

TYPES OF RESISTORS

Resistors come in a variety of shapes and sizes. They might be through-hole or surface-mount. They might be a standard, static resistor, a pack of resistors, or a special variable resistor.

Termination and mounting

Resistors will come in one of two termination-types: through-hole or surface-mount. These types of resistors are usually abbreviated as either PTH (plated through-hole) or SMD/SMT (surface-mount technology or device).

Through-hole resistors come with long, pliable leads which can be stuck into a breadboard or hand-soldered into a prototyping board or printed circuit board (PCB). These resistors are usually more useful in breadboarding, prototyping, or in any case where you'd rather not solder tiny, little 0.6mm-long SMD resistors. The long leads usually require trimming, and these resistors are bound to take up much more space than their surface-mount counterparts.

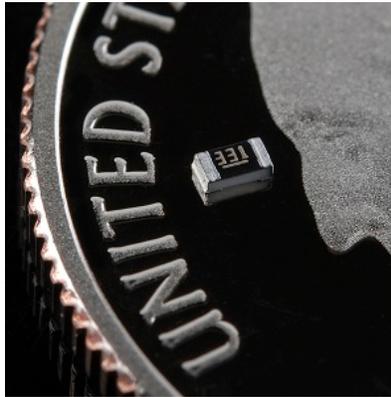
The most common through-hole resistors come in an axial package. The size of an axial resistor is relative to its power rating. A common $\frac{1}{2}W$ resistor measures about 9.2mm across, while a smaller $\frac{1}{4}W$ resistor is about 6.3mm long.



A half-watt ($\frac{1}{2}W$) resistor (above) sized up to a quarter-watt ($\frac{1}{4}W$).

Surface-mount resistors are usually tiny black rectangles, terminated on either side with even smaller, shiny, silver, conductive edges. These resistors are intended to sit on top of PCBs, where they're soldered onto mating landing pads. Because these resistors are so

small, they're usually set into place by a robot, and sent through an oven where solder melts and holds them in place.

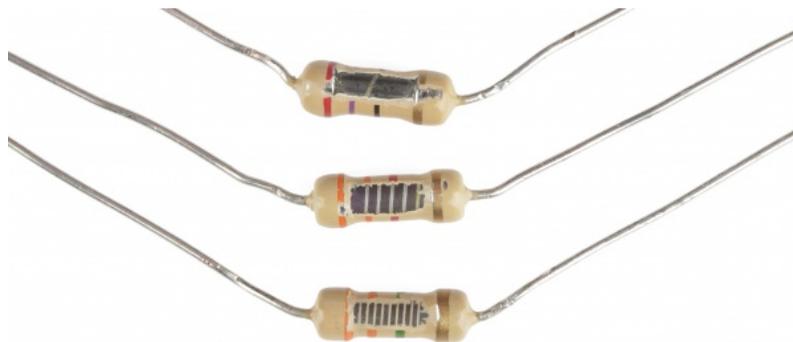


A tiny 0603 330Ω resistor hovering over shiny George Washington's nose on top of a U.S. quarter.

SMD resistors come in standardized sizes; usually either 0805 (0.8mm long by 0.5mm wide), 0603, or 0402. They're great for mass circuit-board-production, or in designs where space is a precious commodity. They take a steady, precise hand to manually solder, though!

Resistor composition

Resistors can be constructed out of a variety of materials. Most common, modern resistors are made out of either **acarbon, metal, or metal-oxide film**. In these resistors, a thin film of conductive (though still resistive) material is wrapped in a helix around and covered by an insulating material. Most of the standard, no-frills, through-hole resistors will come in a carbon-film or metal-film composition.



Peek inside the guts of a few carbon-film resistors. Resistance values from top to bottom: 27Ω, 330Ω and a 3.3MΩ. Inside the resistor, a carbon film is wrapped around an insulator.

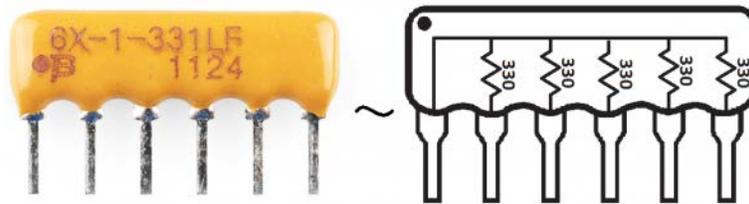
More wraps means a higher resistance. Pretty neat!

Other through-hole resistors might be wirewound or made of super-thin metallic foil. These resistors are usually more expensive, higher-end components specifically chosen for their unique characteristics like a higher power-rating, or maximum temperature range.

Surface-mount resistors are usually either **thick or thin-film** variety. Thick-film is usually cheaper but less precise than thin. In both resistor types, a small film of resistive metal alloy is sandwiched between a ceramic base and glass/epoxy coating, and then connected to the terminating conductive edges.

Special resistor packages

There are a variety of other, special-purpose resistors out there. Resistors may come in pre-wired packs of five-or-so-resistor arrays. Resistors in these arrays may share a common pin, or be set up as voltage dividers.



An array of five 330Ω resistors, all tied together at one end.

Resistors don't have to be static either. Variable resistors, known as **rheostats**, are resistors which can be adjusted between a specific range of values. Similar to the rheostat is the **potentiometer**. Pots connect two resistors internally, in series, and adjust a center tap between them creating an adjustable voltage divider. These variable resistors are often used for inputs, like volume knobs, which need to be adjustable.



A smattering of potentiometers. From top-left, clockwise: a standard 10k trimpot, 2-axis joystick, softpot, slide pot, classic right-angle, and a breadboard friendly 10k trimpot.

Source : <https://learn.sparkfun.com/tutorials/resistors#types-of-resistors>