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Basics of Standby Power

A quickSTEP Online Course

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Course Topics

Welcome to Basics of Standby Power. This course covers the following topics:

Chapter 1 – Introduction
- Overview
- Electric Power

Chapter 2 – Residential Applications
- Air Cooled Generators
- Automatic Transfer Switches
- Portable Power

Chapter 3 – Commercial Applications
- Liquid Cooled Generators
- Diesel Generators
- Automatic Transfer Switches

Final Exam

If you do not have an understanding of basic electrical concepts, you should complete Basics of Electricity before attempting this course.

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Course Objectives

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Upon completion of this course you will be able to…

- Define what is meant by optional standby generator
- List the key reasons for growth in the optional standby generator market
- Explain key characteristics of alternating current and voltage
- Describe the difference between 1-phase and 3-phase alternating current
- List the models of Siemens portable generators and the key specifications for each model
- Describe the function of a mechanical interlock used with a portable generator
- List the models of Siemens air cooled, liquid cooled, and diesel optional standby generators and the key specifications for each model
- Describe the key features of Evolution controllers
- Identify the accessories available for Siemens air cooled, liquid cooled, and diesel generators
- Describe the function of an automatic transfer switch
- List the types of Siemens automatic transfer switches use with Siemens optional standby generators

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Optional Standby Generators

The National Electrical Code® (NEC®) identifies three categories of generators: emergency generators, standby generators, and optional standby generators. The first two categories are legally required systems. This course covers optional standby generators as defined in NEC Article 702, which are not legally required.

Some optional standby generators are portable, but most of the generators covered in this course are not portable. Instead, they are permanently positioned and hardwired to a load center, panelboard, or other service entrance equipment. This eliminates the need to roll out a generator and plug it in when the power fails. Considering that when power fails it is often in bad weather, this is a significant advantage.

Stationary optional standby generators have an outdoor enclosure and can be equipped to handle extreme weather conditions. When combined with an automatic transfer switch, stationary standby generators function completely automatically during both start up and shut down.

Because stationary optional standby generators are available with higher power ratings than portable generators, they can back up more circuits. In addition, the stationary standby generators discussed later in this course automatically monitor themselves weekly by running for a short test period.

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Portable Generators

Portable generators are contained in a steel frame with wheels for easy relocation. They are powered by gasoline stored in the attached gas tank and require manual refueling.

Portable generators offer an inexpensive way to temporarily supply limited back-up power. In addition, they work well for construction site power, eliminating the need for temporary power poles and utility hook ups.

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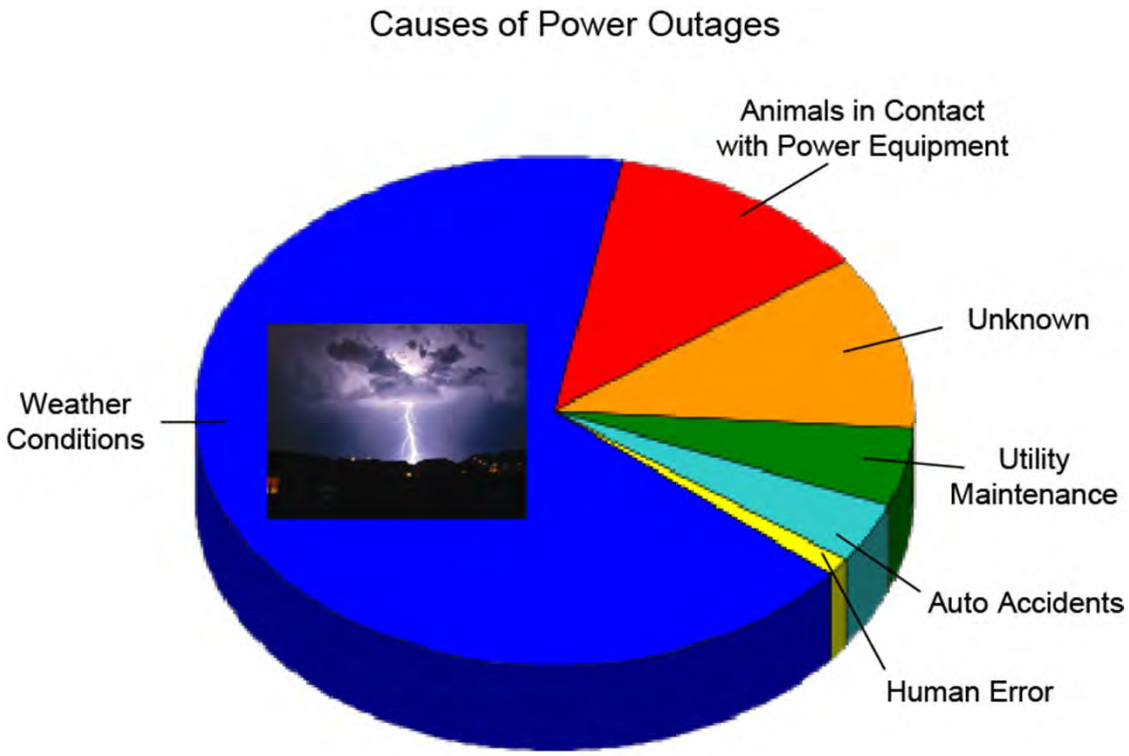
Power Outages



Source: Edison Institue

Because optional standby generator systems are primarily used when a power outage occurs, it is useful to consider the causes of power outages.

It is not surprising that the majority of power outages, approximately 70% according to the Edison Institute, are caused by weather conditions. It is easy to see how thunderstorms and their associated lightning, high winds, and driving rain could cause a power outage, but other conditions, such as snow and ice, are also important causes. In addition, heat, while usually not a direct cause, results in increased use of electricity which can overburden transmission equipment.

While most power outages are short in duration, severe weather conditions can result in extended outages and extreme hardship for people without power.

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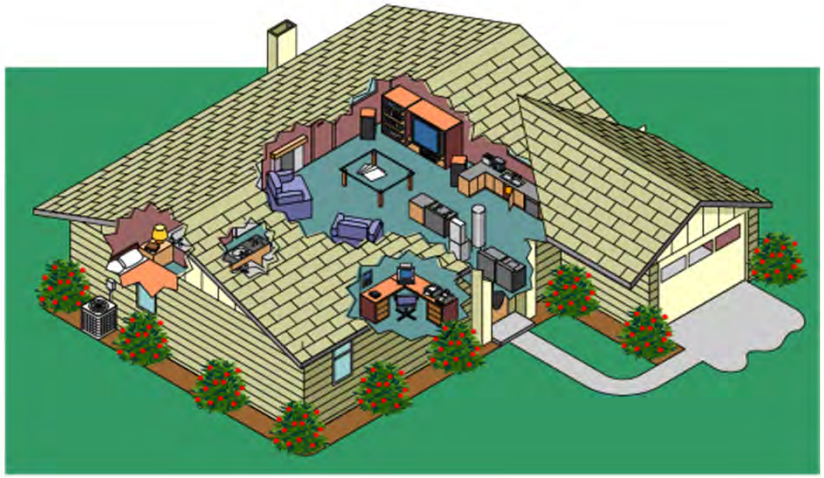
Residential Power Outages

- Health care equipment
- Home office equipment
- Computers/Internet
- Refrigerator/freezer
- Microwave
- Electric stove and oven
- Heating and air conditioning
- Lighting
- Electric water heater
- Washer and dryer
- Dishwasher
- Pumps
- Home security system
- Cordless telephone
- Television
- Clocks
- Hair dryer
- Aquarium



For a typical homeowner, a short-duration power outage is usually a minor inconvenience. It is true that a typical home has an increasing array of electrical and electronic devices that we have all become dependent upon, but we can usually get by if the outage duration is short.

However, for people who perform critical work at home or whose health is dependent on health care equipment, heat, air conditioning, or other systems, even a short duration outage can be serious.

As the duration of an outage lengthens, particularly if it occurs during extreme conditions, loss of power can have greater consequences. Even if the conditions are not extreme, consider how you would react if you were without the use of electrical devices and systems for several days. For people in some locations or geographic regions, this is more than a hypothetical situation.

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Commercial Power Outages

For commercial applications, the need for standby power is clear. When the power goes out, you lose sales. Without lights, communication systems, cash registers, computers, etc., a business cannot operate. In addition, for businesses that require refrigeration, an extended outage can result in significant loss of perishable merchandise and an even longer time without sales while the inventory is being replaced.

While the actual numbers vary significantly depending on the facility, the payback for adding a standby generator is quick. In fact, avoiding just one extended power outage can pay for the entire system.

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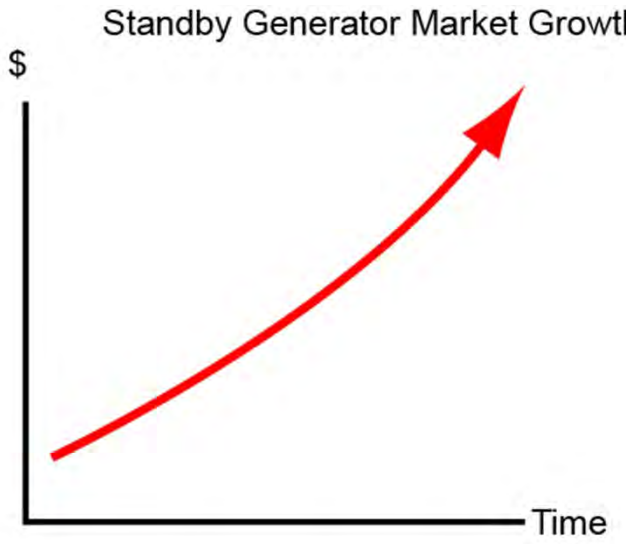
Market Growth and Customer Expectations



Factors Driving Growth

- Population Growth
- Changes in Population Demographics
- Increased Reliance on Electrical/Electronic Products
- Competitive Standby Generator Pricing

Fueled by population growth, changes in population demographics, our increased reliance on electrical and electronic products, and competitive standby generator pricing, the market for optional standby generators has grown significantly in recent years. However, customers are demanding, and only those generators that meet the following customer expectations are positioned to participate in future market growth.

- Reliability – standby generators must startup quickly and operate reliably in variable weather conditions.
- Quality power – standby generators must provide consistent power output without frequency variation.
- Convenience – standby generators must be easy to operate and maintain.
- Quiet Operation – standby generators must operate quietly in residential or other noise-sensitive applications.
- Durability – standby generators must provide long service life despite being exposed to harsh weather conditions.
- Strong value proposition – standby generators must provide a quick payback for commercial customers and improved quality of life at a reasonable cost for residential customers.

Later in this course you will learn about a broad range of Siemens optional standby generators that meet these customer expectations, but first we need to discuss a few basic concepts.

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Quantity	Formula	Unit	Unit Symbol	Unit x 1000	Unit x 1000 Symbol
Real Power	$= I^2 \times R$	watt	W	kilowatt	kW
Apparent Power	$= I \times E$	volt-ampere	VA	kilovolt-ampere	kVA

This chapter covers the following topics:

- Overview
- **Electric Power**

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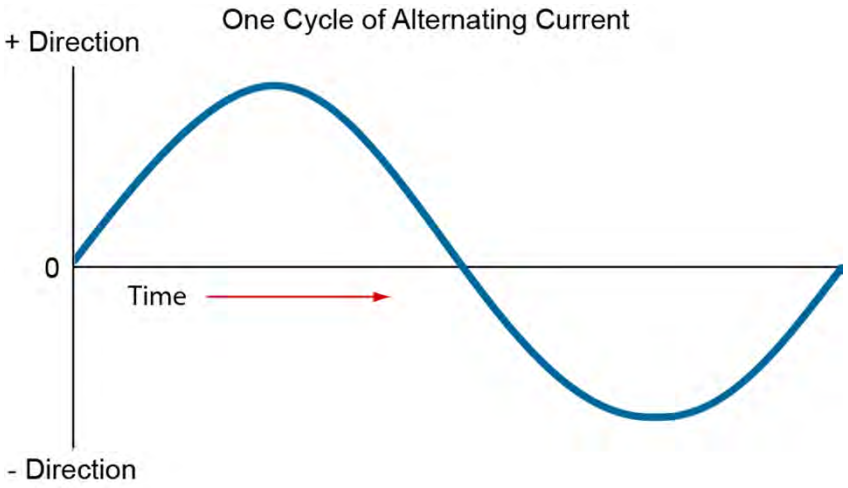
Alternating Current



The supply of current for electrical devices may come from a direct current (DC) source, or an alternating current (AC) source. In a direct current circuit, electrons flow continuously in one direction from the source of power through a conductor to a load and back to the source of power. Voltage polarity for a direct current source remains constant. DC power sources include batteries and DC generators.

By contrast, an AC generator makes electrons flow first in one direction then in another. In fact, an AC generator reverses its terminal polarities many times a second, causing current to change direction with each reversal.

Alternating voltage and current vary continuously. The graphic representation for AC is a sine wave. A sine wave can represent current or voltage. There are two axes. The vertical axis represents the direction and magnitude of current or voltage. The horizontal axis represents time.

When the waveform is above the time axis, current is flowing in one direction. This is referred to as the positive direction. When the waveform is below the time axis, current is flowing in the opposite direction. This is referred to as the negative direction. A sine wave moves through a complete rotation of 360 degrees, which is referred to as one cycle. Alternating current goes through many of these cycles each second.

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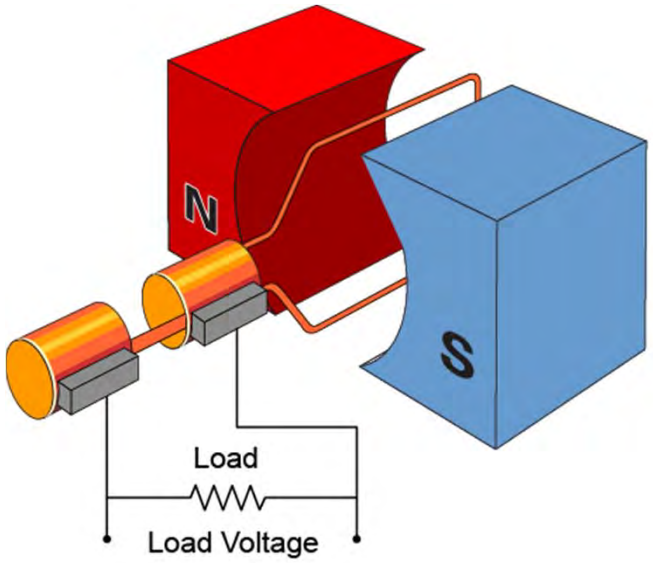
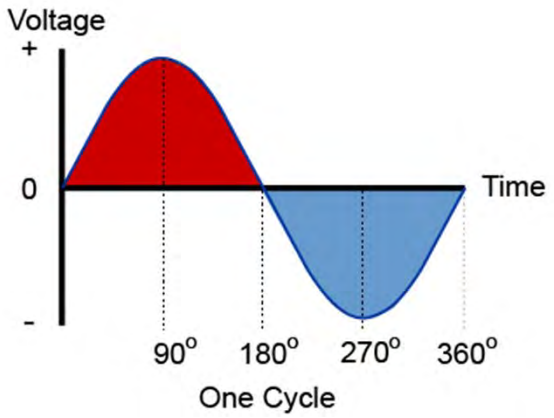
Basic AC Generators





AC generators operate on the theory of electromagnetic induction. This means that, when conductors are moved through a magnetic field, a voltage is induced into the conductors. For the purpose of explanation, a basic generator can be constructed from magnets, an armature, slip rings, brushes, and some type of resistive load. An armature is any number of conductors wound in loops which rotate through the magnetic field created by the magnets. For simplicity, one loop is shown in the accompanying illustration.

If you track the rotation of the AC generator through a complete revolution of 360°, during the first quarter of a revolution, voltage increases until it reaches a maximum positive value at 90°. Voltage decreases during the second quarter of a revolution until it reaches zero at 180°. During the third quarter of a revolution, voltage increases in the opposite direction until it reaches a maximum negative value at 270°. During the last quarter of a revolution, voltage decreases until it reaches zero at 360°. This is one complete cycle of operation. If the armature of this simple AC generator rotates 3600 times per minute (3600 RPM), it produces 60 cycles of voltage per second, or 60 hertz.

Commercially available generators differ significantly from the simple AC generator shown here. However, the resulting effect is the same, mechanical energy is converted into electrical energy and the frequency of the alternating current is dependent upon the number of poles and the speed of rotation.

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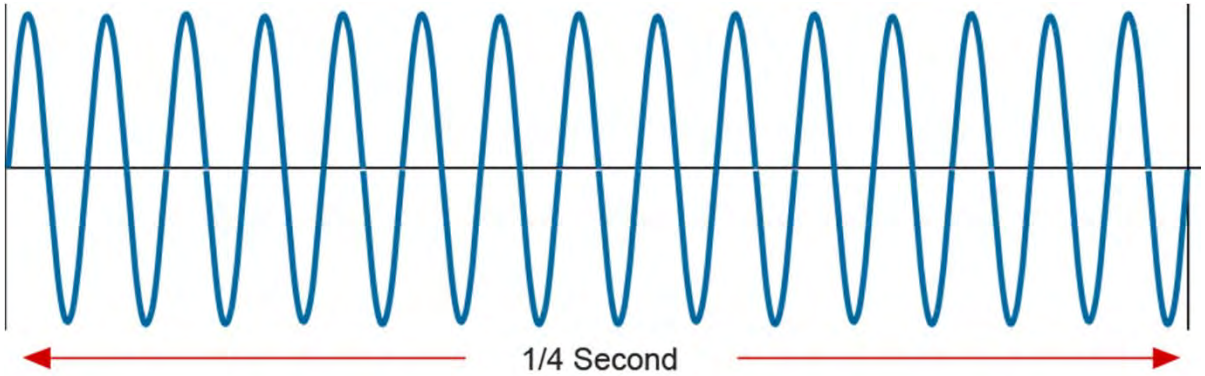
Frequency



The number of cycles per second of voltage induced in the armature is the frequency of the generator. If a two-pole armature rotates at a speed of 60 revolutions per second, the generated voltage will be 60 cycles per second. The recognized unit for frequency is hertz, abbreviated “Hz.” 1 Hz is equal to 1 cycle per second.

Power companies generate and distribute electricity at very low frequencies. The standard power line frequency in the United States and many other countries is 60 Hz. 50 Hz is also a common power line frequency used throughout the world. The following illustration shows 15 cycles in 1/4 second which is equivalent to 60 hertz.

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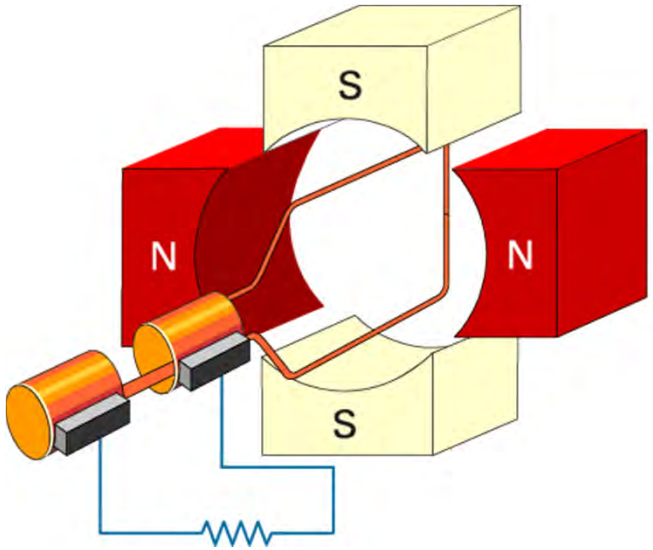
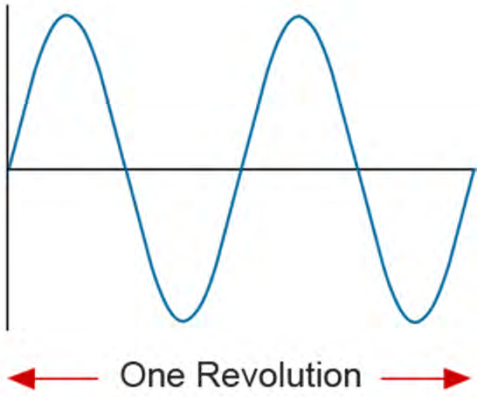
Four-Pole AC Generator





The frequency is the same as the number of rotations per second if the magnetic field is produced by only two poles. An increase in the number of poles causes an increase in the number of cycles completed in a revolution.

A two-pole generator completes one cycle per revolution and a four-pole generator completes two cycles per revolution. In other words, an AC generator produces one cycle per revolution for each pair of poles.

The important thing to remember here is that a four-pole generator produces a 60 hertz output with a rotational speed of 1800 RPM and a two-pole generator must rotate at 3600 RPM to produce the same frequency.

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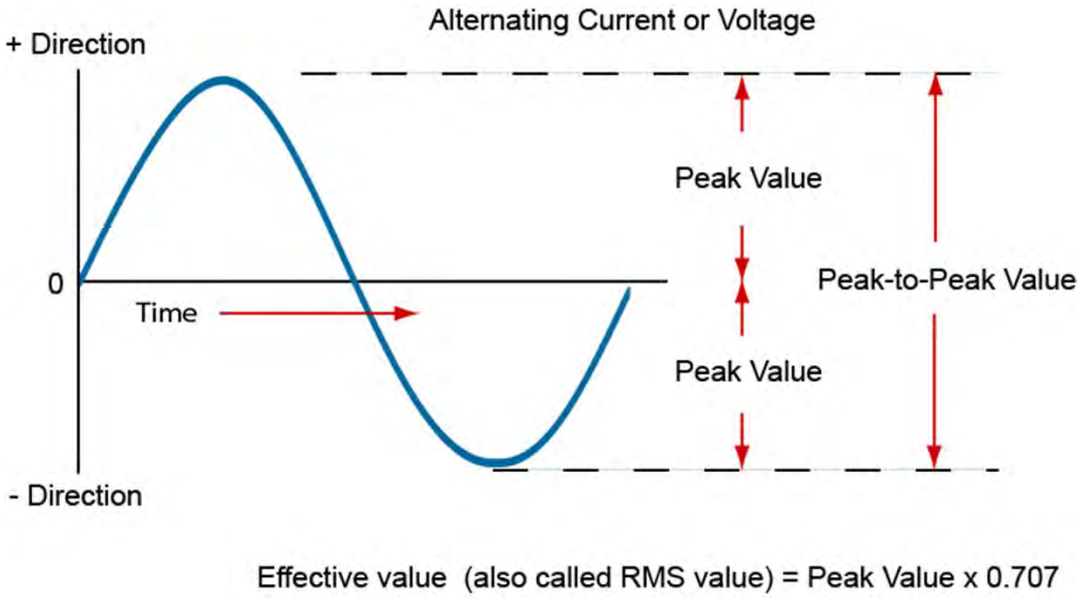
Amplitude



Effective value (also called RMS value) = Peak Value x 0.707

Voltage and current in an AC circuit rise and fall over time in a pattern referred to as a sine wave. In addition to frequency, which is the rate of variation, an AC sine wave also has amplitude, which is the range of variation. Amplitude can be specified in three ways: peak value, peak-to-peak value, and effective value. The units used for these values are volts for voltage and amperes, often shortened to amps, for current.

The peak value of a sine wave is the maximum value for each half of the sine wave. The peak-to-peak value is the range from the positive peak to the negative peak. This is twice the peak value.

The effective value of AC is defined in terms of an equivalent heating effect when compared to DC. Instruments designed to measure AC voltage and current usually display the effective value. The effective value of an AC voltage or current is approximately equal to 0.707 times the peak value.

The effective value is also referred to as the RMS value. This name is derived from the root-mean-square mathematical process used to determine the effective value of a waveform.

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Power in an AC Circuit

Quantity	Formula	Unit	Unit Symbol	Unit x 1000	Unit x 1000 Symbol
Real Power	$= I^2 \times R$	watt	W	kilowatt	kW
Apparent Power	= I x E	volt-ampere	VA	kilovolt-ampere	kVA

When a force causes motion, work is accomplished. If a force is exerted without causing motion, then no work is done. In an electrical circuit, voltage applied to a conductor causes electrons to flow. Voltage is the force and electron flow is the motion. The rate at which work is done is called power and is represented by the letter “P.”

In resistive circuits, power is dissipated in heat. This is called true power or effective power because it is the rate at which energy is used. True power is equal to the current squared times the resistance. The unit for true power is the watt, which is often represented by a “W.” Because the watt is a small unit, metric unit prefixes such as “kilo” are often used. 1 kW is equal to 1000 W.

Although reactive components do not consume energy, they do increase the amount of energy that must be generated to do the same amount of work. The rate at which this non-working energy must be generated is called reactive power. The unit for reactive power the var (or VAr), which stands for volt-ampere reactive.

The vector sum of true power and reactive power is called apparent power. Apparent power is also equal to the total current multiplied by the applied voltage (P = IE). The unit for apparent power is the volt-ampere (VA).

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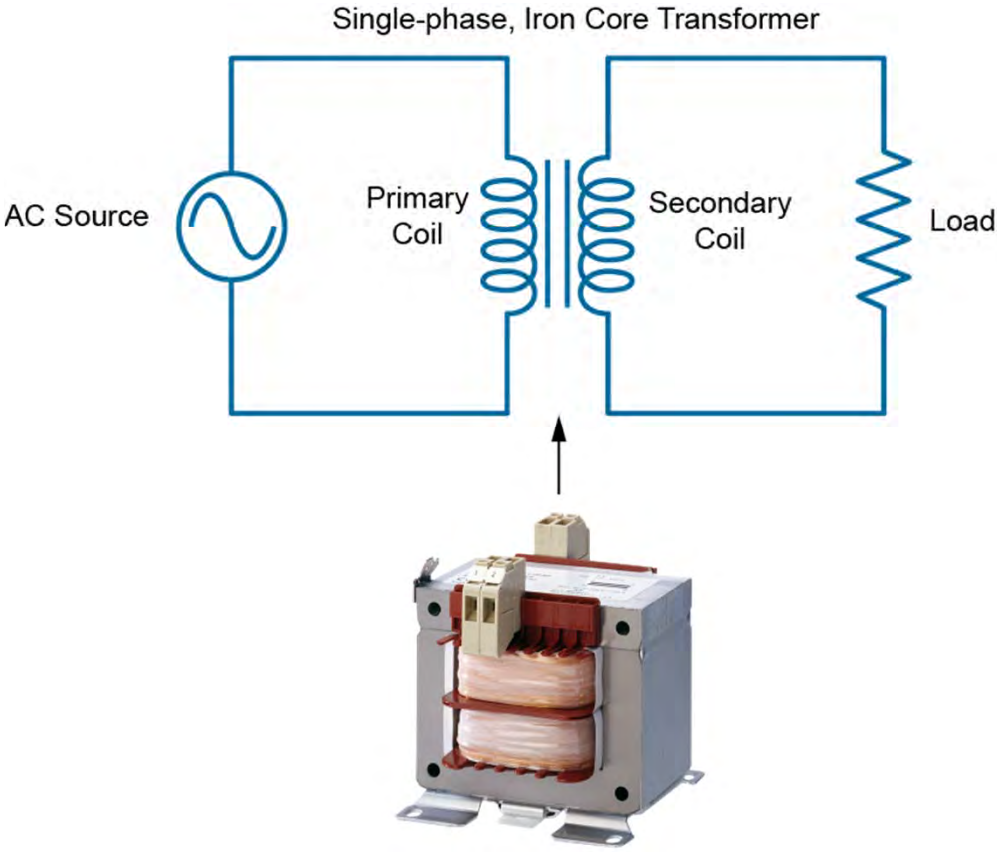
Transformers



Transformers are electromagnetic devices that transfer electrical energy from one circuit to another by mutual induction. They are frequently used to step up or step down a voltage. Because direct current cannot flow from one transformer winding to another, transformers can also be used to provide DC isolation from one circuit to another.

A single-phase transformer has two coils, a primary coil and a secondary coil. Energy is transferred from the primary to the secondary via mutual induction.

The accompanying illustration shows an AC source connected to the primary coil. The magnetic field produced by the primary induces a voltage in the secondary coil, which supplies power to a load.

Mutual inductance between two coils depends on their flux linkage. Maximum coupling occurs when all the lines of flux from the primary coil cut through the secondary coil. To maximize the amount of coupling, both coils are often wound on the same iron core, which provides a good path for the lines of flux. The following discussions of step-up and step-down transformers apply to transformers with an iron core.

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Transformer Turns Ratio

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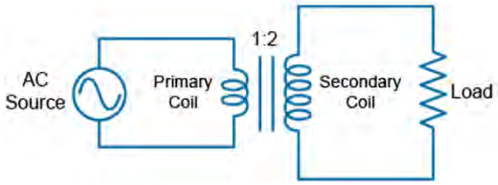
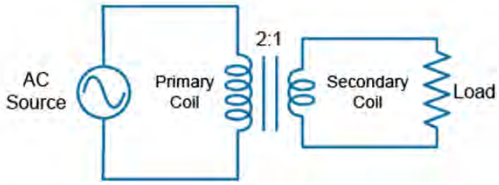
Step-up Transformer Example

Primary Voltage (E_P) = 120 V
Primary Current (I_P) = 10 A
Number of Primary Turns (N_P) = 900
Secondary Voltage (E_S) = 240 V
Secondary Current (I_s) = 5 A
Number of Secondary Turns (N_s) = 1800



Step-down Transformer Example

Primary Voltage (E_P) = 240 V
Primary Current (I_P) = 5 A
Number of Primary Turns (N_P) = 1800
Secondary Voltage (E_S) = 120 V
Secondary Current (I_s) = 10 A
Number of Secondary Turns (N_s) = 900



$$\frac{N_P}{N_S} = \frac{E_P}{E_S} = \frac{I_S}{I_P} \qquad E_S = \frac{N_S E_P}{N_P} \qquad I_S = \frac{N_P I_P}{N_S} \qquad Z_P = \left(\frac{N_P}{N_S}\right)^2 Z_L$$

Z_P = Impedance of the Primary
Z_L = Impedance of the Load

There is a relationship between primary and secondary voltage, current, and impedance and the ratio of transformer primary turns to secondary turns.

When the primary has fewer turns than the secondary, voltage is stepped up from primary to secondary. For the circuit on the left, the transformer secondary has twice as many turns as the primary, and voltage is stepped up from 120 VAC to 240 VAC. Because the impedance of the load is also higher than the impedance of the primary, current is stepped down from 10 amps to 5 amps.

When the primary has more turns than the secondary, voltage is stepped down from primary to secondary. For the circuit on the right, the primary coil has twice as many turns as the secondary coil, and voltage is stepped down from 240 VAC to 120 VAC. Because the impedance of the load is lower than the impedance of the primary, the secondary current is stepped up from 5 amps to 10 amps.

Transformers are rated for the amount of apparent power they can provide. Because values of apparent power are often large, the transformer rating is frequently given in kVA (kilovolt-amperes).

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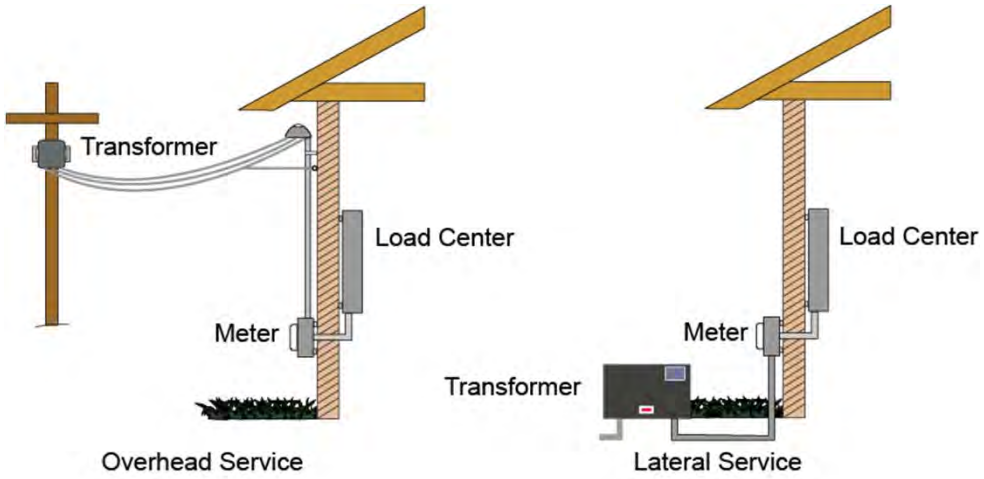
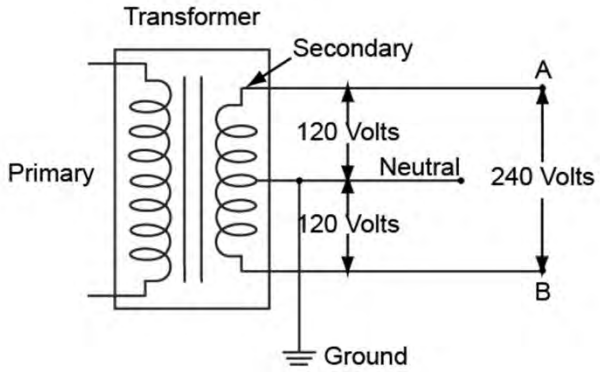
Residential Transformers





The most common power supply system used in residential applications in the United States today is a single-phase, three-wire supply system.

In this system, the voltage between either hot wire and neutral is 120 volts, and the voltage between the two hot wires is 240 volts.

The 120-volt supply is used for general-purpose receptacles and lighting. The 240 volt supply is used for heating, cooling, cooking, and other high-demand loads

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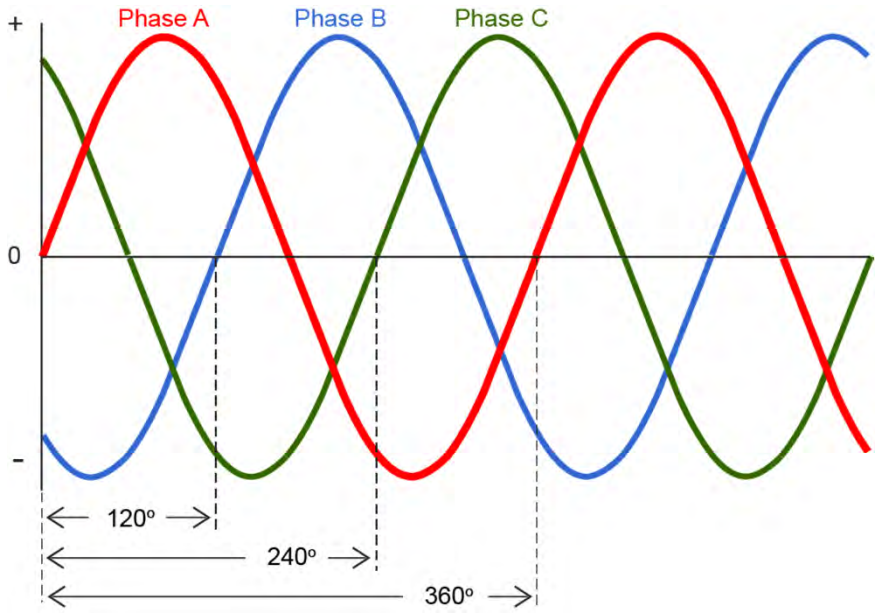
Three-Phase Power



Up till now, we have been talking only about single-phase AC power. Single-phase power is used where power demands are relatively small, such as for a typical home.

However, power companies generate and distribute three-phase power. Three-phase power is used in commercial and industrial applications.

Three-phase power, as shown in the accompanying illustration, is a continuous series of three overlapping AC cycles. Each wave represents a phase and is offset by 120 electrical degrees from each of the two other phases.

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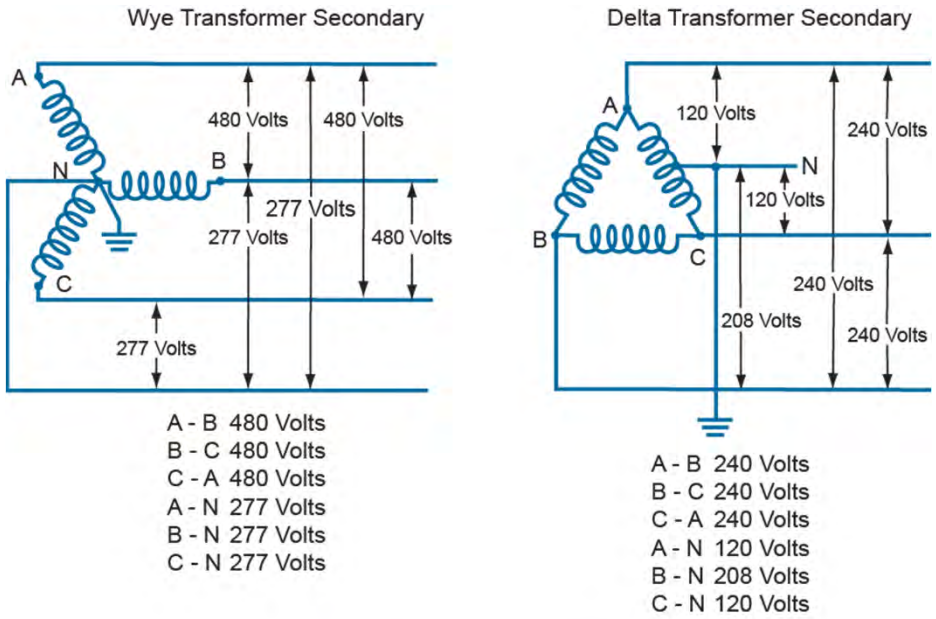
Three-Phase Transformers



Unlike single-family residential applications, which in most cases use only single-phase power, commercial and industrial applications primarily use three-phase power.

Transformers used with three-phase power require three interconnected coils in both the primary and the secondary. These transformers can be connected in either a wye or a delta configuration. The type of transformer and the voltage depend on the requirements of the power company and the needs of the customer.

The accompanying illustration shows the secondary windings of a wye-connected transformer and the secondary windings of a delta-connected transformer. For simplicity, the primary windings are not shown. The majority of applications are wye-connected, but delta-connected commercial and industrial applications are also common.

These are only examples of possible distribution configurations, the specific voltages and configurations vary widely depending upon the application requirements.

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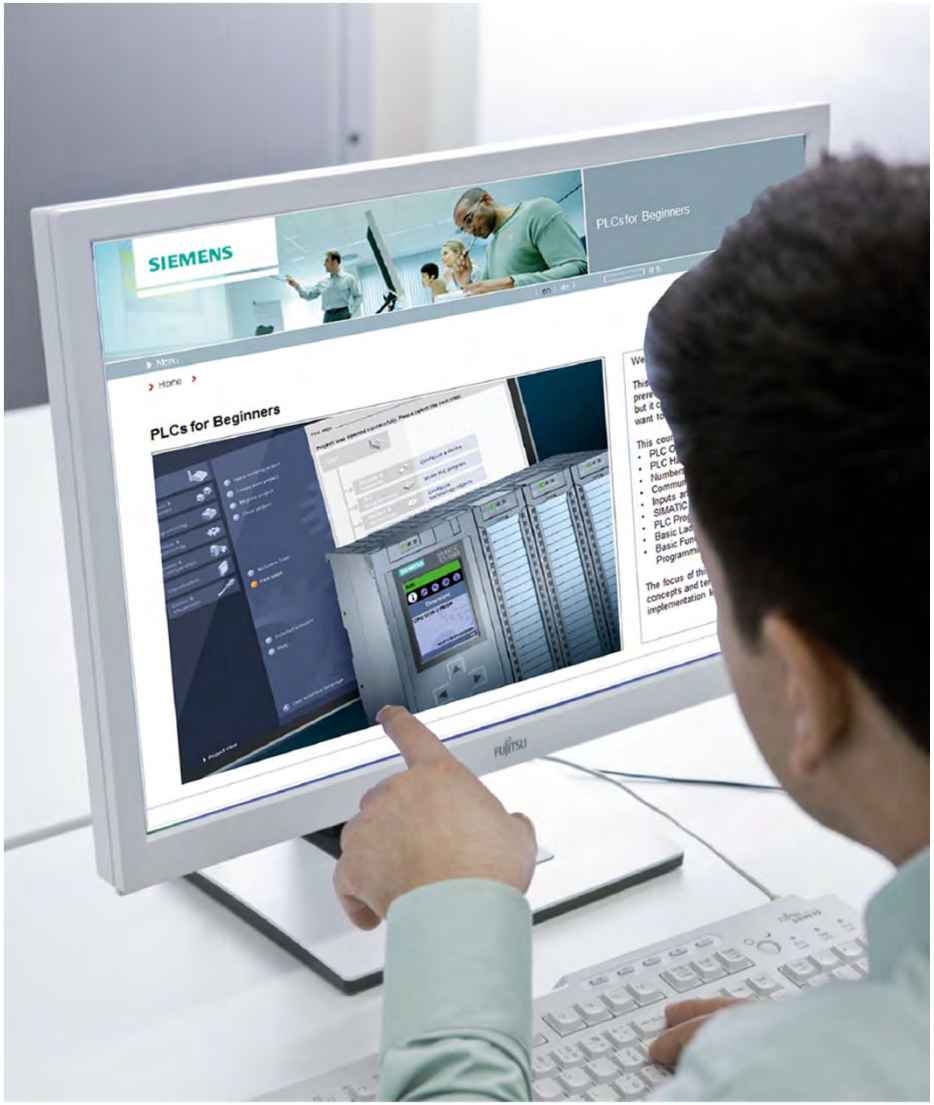

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Chapter 2 – Residential Applications

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This chapter covers the following topics:

- **Air Cooled Generators**
- Automatic Transfer Switches
- Portable Generators

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Typical U.S. Residential Electric Energy Usage

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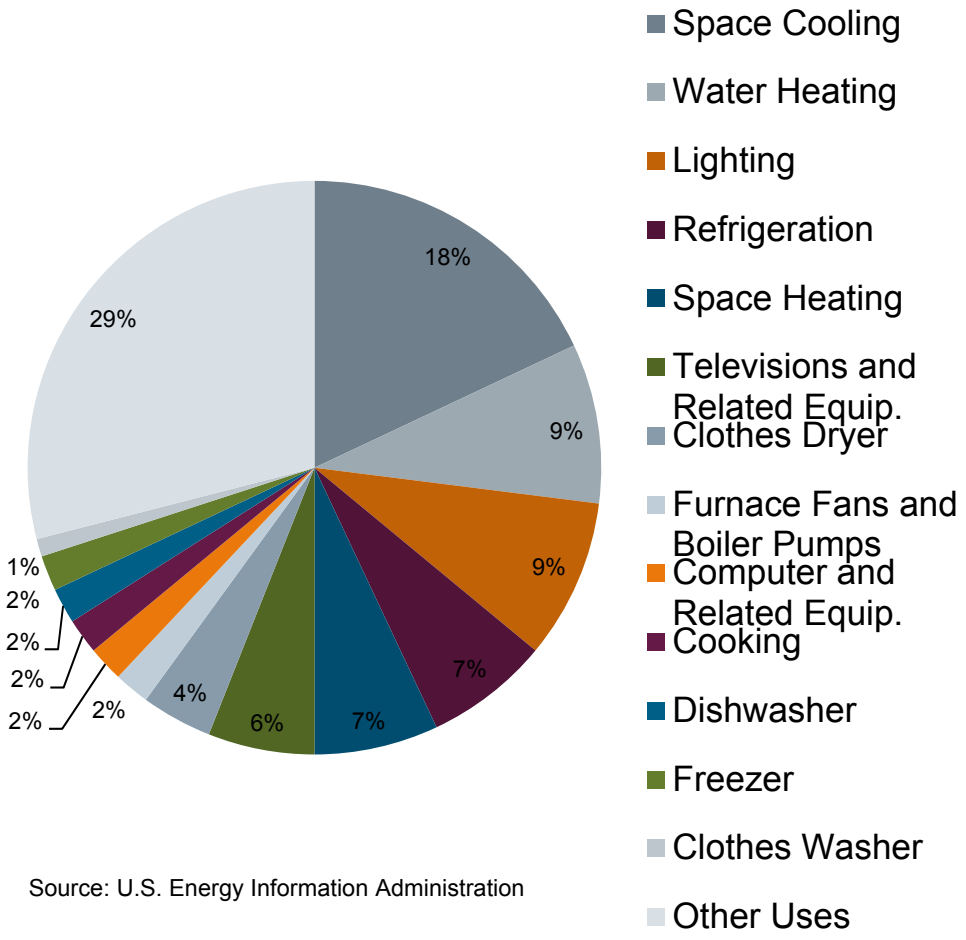

Source: U.S. Energy Information Administration

According to the U.S. Energy Information Administration the average monthly energy usage in a recent year for a U.S. home was 901 kilowatt-hours (kWh.); however, the average usage varied considerably by state from a low of 514 kwh. for Hawaii to a high of 1286 kwh. for Louisiana. In addition, to these regional variations, electric energy usage also varies considerably based on a number of other factors including: season, time of day, house size, house design, house condition, number of occupants, number and size of air conditioners, type heating, type of oven/stove, etc.

Although a customer may purchase an optional standby generator sized to back up all the circuits in a home, this is not the typical residential application. Most residential customers consider system cost as a critical selection factor. As a result, standby generators in residential application are typically sized to back up selected circuits.

Before selecting a standby generator, an audit of the load requirements must be done. While it is common to back up heating and air conditioning loads and other circuits critical for bad weather conditions, many other circuits vary in importance depending on the needs of the homeowner.

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Siemens Air Cooled Generator Standard Features

- UL 2200 listed
- Four-cycle industrial engines provide durable,
- reliable, long life
- Operate on either natural gas or propane vapor
- Composite mounting pad approved to eliminate need to pour concrete pad (local code permitting)
- Automatic high temperature, low oil pressure, and over speed and over crank shutdown
- Low battery voltage indicator
- Standard safety fuse
- Provided with Type "E" Evolution controller

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Siemens Air Cooled Standby Generators

Siemens Air Cooled Generator Catalog Number Logic

Air Cooled Siemens Generator	kW Rating[1]	Voltage/Phases R = 120/240 V 1-Phase	Fuel B = Both[2]	Enclosure A = Alluminum
ASGM	009	R	B	A
ASGM	011	R	B	A
ASGM	016	R	B	A
ASGM	020	R	B	A
ASGM	022	R	B	A

1. Based on use of Liquid Propane Vapor
2. Natural Gas or Liquid Propane Vapor

Catalog Number	ASGM009RBA	ASGM011RBA	ASGM016RBA	ASGM020RBA	ASGM022RBA
Rated Maximum Power (kW) with Propane Vapor	9 kW	11 kW	16 kW	20 kW	22 kW
Rated Maximum Power (kW) with Natural Gas	8 kW	10 kW	16 kW	18 kW	19.5 kW
Rated Voltage	240 V	240 V	240 V	240 V	240 V
Number of Phases	1	1	1	1	1
Rated Maximum Continuous Load Current - 240 VAC (LP/NG)	37.5A/33.3A	45.8A/41.7A	66.6A/66.6/A	83.3A/75A	91.6A/81.3A
Main Line Circuit Breaker	40 A	50 A	70 A	100 A	100 A
Rated AC Frequency	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz
Power Factor	1	1	1	1	1
Number of Rotor Poles	2	2	2	2	2
Operating RPM	3600	3600	3600	3600	3600
Battery Requirement (Not Included)	Group 26R, 12 V, 540 CCA Minimum				
Maintenance Kit (Not Included)	GENMKIT19	GENMKIT20	GENMKIT21	GENMKIT22	GENMKIT22
Unit Weight (Pounds)	360	428	448	516	526
Dimensions (Inches)	48 x 25 x 29				
Engine (Cubic Centimeters)	410	530	992	999	999
Sound Level with Normal Load (dbA at 7 meters)	66	63	66	66	67
Sound Level During Exercise (dbA at 7 meters)	60	57	58	58	58
Exercise Duration	5 min.	5 min.	5 min.	5 min.	5 min.

For residential applications, Siemens offers air cooled, single-phase generators that provide 120/240 VAC power and have power ratings as shown in the accompanying graphic. They are shipped ready for natural gas, but require only minor adjustments for use with liquid propane vapor. All models shown are UL 2200 listed.

All models have four-cycle industrial engines for long service life and are designed to automatically shutdown in the event of high temperature, low oil pressure, over speed, or over crank. A low battery voltage indicator is also provided. The battery is not included.

The composite mounting pad provided with these generators eliminates the need for a concrete pad where building codes permit.

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Type "E" Evolution Digital LCD Controller

Type "E" Evolution digital LCD controller functions include monitoring utility power, triggering the automatic transfer switch, starting and stopping the generator, exercising the generator, and monitoring the generator for any system faults.

High Voltage Shutdown
Shuts down the generator at >130% rated voltage for 200 milliseconds or >110% for 5 seconds to better protect home owner appliances or connected items.

Low Voltage Shutdown
Shuts down the generator at <60% voltage for 5 seconds to better protect home owners appliances or connected items.

Internal Fault Shutdown
Shuts down the generator when a failure is detected within the Evolution controller for more protection and easier diagnostics.

Event Log
All generators (8-22 kW) feature a full event log capable of recording 50 events.

Smart Battery Charger
Only delivers a charge to the battery when needed. Battery charge depends on ambient air temperature.

Voltage Regulation
Voltage regulation is an industry leading +/- 1%.

Product Activation
Requires each generator to be activated via web site or phone before automatic function is enabled . Allows a warranty activation start point for every generator sold.

External Common Fault Alarm
The Evolution controller has a provision to connect to a set of contacts that will allow for a common alarm when a generator shut down occur. This can be used to trigger and alarm or for a connection to a security system, or home automation system..

Adjustable generator start time
The controller is factory set to delay 10 seconds after a utility power failure before starting the engine. This delay can be changed to a value from 2 to 1500 seconds.

Incorrect Wiring Error
Eliminates the potential for damaging the controller if it is not connected properly, a warning message is displayed and he error corrected before the controller is allowed to be fully operational.

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Wireless Remote Monitor

Wireless Monitor (5928)

Features

- Compact, sleek design
- Magnetic back for refrigerator mounting
- Red, yellow and green status indicator LEDs
- “Chirp” function to alert owners when the generator needs attention
- Area for dealer contact information on the rear panel
- Easy battery replacement

The Wireless Monitor (catalog number 5928) provides truly wireless in-home generator status. About the size of a credit card, this battery operated wireless device makes monitoring your generator easy and convenient.

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Mobile Link

Mobile Link is a cellular remote monitoring system for Siemens standby generators that is compatible with most 2008 and newer Siemens air cooled standby generators and 2010 and newer Siemens liquid cooled standby generators.

Email or Text Notifications

- StandbyStatus.com provides over 40 different notifications, including successful exercise, maintenance reminders, change in status, low battery, fault alert and more.
- When maintenance is required or fault conditions occur, StanbyStatus.com automatically sends out alerts
- Dealer gets accurate data and can respond quickly and efficiently to problems
- Customers designate up to 4 different accounts to receive email and text notifications, including their dealer, so that they can discuss options with the customer to address the generator's issues.
- Notifications drive regular, timely communication with the customer.

StandbyStatus.com

- StandbyStatus.com features a user-friendly dashboard that allows the customer to check their generator's status anytime, anywhere.
- View current generator status and upcoming maintenance needs
- Remotely set exercise schedule
- Review run and maintenance history
- Get local weather updates
- Change messaging settings

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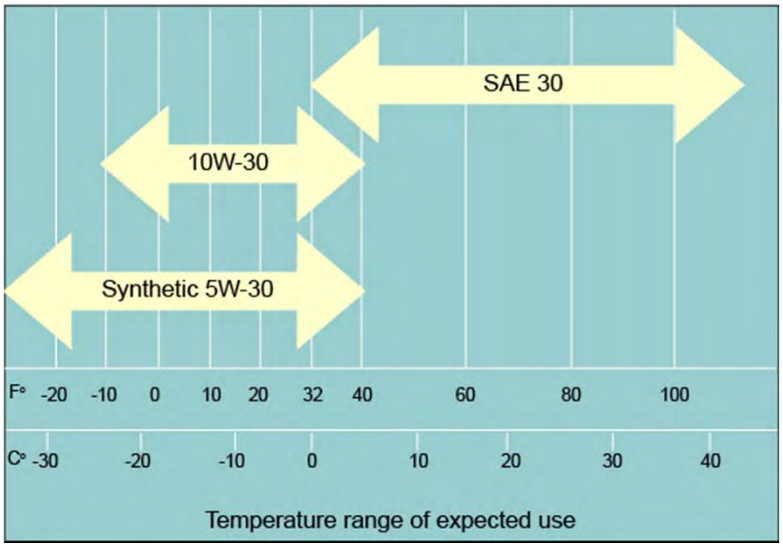
Maintenance Kits and Other Accessories

Recommended Oils



Scheduled maintenance is a necessity for all standby generators. Air cooled generator scheduled maintenance kits offer all the hardware necessary to perform scheduled maintenance on Siemens air cooled generators. Oil must be purchased separately. The accompanying chart shows the recommended oil types based on the temperature range of expected generator use.

Scheduled maintenance is recommended every 200 hours of generator use or every 2 years, which ever comes first. If the generator is operated in a dusty environment, more frequent maintenance may be required. Additional maintenance details can be found in the owner's manual for the generator.

Additional accessories available for Siemens air cooled generators include:

- Cold weather kits
- 26R battery
- Generator cart
- Auxiliary transfer switch contact
- Pad skirts
- Touch-up paint

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ST Type
Automatic Transfer Switch/Load Center

Generator Ready Load Center

SM Automatic Transfer Switch

This chapter covers the following topics:

- Air Cooled Generators
- **Automatic Transfer Switches**
- Portable Generators

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Automatic Transfer Switches

ST Type
Automatic Transfer Switch/Load Center

Generator Ready Load Center

SM Automatic Transfer Switch

A generator and utility power must never supply power to service equipment at the same time. This condition can be prevented by using a manual interlock, which requires someone to manually switch connections. While this approach is used for portable generator applications, it does not offer the automatic switching that customers typically require with a stationary standby generator.

In automatic standby generator applications, the service switchover is performed by an automatic transfer switch upon signal from the generator controller, which is constantly monitoring utility power. Siemens offers the following three approaches for automatic transfer in residential applications.

- ST type automatic transfer switch/load center
- Generator ready load center with automatic transfer switch
- SM type automatic transfer switch

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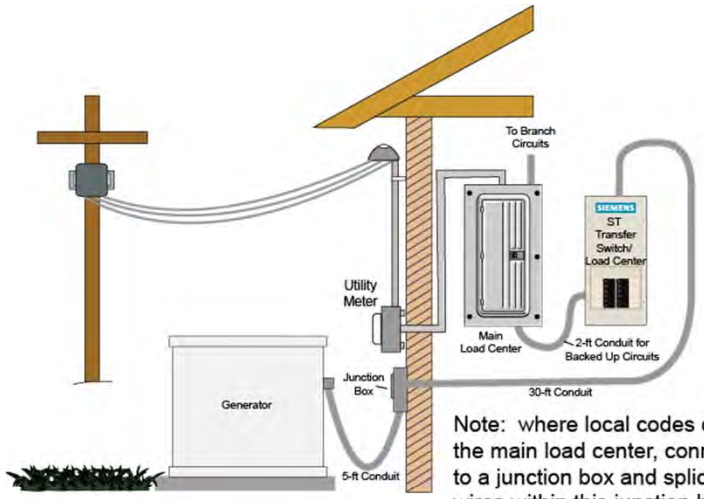
ST Type Automatic Transfer Switch/Load Center



Note: where local codes do not permit splicing within the main load center, connect wires in the 2-ft conduit to a junction box and splice the backed-up branch circuit wires within this junction box.

		ST ATS/Load Center Models		
	Model	ST100R10C	ST100R12C	ST100R16C
	Voltage	120/240 VAC	120/240 VAC	120/240 VAC
	Phases	1	1	1
	Ampere Rating	50	50	100
	kW Ratng	8	11	16
Circuits	240V/50A			1
	240V/40A		1	1
	240V/30A	1	1	
	240V/20A	1		1
	120V/20A	3	3	5
	120V/15A	3	5	5

Siemens ST type automatic transfer switch (ATS)/load center is designed for use with Siemens air cooled standby generators. The transfer switch contacts are electrically-operated, mechanically-held for fast, positive connections and operate with an open load transition, meaning that when a transition occurs, the existing power source is disconnected before the new source is connected.

The ST type ATS/load center has a NEMA 1 steel enclosure that houses both the automatic transfer switch and circuit breakers for loads backed up by the generator.

Three models of ST type ATS/load center are available. As shown in the accompanying chart, each model has multiple branch circuit breakers. These breakers are pre-wired with wires extending through a 2-ft conduit for connection in the main load center to those branch circuits that are backed up by the generator.

Each ST type ATS/load center also a includes an external junction box with a five-foot, pre-wired, weatherproof conduit for connection to the generator and a 30-foot, pre-wired conduit to connect the transfer switch to the external junction box.

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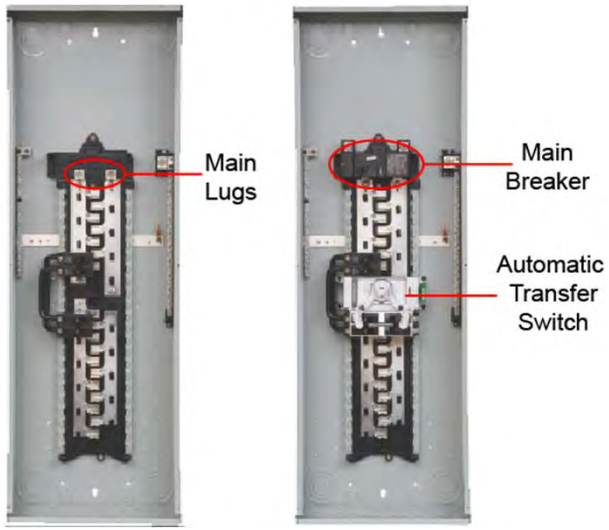
Generator Ready Load Center



Siemens generator ready load center is designed for single-phase, 120/240 V applications and is compatible with Siemens, Generac, Guardian, and Centurion standby generators up to 30 kW and any brand of portable generator with up to 125 A output.

It is available with a NEMA 3R (outdoor) enclosure or a NEMA 1 (indoor) enclosure and has a continuous current rating of 225 A.

The load center can be purchased with a main breaker or main lugs, for use where a main breaker is installed separately. A main lug kit is available to convert a main breaker load center to a main-lug-only load center, and a main-lug-only load center may also be converted to a main breaker load center.

A kit is available to install the automatic transfer switch in the field. Purchasing the load center without an automatic transfer switch kit is common when a standby generator is not initially installed and only the load center functionality is needed or when a mechanical interlock kit will be installed to allow for portable generator use.

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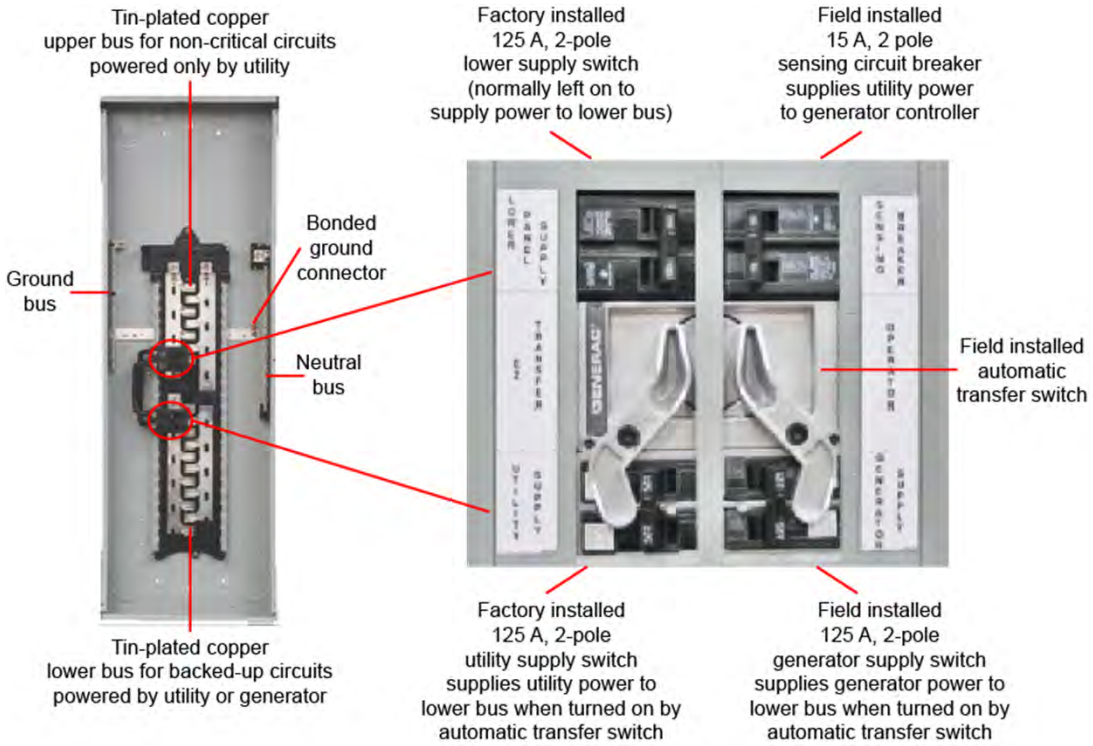
Generator Ready Load Center



Instead of having one interior like a standard load center, Siemens generator ready load centers have two interiors. Normally both interiors are powered by the utility. When utility power is unavailable, only the lower interior, which supplies the critical circuits, is powered.

The upper interior has 10 one-inch spaces for 10 circuits. The lower interior has 18 one-inch spaces for 30 circuits. Two additional one-inch spaces are available for use by the two-pole sensing circuit breaker that supplies the utility power sensed by the generator controller.

Because standby generators are hardwired into the home's electrical system and plumbed into the natural gas or propane supply, installing them after the home construction is complete can be costly. However, if a Siemens generator ready load center is installed during construction, this eliminates the need for future rewiring if a generator is added later. Pre-planning on the builder's part should also include running a gas line to the future generator site, and installing a junction box for future connections to the generator ready load center.

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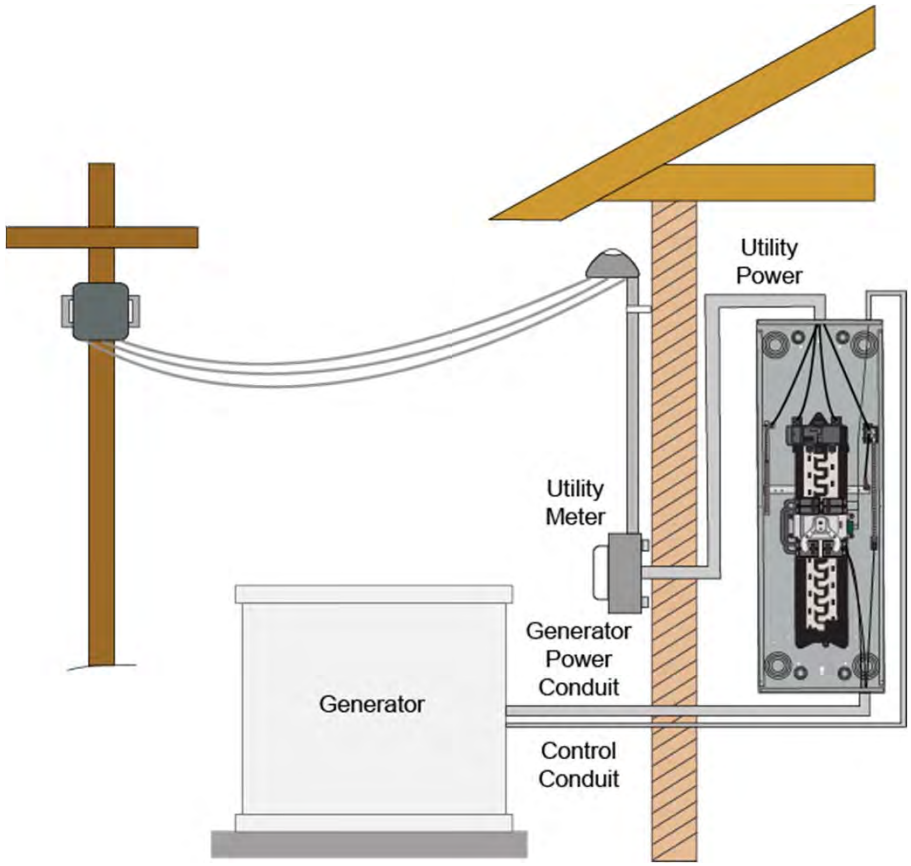
Generator Ready Load Center Installation



When installing the generator cabling for connection to the Siemens generator ready load center, the generator power wires must be run in a separate conduit from the generator control wires. This is necessary to prevent interference in the control wires that can cause erratic generator operation.

Check wiring instructions and local building codes to determine if an exception to this rule is appropriate for a specific installation.

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SM Type Automatic Transfer Switch

Siemens SM type automatic transfer switches (ATS) are primarily designed for use with Siemens single-phase, liquid cooled or diesel generators. However, they can also be used with Siemens air cooled generators. This is useful because ST type ATS/load center models are not compatible with Siemens 20 kW and 22 kW air cooled generators.

100, 200, and 400 amp open transition switches are in both service equipment rated and non-service equipment rated configurations. 150 and 300 amp open transition switches are only available in a service rated equipment configuration.

Service rated SM automatic transfer switches are housed in an aluminum NEMA 3R enclosure. The heavy duty Siemens contactor is a UL recognized device, designed for years of service. The generator's controller handles all the timing, sensing, exercising functions, and transfer commands.

Through the use of digital power management (DPM) technology, these switches have the capability to cycle two air conditioner on and off with no additional hardware.

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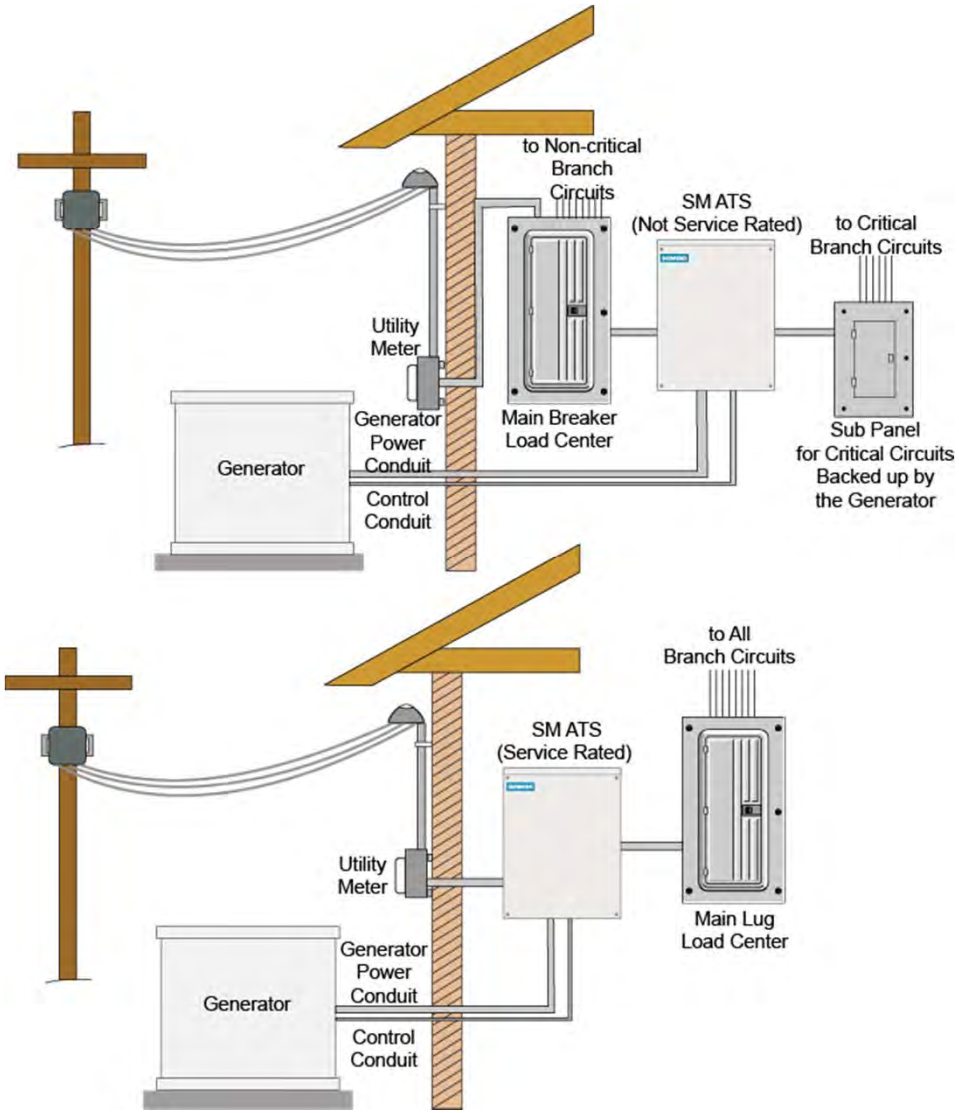
SM Type Automatic Transfer Switch Installation



The accompanying illustration shows two installations. In the upper diagram, a non-service rated SM type automatic transfer switch is installed in an application with a main breaker load center which powers non-critical branch circuits. Utility power is also provided through the transfer switch to a sub panel which powers critical circuits. When utility power is lost, the transfer switch automatically connects the standby generator to the sub panel.

There are variations from this configuration. For example, a meter main or separate enclosed main breaker could be used and this would eliminate the need for a main breaker in the main load center.

In the lower diagram, a service rated SM type automatic transfer switch is installed. This allows a main lug load center to be used. In this example, the power required by all circuits is within the capabilities of the generator and automatic transfer switch. This eliminates the need for a sub panel and simplifies the installation.

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SIEMENS

This chapter covers the following topics:

- Air Cooled Generators
- Automatic Transfer Switches
- **Portable Generators**

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Portable Generators

Model	PG0055	PG0065	PG0075SE	PG0080E	PG015	PG017
Rated Power (kW)	5.5	6.5	7.6	8	15	17.6
Surge (kW)	6.875	8	9.37	10	22.5	26.2
Rated Current (amps) @ 60 Hz, 120/240 V Single-phase, 1.0 PF	22.9	27.1	31.2	33.3	62.5	73
Engine Speed (RPM)	3600	3600	3600	3600	3600	3600
Fuel Capacity (gallons)	6.6	6.6	8	8	16	8
Weight (pounds)	180	172	201	192	450	475
Dimensions (inches)	34x26.5x27.5	34x27x28	26.5x26.5x26	34x27x28	39x31x49	39x31x49
Scheduled Maint. Kit Catalog Number	PORTMKIT2	PORTMKIT2	PORTMKIT3	PORTMKIT3	PORTMKIT1	PORTMKIT1

Portable generators are popular for residential applications because they are inexpensive to purchase and install. Unlike, stationary standby generators, however, they are not permanently installed and, when needed, must be moved to an appropriate location, set up, and started. When generator power is no longer needed, they must be stopped and stored.

These factors make portable generators most appropriate for short-term back-up of high-priority circuits in residential applications or for use at construction sites. In addition, small portable generators are often used in recreational applications such as for camping or tailgating.

As shown in the accompanying chart, Siemens offers portable generators with continuous power ratings up to 17.6 kW. These generators also have a surge rating which indicates the short duration power available in response to surges associated with startup of electric motors and other equipment.

Siemens portable generators have a gasoline-powered overhead valve engine with a low-noise muffler. As the accompanying chart shows, scheduled maintenance kits are available to simplify scheduled generator maintenance.

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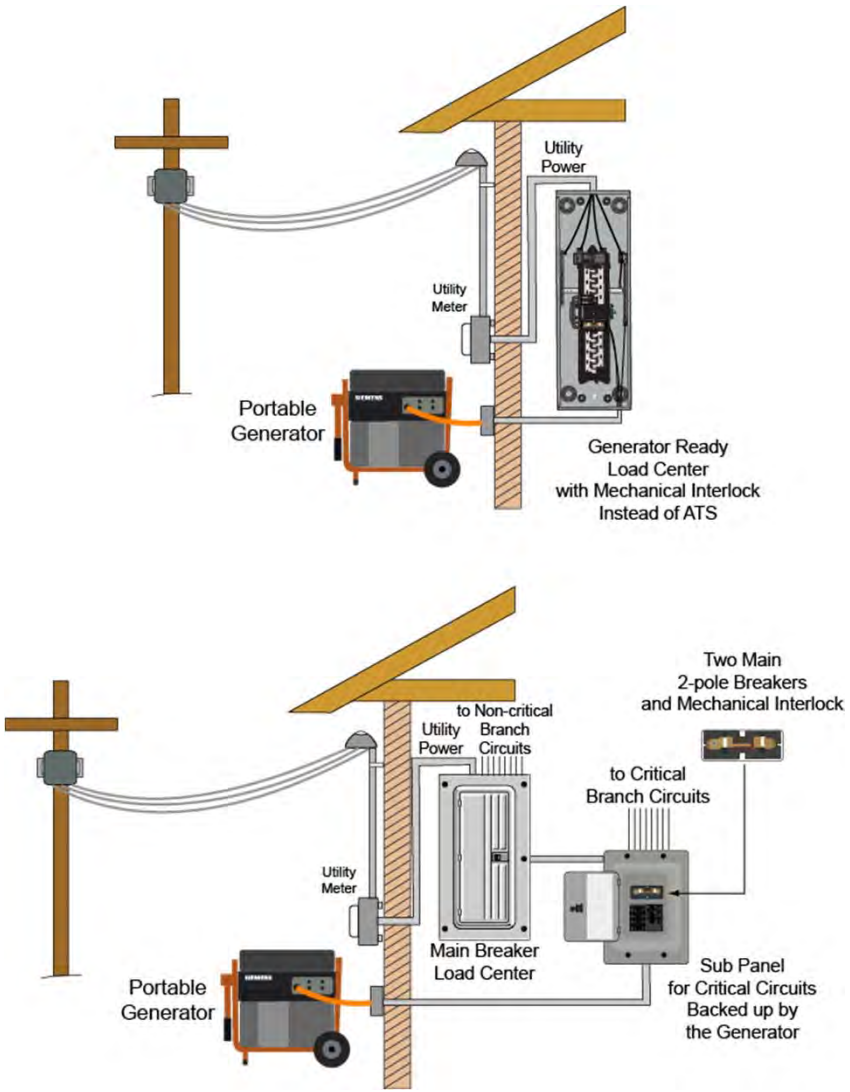
Backing Up Only Critical Circuits



Portable generators are not permanently installed. When used to back up circuits in a residence or other permanent facility, the recommended approach is to have a pre-wired hook-up. This simplifies installation, which often must be done in bad weather. In addition, having a pre-wired hook-up reduces the likelihood of a generator overload.

Often the generator is used to power only critical circuits. As shown in the accompanying graphic, this can be accomplished by using Siemens generator ready load center with a mechanically interlocked breakers instead of an automatic transfer switch or by powering non-critical circuits from a main load center and critical circuits through a sub panel.

In either case, a mechanical interlock kit must be installed to prevent the generator from back feeding the main service or from being connected to the circuits powered by the utility when service is resumed.

In the accompanying graphic, the service entrance load center is shown as having a main breaker. Keep in mind that where a main breaker is provided in a separate enclosure, a main lug load center can be used.

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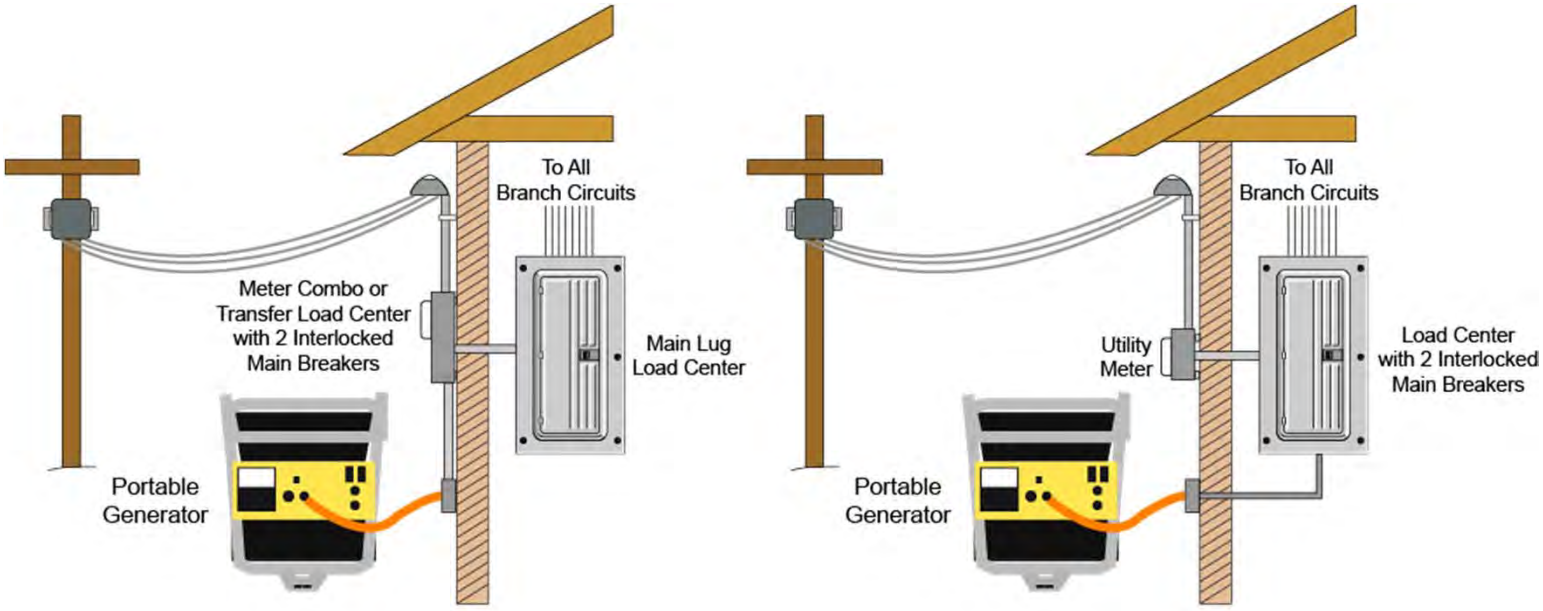
Backing Up All Circuits



It is also possible to use a portable generator to back up all the circuits in a residence, provided that the generator is sized to accommodate the load.

Note: The generator must be sized to accommodate all circuits. Where a meter combo or transfer load center is used it must include a mechanical interlock. Otherwise, the mechanical interlock must be installed in the main load center.

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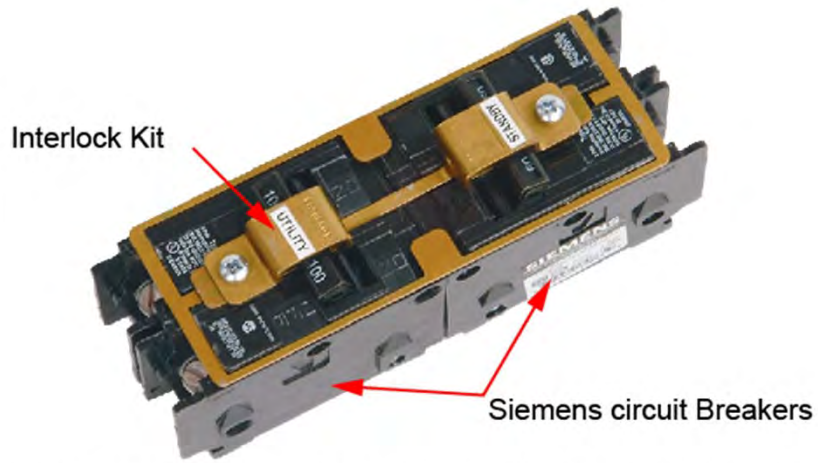
Manual Transfer Interlock Kits for Load Centers and Meter Combinations



Circuit Breakers with ECSBPK01 Manual Transfer Interlock Kit
For use on load centers or meter combinations that will accept 2-pole circuit breakers opposite one another as shown.

Siemens offers a variety of mechanical interlock kits that are UL listed for use in most Siemens load centers and meter combos. The accompanying graphic shows one example of an interlock kit installed on two Siemens circuit breakers. Refer to the Siemens Speedfax catalog, which is available online on the Siemens Industry, Inc. web site, for information regarding which mechanical interlock kits are appropriate for Siemens load centers and meter combos.

These kits are used to interlock the utility and standby power main breakers in a load center or meter combo so that both cannot be on at the same time. The kits are suitable for use with optional standby systems in accordance with article 702 of the National Electric Code.

The kits do not include the circuit breakers to be interlocked, but are easy to assemble and do not require modifications to the load center or meter combo. They remain attached to the main breakers when load center cover is removed and have a corrosion resistant finish.

Note that panels in which the bussing or wire forms from the meter socket land on main lugs are not acceptable for use in standby systems because turning the main breaker off does not prevent feedback to the utility power lines.

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Chapter 3 – Commercial Applications

This chapter covers the following topics:

- **Liquid Cooled Generators**
- Diesel Generators
- Automatic Transfer Switches

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Liquid Cooled Optional Standby Generators

Standard features

- UL 2200 Listed
- All models meet EPA emission regulations. (Generators 45kW and above must have emissions catalyst when used in California or Massachusetts.)
- Operate on either natural gas or propane vapor
- Automatic high temperature, low coolant, low oil pressure, and over speed shutdown
- Automatic voltage regulator with over voltage protection
- Isochronous electronic governor
- Safety fuse included
- Smart battery charger
- Quiet run weekly self test
- Provided with type "E" Evolution controller
- Compatible "SL" and "SM" type automatic transfer switches are available

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Liquid Cooled Optional Standby Generators

Siemens Liquid Cooled Standby Generator Catalog Logic

Liquid Cooled Generator	kW Rating	Voltage/Phases R = 120/240V, 1-Phase C = 120/208V, 3-Phase J = 120/240V, 3-Phase I = 277/480V, 3- Phase	Fuel G = Natural Gas P = Liquid Propane Vapor B = Both	Enclosure A = Alluminum	Engine Speed Blank = 3600 RPM[1] L = Low (1800 RPM)	Emissions E = Exhaust Catalyst[2]
SGE	022	R, C, J	B	A	L	
SGE	025	R, C, J	B	A		
SGE	027	R, C, J	B	A	L	
SGE	030	R, C, J	B	A		
SGE	032	R, C, J, I	B	A	L	
SGE	036	R, C, J, I	B	A		
SGE	038	R, C, J, I	B	A	L	
SGE	045	R, C, J, I	B	A		E
SGE	048	R, C, J, I	B	A	L	E
SGE	060	R, C, J, I	G, P	A		
SGE	070	R, C, J, I	G, P	A	L	E
SGE	080	R, C, J, I	G, P	A		
SGE	100	R, C, J, I	G, P	A	L	E
SGE	130	R, C, J, I	G, P	A		E
SGE	150	R, C, J, I	G, P	A		E

1 = 2300 RPM for 100 kW

2 = All units 38kW and below do not fall under CA/MA emissions standards, therefore are not required to have a catalyst.
Option for 45, 48, and 70 kW models, factory installed in 100 to 150 kW models.

Siemens liquid cooled generators are Ideal for whole house back up for larger homes, but are primarily use for commercial applications including small office buildings, churches, retail centers, schools, and restaurants.

They can be fueled by natural gas, which is a clean burning fuel that is available continuously and reliably in many locations. Natural gas fueled generators avoid problems, such as odors and spills, that are common with many other types of generators.

Where natural gas is unavailable, Siemens liquid cooled generators can be equipped to run from liquid propane vapor. Liquid propane can be safely stored on-site in a storage tank and remains usable for years. In addition, most generators provide a slightly higher power output when liquid propane is used, as compared to natural gas.

Generators up to 48 kW are field convertible from natural gas to liquid propane.

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Liquid Cooled Generator Ratings

kW Rating[1]	Current Ratings 120/240V 1-Phase 1.0 PF	120/208V 3-Phase 0.8 PF	120/240V 3-Phase 0.8 PF	277/480V 3-Phase 0.8 PF	Engine Full Load RPM	Natural Gas Fuel Consumption (ft.^{3}/hr.)	LP Vapor Fuel Consumption (gal./hr.)	Sound Levels in dBA at 7 meters Normal Load	Exercise
22	92	76	66	-	1800	316	3.40	70	61
25	104	87	75	-	3600	430	4.70	72	59
27	113	94	81	-	1800	359	3.90	70	61
30	125	104	90	-	3600	492	5.40	73	59
32	133	111	96	48	1800	448	4.90	64	58
36	150	125	108	54	3600	503	5.50	70	61
38	158	132	114	57	1800	533	5.80	64	58
45	188	156	135	68	3600	730	8.00	73	61
48	200	167	144	72	1800	756	7.96	68	63
60	250	208	180	90	3600	862	9.00	72	65
70	292	243	210	105	1800	1020	11.17	65	61
80	333	278	241	120	3600	1154	12.78	74	64
100	417	347	301	150	2300	1260	13.90	72	61
130	542	451	391	195	3600	1786	19.80	75	65
150	625	520	451	226	3600	2061	22.57	79	66

1. kW rating is for units running on liquid propane vapor. Ratings for natural gas units may be less.

For 1-phase generators: Current Rating = $\frac{\text{Power Rating}}{\text{Maximum Voltage}}$ Example: $\frac{48{,}000\ \text{W}}{240\ \text{V}}$ = 200 A

For 3-phase generators: Current Rating = $\frac{\text{Power Rating}}{\text{Maximum Voltage} \times \sqrt{3} \times \text{Power Factor}}$ Example: $\frac{60{,}000\ \text{W}}{480\ \text{V} \times 1.73 \times 0.8}$ = 90.3 A

Note: 1-phase calculations assume a power factor (PF) of 1.0 and 3-phase calculations assume a PF of 0.8

Siemens liquid cooled generators are available with power ratings from 22 kW to 150 kW. In addition to the required power output and fuel type, another critical selection criteria for these generators is output voltage. Each Siemens liquid cooled generator model supplies one of the following output voltages.

- 120/240 VAC, 1-phase
- 120/208 VAC, 3-phase
- 120/240 VAC, 3-phase
- 277/480 VAC, 3-phase

The power output, voltage output, and power factor combine to determine the available current. The current ratings shown in the accompanying table are calculations based on the maximum power output, the maximum available voltage, and an assumed power factor. Depending on the installation, the available current will vary from what is shown here.

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Quiet Operation

kW Rating	Engine Full Load RPM	Engine Exercise RPM	Sound Levels in dBA at 7 meters	
			Normal Load	Exercise
22	1800	1400	70	61
25	3600	1800	72	59
27	1800	1400	70	61
30	3600	1800	73	59
32	1800	1400	64	58
36	3600	1800	70	61
38	1800	1400	64	58
45	3600	1800	73	61
48	1800	1400	68	63
60	3600	1800	72	65
70	1800	1400	65	61
80	3600	1800	74	64
100	2300	1800	72	61
130	3600	1800	75	65
150	3600	1800	79	66

Low speed models are highlighted in green.

All Siemens liquid cooled generators are designed to run at lower noise levels than competitive models. In addition, during the weekly test operation, sound levels are lower than during normal operation.

Siemens also offers low speed models with even lower noise levels. The engine and alternator speeds and the noise levels during test and normal operation for these models are highlighted in green in the accompanying chart.

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Liquid Cooled Generator Accessories

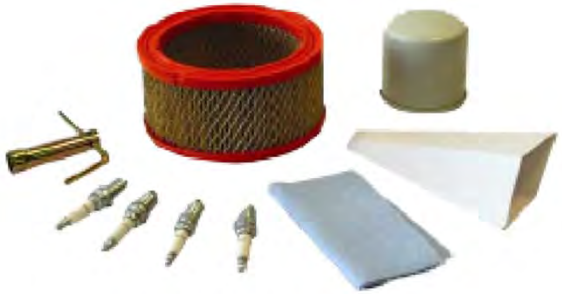
Wireless Remote Monitor

Mobile Link

ATS Contact

Cold Weather Kit

Extreme Cold Weather Kit



Maintenance Kit

The following accessories are available for Siemens liquid cooled generators.

- Mobile Link remote monitoring – a cellular remote monitoring system that provides generator status information to a computer or mobile device.
- Wireless remote monitor – a small wireless, battery powered device with indicator lights and audible tones that provide generator status information.
- Auxiliary transfer switch contact kit – allows an automatic transfer switch to interrupt a large appliance, such as a central air conditioning unit, when power is provided by a generator.
- Cold weather kit – a battery warmer with a thermostat for areas where the temperature drops below 32^{o} F.
- Extreme cold weather kit – an engine block heater for areas where the temperature drops below 32^{o} F for extended periods.
- Scheduled maintenance kit – needed for recommended scheduled maintenance.

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Simulators

Engineered to provide a real-world experience, Siemens simulators are fully functional, ready-to-use systems available in a variety of configurations.

System-level design makes the simulators an invaluable tool for program testing and debugging, reinforcing learning, shop floor troubleshooting, and more. With portable construction and hard-shell cases, they can be easily transported. Custom-built systems are also available.

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Chapter 3 – Commercial Applications

This chapter covers the following topics:

- Liquid Cooled Generators
- **Diesel Generators**
- Automatic Transfer Switches

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Protector Series Optional Standby Diesel Generators

Evolution Controller

Building and zoning codes can vary wildly from one region to another. In the past, this meant that expensive, custom-configured, standby power solutions were needed.

Siemens Protector series diesel optional standby generators for residential and light commercial applications feature a code ready set of popular preconfigured options and a range of accessories that conform to local codes. The Protector series is versatile, adaptable, affordable, and meets UL requirements.

Features

- Two-line LCD multilingual digital Evolution controller (English, Spanish, French, Portuguese) with external viewing window for easy determination of generator status and breaker position
- Isochronous electronic governor
- Sound attenuated enclosure
- Smart battery charger
- UV/ozone resistant hoses
- +-1 % voltage regulation
- Integrated base tank provides at least 24 hours of run time at half load
- UL/CUL2200/UL 142 Listed
- Meets code requirements for external vent and fill

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Protector Series Standby Diesel Generator Ratings

kW Rating	Current Ratings 120/240V 1-Phase 1.0 PF	120/208V 3-Phase 0.8 PF	120/240V 3-Phase 0.8 PF	277/480V 3-Phase 0.8 PF	Engine Full Load RPM	Fuel Consumption at Half Load gal./hr. (l/hr.)	Fuel Consumption at Full Load gal./hr. (l/hr.)	Sound Levels in dBA at 7 meters Normal Load	Exercise
15	63	52	45	-	1800	0.79 (2.99)	1.48 (5.58)	70	65
20	83	69	60	-	1800	1.05 (3.97)	1.98 (7.48)	70	65
30	125	104	90	45	1800	1.45 (5.5)	2.74 (10.4)	70	65
48	200	-	-	-	1800	2.3 (8.71)	4.3 (16.36)	70	65
50	-	173	150	75	1800	2.3 (8.71)	4.3 (16.36)	70	65

For 1-phase generators: Current Rating = $\frac{\text{Power Rating}}{\text{Maximum Voltage}}$ Example: $\frac{48{,}000\ \text{W}}{240\ \text{V}}$ = 200 A

For 3-phase generators: Current Rating = $\frac{\text{Power Rating}}{\text{Maximum Voltage} \times \sqrt{3} \times \text{Power Factor}}$ Example: $\frac{50{,}000\ \text{W}}{480\ \text{V} \times 1.73 \times 0.8}$ = 75.3 A

Note: 1-phase calculations assume a power factor (PF) of 1.0 and 3-phase calculations assume a PF of 0.8

Siemens diesel generators are available with power ratings from 15 kW to 50 kW. In addition to the required power output, another critical selection criteria for these generators is output voltage. Each Siemens diesel generator model supplies one of the following output voltages.

- 120/240 VAC, 1-phase
- 120/208 VAC, 3-phase
- 120/240 VAC, 3-phase
- 277/480 VAC, 3-phase

The power output, voltage output, and power factor combine to determine the available current. The current ratings shown in the accompanying table are calculations based on the maximum power output, the maximum available voltage, and an assumed power factor. Depending on the installation, the available current will vary from what is shown here.

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Protector Series Standby Diesel Generator Catalog Logic

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Catalog Number	Catalog Logic			
	Diesel	kW Rating 015 = 15kW 020 = 20kW 030 = 30kW 048 = 48kW 050 = 50kW	Engine Size in Liters 23 = 2.3L 24 = 2.4L 34 = 3.4L	Voltage & Phase ADAE = 120/240V, 1Ø GDAE = 120/208V, 3Ø JDAE = 120/240V, 3Ø KDAE = 277/480V, 3Ø
RD01523ADAE	RD	015	23	ADAE
RD01523GDAE	RD	015	23	GDAE
RD01523JDAE	RD	015	23	JDAE
RD02023ADAE	RD	020	23	ADAE
RD02023GDAE	RD	020	23	GDAE
RD02023JDAE	RD	020	23	JDAE
RD03024ADAE	RD	030	24	ADAE
RD03024GDAE	RD	030	24	GDAE
RD03024JDAE	RD	030	24	JDAE
RD03024KDAE	RD	030	24	KDAE
RD04834ADAE	RD	048	34	ADAE
RD05034GDAE	RD	050	34	GDAE
RD05034JDAE	RD	050	34	JDAE
RD05034KDAE	RD	050	34	KDAE

Siemens diesel generators are fully configured with the generator and tank together. The accompanying table shows the catalog numbers for all generator models.

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Protector Series Standby Diesel Generator Accessories – Part 1

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Model Number	Accessory	Description
6502	Spill Box	The 5-gallon spill box screws into the existing fuel fill port of the base tank. It captures and contains fuel if over fueling or spilling occurs during the fill process.
6504	90% Fuel Level Alarm	The 90% fuel level alarm alerts the fuel fill operator when the tank reaches a 90% fill level by sounding an audible alarm and triggering an LED warning light.
6505 – 15 & 20 kW 6506 – 30 & 50 kW	Tank Risers	Tank risers are required in some municipalities to help avoid potential base tank corrosion caused by mounting on rough surfaces.
6507	Fuel Fill Drop Tube	A powder coat painted, steel fuel fill drop tube is required in some municipalities to prevent sparking due to static electricity buildup, which can be caused by the fuel dropping into the tank from the fill area. Using a drop tube also results in submerged filling, which increases the fuel delivery flow rate and reduces vapors, foam and potential tank evaporation.
6513 – 15 & 20 kW 6517 – 30 kW 6516 – 50 kW	Stainless Steel Fuel Lines	Some municipalities require the use of stainless steel fuel lines instead of the standard hoses provided with the diesel generator products. These stainless steel lines are fire resistant for additional safety.
6510	E-Stop	E-stop allows for immediate fuel shutoff and generator shutdown in the event of an emergency.
6511	Spill Box Drainback Kit	The spill box drainback kit allows fuel that was captured in the 5-gallon spill box to be drained directly back into the fuel tank to avoid vapors.
6512	Lockable Fuel Cap	The cast iron, lockable fuel cap provides the ability to lock the fuel system to prevent unwanted fuel tampering or fuel siphoning.
6572 – 15 & 20 kW 6571 – 30 kW 6570 – 50 kW	Maintenance Kits	The Protector maintenance kits offer all the hardware necessary to perform complete maintenance on Protector series generators.
6560 – 15 & 20 kW 6559 – 30 kW 6558 – 50 kW	Cold Weather Kits	Recommended for generators installed in regions where the temperature regularly falls below 32 °F (0 °C). The cold weather kits consist of a block heater with all necessary mounting hardware and a battery warmer with a thermostat built into the battery wrap.

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Protector Series Standby Diesel Generator Accessories – Part 2

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Model Number	Accessory	Description
6576	Fuel Maintenance Kit	The fuel maintenance kit contains everything needed to maintain and clean a diesel fuel system.
5704	Paint Kit	If the generator enclosure is scratched or damaged, it is important to touch-up the paint to protect from future corrosion. The paint kit includes the necessary paint to properly maintain or touch-up a generator enclosure.
5928	Basic Wireless Remote	Completely wireless and battery powered, the wireless remote monitor provides you with instant status information without ever leaving the house.
5951	Advanced Wireless Remote	Remotely control generator functions with the advanced model's LCD display. In addition to remote testing of the generator, set the exercise cycle and maintenance interval reminders.
6199	PMM Starter Kit	The PMM starter Kit consists of a 24 VAC, field installed transformer that enables the use of the 24 VAC power management modules (PMMs) and one PMM. The standard controller (without starter kit) can control two HVAC loads with no additional hardware. Not compatible with pre-wired switches.
6186	Power Management Module (50 Amps)	Power management modules are used in conjunction with the smart switch to increase its power management capabilities. It gives the smart switch additional power management flexibility not found in any other transfer switch. Not compatible with pre-wired switches. Note: PMM starter kit required.
6588	Vent Extension Support Kit	The vent extension support kit consists of two aluminum plates with the appropriate pipe cutouts to secure the bent extension pipes coming through the top of the generator enclosure. It helps to minimize stress on the NPT fittings integrated on the tank and also helps protect against pests.
6463	Mobile Link	Mobile Link is designed for use with a generator equipped with an LCD display. Mobile Link sends status updates to StandbyStatus.com.
6478	Extension Cable	An extension cable to connect Mobile Link to the diesel generators.

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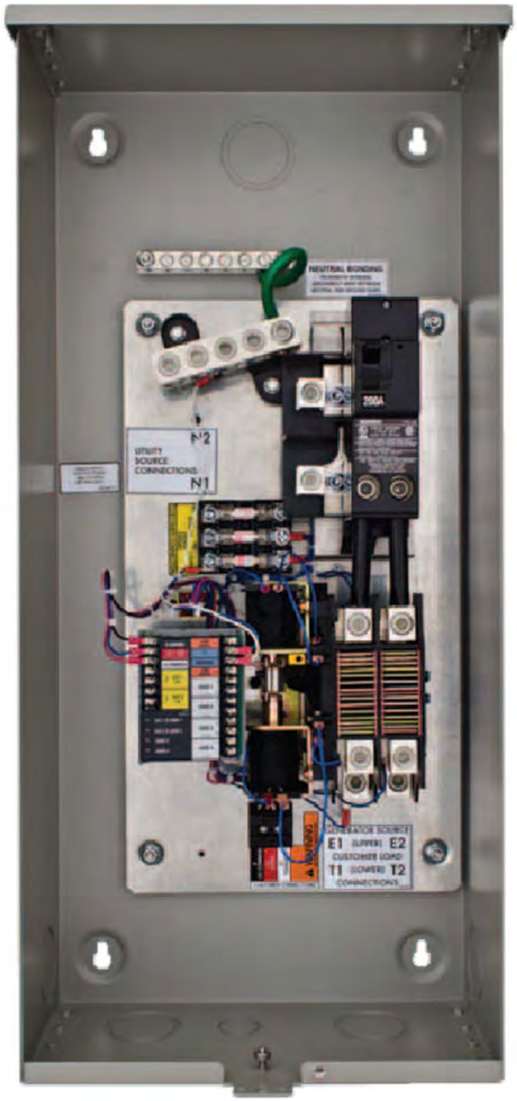

This chapter covers the following topics:

- Liquid Cooled Generators
- Diesel Generators
- **Automatic Transfer Switches**

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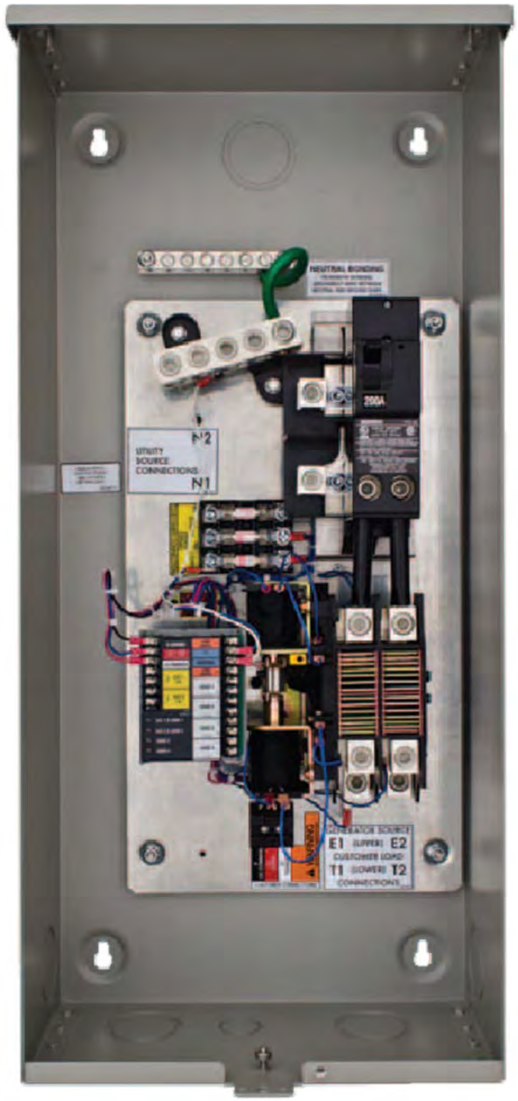
SM and SL Type Automatic Transfer Switches



Automatic transfer switches provide the mechanism for transferring power service from the utility to a standby generator or vice versa. 100 to 400A single-phase SM and SL type transfer switches have the ability to cycle on and off two air conditioners without adding additional components, allowing for a smaller generator to cover more circuits than when paired with a standard transfer switch. SM and SL transfer switches are compatible with natural gas/propane and diesel generators.

Features

- 100 to 800A continuous current ratings
- Outdoor NEMA 3R aluminum enclosure
- Open transition
- Compatible with Evolution controllers
- Cover more circuits with a smaller generator
- Service rated and non-service rated units available
- Add additional individual SMM modules (68730) and manage up to four additional large loads on a single SM transfer switch

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SM and SL Type Automatic Transfer Switch Ratings

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Catalog Number	Continuous Current Rating (Amps)	Withstand Rating (Amps)	Voltage Rating (VAC)	Disconnect Included
SM100R	100	10,000	120/240, 1Ø	No
SM100RD	100	10,000	120/240, 1Ø	Yes
SM150RD	150	10,000	120/240, 1Ø	Yes
SM200R	200	10,000	120/240, 1Ø	No
SM200RD	200	10,000	120/240, 1Ø	Yes
SM300RD	300	22,000	120/240, 1Ø	Yes
SM400R	400	22,000	120/240, 1Ø	No
SM400RD	400	22,000	120/240, 1Ø	Yes
SL100C	100	10,000	120/208, 3Ø	No
SL100J	100	14,000	120/240, 3Ø	No
SL100I	100	14,000	277/480, 3Ø	No
SL200C	200	10,000	120/208, 3Ø	No
SL200J	200	25,000	120/240, 3Ø	No
SL200I	200	25,000	277/480, 3Ø	No
SL400C	400	18,000	120/208, 3Ø	No
SL400J	400	18,000	120/240, 3Ø	No
SL400I	400	18,000	277/480, 3Ø	No
SL600R	600	42,000	120/208, 1Ø	No
SL600C	600	42,000	120/208, 3Ø	No
SL600J	600	42,000	120/240, 3Ø	No
SL600I	600	42,000	277/480, 3Ø	No
SL800R	800	65,000	120/208, 1Ø	No
SL800C	800	65,000	120/208, 3Ø	No
SL800J	800	65,000	120/240, 3Ø	No
SL800I	800	65,000	277/480, 3Ø	No

SM and SL type automatic transfer switches are available for Siemens standby generators rated from 8 kW to 150 kW.

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Course Completion

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This course covered the following topics:

Chapter 1 - Introduction

- Overview
- Electric Power

Chapter 2 – Residential Applications

- Air Cooled Generators
- Automatic Transfer Switches
- Portable Power

Chapter 3 – Commercial Applications

- Liquid Cooled Generators
- Diesel Generators
- Automatic Transfer Switches

This course has covered the topics shown on the left. Thank you for your efforts. You can complete this course by taking the final exam and scoring at least 70%.

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