Electronics
Resistors and Resistance

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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.
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
Resistors and Measuring Resistance

Resistors in Circuit Diagrams
Resistor Colour Codes
Tolerance Colour Codes

low power; 1/4 W

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Resistors and Measuring Resistance

Resistors in Circuit Diagrams
Resistor Colour Codes
Tolerance Colour Codes

- low power; 1/4 W
- medium power; 1/2 W

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Resistors in Circuit Diagrams

Resistor Colour Codes

Tolerance Colour Codes

low power; 1/4 W

medium power; 1/2 W

medium high power; 1 W
Resistors in Circuit Diagrams

- 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 \textit{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)
Resistors and Measuring Resistance

Resistors in Circuit Diagrams
Resistor Colour Codes
Tolerance Colour Codes

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 × 10^5 ± 5%
First 2 bands give prefix; eg. 20 (Red Black)
Resistors and Measuring Resistance

Resistors in Circuit Diagrams
Resistor Colour Codes
Tolerance Colour Codes

- 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)
Resistors and Measuring Resistance

Resistors in Circuit Diagrams
Resistor Colour Codes
Tolerance Colour Codes

- 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

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

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Electronics Resistors and Resistance
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”.
Resistors and Measuring Resistance

Resistors in Circuit Diagrams
Resistor Colour Codes
Tolerance Colour Codes

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 \(205 \times 10^0 \pm 1\%\)

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Electronics Resistors and Resistance
- 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