Electronics
Resistors and Resistance

Terry Sturtevant

Wilfrid Laurier University

September 7, 2017

Resistors and Measuring Resistance

Resistors and Measuring Resistance

Resistance can only reliably be measured when a resistor is *not* part of a circuit.

Resistors and Measuring Resistance

Resistance can only reliably be measured when a resistor is *not* part of a circuit.

If this can't be done, then the power to the circuit must be turned off.

Resistors and Measuring Resistance

Resistance can only reliably be measured when a resistor is *not* part of a circuit.

If this can't be done, then the power to the circuit must be turned off.

Current and voltage must be measured with power applied to the circuit

Resistors in Circuit Diagrams

Resistors in Circuit Diagrams

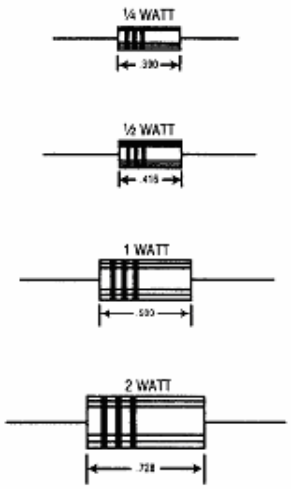
Resistor symbols

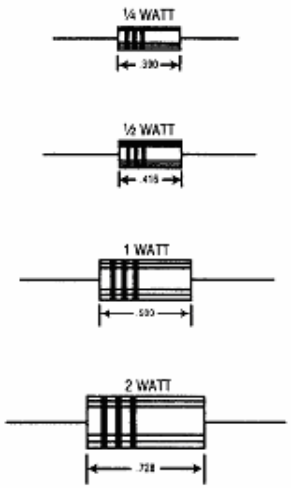
Resistors in Circuit Diagrams

Resistor symbols

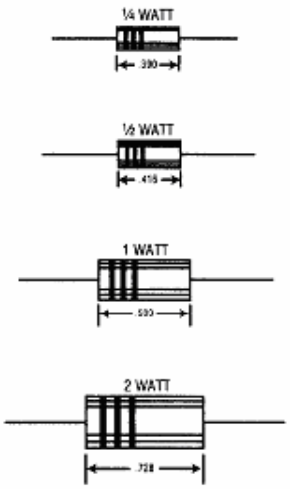
North American

European


¼ WATT
½ WATT
1 WATT
2 WATT

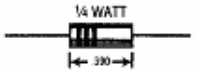


low power; 1/4 W



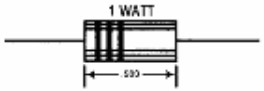
low power; 1/4 W

medium power; 1/2 W

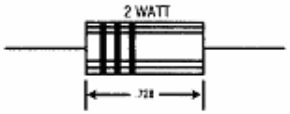


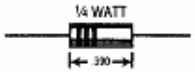
low power; 1/4 W

medium power; 1/2 W



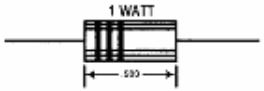
medium high power; 1 W



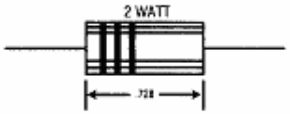


low power; 1/4 W

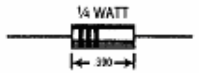
medium power; 1/2 W



medium high power; 1 W

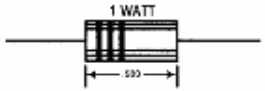


high power; 2 W

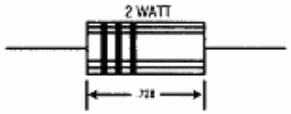


low power; 1/4 W

medium power; 1/2 W



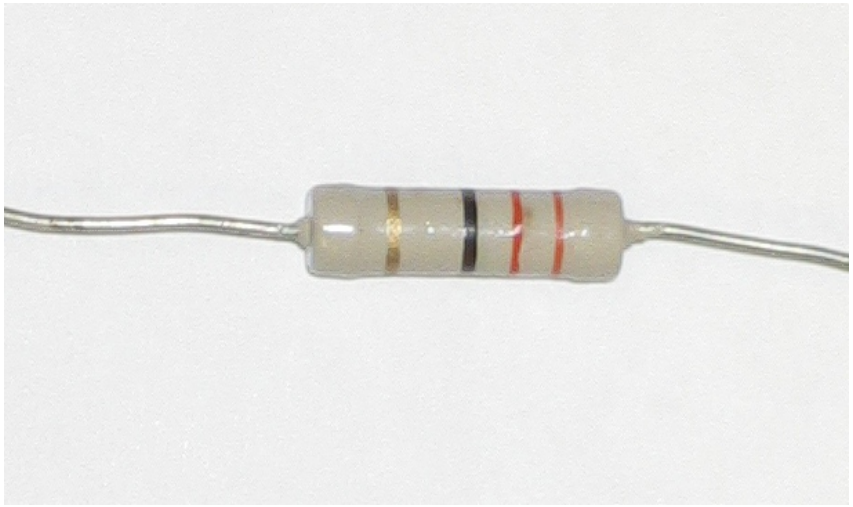
medium high power; 1 W



high power; 2 W

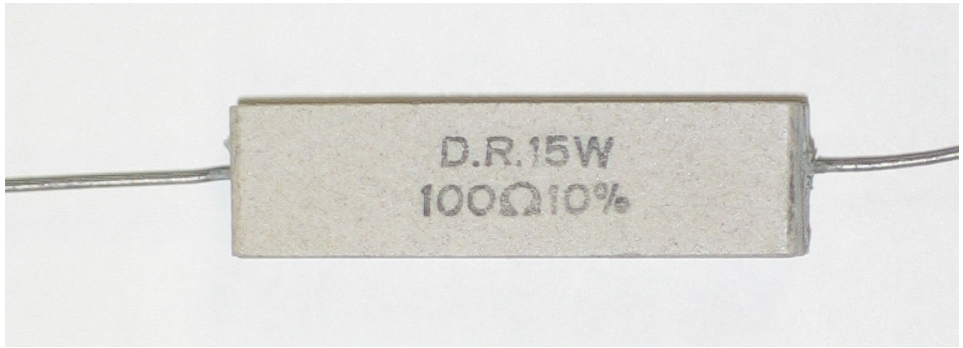
Higher power resistors are bigger so they can dissipate more heat.

"Normal" (i.e. 1/4 W) resistor

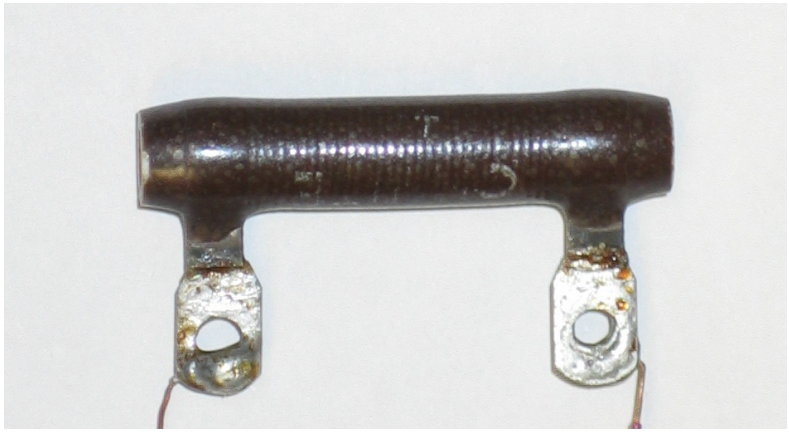


1/2 W resistor

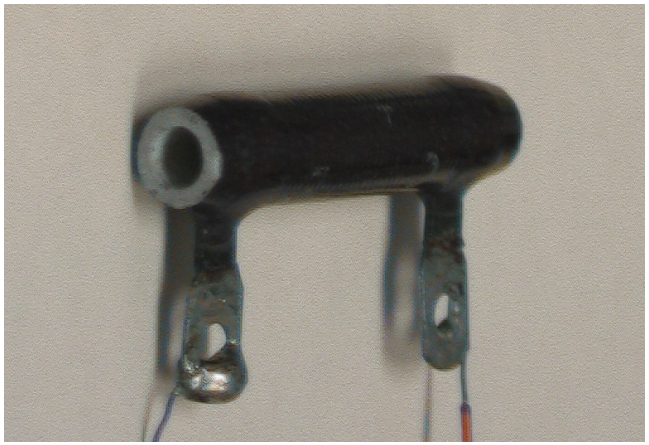
One kind of high power resistor (fins)



The wattage is indicated on this resistor.



High power hollow resistor



High power hollow resistor (end view)

- Always measure resistance by ohmmeter when the power is off *but never when the power is on*.

- Always measure resistance by ohmmeter when the power is off *but never when the power is on*.
- *Determine resistance* based on ohm's law using the voltage across the resistor and the current passing through it.

- Always measure resistance by ohmmeter when the power is off *but never when the power is on*.
- *Determine resistance* based on ohm's law using the voltage across the resistor and the current passing through it.
- **The most reliable measurement will be with the resistor removed from any circuit.**

Resistor Colour Codes

Resistor Colour Codes

Colour codes

Resistor Colour Codes

Colour codes

- allow resistors to be identified visually

Resistor Colour Codes

Colour codes

- allow resistors to be identified visually
- are international

Colour Codes

Colour Codes

- Better (Black - 0)

Colour Codes

- Better (Black - 0)
- Be (Brown - 1)

Colour Codes

- Better (Black - 0)
- Be (Brown - 1)
- Right (Red - 2)

Colour Codes

- Better (Black - 0)
- Be (Brown - 1)
- Right (Red - 2)
- Or (Orange - 3)

Colour Codes

- Better (Black - 0)
- Be (Brown - 1)
- Right (Red - 2)
- Or (Orange - 3)
- Your (Yellow - 4)

Colour Codes

- Better (Black - 0)
- Be (Brown - 1)
- Right (Red - 2)
- Or (Orange - 3)
- Your (Yellow - 4)
- Great (Green - 5)

Colour Codes

- Better (Black - 0)
- Be (Brown - 1)
- Right (Red - 2)
- Or (Orange - 3)
- Your (Yellow - 4)
- Great (Green - 5)
- Big (Blue - 6)

Colour Codes

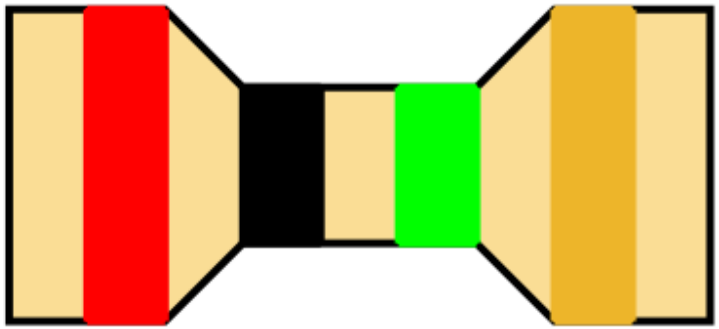
- Better (Black - 0)
- Be (Brown - 1)
- Right (Red - 2)
- Or (Orange - 3)
- Your (Yellow - 4)
- Great (Green - 5)
- Big (Blue - 6)
- Venture (Violet - 7)

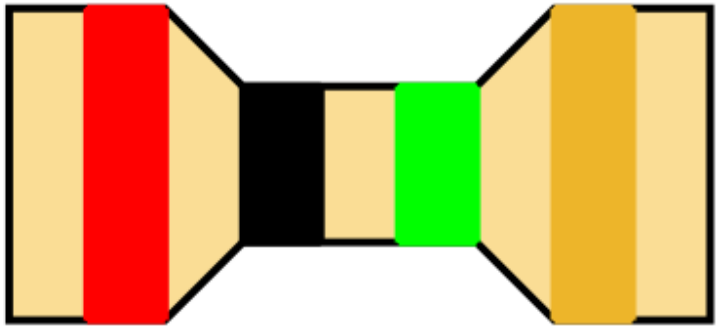
Colour Codes

- Better (Black - 0)
- Be (Brown - 1)
- Right (Red - 2)
- Or (Orange - 3)
- Your (Yellow - 4)
- Great (Green - 5)
- Big (Blue - 6)
- Venture (Violet - 7)
- Goes (Grey - 8)

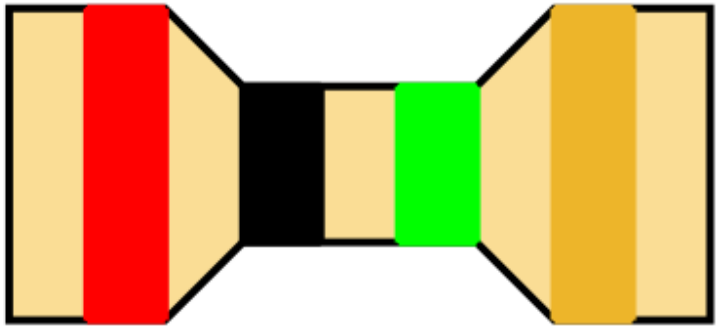
Colour Codes

- Better (Black - 0)
- Be (Brown - 1)
- Right (Red - 2)
- Or (Orange - 3)
- Your (Yellow - 4)
- Great (Green - 5)
- Big (Blue - 6)
- Venture (Violet - 7)
- Goes (Grey - 8)
- Wrong (White - 9)

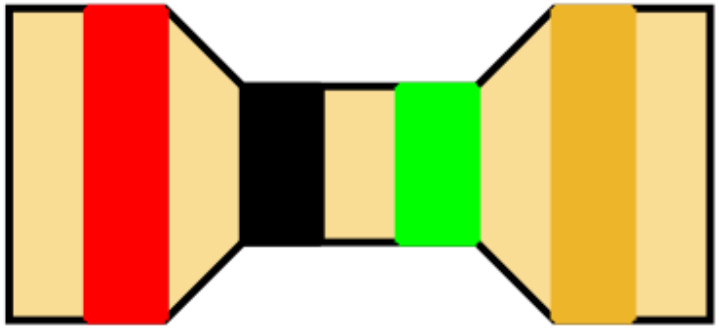




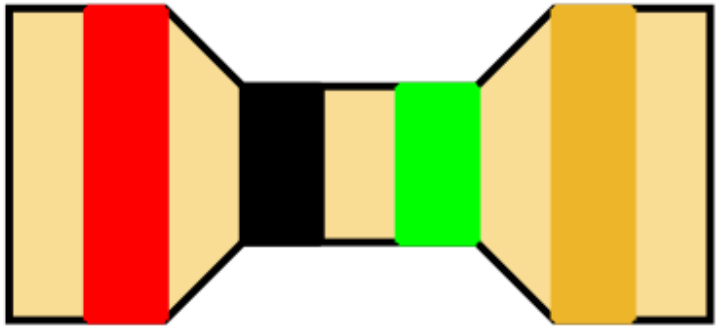
- First 2 bands give prefix; eg. 20 (Red Black)



- First 2 bands give prefix; eg. 20 (Red Black)
- Third band gives multiplier; eg. 5 (Green)



- First 2 bands give prefix; eg. 20 (Red Black)
- Third band gives multiplier; eg. 5 (Green)
- Fourth band gives tolerance; eg. 5% (Gold)



- First 2 bands give prefix; eg. 20 (Red Black)
- Third band gives multiplier; eg. 5 (Green)
- Fourth band gives tolerance; eg. 5% (Gold)
- Result $20 \times 10^5 \pm 5\%$

Smaller resistance values

Smaller resistance values

What about resistors below 10 Ω?

Smaller resistance values

What about resistors below 10 Ω?

- A *gold* multiplier means “divide by 10”.

Smaller resistance values

What about resistors below 10 Ω?

- A *gold* multiplier means “divide by 10”.
- A *silver* multiplier means “divide by 100”.

- First 3 bands give prefix; eg. 205 (Red Black Green)

- First 3 bands give prefix; eg. 205 (Red Black Green)
- Fourth band gives multiplier; eg. 0 (Black)

- First 3 bands give prefix; eg. 205 (Red Black Green)
- Fourth band gives multiplier; eg. 0 (Black)
- Fifth band gives tolerance; eg. 1% (Brown)

- First 3 bands give prefix; eg. 205 (Red Black Green)
- Fourth band gives multiplier; eg. 0 (Black)
- Fifth band gives tolerance; eg. 1% (Brown)
- Result $205 \times 10^0 \pm 1\%$

3 or 4 Band Tolerance Colour Codes

3 or 4 Band Tolerance Colour Codes

- Gold - 5%

3 or 4 Band Tolerance Colour Codes

- Gold - 5%
- Silver - 10%

3 or 4 Band Tolerance Colour Codes

- Gold - 5%
- Silver - 10%
- No band - 20%

5 or 6 Band Tolerance Colour Codes

5 or 6 Band Tolerance Colour Codes

- Black NA

5 or 6 Band Tolerance Colour Codes

- Black NA
- Brown 1%

5 or 6 Band Tolerance Colour Codes

- Black NA
- Brown 1%
- Red 2%

5 or 6 Band Tolerance Colour Codes

- Black NA
- Brown 1%
- Red 2%
- Orange 3%

5 or 6 Band Tolerance Colour Codes

- Black NA
- Brown 1%
- Red 2%
- Orange 3%
- Yellow 4%

5 or 6 Band Tolerance Colour Codes

- Black NA
- Brown 1%
- Red 2%
- Orange 3%
- Yellow 4%
- Green 0.5%

5 or 6 Band Tolerance Colour Codes

- Black NA
- Brown 1%
- Red 2%
- Orange 3%
- Yellow 4%
- Green 0.5%
- Blue 0.25%

5 or 6 Band Tolerance Colour Codes

- Black NA
- Brown 1%
- Red 2%
- Orange 3%
- Yellow 4%
- Green 0.5%
- Blue 0.25%
- Violet 0.1%

5 or 6 Band Tolerance Colour Codes

- Black NA
- Brown 1%
- Red 2%
- Orange 3%
- Yellow 4%
- Green 0.5%
- Blue 0.25%
- Violet 0.1%
- Grey 0.05%

5 or 6 Band Tolerance Colour Codes

- Black NA
- Brown 1%
- Red 2%
- Orange 3%
- Yellow 4%
- Green 0.5%
- Blue 0.25%
- Violet 0.1%
- Grey 0.05%
- White NA