurements, did the resistance increase, decrease, or stay the same as you increased the current? (Be careful: are your measurements of current and voltage precise enough to support your conclusion?) Is the temperature coefficient positive or negative for this resistor?

5. Now repeat your measurements for each of the other resistors, recording results in the tables below. *Be careful not to burn your fingers!*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Resistor: (describe value, physical size and appearance): | | | | | |
| ΔV(nominal) | ΔV(measured) | I | P | ΔV/I | How hot? |
| 0.3 volts |  |  |  |  |  |
| 1 volt |  |  |  |  |  |
| 3 volts |  |  |  |  |  |
| 10 volts |  |  |  |  |  |
| 30 volts |  |  |  |  |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Resistor: (describe value, physical size and appearance): | | | | | |
| ΔV(nominal) | ΔV(measured) | I | P | ΔV/I | How hot? |
| 0.3 volts |  |  |  |  |  |
| 1 volt |  |  |  |  |  |
| 3 volts |  |  |  |  |  |
| 10 volts |  |  |  |  |  |
| 30 volts |  |  |  |  |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Resistor: (describe value, physical size and appearance): | | | | | |
| ΔV(nominal) | ΔV(measured) | I | P | ΔV/I | How hot? |
| 0.3 volts |  |  |  |  |  |
| 1 volt |  |  |  |  |  |
| 3 volts |  |  |  |  |  |
| 10 volts |  |  |  |  |  |
| 30 volts |  |  |  |  |  |

6. Now that they are no longer hot, make a final resistance measurement of each resistor (or whatever is left of it). Have any of their resistances changed permanently?

7. What difference does physical size of the resistor make in the results of any of your measurements? Why?

8. Based on your measurements, what can you conclude about the temperature coefficient of each of the resistors? (Is the coefficient positive or negative?)

9. Compare your findings with the stated power rating of each resistor. Are the power ratings an accurate reflection of what you saw? What do you expect to happen if you deliver 1.1 Watts to a resistor rated at 1 Watt?