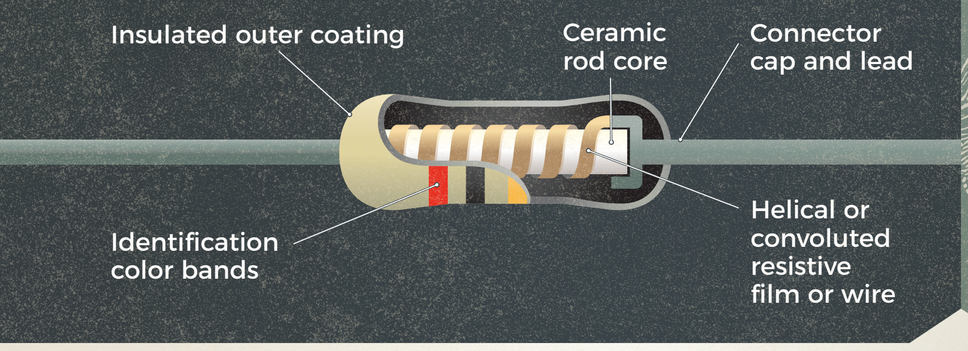
FIELD GUIDE TO RESISTORS

In order for an electrical circuit to function properly, the power requirements, size and complexity of the circuit need to be in perfect balance. Too much power and the circuit will fail; too little and it may not function at all. You can achieve this balance by using a type of component called a resistor to introduce resistance in the circuit and ensure your components function properly.

INSIDE A TYPICAL RESISTOR



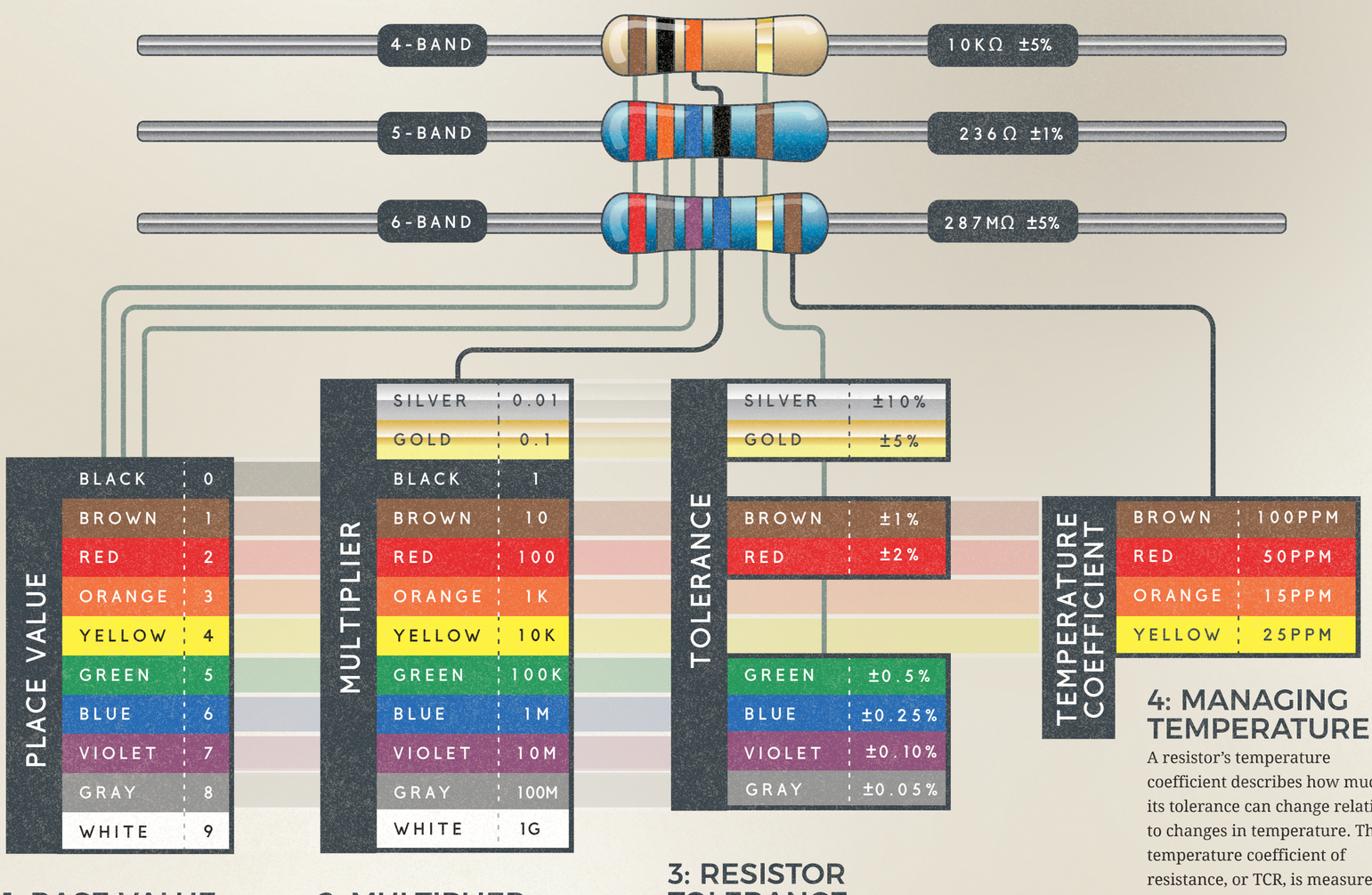
OHM'S LAW

If you know the voltage and current of your circuit, determine how much resistance your circuit needs by using Ohm's law.

$$\frac{\text{VOLTAGE}}{\text{CURRENT}} = \textbf{\textit{RESISTANCE}}$$

Once you've determined the value of ***R***, you can select the resistor or combination of resistors that you will install in your circuit by "reading" the series of colorful bands printed on the outer coating.

HOW TO READ COLOR BANDS



1: BASE VALUE

The first two bands describe a resistor's base value (or the first three bands, in the case of five- and six-band resistors). The value of these bands in sequence – *NOT* added together – indicates the base resistance value in ohms.

2: MULTIPLIER

For resistors that have values higher than three digits, a multiplier band is used – K (kilo) indicating 1,000, M (mega) indicating one million and G (giga) indicating 1,000 million. Resistors not needing a multiplier will still display a black multiplier band.

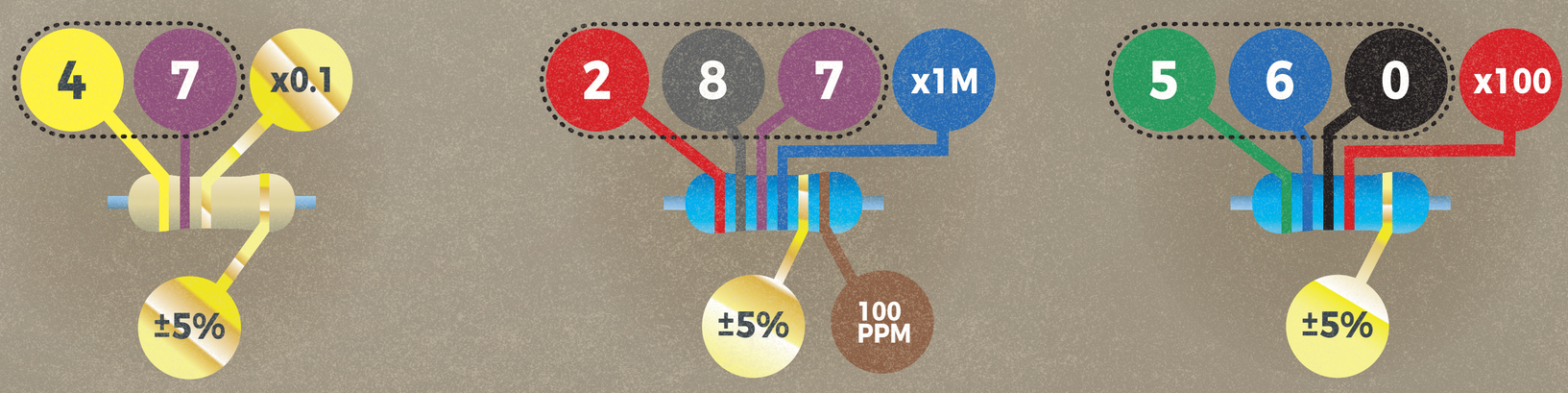
3: RESISTOR TOLERANCE

Even though resistors are manufactured to precise specifications, they aren't perfect. The tolerance value indicates what percentage of voltage, higher, or lower, that the resistor will allow through the circuit.

4: MANAGING TEMPERATURE

A resistor's temperature coefficient describes how much its tolerance can change relative to changes in temperature. The temperature coefficient of resistance, or TCR, is measured in parts per million ºC. A resistor with a TCR value of 100ppm will not change in tolerance more than 0.00010% per ohm, per degree celcius.

COLOR BAND EXAMPLES



RESISTOR TYPES

Different types, sizes and complexities of electrical circuits use a mind-boggling variety of resistors.
Here are a few of the most common types you may encounter.

CARBON FILM

Carbon film resistors are the archetypical resistor encountered in DIY electronics. Inexpensive and available in thousands of values, they've been used in electrical circuits for over 100 years.

COMMONLY FOUND

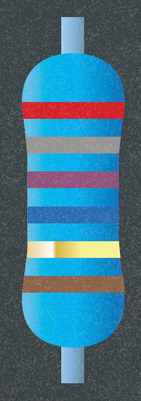
These can be found almost everywhere. These are the breadboard-friendly resistors that end up in all kits, and in most soldering projects.

POWER RESISTOR

Power resistors are the best choice when you're dealing with higher power levels. They come in significantly larger power ratings than standard resistors (into full watts), and are typically large enough to have their value printed on their housing instead of using color bars.

COMMONLY FOUND

Commonly seen in heating applications, due to the heat they generate. Some applications may even have cooling elements or a liquid cooling system.

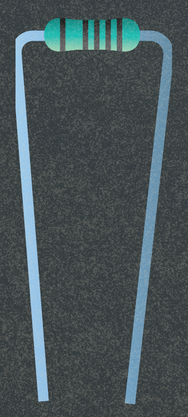


METAL FILM

Metal film resistors, like carbon film resistors, are among the most common resistors you'll find in electrical circuits. They are the logical outgrowth of the wire-wound resistors that populated the golden age of radio electronics.

COMMONLY FOUND

These are very precise resistors. Their stability and accuracy make them a great choice for critical projects that demand a high level of accuracy.



THROUGH-HOLE

Through-hole components have been at the center of small projects for a long time. Both carbon film and metal film resistors are typically found in through-hole applications and need to be used on circuit boards that are drilled for PTH components.

COMMONLY FOUND

PTH or "plated through-hole" resistors are an easy choice for common breadboarding activities and simple prototypes that don't require mass production.

SURFACE-MOUNT

Surface-mounted devices, or "SMD" components, don't pass all the way through a circuit board the way a PTH component does, and instead, are soldered only to the surface of the board. Common SMD resistors like the 0602 are typically much smaller than their through-hole counterparts.

COMMONLY FOUND

They are at the heart of large-scale, commercial circuit board production and manufacturing for many applications.

Learn More

KEEP GOING! If you want to learn more about resistors, circuits and how to use them appropriately in your next project, you can find plenty of tutorials and guides at **learn.sparkfun.com.**

sparkfun® START SOMETHING