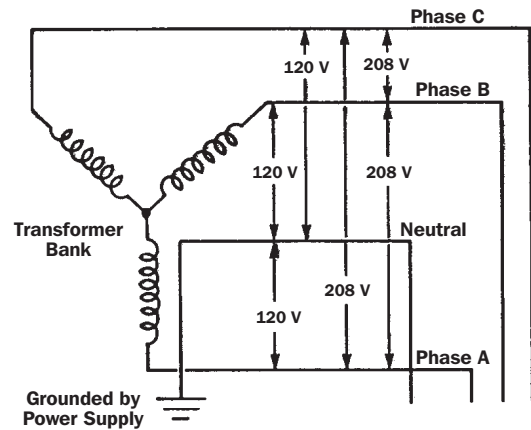


# Terminology and Symbols: Electricity and Electronics

**T**O LEARN to create and read electrical drawings, you must first learn the meaning of coded symbols and terms. Almost every element of an electrical plan is conveyed with a graphic symbol, which often includes numbers and/or an abbreviation for a term. These symbols convey a lot of important information. For the safety of workers and clients, you must interpret the symbols and terms to understand the circuits, their connections, the switching, and the fixtures shown on an electrical plan.



## Objectives:



1. Review basic electrical systems.
2. Interpret electrical terminology and symbols.

## Key Terms:



amperes	four-way switch	switch
amps	fuse	switch-leg
circuit	ground	tag
circuit breaker	home run	three-way switch
electric panel	junction	two-gang
electrical connector	receptacle	wire gauge
EMT conduit	Romex wiring	wire nuts

## Basic Electrical System Devices

Electrical systems for buildings and for equipment may include a large range of electrical devices and wiring. It is not practical to draw all of the devices and wires as they actually appear. It would require too much space on the plans and prints and is not necessary if people know the basic standard symbols developed to indicate each device and wire.

## ELECTRICAL SYSTEM COMPONENTS

Electrical systems in a building require electric panels, junctions, receptacles, wiring, switches, light fixtures, and appliances.

- ◆ An **electric panel** (service panel) is the distribution box that sends the electric current through different circuits.
- ◆ **Circuits** are the complete path of electric current, including the electric energy source.
- ◆ A **junction** (junction box) is a metal or plastic container used to hold electrical connections.
- ◆ A **receptacle** (outlet) is a fitting in a wiring system where current is directed to operate electrical devices. The wiring diagram should show which lights are controlled by which switches. It is not necessary to show the wiring in its exact path. A line in the shape of an arc is drawn that connects the appropriate switch to its fixture.

## SYMBOLS

The switches and outlets or receptacles are shown as symbols in their appropriate position. Electrical fixtures are also shown as symbols in their correct place. When an exact location is important, it will be dimensioned. The engineer draws most major appliances as they actually appear to make sure they fit. The same symbols and abbreviations drawn on plans are located in a schedule or legend. There they are defined, and more specific information is provided (e.g., type, color, and manufacturer).

### Organization

Symbols and terms are used to simplify and organize drawings. Knowing what each symbol and term means allows a person to interpret electrical documents. There is no mandated set of standard symbols, so some designers and engineers modify them. Therefore, it is important to understand the specific symbols being used on each project. To ensure accuracy, it is necessary to check the symbol legend to be certain of meanings.



## FURTHER EXPLORATION...

### ONLINE CONNECTION: How to Read Electrical Drawings

Learning to read electrical documents can take some time and practice. Almost all information is in a coded form or is represented with an abstract graphic. Communicating the correct information is extremely important. It is necessary to learn what all the symbols and terms mean and how they are represented on a drawing. To learn more about how to read electrical drawings, please visit:

<http://www.youtube.com/watch?v=uvJD1sSt1PM>

## Tag

Some electric symbols are generic and require an additional tag on the symbol. A **tag** may be a line through the symbol, a side shaded, a number, or a letter. A tag allows symbols to be more specific for different uses.

## Abbreviations

Abbreviations (e.g., those for receptacles or outlets) are drawn along with the electrical symbols. These abbreviations designate that the outlet is to be used for a specific appliance. For example, a receptacle dedicated for a refrigerator would include the abbreviation “REF” next to the symbol. In addition, when a receptacle needs to be waterproof, it would have the abbreviation “WP” next to it.

# Electrical Terminology, Symbols, and Abbreviations

Electrical terminology and symbols have developed over the years. Although there is no specific set for every designer, engineer, builder, and fabricator, the following are common in the industry.

## TERMINOLOGY

- ◆ An **electrical connector** is a device used to tie electric lines to electrical boxes or junctions. It is used with Romex wiring and with EMT conduit.
- ◆ **Romex wiring** (non-metallic sheathed cable) is a type of electrical wire covered with a non-metallic material; it has a plastic sheathing wrapped around several wires. The gauge and amount of wires within the plastic wrap ranges, depending on use.
- ◆ **EMT conduit** (electrical metal tubing) is metal tubing with thin walls and is used to run electrical wiring. The wiring is pulled through the conduit after the conduit is properly located. The metal tubing protects the wiring and is fitted together with connectors.
- ◆ A **wire gauge** is a measure of the thickness of the wire’s diameter. The gauge determines how much electric current the wire can safely carry. A thicker wire can carry more current.
- ◆ A breaker panel (circuit box) is the electrical box that distributes electricity entering the building to each branch circuit (each plug and switch). It is made up of **circuit breakers**—safety devices that detect too much current in a circuit.
- ◆ A **fuse** is an electrical safety device that limits the amount of current flow. Once the flow (measured in amps) reaches a certain amount, the fuse will melt and stop the electric flow.

- ◆ **Amperes** is a measurement of the rate at which electricity flows through a wire, a piece of machinery, or an appliance. Another name for amperes is **amps**. It is the measure (unit) of electric current passing a point in an electric circuit per unit of time (meter-kilo-gram-second system).
- ◆ A **ground** is a direct electrical connection to the earth; it drains away any unwanted buildup of electrical charge. Grounding minimizes the effect of a lightning strike and eliminates electrostatic buildup in appliances, computer systems, and other electronic devices.
- ◆ A **home run** is the main electrical line that runs from the electric panel to the first device on a circuit. It is the cable that carries power from the main circuit breaker panel to the first electrical box, plug, or switch in the circuit.
- ◆ A **switch** is a device that makes, breaks, or changes the course of an electric circuit; it interrupts and manipulates current in circuits. A switch consists of a power wire and a switch leg.
- ◆ A **switch-leg** is a control leg of the branch circuit. It is the part of a circuit that runs from a lighting outlet box to a light fixture or lamp holder down to an outlet box that contains the wall switch that turns the light or other load on or off.
- ◆ A **two-gang** is a type of electrical box that can hold two switches, two receptacles, or one switch and one receptacle.
- ◆ A **three-way switch** (a single-pole double-throw switch) is a light switch that has three terminals (screws, plus a ground screw); this allows a fixture to have multiple electricity sources. It is used to control a circuit from two locations.
- ◆ A **four-way switch** is a light switch that has four terminals (screws, plus a ground screw); it allows a fixture to have multiple switches and one is able to turn a fixture on or off at three or more locations. Four-ways are used between two three-way switches to control a light from a third (or more) location(s).
- ◆ **Wire nuts** are twist-on plastic connectors used to fasten two or more electrical conductors together; they connect bare wires.

## SYMBOLS AND ABBREVIATIONS

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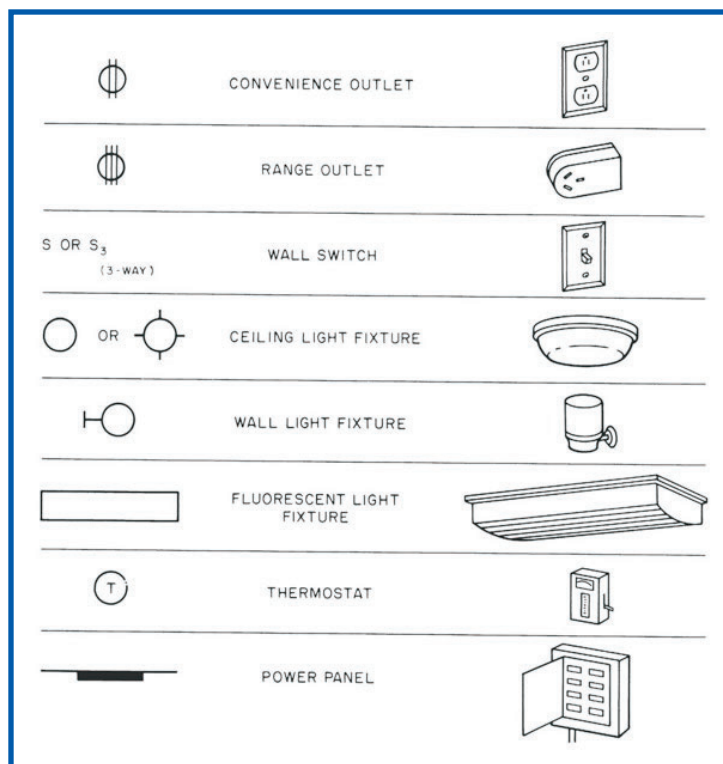
Symbols used in an electrical plan are not always the same as those used in elevation or section drawings. Typically, symbols are graphics that may contain letters or numbers. In elevation drawings, electrical elements or fixtures are often shown as they actually appear.

Symbols and graphic representations are used to designate the circuiting.

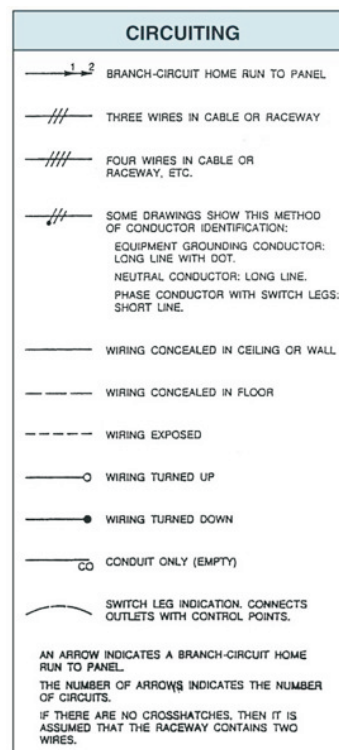
Electrical symbols and terms use a typical set of abbreviations next to the electrical symbols. They are used to represent and clarify specific switch types, receptacles, fixtures, etc. A full range of electrical symbols are used to represent receptacles.

Electrical power equipment, remotes, and motor types have a set of designated symbols.

Electrical distribution and lighting fixture symbols are commonly used in drawings.



**FIGURE 1.** Common electrical symbols and the fixtures they represent are shown in this image. (Courtesy, Shanghai Jiao Tong University, Shanghai, China)



**FIGURE 2.** These are common symbols used in electrical circuiting. (Courtesy, Shanghai Jiao Tong University, Shanghai, China)

ELECTRICAL ABBREVIATIONS (Apply only when adjacent to an electrical symbol.)		ELECTRICAL SYMBOLS	
		Switch Outlets	
Central Switch Panel	CSP	Single-Pole Switch	S
Dimmer Control Panel	DCP	Double-Pole Switch	S <sub>2</sub>
Dust Tight	DT	Three-Way Switch	S <sub>3</sub>
Emergency Switch Panel	ESP	Four-Way Switch	S <sub>4</sub>
Empty	MT	Key-Operated Switch	SK
Explosion Proof	EP	Switch and Fusestat Holder	SFH
Grounded	G	Switch and Pilot Lamp	SP
Night Light	NL	Fan Switch	SF
Pull Chain	PC	Switch for Low-Voltage Switching System	SL
Rain Tight	RT	Master Switch for Low-Voltage Switching System	SLM
Recessed	R	Switch and Single Receptacle	S
Transfer	XFER	Switch and Duplex Receptacle	S
Transformer	XFRMR	Door Switch	SD
Vapor Tight	VT	Time Switch	ST
Water Tight	WT	Momentary Contact Switch	SMC
Weather Proof	WP	Ceiling Pull Switch	S
		"Hand-Off-Auto" Control Switch	HOA
		Multi-Speed Control Switch	M
		Push Button	•

**FIGURE 3.** These are common electrical abbreviations and symbols for switches, receptacles, and fixtures.

Receptacle Outlets		Example of the use of several floor outlet symbols to identify a 2, 3, or more gang flow outlet.	
Where weather proof, explosion proof, or other specific types of devices are to be required, use the upper-case subscript letters. For example, weather proof single or duplex receptacles would have the uppercase WP subscript letters noted alongside of the symbol. All outlets should be grounded.		Underfloor duct and junction box for triple, double, or single duct system as indicated by the number of parallel lines.	
Single Receptacle Outlet		Example of use of various symbols to identify location of different types of outlets or connections for underfloor duct or cellular floor systems.	
Duplex Receptacle Outlet		Cellular Floor Header Duct	
Triplex Receptacle Outlet		*Use numeral keyed to explanation in drawing list of symbols to indicate usage.	
Quadruplex Receptacle Outlet			
Duplex Receptacle Outlet (Split Wired)			
Triplex Receptacle Outlet (Split Wired)			
250-V Receptacle Single Phase			
Use Subscript Letter to Indicate Function (DW—Dishwasher, RA—Range, CD—Clothes Dryer) or Numeral (with explanation in symbol schedule).			
250-V Receptacle Three Phase			
Clock Receptacle			
Fan Receptacle			
Floor Single Receptacle Outlet			
Floor Duplex Receptacle Outlet			
Floor Special-Purpose Outlet			
Floor Telephone Outlet (Public)			
Floor Telephone Outlet (Private)			

**FIGURE 4.** These are common electrical symbols used for receptacles. (Courtesy, Shanghai Jiao Tong University, Shanghai, China)



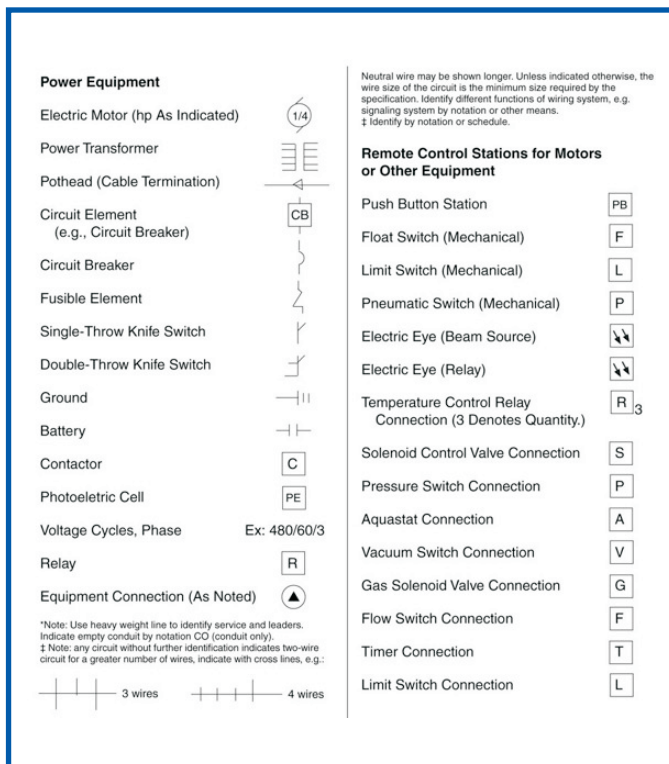


FIGURE 5. These are common symbols used to represent electrical power equipment, remotes, and motors.

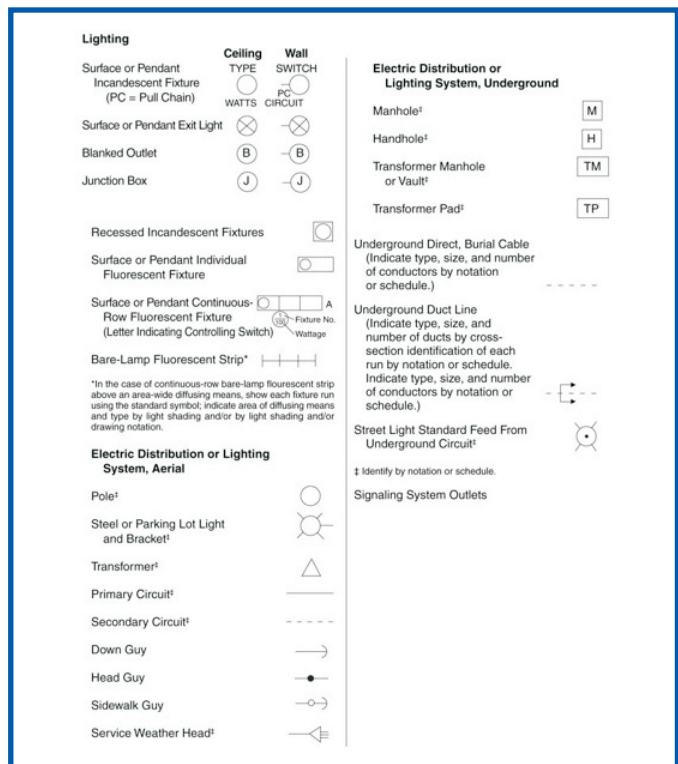


FIGURE 6. These are common symbols used in electrical distribution and lighting fixtures. (Courtesy, Shanghai Jiao Tong University, Shanghai, China)

## Summary:



Electrical systems in a building or in equipment include a range of electrical devices and wiring. It is not practical to draw everything as it actually appears, so standard symbols have been developed to indicate the items.

Switches and receptacles are shown as symbols in their appropriate position on the plan drawings. Symbols and terms are used to simplify and organize drawings. Some of the electric symbols are generic and, as such, require an additional tag on the symbol. There are also abbreviations drawn with electrical symbols.

Electrical terminology and symbols have developed throughout the years. Although there is not a specific set for every designer, engineer, builder, and fabricator, most electrical symbols, terms, and abbreviations are common and standard.

## Checking Your Knowledge:



1. How is the diameter of a wire measured?
2. What is a wire nut?
3. What is an electrical safety device that limits the amount of current flow?

4. What is the metal or plastic container used to hold electrical connections?
5. What are the advantages of using symbols and abbreviations on a wiring plan?

## Expanding Your Knowledge:

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A great way to learn more about electrical symbols and terms is to visit an electrical contractor or an electrical engineering firm. These professionals use electrical symbols and terms all the time and can help explain the importance of using them correctly. Call and schedule a trip to one of these offices. Make sure you prepare a list of questions in advance. In addition, many books at your local library and online can help you learn and practice electrical symbols and terms. Take a trip to the library to check out some books.

## Web Links:

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### Circuit Symbols

<http://www.kpsec.freeuk.com/symbol.htm>

### Electrical Symbols

[http://www.constructionjargon.com/Electrical\\_Symbols.html](http://www.constructionjargon.com/Electrical_Symbols.html)

### Electronic Components and Industrial Controls

[http://www.jentronics.ns.ca/helpful\\_hints.html](http://www.jentronics.ns.ca/helpful_hints.html)

### Electronic Symbols

[http://www.rapidtables.com/electric/electrical\\_symbols.htm](http://www.rapidtables.com/electric/electrical_symbols.htm)