

Home Electrical Wiring

Electrical circuits in homes are mainly power circuits. Power circuits carry 115 volt or 230 volt electricity to an electric device such as a light, fan, pump, or heater. Home power circuits also supply electricity to *duplex receptacles*, which provide power to portable electric devices, such as room heaters and appliances.

Home electrical systems consist of parallel circuits originating in a *main service panel box*. Each of the branch circuits is wired in parallel with the others. The outlets, lights, heaters, and appliances sharing a branch circuit are also in parallel, using the same voltage.

Service Equipment

The 230-volt home electrical system consists of *service wires*; an *electric meter*; *feeder wires*; one or two *main switches*; a *main service panel box* with *circuit breakers* or *fuses*; and the wires, receptacles, and fixtures in the home.

The main service wires come through the ground or overhead from the utility company's transformer. These three wires, two hot wires and a neutral wire, attach to the utility side of the electric meter. Attached to the house side of the electric meter are the feeder wires. The feeder wires are two hot wires (red and black), a neutral wire (white), and an equipment grounding wire (green or bare). The neutral wire and grounding wire are attached together at the meter and attached to a copper grounding rod driven into the earth outside the home. The feeder wires are either part of a cable or are carried in a metal *conduit* (pipe).

The feeder wires run from the meter and main switch into the home's service panel box. The black and red feeder wires are connected to *bus bars*, which hold the breakers or fuses in the panel box. A bus bar is a large electrical terminal where many wires may be connected. The white feeder

wire is the neutral and is connected to the neutral bus bar, which is electrically insulated from the panel box. The bare feeder wire is the grounding wire and is connected to the grounding bus bar, where all the ground wires from the branch circuits are also attached.

Branch and Appliance Circuits

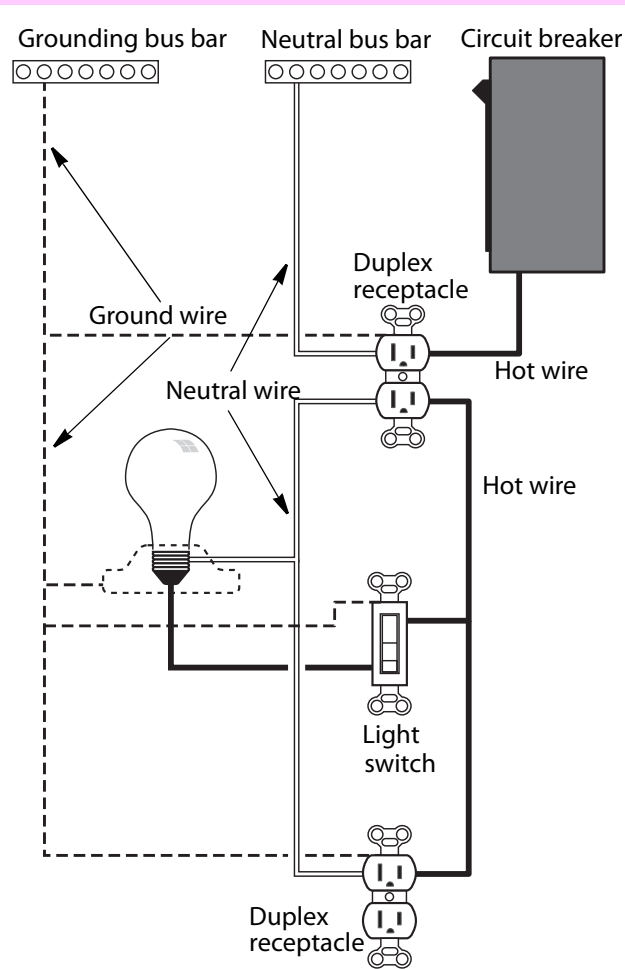
Branch circuits are systems of wire, outlets, and built-in fixtures for lighting, heating, and other purposes. *Appliance circuits* are circuits serving a single appliance like a furnace, air conditioner, electric range, or electric dryer.

The breakers or fuses protect the wire in branch circuits from carrying too much electrical current. When a breaker trips or a fuse blows, the cause of the circuit overload should be found and remedied. If a breaker on a circuit fails, or if the fuse blows, it should be replaced with another having the proper amp rating to match the wire used in the home (15 amps for older home circuits and 20 amps for newer home branch circuits).

Energy auditors should check fuses and breakers before insulating to insure no oversized circuit protectors exist in the panel box. Oversized fuses or breakers will allow excessive amperage to flow, possibly heating the wires. Insulation could make a bad problem worse if the overheated wires are surrounded by the newly installed insulation.

A short circuit is an accidental circuit with no intentional load. Short circuits in appliances are particularly dangerous in the kitchen and bathroom because of the presence of water in those areas. In newer homes, circuits in the kitchen, bathroom, and garage are protected by special breakers known as *ground fault circuit interrupters* (GFCI). These GFCIs will trip if they detect electricity flowing in the grounding wires. Electricity won't flow in the grounding wires unless there is a short circuit.

Branch Circuit Anatomy



Branch circuits originate at the breaker panel and connect lights and duplex receptacles. This branch circuit powers two duplex receptacles and one light.

It's very important that all hot wires be connected to breakers or fuses, and that neutral wires be connected to the neutral bus bar in the panel box. Sometimes the neutral bus is accidentally connected to a hot wire somewhere in the system. This can happen at an outlet or light, if the hot and neutral wires are reversed. When the wires are reversed at a receptacle, the white wire is connected to the brass-colored terminal and the black wire is connected to the silver-colored terminal of the outlet. This reversal is dangerous, and it can be detected using a *circuit tester*, a plug-in device with lights indicating correct or incorrect wiring.

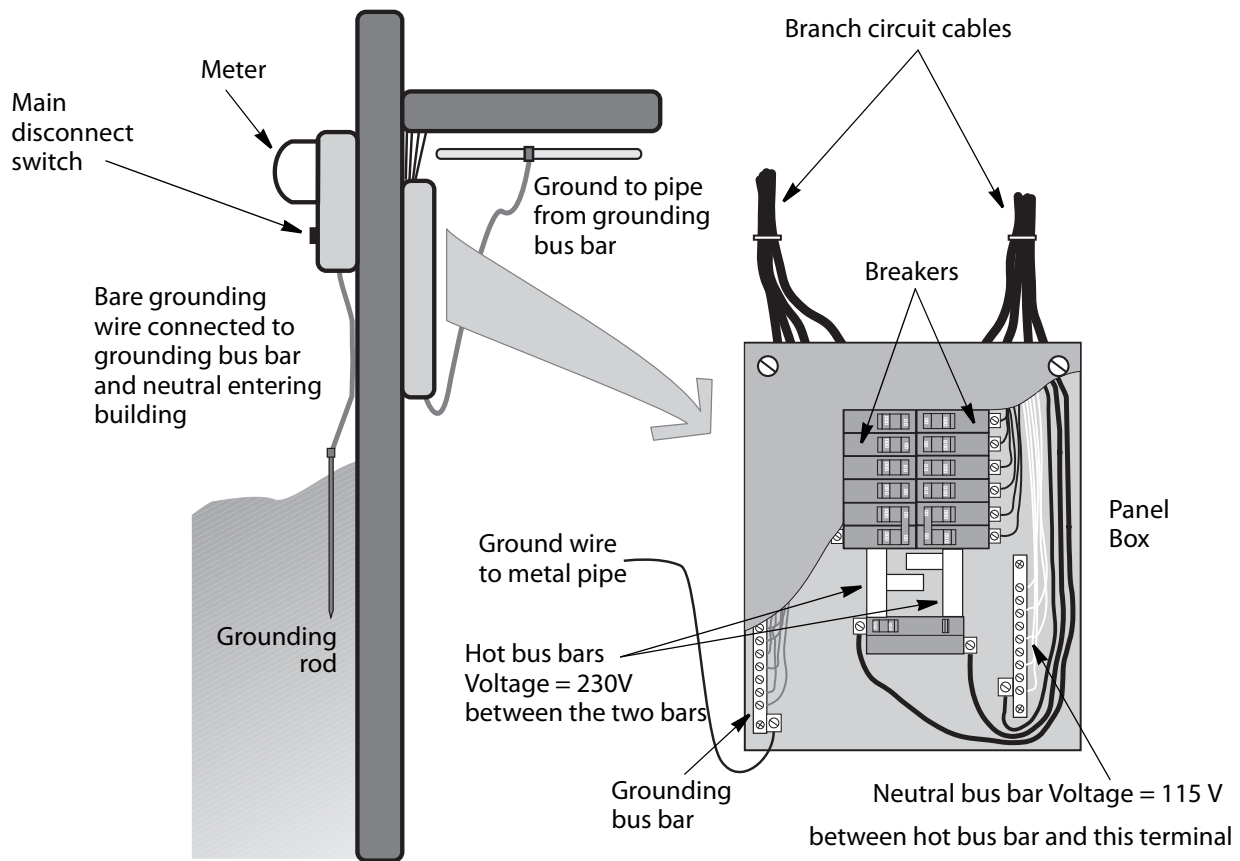
Grounding

Home electrical systems use the earth or the ground in two ways. The first is to ground the neutral feeder wire. The earth is electrically neutral and provides a kind of vacuum that draws electricity from the hot wires toward the earth through the home's electrical devices. The neutral wire is also grounded by the electric utility at the transformer, generator, and other locations in the transmission system.

Equipment used in electrical systems also is grounded. The *equipment grounding* wire is the bare wire connected to: each green grounding terminal of a receptacle; each metal electrical box (including the main panel box); and the metal cabinets of fixtures and appliances. The grounding bus bar in the breaker box is electrically connected to all the branch circuits. This network of equipment grounding connections gives stray electricity an easy and safe path to flow into the ground rather than flowing through some unlucky person in the event of a short circuit.

A bare copper wire also connects the metal piping and sometimes the metal ducts to the grounding bus bar. The home's piping system usually runs into the ground and helps establish a conductive attachment to the ground. However, the main reason for bonding pipes and ducts to a ground is to lead stray current away in the event that a hot wire shorts to a pipe or wire.

Home Electrical System



The major parts of a home electrical system are the service panel and the distribution panel box. The service panel contains the meter and main switch. The distribution panel box contains the breakers or fuses, and the power, neutral, and grounding, bus bars.