SIEMENS

STEP 2000

Residential Surge Protection

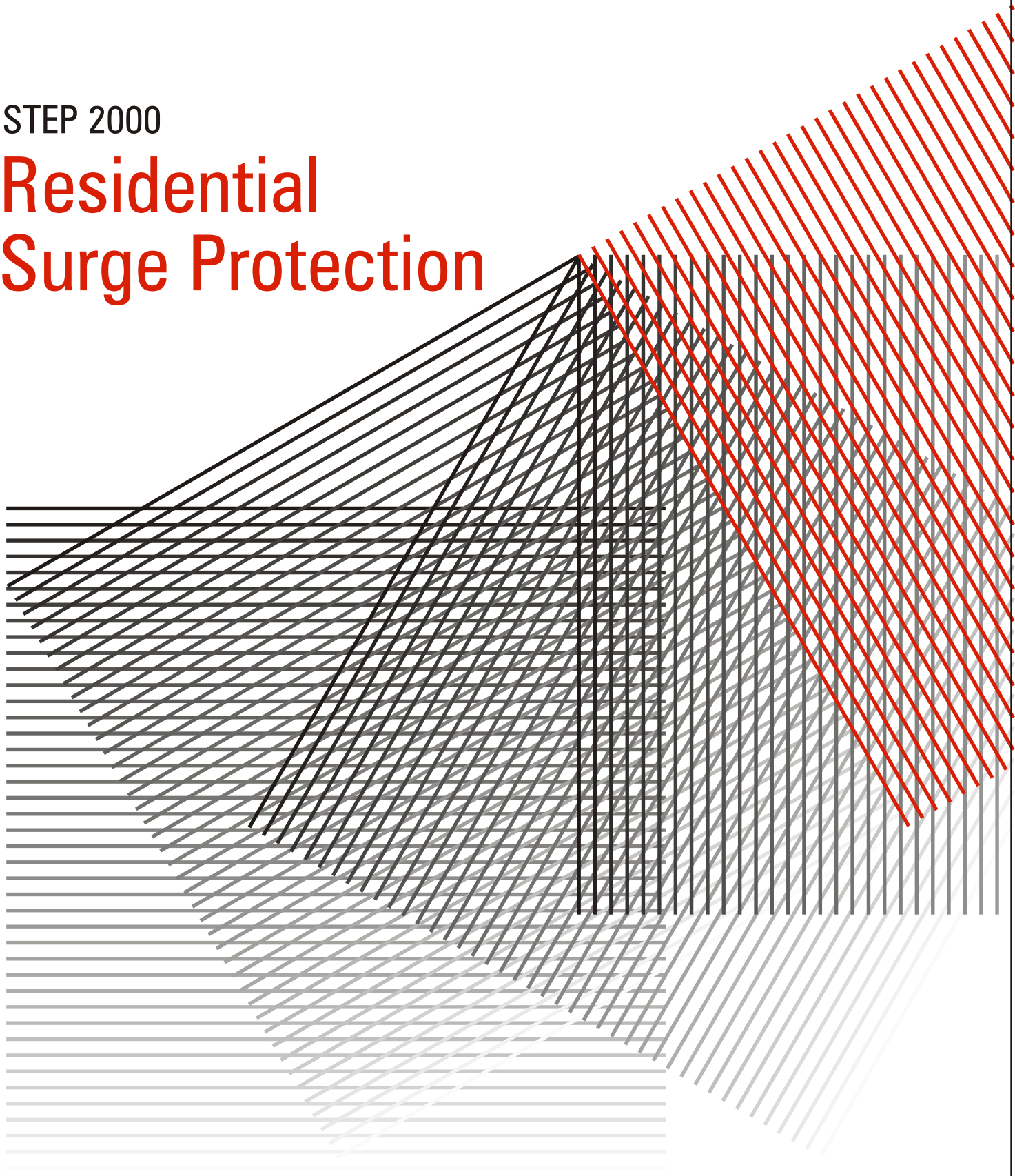


Table of Contents

Introduction 2
Siemens Residential Products 4
Residential Power Distribution 6
Power Quality 8
Sources of Voltage Surges 13
Surge Protection 16
Point-of-Entry Surge Protection 24
Point-of-Use Surge Protection 29
Whole-House Protection 35
Review Answers 43
Final Exam 44

Introduction

Welcome to another course in the STEP 2000 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 **Residential Surge Protection**.

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

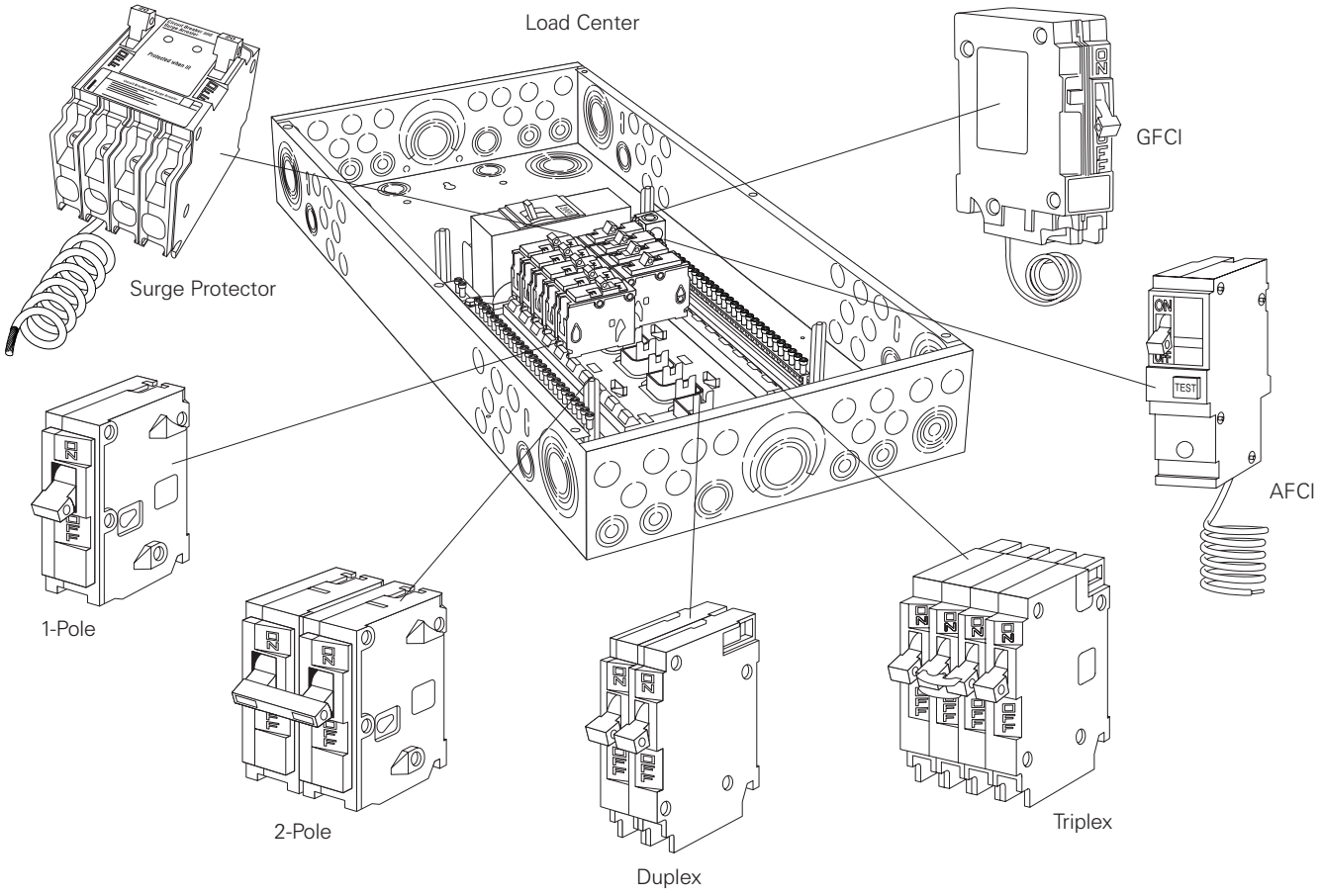
- Explain the role of surge protectors in the Siemens residential product line
- Explain the need for surge protection
- Describe the damaging effects of lightning strikes and other electrical surges to the home distribution system
- Explain the difference between point-of-use and point-of-entry surge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

This knowledge will help you better understand customer applications. In addition, you will be better prepared to discuss electrical products and systems with customers.

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.

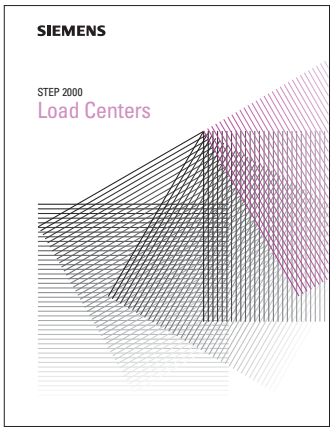
Siemens Residential Products

Siemens manufactures a variety of electrical distribution products for residential applications. Load centers and associated circuit breakers supply electrical power throughout the home.



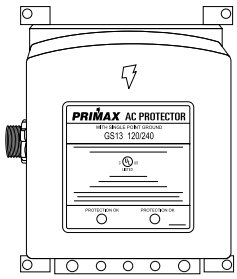
STEP 2000

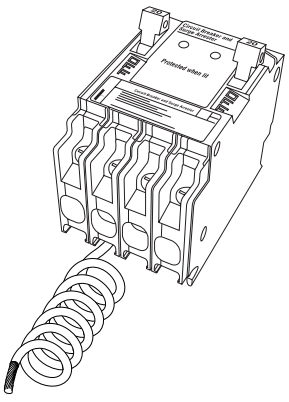
Load centers and their associated components are covered in the STEP 2000 course titled **Load Centers**. You should complete the load center course prior to completing **Residential Surge Protection**. Many of the concepts covered in **Load Centers** will give you a better understanding of the topics discussed in **Residential Surge Protection**.

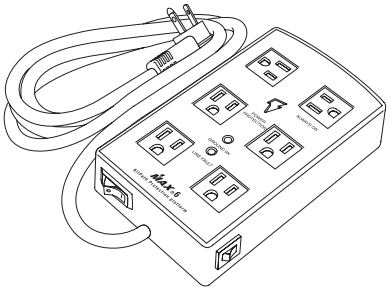


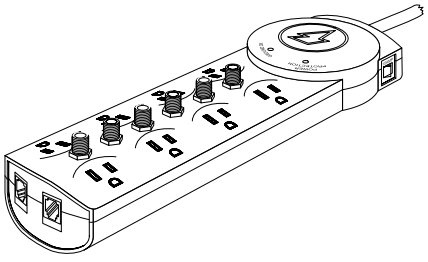
Surge Protection Products

Load centers and standard circuit breakers cannot protect a home from damaging electrical surges such as those produced by lightning. Siemens manufactures products specifically 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 surge protection products are the focus of this course.



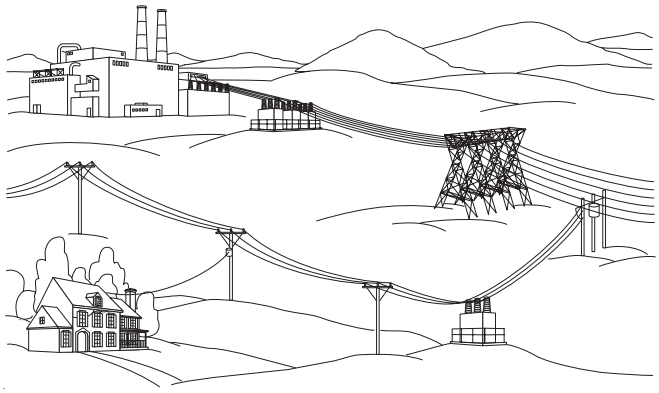






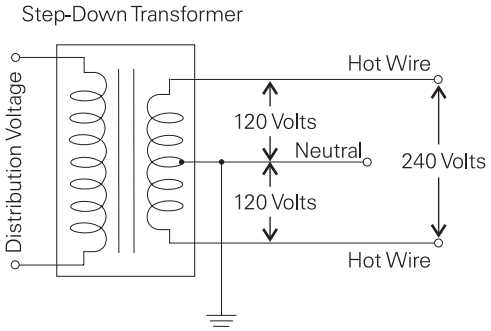
Residential Power Distribution

Power is generated at a power plant. The most efficient way to transmit this voltage to customers is to increase the voltage. Transmission voltage levels vary, depending on distance and the load it must supply. Transmission voltages are typically 60kV and above. In some cases transmission voltages can be in what is called the extra high voltage range (EHV) of 300 kV and above. Once transmission voltage reaches a local substation it is stepped down to a lower distribution voltage.



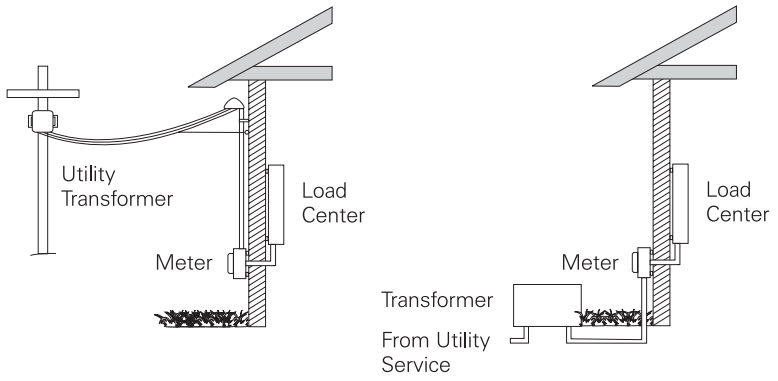
Power Supply

When the voltage reaches its final destination at a residential customer it is stepped down to 240 volts. The most common supply system used in residential applications today is a single-phase, three-wire supply 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.

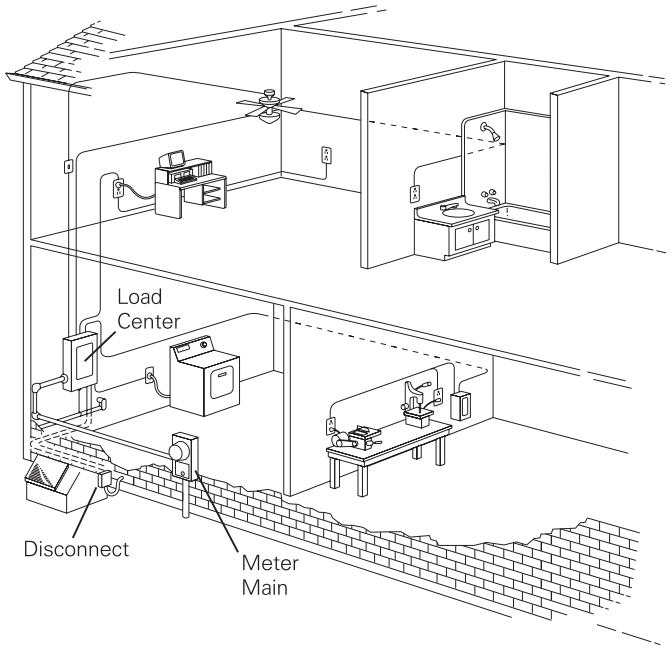


Overhead Service

Lateral Service

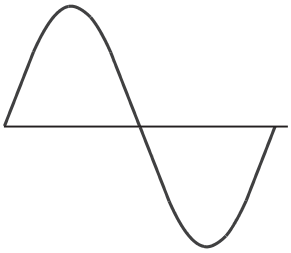
Distribution

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

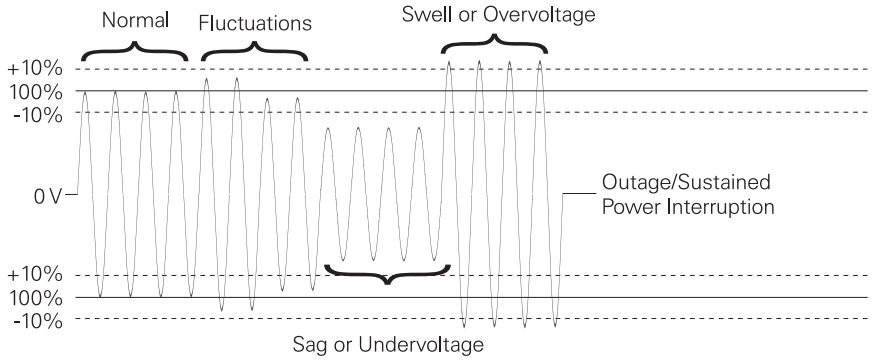
Voltage used in the home can be represented by a sine wave. Ideally a sine wave would be smooth and free of disturbances. However, even the best distribution systems are subject to changes in system voltage from time-to-time.



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 outside normal rated tolerance. An undervoltage is often referred to as a sag when the duration is two seconds or less. Undervoltages and sags can cause a computer to crash and confuse a digital clock.

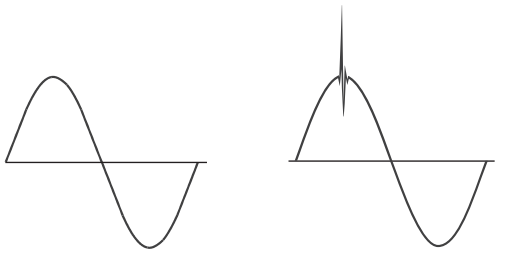
Overvoltages occur when voltage increases above normal rated tolerance. An overvoltage is referred to a swell when the disturbance lasts two seconds or less. Overvoltages and swells can upset sensitive electronic equipment, and cause damage in some cases.



*Based on Equipment with Normal Rated Voltage Tolerance of ±10%

Surges

Utility companies strive to maintain uniform voltage but disturbances from outside sources, such as lightning and short circuits, can appear on the sine wave in the form of surges. Surges can range from a few volts to several thousand volts and last from a few microseconds to a few milliseconds. While overvoltage and undervoltage can upset or damage sensitive electronic equipment, surges are far more destructive.



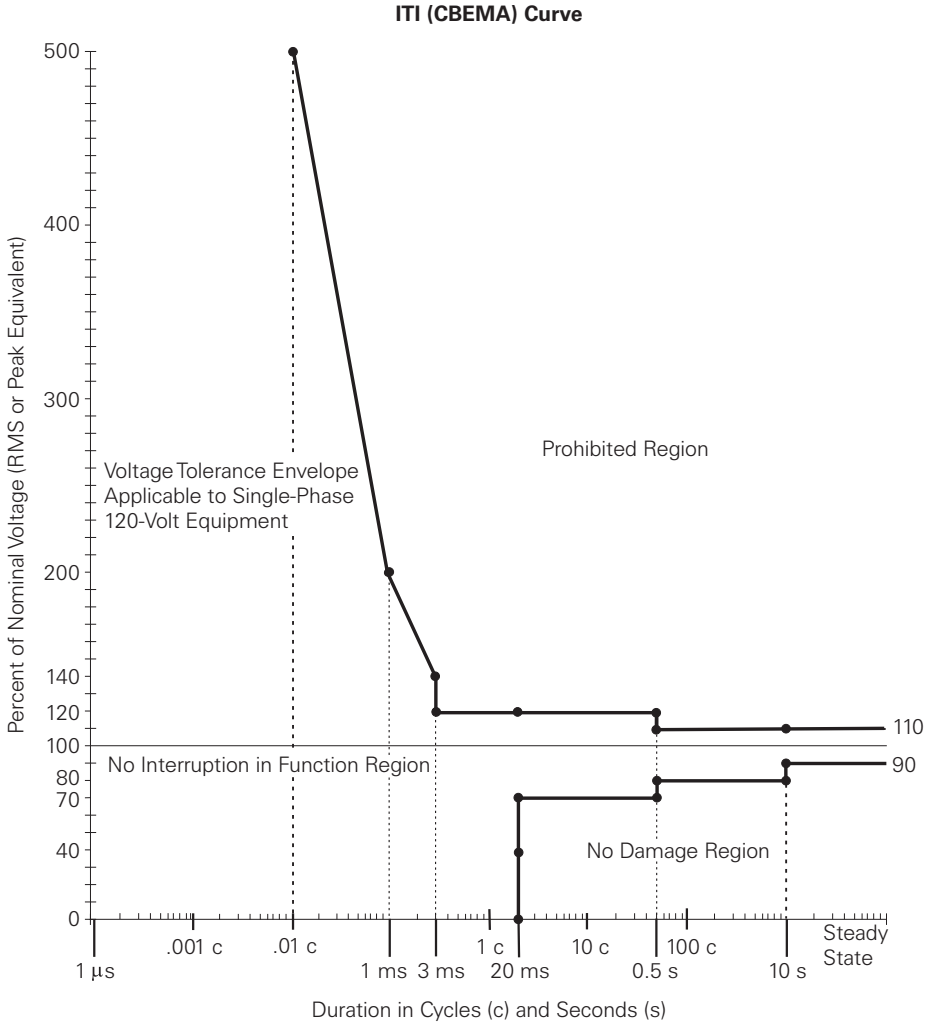
Normal Voltage Voltage with Surge Present

ITI (CBEMA)

Manufacturers of sensitive electronic devices, such as computers, strive to make equipment that will survive fluctuations in the power supply. The Information Technology Industry Council (ITI) was formerly known as the Computer Business Equipment Manufacturers Association (CBEMA). Working with the Department of Commerce, ITI published a set of guidelines for powering and protecting sensitive equipment. As the use of computers has grown, other organizations have made additional recommendations. The Institute of Electrical and Electronic Engineers (IEEE), for example, published engineering guidelines for the selection and application of emergency and standby power systems.

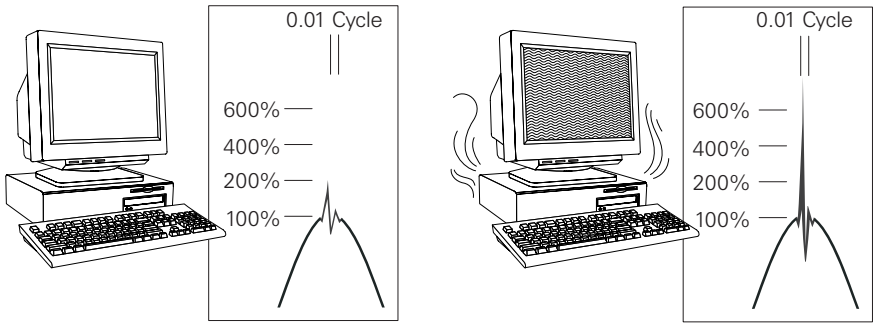
ITI (CBEMA) Curve

The ITI (CBEMA) curve was developed to be used as a guideline for manufacturers in designing power supplies for use with sensitive electronic equipment. The vertical axis of the graph is the percent of rated voltage applied to a circuit. The horizontal axis is the time the voltage is applied. Electronic equipment manufactured to these guidelines are expected to survive voltage spikes of short duration. However, voltage spikes that exceed either amplitude or duration of the voltage tolerance envelope will enter the prohibited region. Sensitive electronic equipment can be damaged when voltage spikes are severe enough to enter the prohibited region. In general, the greater the voltage spike or transient, the shorter the duration it can occur before equipment is damaged.



ITI (CBEMA) Curve used with permission of Information Technology Industry Council.

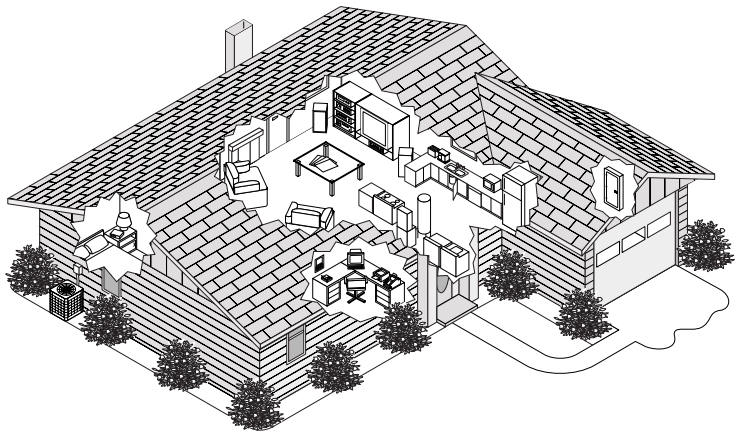
In spite of the utility company's effort to minimize voltage fluctuations and the manufacturer's efforts to protect equipment, home electronic equipment is still susceptible to damage anytime supply voltage exceeds the manufacturer's recommended tolerance. Sensitive electronic equipment is most vulnerable during overvoltage disturbances that exceed the voltage tolerance envelope of the ITI (CBEMA) curve, such as those caused by lightning or switching of loads on the distribution system.



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 just to keep the lights on. The typical home had relatively few items at risk.

Today's modern homes, however, are full of complex and sensitive electronic equipment. Family rooms have everything from a simple television to complex home entertainment systems with DVD players and surround sound. Home offices include computers, fax machines, printers, and telephone systems. Traditional kitchen and laundry appliances have been replaced with refrigerators, stoves, microwave ovens, and dishwashers that use electronic components. It takes as little as one surge to damage these sensitive electronic components.



Review 1

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

2. In a residential system there is 240 volts between the two hot wires. From either hot wire to neutral there is _____ volts.

3. Residential electrical service can come from an overhead utility transformer or from a _____ service run underground.

4. According to ITI (CBEMA), the _____ the voltage spike or curve, the shorter its duration can be before damage occurs.

5. Voltage spikes that exceed either amplitude or duration of the voltage tolerance envelope will enter the _____ region of the ITI (CBEMA) curve.