# Relays

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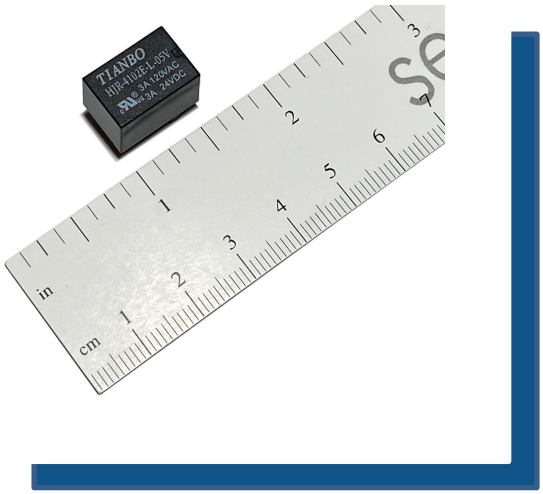
## What is a Relay?

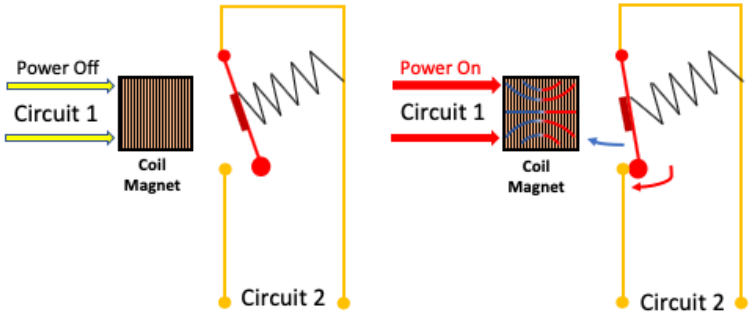
A relay is an electromagnetic switch operated by a relatively small electric current that can turn on or off a much larger electric current. The heart of a relay is an electromagnet (a coil of wire that becomes a temporary magnet when electricity flows through it). Think of a relay as a kind of electric lever: switch it on with a tiny current and it switches on ("leverages") another appliance using a much bigger current. Why is that useful? As the name suggests, many sensors are incredibly sensitive pieces of electronic equipment and produce only small electric currents. But often we need them to drive bigger pieces of apparatus that use bigger currents. Relays bridge the gap, making it possible for small currents to activate larger ones. That means relays can work either as switches (turning things on and off) or as amplifiers (converting small currents into larger ones).




## How does a relay work?

A relay has two main parts: the contacts and the electromagnet. The contacts work exactly the same way as a mechanical switch works – using terminals or contacts. The incoming wire is attached to one contact, and the outgoing wire to the other contact. The switch either connects the two contacts, allowing electricity to pass through, or it disconnects them, breaking the path from the power source to the ground and stopping the power in its tracks. The electromagnet in a relay takes the place of human fingers. When current is run through the relay's electromagnet (from a different circuit than the one being turned on and off with the relay), energy is forced through a coil of copper wire. This energy creates a magnetic pull on one of the contacts, physically bending it or drawing it until it touches the other contact, creating a closed circuit. When the current stops flowing through the coil, the magnetism disappears and the contact is restored to its original position, no longer touching the other terminal.

Figure 1: Relay




## Why are relays needed?

A small electric motor needs nothing more than a battery, a switch, and a thin 24 gauge wire. The motor draws at most a half amp of electricity, which will easily pass through the thin wire. However, a much larger motor will draw more amps, and therefore will need a larger wire. Think of people in a hallway. If too many people try to get through at the same time, the hallway gets clogged. And if they stay there for a while, because they are moving more slowly, the hall will heat up from everyone's body heat.

The same is true for electricity. If too much electricity tries to go through a wire that is too small, the electricity backs up, and the wire heats up. As a result, the larger the motor needed for an application, the larger the wire is needed. Larger switches are needed with larger wires to handle the added power needed to run a bigger motor. In order to run a large, complex piece of machinery, several motors, large switches, and less flexible larger wires are needed.

All of this becomes too big and unwieldy to be very useful. By using relays, small wires and small switches can be used to turn the circuits on and off. Relays help make control boxes a more manageable size and the cabling going between the control box and the motors easier to work with.

Figure 2: How a Relay Activates a Large Circuit