Table of Contents

Introduction

Welcome to another course in the STEP series, **S**iemens **T**echnical **E**ducation **P**rogram, designed to prepare our distributors to sell Siemens Energy & Automation products more effectively. This course covers **Basics of Surge Protection**. Although some of the products included in this course are used in a variety of commercial applications, the emphasis of this course will be on surge products used in residential and light commercial applications.

Upon completion of **Basics of Surge Protection**, you should be able to:

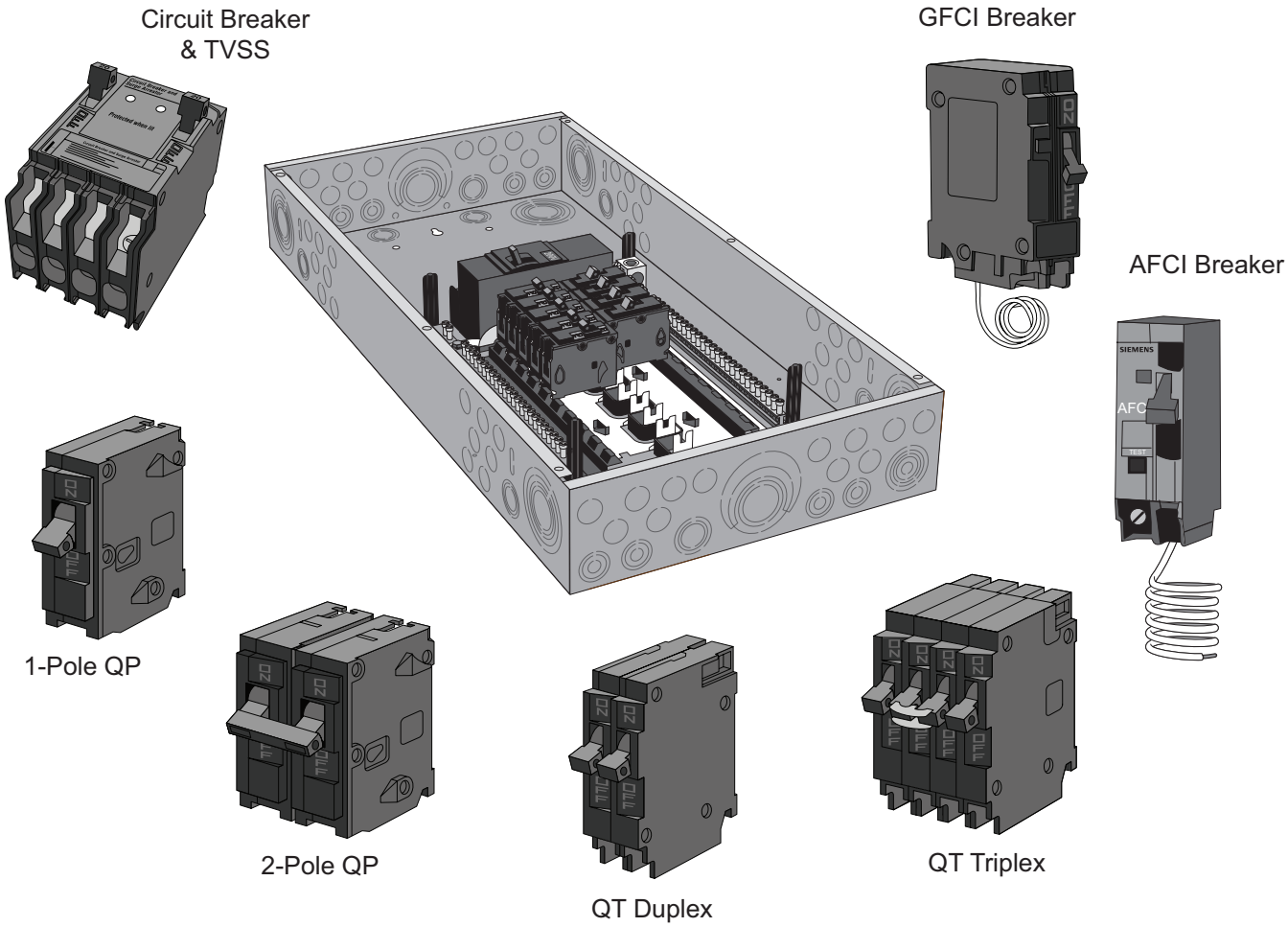
- Describe the damaging effects of lightning strikes and other electrical surges
- Explain the need for surge protection
- Explain the difference between point-of-use and point-of-entry surge protectors
- Explain the need for whole-house surge protection and how to achieve it
- Identify and describe each of the various surge protection products in the Siemens residential product line

This knowledge will help you better understand customer applications. In addition, you will be able to describe products to customers and determine important differences between products. You should complete **Basics of Electricity** and **Basics of Load Centers** or have a basic understanding of electrical concepts before attempting **Basics of Surge Protection**.

If you are an employee of a Siemens Energy & Automation authorized distributor, fill out the final exam tear-out card and mail in the card. We will mail you a certificate of completion if you score a passing grade. Good luck with your efforts.

Siemens Residential Products

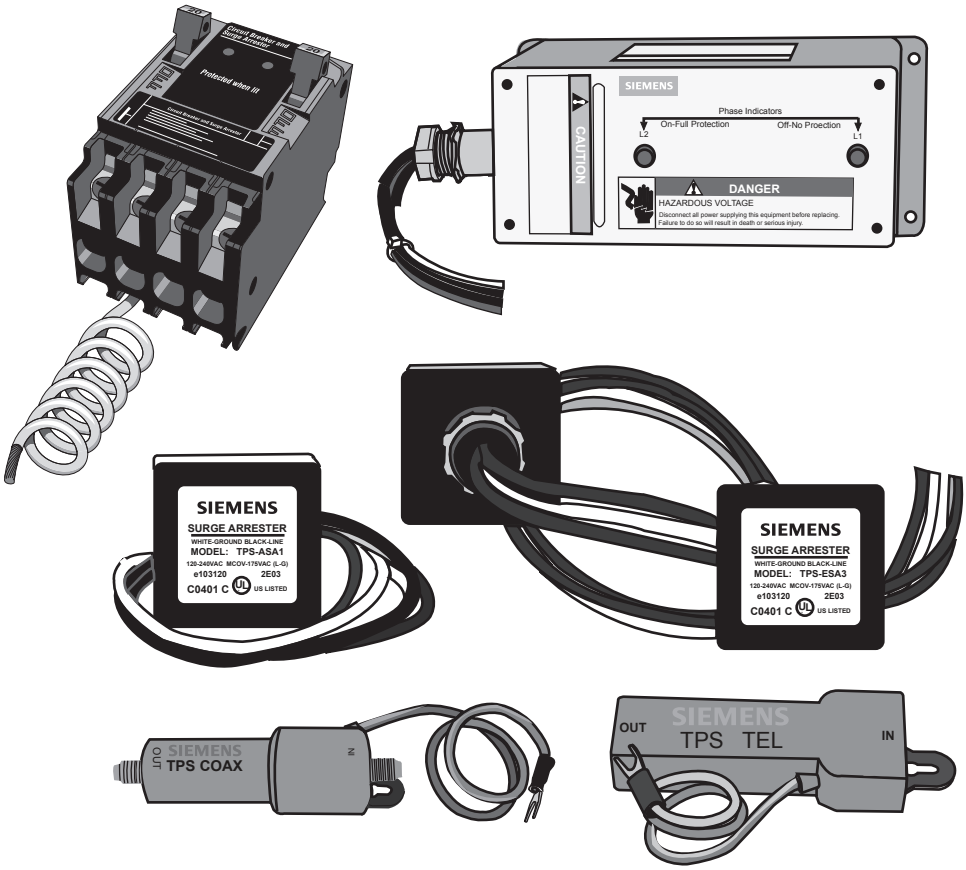
Siemens manufactures a variety of electrical distribution products for residential applications. Central to these applications are **load centers** and associated **circuit breakers**, which control the distribution of electrical power throughout the home. Refer to the STEP course titled **Basics of Load Centers** for additional information regarding these products.



Surge Protection Products

Load centers with standard residential circuit breakers cannot protect a home from damaging electrical surges such as those produced by lightning. Siemens offers a variety of products designed to protect the home from such electrical surges. Siemens electrical surge protection products work in conjunction with load centers and circuit breakers to provide more complete residential circuit protection.

Siemens also provides products used for surge protection in commercial and industrial applications; however, Siemens surge protection products intended for residential and light commercial applications are the focus of this course.

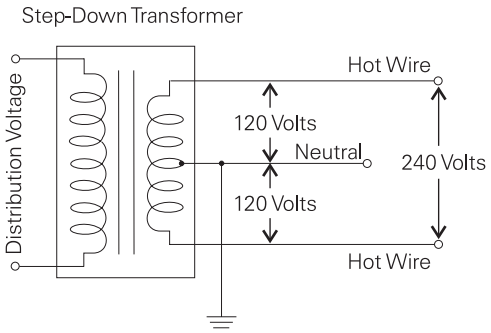


Residential Power Distribution

Electrical energy is generated at a power plant and sent over transmission lines at a voltage high enough for efficient transmission. At various points in the distribution system, energy is drawn from the power lines and stepped down to a lower voltage at substations. Each substation further distributes the electrical energy to nearby customers. When the energy reaches its final destination at a residential customer, the voltage is further stepped down to 240 volts.

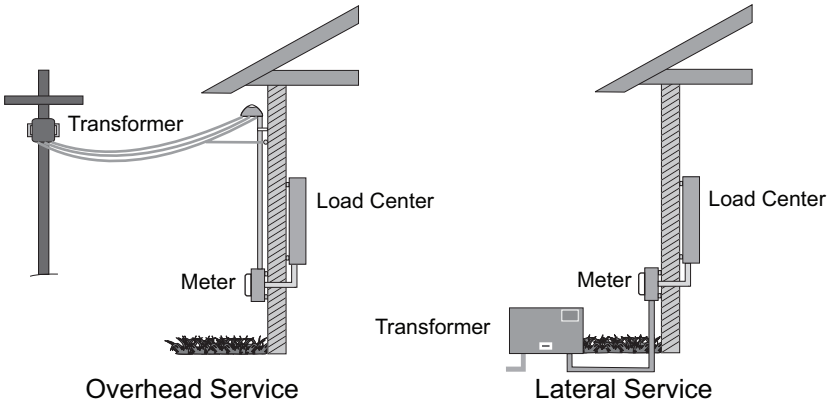
Power Supply

The most common supply system used in U. S. residential applications today is a **single-phase, three-wire** system. In this system, there are 120 volts between either hot wire and neutral and 240 volts between the two hot wires. 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.



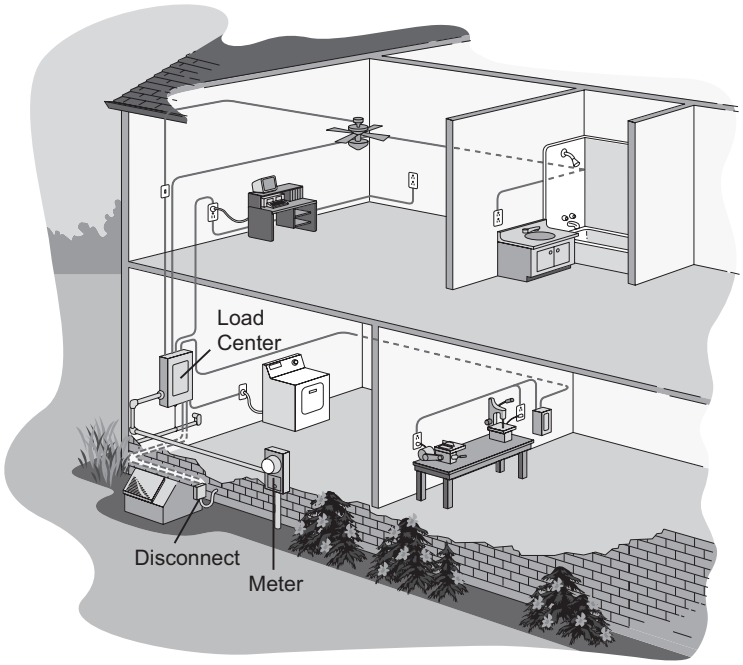
Service Entrance

Power, purchased from a utility company, enters the house through a metering device and connects to a load center. This is the **service entrance**. Residential service can come from an overhead utility transformer or from a lateral service run underground.



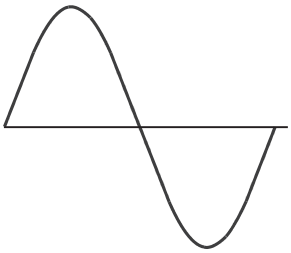
Distribution

Load centers provide circuit control and **overcurrent protection**. Power is distributed from the load center to various branch circuits for lighting, appliances, and electrical outlets.



Power Quality

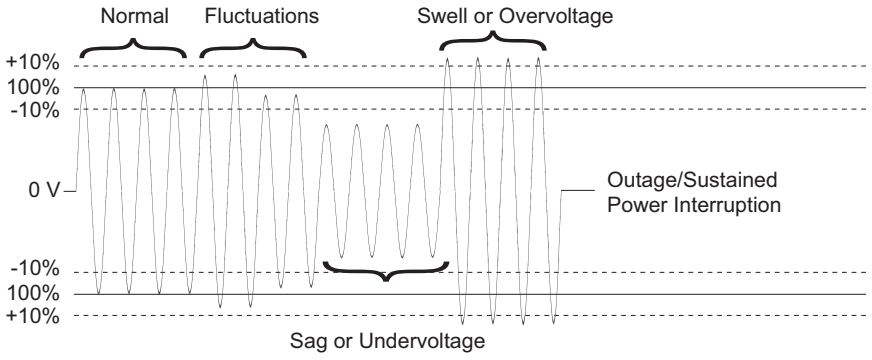
Voltage used in the home can be represented by a **sine wave**. Ideally, a sine wave would be smooth and free of disturbances. However, even the best power distribution systems are subject to voltage fluctuations.



Voltage Variations

Voltage changes can range from small voltage fluctuations of short duration to a complete outage for an extended period of time. **Undervoltage** occurs when voltage decreases below normal rated tolerance. An undervoltage is often referred to as a **sag** when the duration is short, typically no more than a few seconds.

Overvoltages occur when voltage increases above normal rated tolerance. An overvoltage is often referred to as a **swell** when the disturbance lasts a short duration, typically no more than a few seconds.



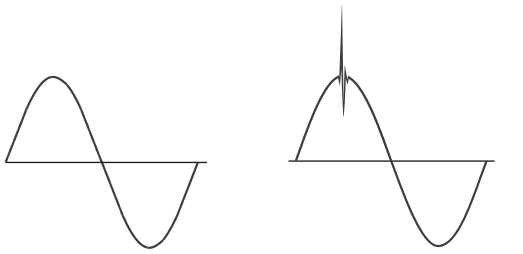
* Based on equipment with normal rated voltage tolerance of +/-10%

Very Short Duration Disturbances

Many voltage fluctuations are even shorter in duration than sags and swells. Very short duration disturbances may be called a **transient**, **impulse**, **spike**, or if opposite in polarity to the sine wave, a **notch**. One common term used to describe a very short duration rise in voltage and current is a **surge**.

Surges

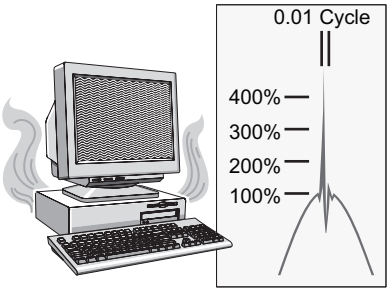
The definition for a surge varies, but, in general, it is an increase of at least ten percent in current and voltage that typically lasts only a few microseconds. Although the duration of a surge is very short, the amount of electrical energy associated with a surge can be significant because, during a surge, voltage can rise to as much as a few thousand volts.



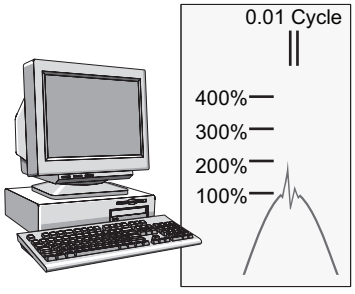
Normal Voltage Voltage with Surge Present

In spite of the efforts of electric utilities to minimize voltage fluctuations and electronic equipment manufacturers to protect equipment, electronic equipment is still susceptible to damage anytime the supply voltage exceeds the manufacturer's recommended tolerance.

Large surges, such as those caused by lighting, can result in immediate, catastrophic failure of electronic equipment. However, even smaller surges occurring repetitively can, over time, degrade and eventually damage electronic equipment.



A large surge can cause immediate damage

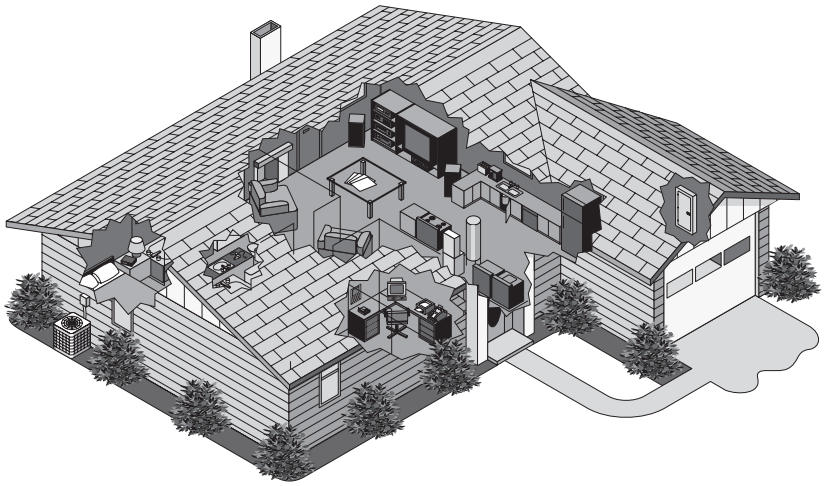


Even small, repetitive surges can, over time, damage equipment

Sensitive Equipment in the Home

By now you may be wondering what all of this has to do with the average home owner. In the past, it was considered sufficient for home power distribution systems to provide short circuit and overload protection. More recently, selected circuits have been required to have ground fault or arc fault protection. In general, the purpose of most protective devices in a home power distribution system is safety and not equipment protection.

Today's modern homes, however, are full of complex and sensitive electronic equipment. Many homes now have a variety of electronic entertainment devices, home appliances often incorporate electronic circuits, and computers and office equipment are also commonly used in the home. While the value of these systems varies, it is not uncommon for a typical home to have thousands of dollars of electronic equipment, and it can take as little as one surge to damage these devices.



Function of a Surge Protective Device

As the name implies, the function of a **surge protective device (SPD)** is to provide a degree of protection for electrical equipment from the damaging effects of electrical surges. The amount of protection provided depends upon the ratings of the device.

The way that an SPD protects an electrical circuit is by limiting the voltage that can be applied to the protected circuit in the event of a surge. This requires the SPD to channel the excess energy of the surge away from the protected circuit to ground through the SPD.

Review 1

1. The most common supply system used in residential applications is a _____ -phase, _____ -wire system.

2. In a typical U. S. residential electrical system, the voltage between the two hot wires is 240 volts, and the voltage from either hot wire to the neutral wire is _____ volts.

3. A short duration undervoltage is sometimes called a _____, and a short duration overvoltage is sometimes called a _____.

4. A _____ is an increase of at least ten percent in current and voltage that typically lasts only a few microseconds.

5. In general, the purpose of most protective devices in a home power distribution system is _____ and not equipment protection.

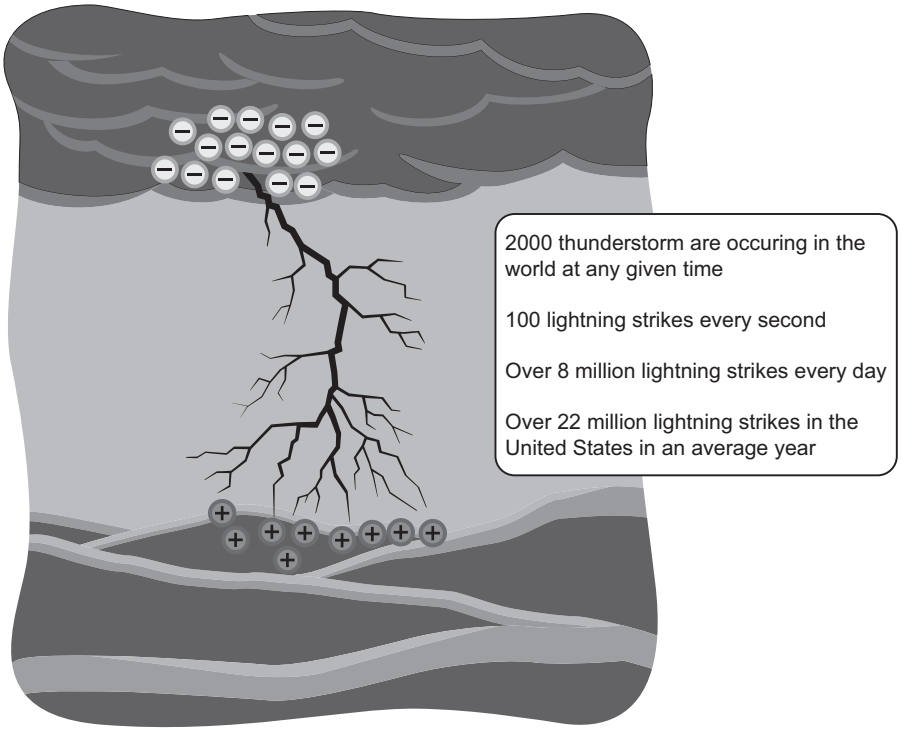
6. An SPD protects an electrical circuit by limiting the _____ applied to the protected circuit in the event of a surge.

Causes of Surges

Surges from Outside the Home

Surges can be caused by sources outside a home, such as when large electrical loads are turned on and off. Disturbances can result from the routine operation of electrical machinery at a nearby factory or large commercial facility, but they can also be caused by the electric utilities protective devices.

The most damaging source of electrical surges, however, is lightning. Lightning is caused by the attraction of positive and negative charges in the atmosphere. This results in a buildup and discharge of electrical energy. Lightning can occur within a cloud, from cloud to cloud, or from cloud to earth. According to the National Oceanic and Atmospheric Administration (NOAA), there are an estimated 2000 thunderstorms at any given moment in the world, resulting in 100 lightning strikes every second. In the United States alone, there are over 22 million lightning strikes in an average year. A typical lightning strike might range from 20,000 to 100,000 amps at a potential of up to 30 million volts.

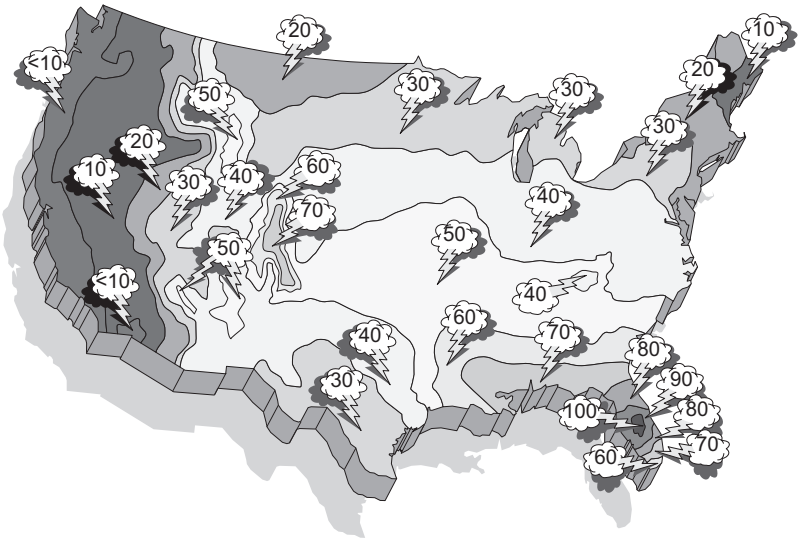


Electrical Equipment Damage

Lightning does not have to strike a home, or near a home to cause electrical damage. A lightning strike on a power line several miles away still has the potential to cause extensive electrical damage in a home. In addition to causing surges on the power line, lightning can also cause damaging surges on telephone lines and TV cables.

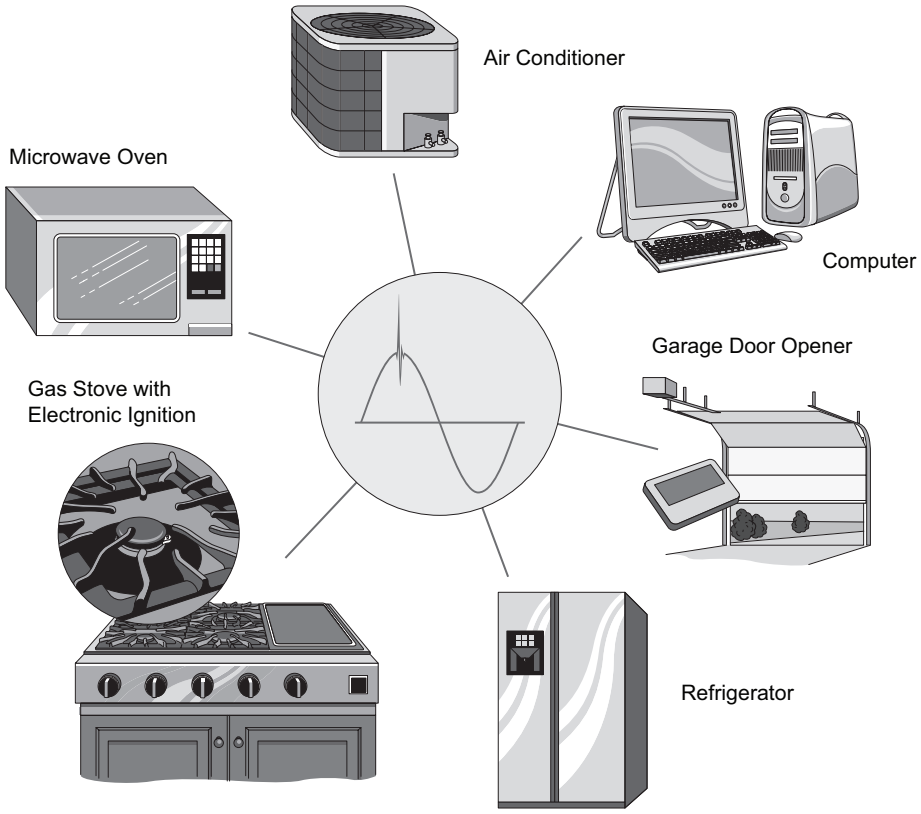
Thunderstorm Locations

Thunderstorms occur everywhere in the United States. The following map shows the approximate mean annual number of days with thunderstorms in the United States.



Surges from Within the Home

In addition to external sources of electrical surges, devices in or near the home also produce electrical surges. For example, electrical appliances that incorporate electric motors or turn on or off very quickly also cause power surges.



Surge Protection Terminology

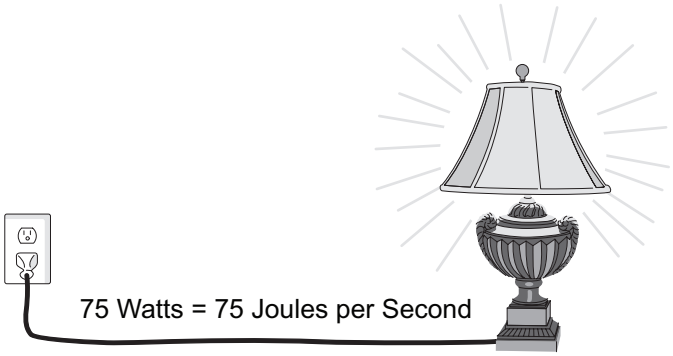
There are a variety of SPDs available to protect sensitive electronic equipment from surges. In order to understand these devices, it is necessary to understand some basic terminology.

Joule Rating

One of the more common ratings for an SPD is the amount of electrical energy the device can absorb in a designated time without failing. This rating is sometimes called the **joule rating** because the **joule (J)** is a basic unit of measurement for energy. However, this rating is often referred to by other names such as **transient energy rating** or **single pulse energy dissipation rating**.

In theory, the higher the joule rating, the more energy an SPD can channel away from the protected circuit. However, procedures for testing the amount of single pulse energy that an SPD can dissipate without failing vary, so the joule rating should be considered in the context of other ratings provided by an SPD supplier.

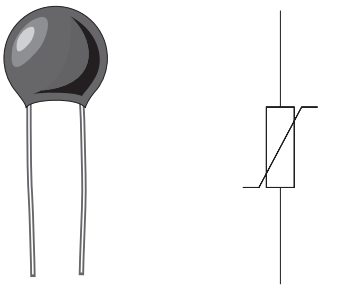
One way to think about the concept of a joule of electrical energy is to relate it to another more familiar electrical unit, a **watt**. One watt is the basic unit of measurement for power, and power is the rate at which energy is used. More specifically, for every watt of power, one joule of energy is used every second (joules = watts x seconds). This means that a common 75 watt light bulb uses 75 joules of energy per second.



It is important to note that an SPD's joule rating applies to the energy bypassed by the SPD. The lamp that uses 75 joules per second when operated for more than a few seconds would appear to far exceed the capability of a surge suppressor rated for 500 joules. However, the SPD does not absorb energy delivered to the load.

Metal Oxide Varistor (MOV)

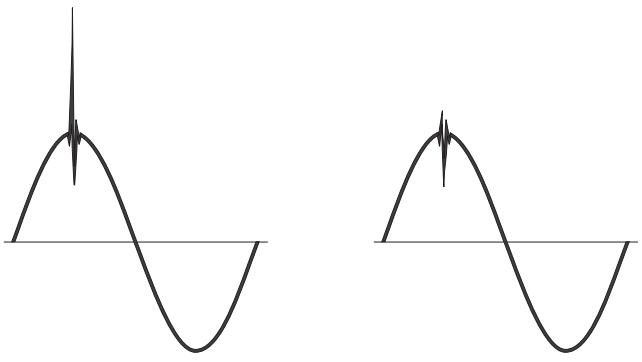
A **metal oxide varistor (MOV)** is a device commonly used in an SPD to provide a path for excess energy. There are two characteristics of MOVs that make them desirable for surge protection. First, the resistance of an MOV decreases with an increase in voltage. In addition, MOVs are fast acting and can respond to a surge in just a few nanoseconds. This results in suppressing a surge before it has a chance to damage electronic equipment.



MOV Circuit Symbol

Clamping Voltage

Clamping voltage is a measure of the voltage-limiting capability of an MOV. Voltage at a lower level than the clamping voltage is passed on to the load. When a surge occurs, the MOV attempts to limit the excess voltage to the level of the clamping voltage by channeling excess energy to ground.



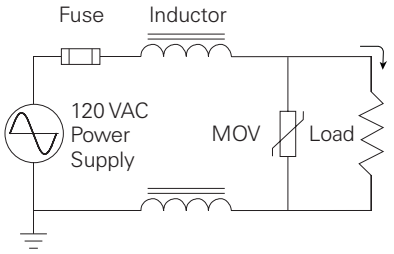
Unsuppressed Surge Suppressed Surge

Peak (or Impulse) Current Rating

The **peak current rating**, also sometimes called the **impulse current rating**, specifies the maximum current that can be dissipated from a single surge without causing the SPD to fail. Over time, however, even the best MOVs degrade in performance if subjected to surges. This is why SPDs are often equipped with one or more indicator lights to show if the SPD is still protecting the associated circuits.

MOV Operation

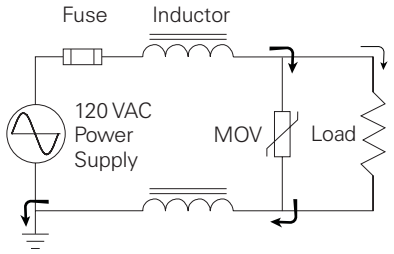
Under normal conditions, an MOV provides a very high resistance path. Resistance can be several hundred thousand ohms, limiting the current flowing through the MOV and allowing most of the current to flow through the load. In residential applications, the load is all electrical devices connected to the power source.



Normal Voltage

The clamping voltage rating of an MOV is greater than the normal supply voltage. Therefore, when a surge occurs and the clamping voltage rating of the MOV is exceeded, the MOV switches from a high resistance path to a low resistance path and excess energy passes through the MOV to ground, bypassing the connected load.

In addition to MOVs, SPDs may have inductors or other filter elements to further reduce the effects of a surge and may incorporate a fuse or other protective devices to insure safe operation of the SPD.



Surge Voltage

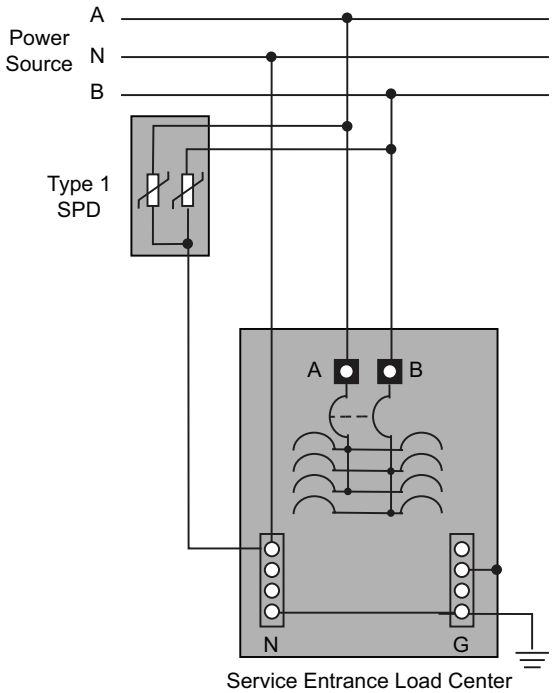
Surge Protective Device (SPD)

The term **surge protective device (SPD)** can refer to a device designed to provide a degree of protection against electrical surges regardless of its placement with respect to the service entrance main overcurrent protection device. However, the 2008 *National Electrical Code*® identifies four types of SPDs.

- **Type 1** - An SPD permanently mounted between the service transformer's secondary and the service's main overcurrent protection device. This type of SPD is also referred to as a **surge arrester**.
- **Type 2** - An SPD permanently mounted on the load side of the service's main overcurrent protection device. This type of SPD is also referred to as a **transient voltage surge suppressor** or **TVSS**.
- **Type 3** - A point-of-use SPD. This type of SPD is also referred to as a transient voltage surge suppressor or TVSS. Point-of-use SPDs are discussed later in this course.
- **Type 4** - An SPD component or assembly. This includes MOVs and assemblies containing MOVs and related components.

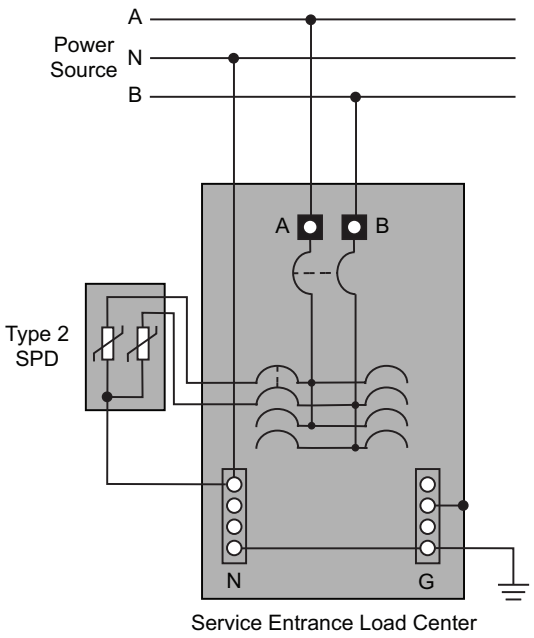
Type 1 SPD

The following illustration shows an example of a type 1 SPD (surge arrester) installed in an application with a single-phase, three-wire service. Note that the SPD is installed on the **line side** of main overcurrent protection device, which in this case is a circuit breaker.



Type 2 SPD

The following illustration shows an example of a type 2 SPD (TVSS) installed in an application with a single-phase, three-wire service. Note that the SPD is installed on the **load side** of main overcurrent protection device.



Refer to **2008 National Electrical Code® article 285** for additional information regarding SPDs rated for 1kV or less.

In the United States, the most widely known company that tests and lists electrical products is **Underwriters Laboratories (UL)**. The UL specification that applies to SPDs is **UL 1449**. This specification provides detailed descriptions of SPD requirements and testing.

Another important SPD standard is **NEMA LS 1-1992 Standard for Low Voltage Surge Suppression Devices**.

Review 2

1. _____ is the most damaging source of surges.

2. In addition to causing surges on the power line, lightning can also cause damaging surges on _____ and _____.

3. The _____ rating, or transient energy rating, of an SPD is an indication of how much energy a surge protector can absorb in a designated time without failing.

4. An _____ is a device commonly used in surge protectors that exhibits a change of resistance with a change in voltage.

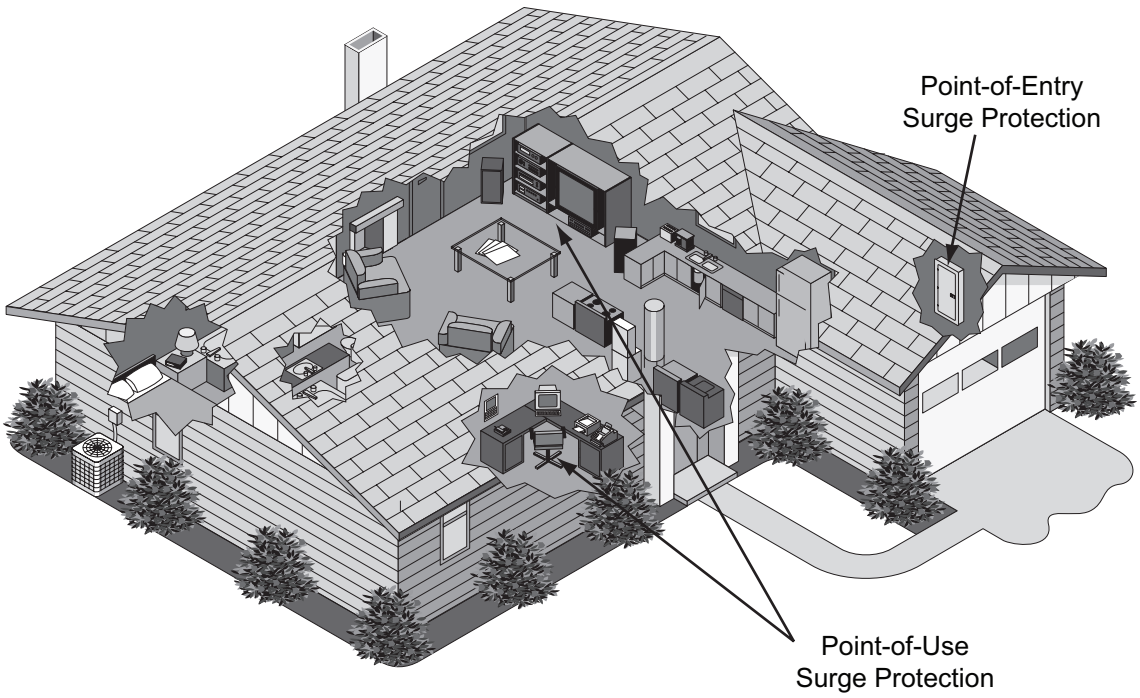
5. SPDs typically providing a path to _____ for excess energy when a surge occurs.

6. According to the *NEC®*, a type 1 SPD, or surge arrester, is connected on the _____ side of the service disconnect overcurrent protection device and a type 2 SPD, or TVSS, is connected on the _____ side of the service disconnect overcurrent protection device.

Whole-House Protection Strategy

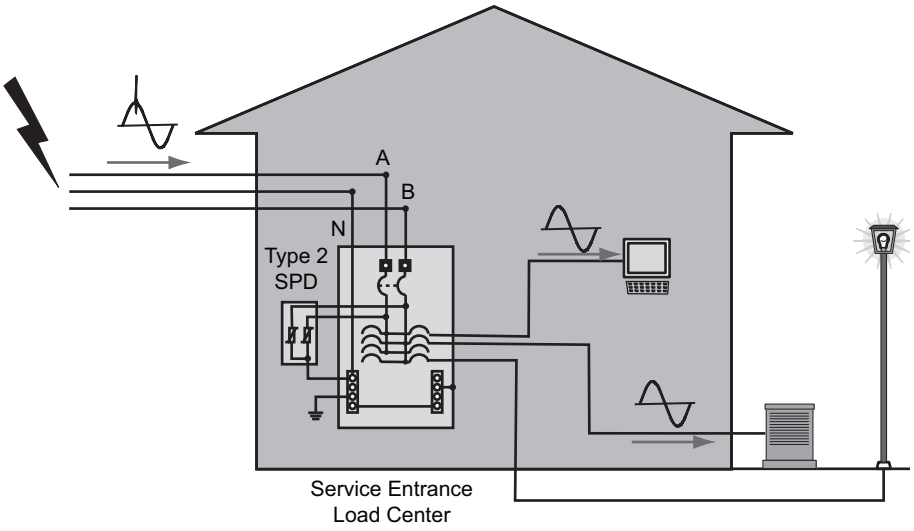
Surge Protection Strategy

No single SPD can protect all the equipment in a residence from all causes of electrical surges. Instead, a whole-house protection strategy, consisting of **point-of-entry** and **point-of-use** SPDs, is necessary to help guard against disturbances from inside and outside the home.



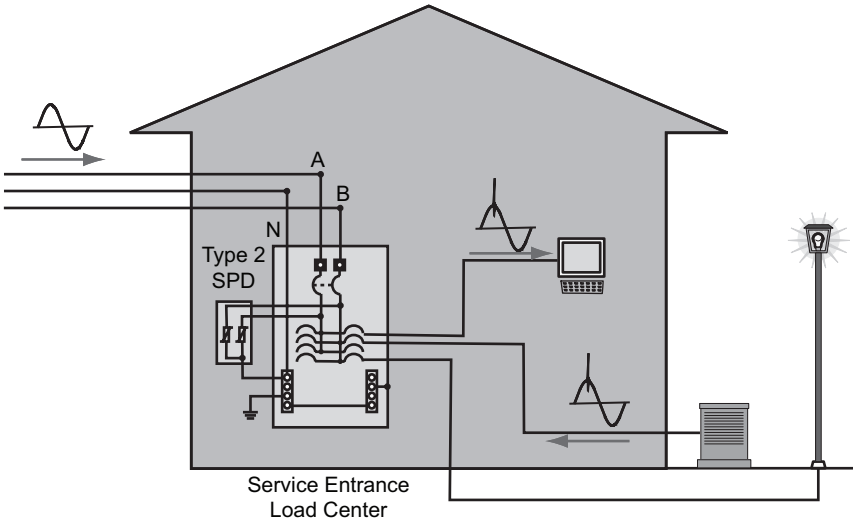
Point-of Entry Protection

A point-of-entry SPD is necessary to limit damage from electrical surges entering the home via service entrance conductors. As previously discussed, these electrical surges can come from a lightning strike on or near high-voltage transmission lines, switching of primary circuits by the local utility, or equipment operation in nearby commercial or industrial facilities.



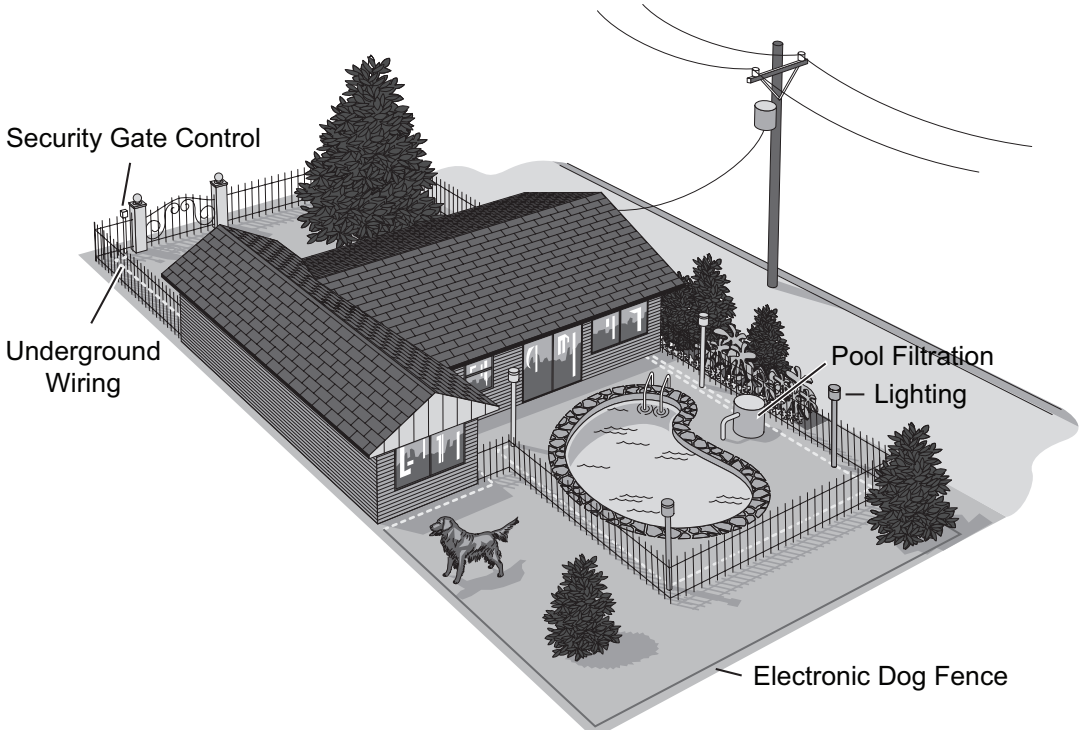
Surges from Within the Home

Point-of-entry SPDs, however, cannot provide protection from surges developed within the home. For example, an air conditioner can cause a small electrical surge every time it cycles on or off. Surges caused by equipment within the home are usually weaker than surges caused by lightning; however, they occur more frequently. These surges are distributed throughout the home's electrical system, possibly causing problems with other connected equipment.

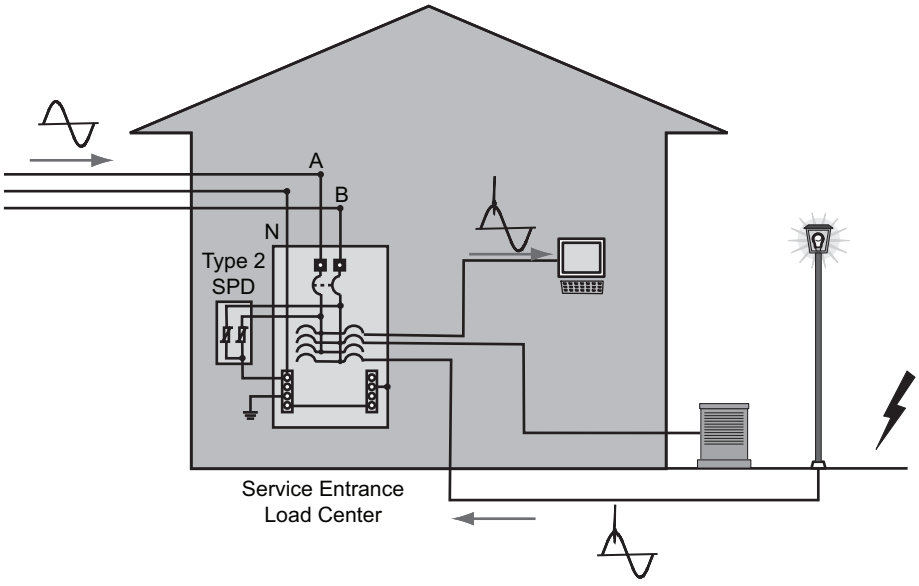


Exterior Wiring

Additionally, many homes have some form of exterior electrical wiring. Security gates, outdoor lighting, electronic dog fences, and swimming pool filtration equipment are just a few examples of outdoor electrical devices in use today.



A cloud-to-earth lightning strike in close proximity to underground wiring can cause a voltage surge which has a direct path to the home distribution system.

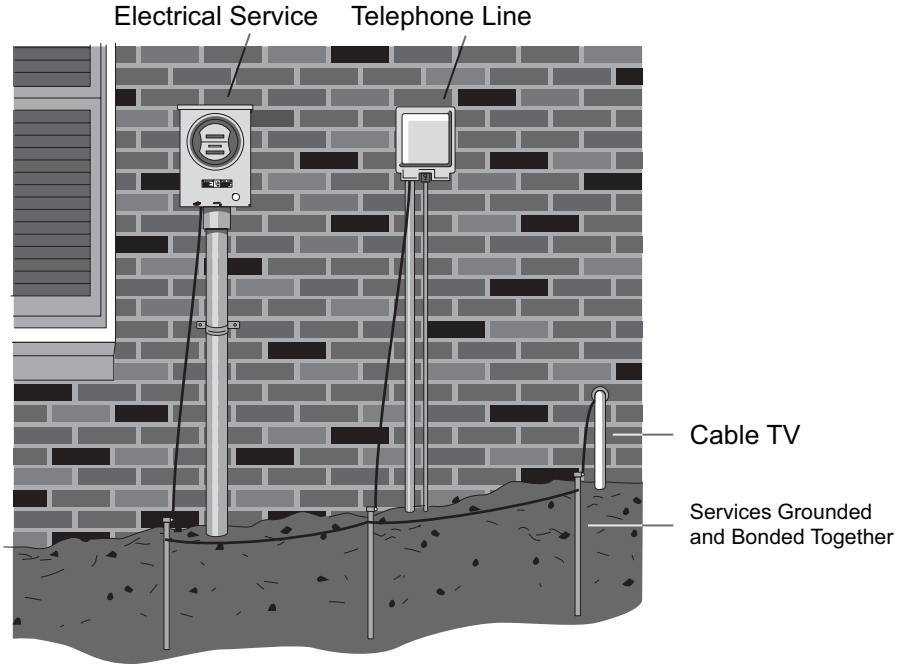


Surges from Other Services

Most damage occurs from electrical surges that enter the home from outside services. We have already learned how lightning strikes can enter the home through the electrical utility. It is equally important to note that **telephone lines** and **TV cables** can also conduct electrical surges into the home causing damage to electronic equipment connected to these lines.

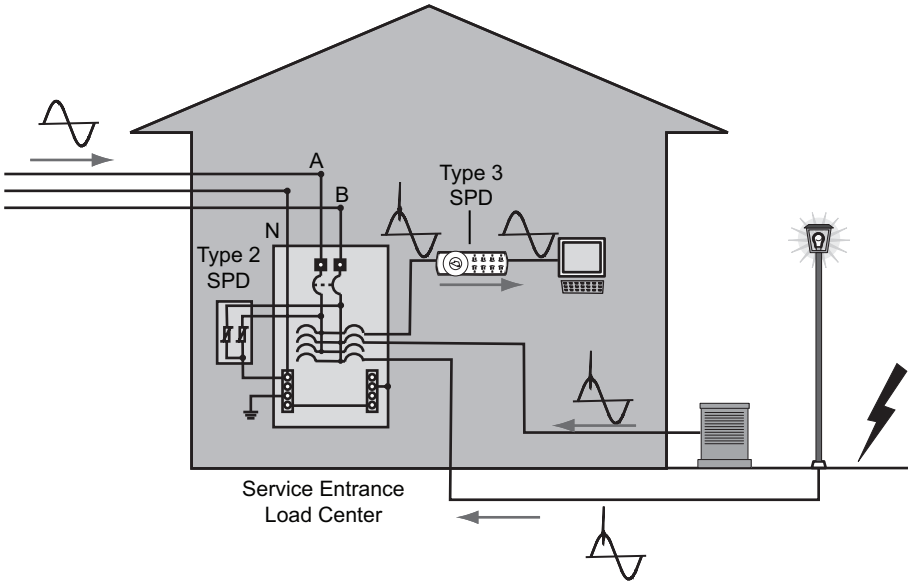
The *National Electrical Code®* requires services to be grounded and bonded together. The purpose is to reduce fire and shock hazard in the event electric utility power conductors come in contact with communication conductors.

However, this will not protect sensitive electrical and electronic equipment located within the house.



Type 3 SPDs

Type 3 SPDs, also called **point-of-use SPDs**, are essential to any surge protection strategy to provide household equipment with a degree of protection from surges created in the home. In addition, point-of-entry SPDs typically have a relatively high clamping voltage and this allows some **let-through energy** that can be absorbed by point-of use SPDs.



Review 3

1. Point-of-entrance SPDs provide a degree of protection from _____.

   a. surges caused by external sources
   b. surges caused by internal sources
   c. surges cause by external and internal sources

2. Point-of-entrance SPDs typically have a clamping voltage that is _____ the clamping voltage of point-of-use SPDs.

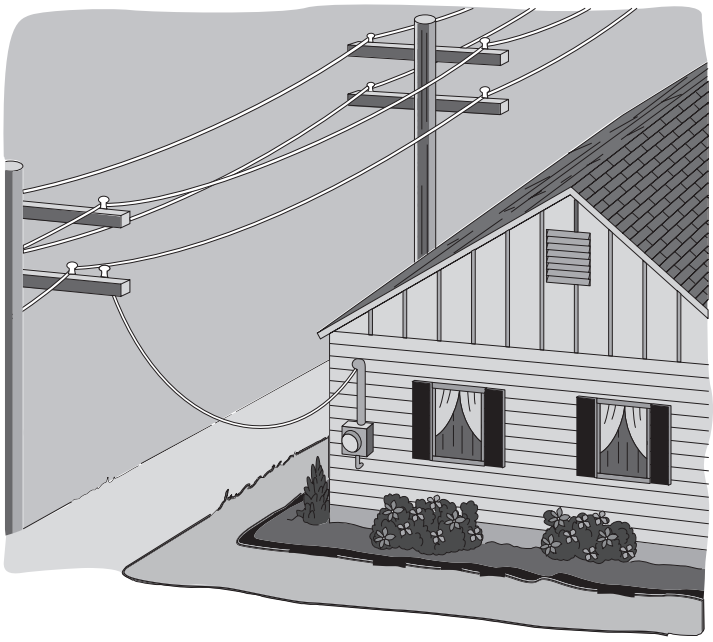
   a. lower than
   b. about the same as
   c. higher than

3. Surges can enter the home distribution system through _____.

   a. electrical service entrance wiring
   b. telephone wiring
   c. cable TV wiring
   d. all of the above

Point-of-Entry Surge Protection

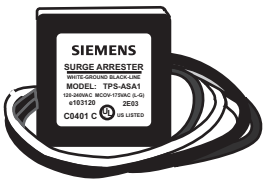
An SPD installed at the service entrance is the first line of defense in a home surge protection strategy. Point-of-entry SPDs provide protection by diverting surges to ground before they can damage equipment. A properly installed and operating point-of-entry SPD protects appliances, such as refrigerators, dishwashers, electric washers and dryers, heaters, and air conditioners, that are not normally connected to point-of-use SPDs.



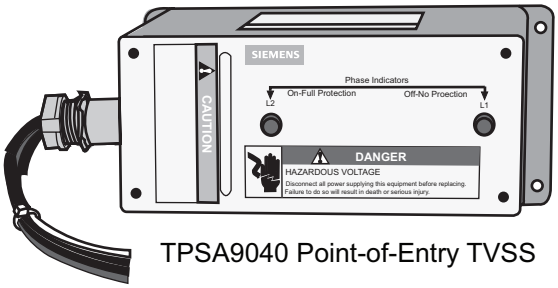
Point-of-Entry Solutions

An electrical surge, whether it is caused by electrical equipment or lightning, always finds a path to ground. When such a surge occurs, any equipment connected to the electrical service can be damaged.

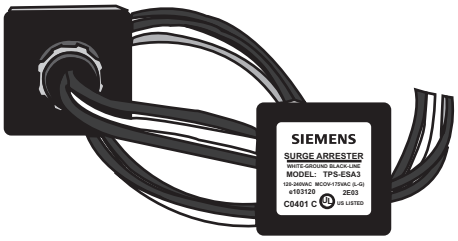
Siemens response to this threat is to offer SPDs that can meet a variety of point-of-entry application requirements. Siemens **Circuit Breaker and Surge Arrester** or **Circuit Breaker and TVSS** can be conveniently installed in Siemens load centers to provide point-of-entry-protection. Alternatively, Siemens **TPSA9040TVSS** can provide point-of-entry protection regardless of the load center used at the service entrance. In addition, Siemens also offers **1-phase** and **3-phase secondary surge arresters**, often referred to as **lightning arresters**.



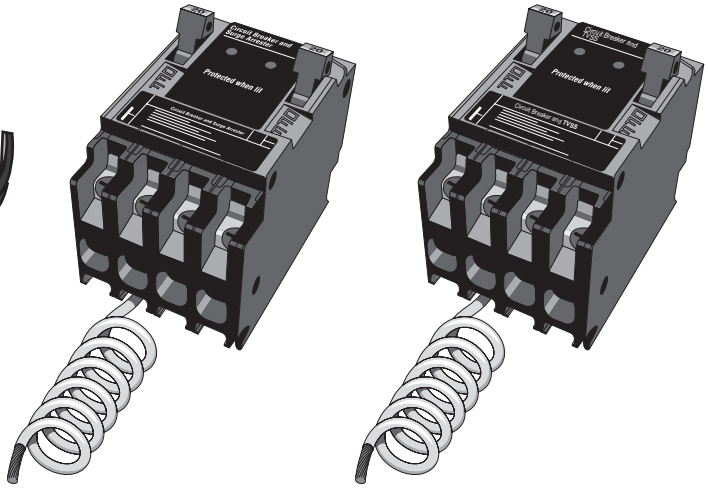
Single-Phase Lightning Arrester



TPSA9040 Point-of-Entry TVSS

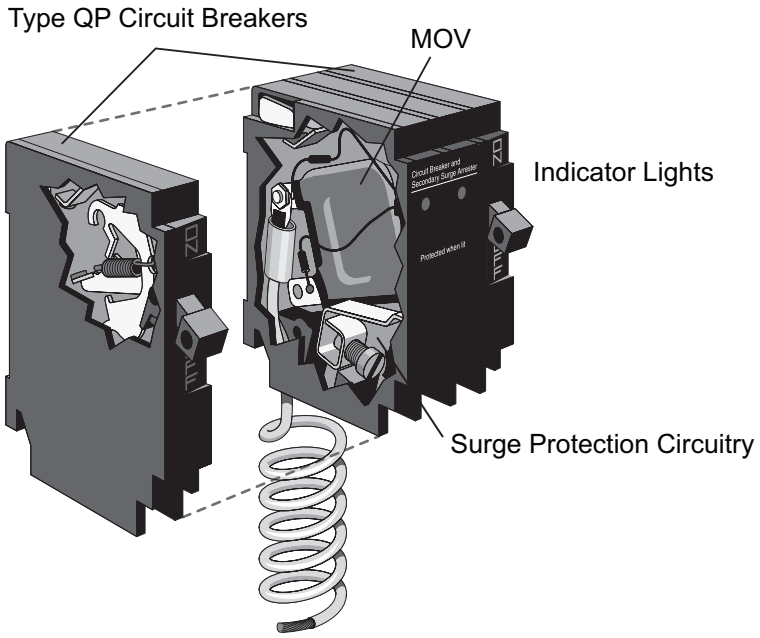


Three-Phase Lightning Arrester



Siemens Circuit Breaker and Surge Arrester and Circuit Breaker and TVSS

Siemens Circuit Breaker and Surge Arrester and Circuit Breaker and TVSS are UL listed, and each of these devices include two independent, 1-pole QP circuit breakers and an integral SPD. The SPD not only provides a degree of protection for the circuits served by the circuit breakers, but also for all circuits connected to the load center.

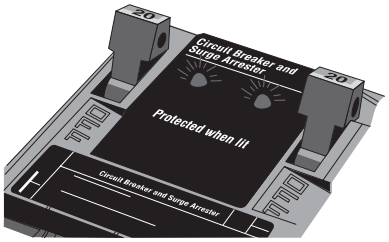


QSA1515 Circuit Breaker and Surge Arrester incorporates two 1-pole, 15 amp **QP** circuit breakers. **QSA2020** Circuit Breaker and Surge Arrester and **QSA2020TVSS** Circuit Breaker and TVSS each incorporates two 1-pole, 20 amp QP circuit breakers.

Although both the Circuit Breaker and Surge Arrester and Circuit Breaker and TVSS provide point-of-entry surge protection, the specifications for these devices differ. In particular, the Circuit Breaker and TVSS incorporates an SPD with a **lower clamping voltage** that provides increased protection for connected devices.

Visual Indication

Even the best point-of-entry surge protectors can fail over time. As a result, Siemens Circuit Breaker and Surge Arrester and Circuit Breaker and TVSS each have two **indicator lights** that illuminate to indicate that surge protection is being provided.



An added exclusive feature of these devices is that, in the event that surge protection is lost, one or both circuit breakers trip to provide an indication of this condition. As a result, these circuit breakers should be used for circuit protection of the more commonly used circuits. This allows the lights or other devices connected to these circuit breakers to provide an effective indication of the status of the SPD.

Installation

These devices occupy two standard width circuit breaker spaces and, in addition to providing point-of-entry surge protection, function to provide overcurrent protection for two 120 volt circuits.

Installation is as simple as mounting a conventional circuit breaker in a Siemens load center. After power is switched off and the trim removed, the Circuit Breaker and Surge Arrestor or Circuit Breaker and TVSS plugs into place. A wire is provided to connect the neutral side of the module to the load center's neutral bus.

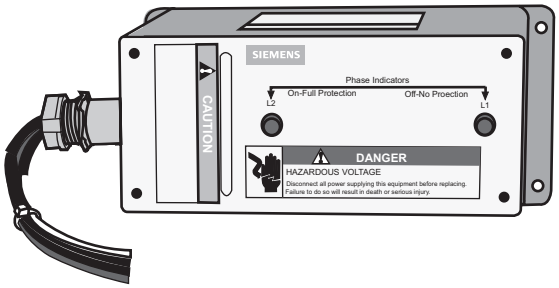
It is best to position the device in the first position of the load center and connect the wire in the first neutral position. This keeps the ground path for the SPD as short as possible.

	Circuit Breaker and Secondary Surge Arrester	Circuit Breaker and TVSS
Initial Clamping Level	360 Volts	240 Volts
Transient Energy Rating	460 Joules line-to-neutral 920 Joules line-to-line	360 Joules line-to-neutral 720 Joules line-to-line
Secondary Surge Arrester Voltage Rating	170 Volts AC max. line-to-ground	Not Applicable
TVSS Voltage Rating	Not Applicable	500 Volts peak, line-to neutral 1000 Volts peak, line-to-line
Peak Current Rating (Impulse)	40,000 Amps	40,000 Amps
Discharge Voltage Characteristic (line-to-neutral)	at 1500 Amps, 600 Volts at 5000, Amps 800 Volts	at 1500 Amps, 600 Volts at 5000, Amps 800 Volts
Discharge Current Withstand Rating (line-to-neutral)	10,000 Amps	10,000 Amps
Circuit Breaker Interrupting Rating	10,000 Amps, 120/240 Volts AC	10,000 Amps, 120/240 Volts AC

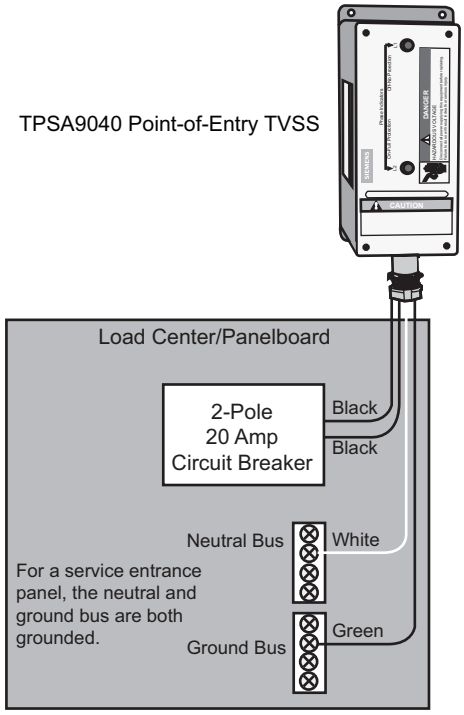
Refer to the product warranty for warranty details.

TPSA9040 Point-of-Entry TVSS

The TPSA9040 is a UL listed point-of-entry TVSS designed to shield motor-driven appliances against electrical power surges, including surges caused by lightning, from entering through the service entrance load center.



The TPSA9040 TVSS is mounted external to the load center and can be used with Siemens or non-Siemens load centers.



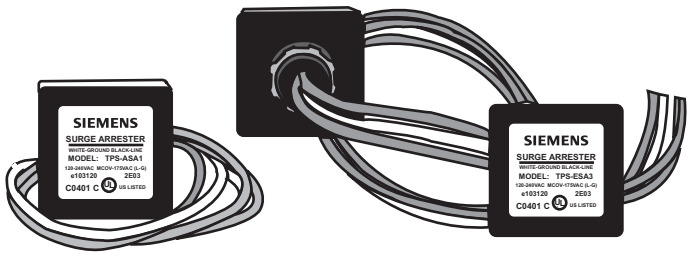
The TPSA9040 TVSS uses **multiple MOV technology** with **thermal disconnects** to prevent catastrophic failure. Two LED indicators and an audible alarm provide system status indications.

	TPSA9040
Initial Clamping Level	400 Volts
Transient Energy Rating	1080 Joules line-to-neutral
Spike Capacity	40,000 Amps
Line Voltage	120/240 Volts, 1-Phase
Rated Voltage	150 Volts
Short Circuit Rating	10,000 Amps

Refer to the product warranty for warranty details.

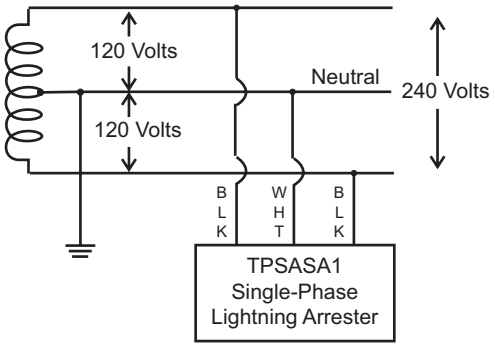
Single-Phase and Three-Phase Lightning Arresters

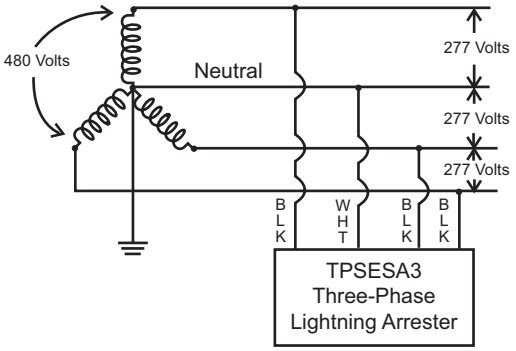
Siemens **TPSASA1** single-phase and **TPSESA3** three-phase secondary surge arresters, also called lightning arresters, are UL listed and designed to protect electrical equipment from the damaging effects of spikes and notches caused by lightning, utility switching, electric motor cycling, and other large or sudden changes in electrical power flowing on incoming AC power lines.



TPSASA1 Single-Phase Lightning Arrester (Secondary Surge Arrester)

TPSESA3 Three-Phase Lightning Arrester (Secondary Surge Arrester)





These secondary surge arresters can be used to provide surge protection for a variety of equipment such as: outdoor lighting, pumps, workshops, farm equipment, electric motors, heat pumps, air conditioning, etc.

	TPSASA1 Single-Phase Lightning Arrester	TPSESA3 Three-Phase Lightning Arrester
Initial Clamping Level	500 Volts	500 Volts
Peak Current Rating (Impulse)	25,000 Amps	25,000 Amps
Max. Continuous Operating Voltage	175 Volts AC line-to-ground	550 Volts AC line-to-ground
Service Voltage	120/240 Volts AC	277Y/480 Volts AC

Refer to the product warranty for warranty details.

Review 4

1. Siemens Circuit Breaker and Surge Arrester and Circuit Breaker and TVSS each provide point-of-entry surge protection and incorporate two 1-pole _____ circuit breakers.

2. In comparison to the Circuit Breaker and Surge Arrester, the Circuit Breaker and TVSS has a lower _____ that provides increased protection for connected devices.

3. Unlike the Circuit Breaker and Surge Arrester or the Circuit Breaker and TVSS, the TPSA9040 TVSS is mounted _____ to the load center and can be used with Siemens or non-Siemens load centers.

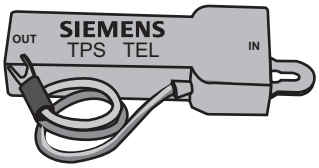
4. Siemens TPSASA1 lightning arrester is designed for use in 120/240 V, _____ circuits and Siemens TPSESA3 lightning arrester is intended for use in 277Y/480 V _____ circuits.

Signal Line Surge Protection

Siemens offers two devices intended to provide point-of-entry or point-of-use surge protection for signal line circuits.

TPSTEL Telecommunication Protector

Siemens **TPSTEL Telecommunication Protector** is a UL listed device that provides lightning protection for equipment connected to RJ45 modem, fax, or DSL telephone lines.

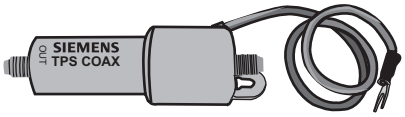


	TPSTEL Telecommunication Protector
Catastrophic Surge Protection	Yes
Overcurrent Protection	Yes
Spike Capacity	200 Amps
Let Through Voltage	< 260 Volts
Response Time	1 nsec.
Data Lines Protected	RJ45 pins 3, 4, 5, and 6

Refer to the product warranty for warranty details.

TPSCOAX Coaxial Protector

Siemens **TPSCOAX Coaxial Protector** is a UL listed device that provides lightning protection for equipment connected to a TV coaxial cable. This includes cables associated with cable TV as well as cables connected directly to an antenna.

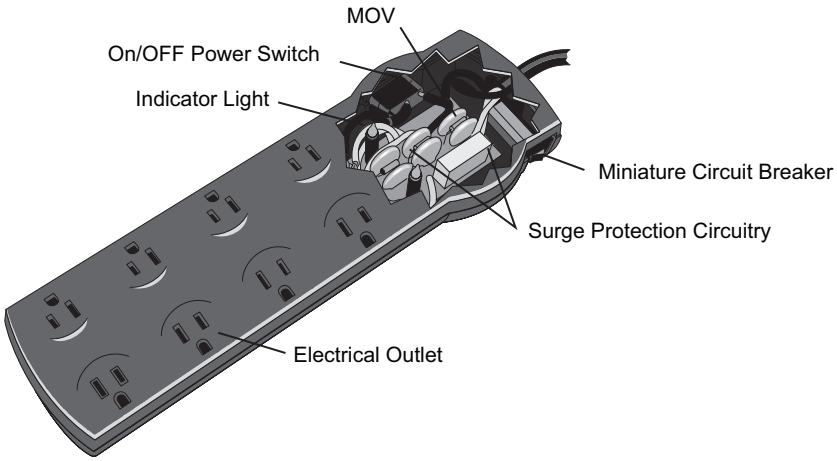


	TPSCOAX Coaxial Protector
Frequency Range	1 MHz through 1.45 GHz
Catastrophic Surge Protection	Yes
Overcurrent Protection	Yes
Spike Capacity	200 Amps
Let Through Voltage	< 85 Volts
Response Time	1 nsec.
Insertion Loss	0 to 3.0 db

Refer to the product warranty for warranty details.

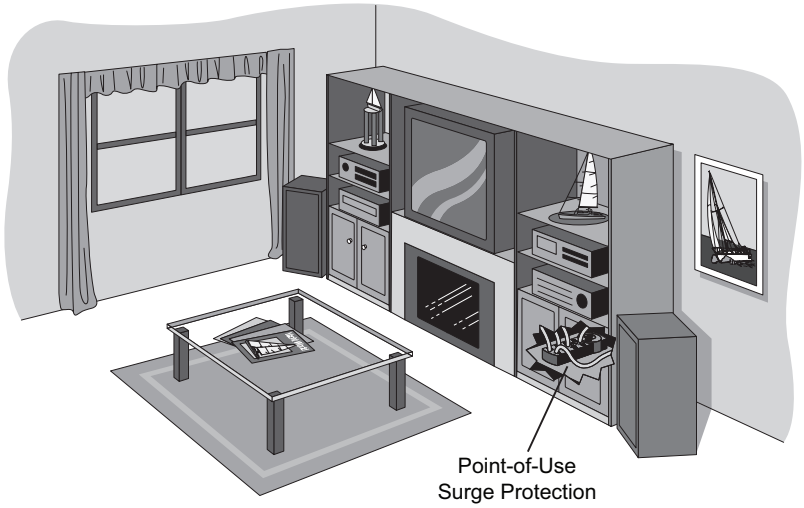
Point-of-Use Surge Protection

Point-of-use surge protection in a home typically consists of a power strip with an SPD circuit built in. Point-of-use surge protection should be used anywhere expensive and sensitive electrical equipment is used. In addition to providing protection from surges generated by air conditioners, major appliances, or other large loads connected to the home power distribution system, point-of-use SPDs provide an additional line of defense from surges created outside the home.



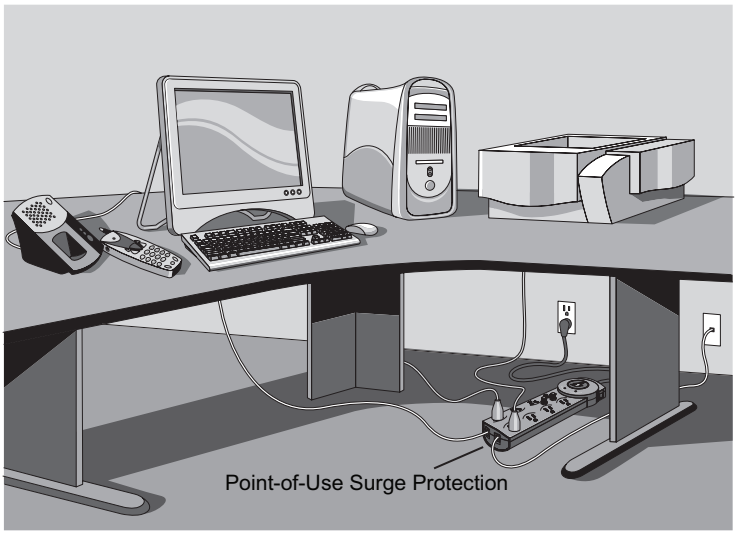
Home Entertainment

The use of expensive and sensitive electronic equipment in the home is on the rise. Today's home entertainment centers, for example, may include a large-screen television set, stereo equipment, a DVD player, and satellite or cable equipment.



Home Office

Today, millions of homes have home offices. Home offices include computers, fax machines, printers, copiers, scanners, and telephones. Home offices benefit from point-of-use surge protection because the replacement cost of equipment is high. Home offices are frequently associated with a home business. The expense of lost business while equipment is down can be significant.

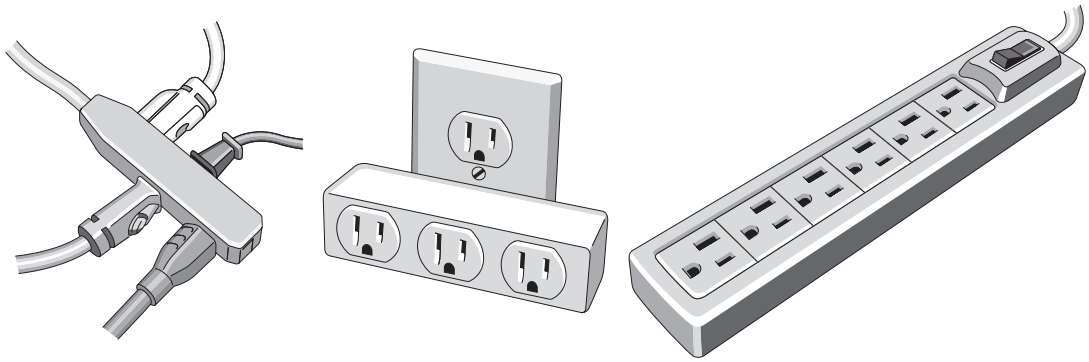


Other Uses for Point-of-Use SPDs

In addition to home entertainment centers and home offices, the number of expensive electronic devices or appliances with built-in electronic circuits connected to a home power distribution system continues to grow. As previously discussed, any of these devices can be damaged by catastrophic or repetitive surges. Therefore, no surge protection system is complete without appropriate use of SPDs to protect this equipment.

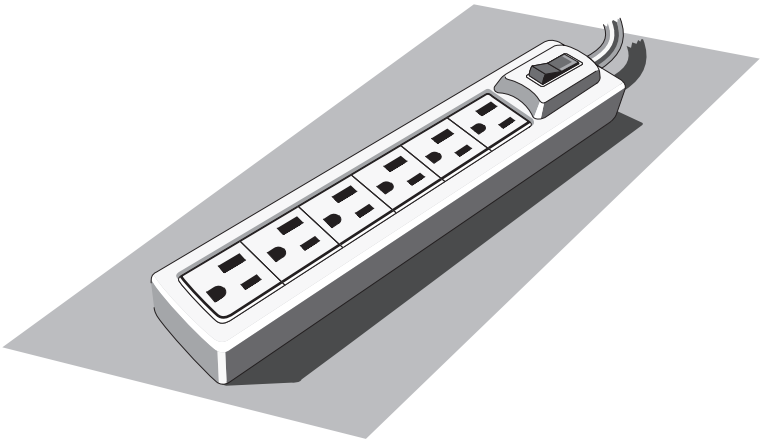
Basic Power Strips

Too often, home owners seek inexpensive solutions to connecting and protecting expensive equipment. Inexpensive extension cords, add-on outlets, and basic power strips provide no surge protection, leaving equipment susceptible to performance degradation and damage.



Basic Surge Protection

Home owners may also settle for an inexpensive surge protected power strip. Some of these may have a fuse or miniature circuit breaker that can be reset, but provide no visual indication that the surge protection circuitry is functioning. A home owner may think the connected equipment is protected, when in reality it is not.



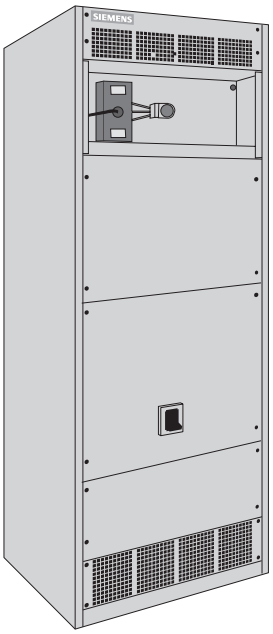
Visual Indication

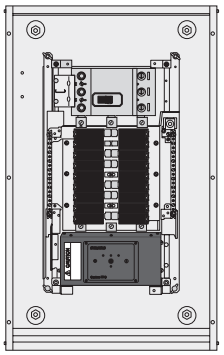
Good point-of-use surge protectors, like good point-of-entry surge protectors, will sacrifice themselves, and not the connected equipment, in the event of a catastrophic surge. It is important to note that many point-of-use surge protectors continue to supply power to equipment even when the surge protection circuitry is damaged. Good point-of-use surge protection devices provide visual indication that the surge protection circuitry is functional and protecting the connected equipment.

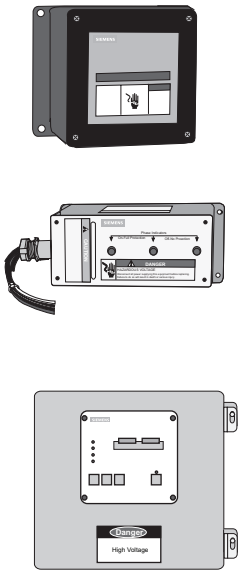
Commercial and Industrial TVSSs

It is not within the scope of this course to cover commercial and industrial use of SPDs; however, the need for surge protection in commercial and industrial power distribution systems is even greater than for a home system. Not only are the sources of surges more numerous and significant in commercial and industrial applications, but the cost of equipment subject to damage from surges is also greater.

Fortunately, Siemens offers multiple options for building in SPDs into new equipment as well as add-on surge protection equipment for existing commercial and industrial power distribution systems. Refer to the **Transient Voltage Surge Suppressors** section of the **SPEEDFAX** catalog for additional information.







Review 5

1. Siemens _____ Telecommunication Protector is a UL listed device that provides lightning protection for equipment connected to telephone lines.

2. Siemens _____ Coaxial Protector is a UL listed device that provides lightning protection for equipment connected to a TV coaxial cable.

3. _____ surge protection in a home provides protection from surges created by large loads connected to the home power distribution system and provides an additional line of defense from surges created outside the home.

4. The need for surge protection in commercial and industrial power distribution systems is _____ the need for surge protection in the home.

   a. less than
   b. greater than
   c. about the same as

Review Answers

Review 1	1) single, three; 2) 120; 3) sag, swell; 4) surge; 5) safety; 6) voltage.
Review 2	1) Lightning; 2) telephone lines, TV cables; 3) joule; 4) MOV; 5) ground; 6) line, load.
Review 3	1) a; 2) c; 3) d.
Review 4	1) QP; 2) clamping voltage; 3) external; 4) single-phase, three-phase.
Review 5	1)TPSTEL; 2) TPSCOAX; 3) Point-of-use; 4) b.

Final Exam

The final exam is intended to be a learning tool. The book may be used during the exam. A tear-out answer sheet is provided. After completing the test, mail the answer sheet in for grading. A grade of 70% or better is passing. Upon successful completion of the test a certificate will be issued.

1. An increase of at least ten percent in current and voltage that typically lasts only a few microseconds is referred to as a/an _____.

   a. surge
   b. swell
   c. sag
   d. notch

2. Generally, the most damaging source of electrical surges comes from _____.

   a. motor driven equipment
   b. lightning strikes
   c. household equipment
   d. utility companies switching primary circuits

3. A 100 watt lamp uses 100 joules of energy per _____.

   a. hour
   b. minute
   c. second
   d. millisecond

4. _____ is a measure of the voltage-limiting capability of an MOV.

   a. Peak current rating
   b. Clamping voltage
   c. Peak impulse rating
   d. Joule rating

5. A/An _____ is a device used in surge protectors that switches from a high resistance to a low resistance when a voltage surge occurs.

   a. MOV
   b. inductor
   c. capacitor
   d. resistor

6. The *NEC*® defines a type 2 SPD as an SPD permanently connected _____.

   a. at the service entrance in front of the main disconnect
   b. on the load side of the service disconnect overcurrent protection device
   c. only at the point of use
   d. either in front of or on the load side of the service disconnect overcurrent protection device

7. A good whole-house surge protection strategy requires all of the following except _____.

   a. point-of-use SPDs
   b. signal line SPDs
   c. point-of-entry surge protection
   d. GFCIs

8. According to the *NEC*® a _____ is connected between the service transformer and the service disconnect overcurrent protection device.

   a. type 1 SPD
   b. type 2 SPD
   c. type 3 SPD
   d. type 4 SPD

9. Which of the following SPD ratings is measured in joules?

   a. clamping voltage rating
   b. peak current rating
   c. transient energy rating
   d. short circuit current rating

10. Siemens Circuit Breaker and Surge Arrester incorporates two 1-pole ___ amp or two 1-pole ___ amp QP circuit breakers.

    a. 5, 10
    b. 5, 15
    c. 10, 15
    d. 15, 20

11. Siemens Circuit Breaker and TVSS is available with two 1-pole ___ amp QP circuit breakers.

    a. 20
    b. 5
    c. 15
    d. 10

12. In comparison to the Circuit Breaker and Surge Arrester, Siemens Circuit Breaker and TVSS has a _____ clamping voltage that provides _____ protection for connected devices.

    a. lower, less
    b. higher, increased
    c. higher, less
    d. lower, increased

13. Siemens _____ is mounted external to the load center and can be used with Siemens or non-Siemens load centers.

    a. Circuit Breaker and Surge Arrester
    b. Circuit Breaker and TVSS
    c. TPSA9040 point-of-entry TVSS
    d. None of the above

14. Siemens _____ is a single-phase lightning arrester.

    a. TPSTEL
    b. TPSCOAX
    c. TPSASA1
    d. TPSESA3

15. Siemens _____ is a three-phase lightning arrester.

    a. TPSTEL
    b. TPSCOAX
    c. TPSASA1
    d. TPSESA3

16. Siemens _____ provides lightning protection for equipment connected to telephone lines.

    a. TPSTEL
    b. TPSCOAX
    c. TPSASA1
    d. TPSESA3

17. Siemens _____ provides lightning protection for equipment connected to a TV cable.

    a. TPSASA1
    b. TPAESA3
    c. TPSTEL
    d. TPSCOAX

18. Point-of-use surge suppressors _____.

    a. are not needed if a point-of-entry SPD is used.
    b. are only needed for telephone or TV signal lines.
    c. are generally not needed
    d. are an important part of a whole-house surge protection strategy

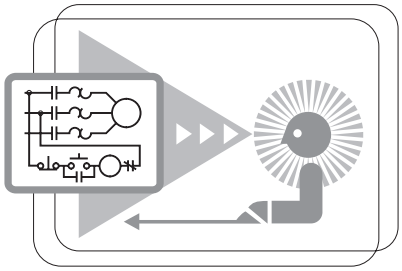
19. A good point-of-use surge protector _____.

    a. is essentially just a power strip
    b. provides visual indication that the surge protection circuitry is functional
    c. works better if connected to a long extension cord
    d. will not sacrifice itself in the event of a catastrophic failure

20. The need for surge protection in industrial and commercial power distribution systems is _____.

    a. even greater than for a home distribution system
    b. less than for a home distribution system
    c. about the same as for a home distribution system
    d. negligible

quickSTEP Online Courses



quickSTEP online courses are available at http://www.sea.siemens.com/step.

The quickSTEP training site is divided into three sections: Courses, Downloads, and a Glossary. Online courses include reviews, a final exam, the ability to print a certificate of completion, and the opportunity to register in the Sales & Distributor training database to maintain a record of your accomplishments.

From this site the complete text of all STEP courses can be downloaded in PDF format. These files contain the most recent changes and updates to the STEP courses.

A unique feature of the quickSTEP site is our pictorial glossary. The pictorial glossary can be accessed from anywhere within a quickSTEP course. This enables the student to look up an unfamiliar word without leaving the current work area.