LESSON 30
Resistor Wattage & Watt's Law

Watch video Lesson 30

When an electron current flows through anything, it causes heat to be produced, especially in electronic resistors.

Resistors are designed to handle a certain amount of heat. This heat is measured in Watts. All resistors have an ohm value and wattage rating.

A watt is defined by the formula:

Watts = Volts x Amps

W = V x A

If a resistor has 10 volts dropped across it, and the resistor is a 100 ohms, then the amount of current flowing through the resistor is:

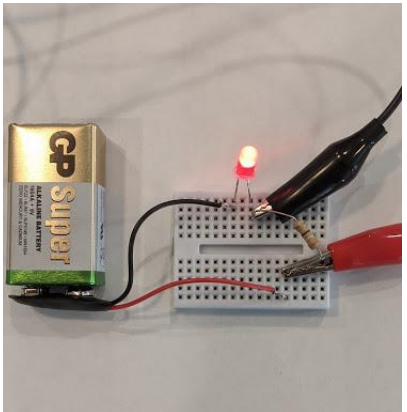
I = E / R
I = 10 / 100
I = 0.1 Amps (100 milliAmps)

Therefore, the Watts of heat this resistor would have to dissipate is equal to:

10 Volts x 0.1 Amps = **1 Watt**

Question:
What is the minimum rating in Watts for this 390 ohm resistor with 6.57 volts dropped across it?

Let's calculate it.



6.57 voltage-drop

Calculations: First, the amount of current flowing through this resistor is equal to:

I = E / R
I = 6.57 / 390
I = 0.0168 Amps (16.8 milliAmps)

So, the minimum wattage rating equals:

Watts = 6.57V x 0.0168A = **0.110 W**

So, the minimum wattage rating for this 390 ohm resistor in this circuit is 0.110 Watts. Since our resistor is rated at 1/2 Watt, it is sufficient to handle more than 0.110 Watts. (We also could have used a 1/4 Watt resistor which is equal to 0.25 Watts.)

Practice Quiz 30

30b | **Answer these questions** | **Activity Page** | **Use Watt's Law to calculate the wattage of a resistor** ud

(1) What is the mathematical formula for Watt's Law?

_____

(2) When we measure volts across a resistor, we are measuring the:?

_____

(3) If there is a voltage drop of 45 volts across a 39,000 ohm resistor, how much current is flowing through the resistor?

_____

(4) If the current through a resistor is 0.0018 Amp and the resistance is 470 ohms, what is the minimum wattage we should use for this resistor?

_____

(5) If the voltage drop across this 390 ohm resistor is 7 volts, how much current is flowing through it?

_____

(6) What is the minimum wattage you would need for the resistor in question #5?

_____

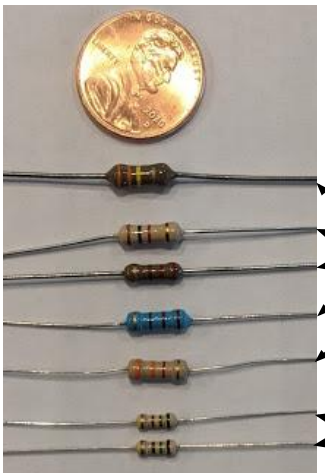
Note: If the current flowing in your circuit is too high, it may cause the resistor to burn because you have exceeded its wattage rating.

(7) If you put a 1/2 watt 10 ohm resistor across a 9-volt battery, how much current will flow in the circuit?

_____

(8) Will it exceed the wattage rating of the 10 ohm 1/2 watt resistor?

_____



How many watts?

To calculate the wattage rating needed for a resistor, you must first find how much current is flowing by dividing the voltage drop by the resistance value.Then multiply that current times the voltage drop to get the minimum Watts needed.

Answer Sheet Page 1 of 2

Answers for 7b

#1. 14
#2. 10
#3. 5
#4. Red and Black
#5. 5
#6. 8
#7. 2
#8. 4
#9. 26
#10. 170
#11. No
#12. red

Answers for 9b

#1. negative
#2. yes
#3. yes
#4. negative
#5. 1
#6. 1
#7. black
#8. multicell
#9. 3
#10. Emitting light

Answers for 10b

#1. solder
#2. Solderless CB
#3. Yellow, violet, brown, gold
#4. yes
#5. black
#6. true
#7. true
#8. Solderless CB
#9. solder
#10. Yes, No, maybe

Answers for 11b

#1. 34
#2. circuit
#3. no
#4. solder
#5. False
#6. 17
#7. true
#8. solder
#9. true
#10. True

Lab #1201

OHM'S LAW and more!

5b

	Number	Value in Ohms
#R1		2400
Band 1	2	
Band 2	4	
Band 3	2	
Band 4	5%	Tolerance ±5%
#R2		
Band 1	1	10,000,000
Band 2	0	
Band 3	6	
Band 4	5%	Tolerance ±5%
#R3		
Band 1	4	430
Band 2	3	
Band 3	1	
Band 4	5%	Tolerance ± 5%
#R4		
Band 1	6	680
Band 2	8	
Band 3	1	
Band 4	5%	Tolerance ± 5%

Answers for 12b

#1. Yes #4. Yes #7. True #10. yes
#2. No #5. False #8. beveled
#3. No #6. Resistor #9. false

6b

	Number	Value in Ohms
#R1		18
Band 1	1	
Band 2	8	
Band 3	0	
Band 4	0.1	Tolerance ±1%
Band 5	1%	
#R2		
Band 1	1	1300
Band 2	3	
Band 3	0	
Band 4	1	Tolerance ±1%
Band 5	1%	
#R3		
Band 1	1	10,000
Band 2	0	
Band 3	0	
Band 4	2	Tolerance ±1%
Band 5	1%	
#R4		
Band 1	7	750,000
Band 2	5	
Band 3	0	
Band 4	3	Tolerance ±1%
Band 5	1%	

Answers for 17b

#1. 5 #4. voltage drop #9. yes
#2. No #5. No #10. yes
#3. Red, yellow, green, blue, clear #6. 2 volts.
#7. (draw symbol)

Answer Sheet Page 2 of 2

Answers for 21b2

#1. series
#2. False
#3. True
#4. 18 mA
#5. 20 mA
#6. before
#7. True
#8. 5
#9. 18.23 mA
#10. 0.01823 Amps

Answers for 22b

#1. 20 mA
#2. COM
#3. 0.01782 Amps
#4. **V Ω mA**
#5. Resistor
#6. Anode
#7. No
#8. OFF
#9. 17.82 mA
#10. ???

Answers for 23b

#1. yes
#2. COM
#3. Tip
#4. no
#5. yes
#6. no
#7. True
#8. 0.00
#9. 17.82 mA
#10. ???

Answers for 24b

#1. yes
#2. three
#3. yes
#4. yes
#5 yes
#6. You may cause damage to the meter
#7. 5 amps
#8. 0.0015 A
#9. **5A**
#10. **5ADC**

Answers for 25b

#1. false
#2. resistor
#3. yes
#4. yes
#5 series
#6. yes
#7. **no**
#8. 20 mA
#9. **15.04 mA**
#10. **???**

Answers for 26b

#1. true
#2. Anode
#3. yes
#4. LED
#5 true
#6. yes
#7. no
#8. true
#9. **7.40 mA**
#10. **???**

Answers for 27b

#1. no
#2. 470
#3. yes
#4. dimmer
#5 false
#6. no
#7. no
#8. true
#9. **2.29 mA**
#10. **???**

Answers for 28b

#1. yes
#2. black
#3. red
#4. 0.015A or 15mA
#5 19.9 mA
#6. true
#7. true
#8. burn out
#9. **1.11 mA**
#10. **???**

Answers for 29b

#1. 5
#2a. 2000 millivolts DC
#2b. 200 volts DC
#3. **COM**
#4 **20 VDC**

Answers for 30b

#1. W=V×A
#2. voltage drop
#3. 1.2mA (0.0012A)
#4. 0.15 W
(Use ¼ W resistor)
#5 0.018
#6. 0.126 W
(Use ¼ W resistor)
#7. 0.9 A
#8. yes

Glossary of Terms and Formulas

- The lower-case letter **'k'** stands for 1000, sometimes called **'kilo'**
- **LED** = means light-emitting diode and they come in different colors
- The lower-case letter **'m'** stands for milli or one thousandth
- The upper-case letter **'M'** stands for one million, sometimes called 'Meg'
- The word **milliamp** = one-thousandth of an Amp
- The word **millivolt** = one-thousandth of a Volt
- **Multimeter** = a meter capable of measuring a variety of electrical measurements
- **Parallel circuit** = an electric circuit with multiple paths for the electrons to flow
- **Resistor Color Code** = a system for labeling resistors with their values
- **Series circuit** = an electric circuit with only one path for the electrons to flow
- **Schematic** = a drawing or diagram using symbols to represent components
- **Solderless circuit board** = sometimes called a solderless breadboard, is used to build circuits without having to solder the pieces together
- **voltage drop** = voltage measured across an active component in a circuit

To calculate wattage needed for a resistor. **1.** Find the voltage drop across the resistor. **2.** Find the ohms of the resistor. **3.** Divide the voltage drop by the ohms to get the current. **4.** Multiply the voltage drop by the current to get the minimum wattage needed for that resistor in that circuit.

Resistor Color Code
(Color Band colors)
Black = 0
Brown = 1
Red = 2
Orange = 3
Yellow = 4
Green = 5
Blue = 6
Violet = 7
Gray = 8
White = 9
Gold = × 0.1
Silver = × 0.01

Tolerance Band
Silver = ± 10% 4 bands
Gold = ± 5% 4 bands
Brown = ± 1% 5 bands

Ohm's Law
E = I × R or
R = E ÷ I or
I = E ÷ R

Watts Law
W = V × A

Equivalent resistance of two resistors in Series
$T_{total} = R1 + R2$

Equivalent resistance of two resistors in parallel
$T_{total} = R1 \times R2 / (R1 + R2)$

Lab #1201

OHM'S LAW and more!

Formula to calculate the resistor in series with an LED.

$R_{ADD} = E_{RES} / I_{LED}$

R_{ADD} = value in ohms of the additional resistor
E_{RES} = voltage drop across the additional resistor
I_{LED} = current required by the the LED
(Remember red, yellow, and green LEDs usually drop about 2 V, blue and clear LEDs drop about 3V.)