

Power Electronics and Network Interruption

Introduction

Power systems are critical to the functioning of modern society, providing electricity to homes, businesses, and industries. However, power systems are complex and interconnected, and they can be subject to a variety of disturbances that can cause interruptions of service. These interruptions can have a significant impact on the economy and on people's lives.

One of the most common causes of power interruptions is short circuits, which can occur when two conductors come into contact with each other. Short circuits can cause large amounts of current to flow through the power system, which can damage equipment and lead

to outages. Other causes of power interruptions include lightning strikes, storms, and human error.

Power system engineers have developed a variety of devices and techniques to protect power systems from interruptions. These include circuit breakers, fuses, and surge arresters. Circuit breakers are designed to interrupt the flow of current in the event of a short circuit, while fuses are designed to melt and open the circuit in the event of an overload. Surge arresters are designed to protect equipment from damage caused by lightning strikes and other high-voltage surges.

In addition to these devices, power system engineers also use a variety of protection schemes to help prevent and mitigate the effects of power interruptions. These schemes include overcurrent protection, overvoltage protection, undervoltage protection, frequency protection, and differential protection.

Power system restoration is a complex process that involves a number of steps. First, the cause of the

interruption must be identified and corrected. Then, the power system must be re-energized and the load restored. This process can take several hours or even days, depending on the severity of the interruption.

The future of power systems is likely to see a number of changes, including the increasing use of distributed generation, renewable energy sources, and energy storage technologies. These changes will require new approaches to power system protection and restoration.

Book Description

Power Electronics and Network Interruption provides a comprehensive overview of the fundamental concepts, devices, and techniques used in power electronics and network interruption. This book is designed to serve as a valuable resource for engineers, researchers, and students in the field of electrical power engineering.

The book begins with an introduction to the basic concepts of power electronics, including power semiconductor devices, power converters, and their applications. It then covers the various types of network interruptions, their causes, and their effects on power systems. The book also discusses the different types of protection devices and schemes used to protect power systems from interruptions, as well as the methods used to restore power after an interruption.

Key Features:

- Provides a comprehensive overview of the fundamental concepts, devices, and techniques used in power electronics and network interruption
- Covers a wide range of topics, including power semiconductor devices, power converters, network interruptions, protection devices, and power system restoration
- Includes numerous illustrations, examples, and case studies to help readers understand the concepts and applications
- Written by a team of experienced engineers and researchers

This book is an essential resource for engineers, researchers, and students in the field of electrical power engineering.

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Chapter 1: Power Electronics Fundamentals

Basic Concepts of Power Electronics

Power electronics is a branch of electrical engineering that deals with the control and conversion of electric power. It is a relatively new field, but it has already had a major impact on many industries, including the automotive, aerospace, and telecommunications industries.

One of the most important concepts in power electronics is the power semiconductor device. Power semiconductor devices are able to control the flow of current and voltage in a circuit, and they are used in a wide variety of applications, such as power converters, inverters, and rectifiers.

Another important concept in power electronics is the power converter. Power converters are used to convert one form of electrical power to another. For example, a

power converter can be used to convert AC power to DC power, or vice versa.

Power electronics is a complex and challenging field, but it is also a very rewarding one. Power electronics engineers are responsible for designing and developing the devices and systems that make it possible to control and convert electric power. These devices and systems are used in a wide variety of applications, and they play a vital role in the modern world.

Applications of Power Electronics

Power electronics is used in a wide variety of applications, including:

- **Adjustable-speed drives:** Power electronics is used to control the speed of electric motors. This is used in a variety of applications, such as electric vehicles, industrial machinery, and home appliances.

- **Power supplies:** Power electronics is used to convert AC power to DC power. This is used in a variety of applications, such as computers, televisions, and cell phones.
- **Inverters:** Power electronics is used to convert DC power to AC power. This is used in a variety of applications, such as solar power systems, wind power systems, and electric vehicles.
- **Rectifiers:** Power electronics is used to convert AC power to DC power. This is used in a variety of applications, such as battery chargers, welding machines, and electroplating equipment.

Power electronics is a rapidly growing field, and it is expected to continue to play a major role in the development of new technologies in the years to come.

Chapter 1: Power Electronics Fundamentals

Power Semiconductor Devices

Power semiconductor devices are essential components of modern power electronics systems. They are used to control and convert electrical power, and they play a vital role in a wide range of applications, including power generation, transmission, and distribution, as well as industrial and consumer electronics.

Power semiconductor devices are typically made from materials such as silicon, gallium arsenide, and silicon carbide. These materials have a number of properties that make them well-suited for use in power electronics applications, including high electrical conductivity, low thermal resistance, and the ability to withstand high voltages and currents.

There are a variety of different types of power semiconductor devices, each with its own unique

characteristics and applications. Some of the most common types of power semiconductor devices include:

- **Diodes:** Diodes are the simplest type of power semiconductor device. They allow current to flow in only one direction, and they are used in a variety of applications, including rectification, freewheeling, and voltage clamping.
- **Transistors:** Transistors are more complex than diodes, and they can be used to amplify or switch electrical signals. Transistors are used in a wide range of applications, including power amplifiers, inverters, and converters.
- **Thyristors:** Thyristors are a type of power semiconductor device that can be turned on and off by a control signal. Thyristors are used in a variety of applications, including power control, lighting control, and motor control.

Power semiconductor devices are essential components of modern power electronics systems. They are used to control and convert electrical power, and they play a vital role in a wide range of applications.

The Dance of Light and Shadows

The history of power semiconductor devices is a story of innovation and progress. In the early days of power electronics, vacuum tubes were used to control and convert electrical power. However, vacuum tubes were large, inefficient, and unreliable. In the 1950s, the invention of the transistor revolutionized the field of power electronics. Transistors were smaller, more efficient, and more reliable than vacuum tubes. This led to the development of a wide range of new power electronics applications.

In the 1960s, the invention of the thyristor further expanded the capabilities of power electronics systems. Thyristors are capable of handling higher voltages and currents than transistors. This made them ideal for use

in a variety of industrial applications, such as motor control and power conversion.

In the 1970s, the development of power MOSFETs (metal-oxide-semiconductor field-effect transistors) led to a new generation of power electronics devices. Power MOSFETs are smaller, faster, and more efficient than thyristors. This made them ideal for use in a wide range of applications, including personal computers, telecommunications equipment, and automotive electronics.

Today, power semiconductor devices are used in a wide range of applications, from everyday consumer electronics to large-scale industrial systems. They are essential components of the modern world, and they play a vital role in the generation, transmission, and distribution of electrical power.

Chapter 1: Power Electronics

Fundamentals

Power Converters

Power converters are electronic devices that convert electrical energy from one form to another. They are used in a wide variety of applications, including power supplies, motor drives, and renewable energy systems.

There are many different types of power converters, each with its own unique characteristics and applications. Some of the most common types of power converters include:

- **AC-DC converters:** These converters convert alternating current (AC) electricity to direct current (DC) electricity. They are used in a variety of applications, including power supplies for electronic devices, battery chargers, and motor drives.

- **DC-AC converters:** These converters convert direct current (DC) electricity to alternating current (AC) electricity. They are used in a variety of applications, including inverters for solar and wind power systems, and variable frequency drives for motor control.
- **DC-DC converters:** These converters convert direct current (DC) electricity from one voltage level to another. They are used in a variety of applications, including power supplies for electronic devices, battery chargers, and voltage regulators.

Power converters are essential components of many modern electronic systems. They play a critical role in the efficient and reliable operation of these systems.

Applications of Power Converters

Power converters are used in a wide variety of applications, including:

- **Power supplies:** Power converters are used in power supplies to convert AC electricity from the grid to DC electricity that can be used by electronic devices.
- **Motor drives:** Power converters are used in motor drives to control the speed and torque of electric motors.
- **Renewable energy systems:** Power converters are used in renewable energy systems to convert the DC electricity generated by solar panels and wind turbines to AC electricity that can be used by the grid.
- **Electric vehicles:** Power converters are used in electric vehicles to convert the DC electricity stored in the battery to AC electricity that can be used to power the electric motor.

Power converters are essential components of many modern electronic systems. They play a critical role in the efficient and reliable operation of these systems.

This extract presents the opening three sections of the first chapter.

Discover the complete 10 chapters and 50 sections by purchasing the book, now available in various formats.

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