DOWNLOAD PDF BASIC ELECTRICITY AND POWER SUPPLIES

Chapter 1 : How to Understand Electricity: Watts, Amps, Volts, and Ohms | Owlcation

Basic Electrical Safety for the DIY Consumer Though electricity is a great benefit to our world, it can also be extremely destructive when things go wrong. Here are some basic tips for performing common electrical installation tasks.

Adapted from Understanding Electricity In order to understand how electronic circuits work, and how to use them to build physical interfaces to digital systems using microcontrollers, there are some basic terms, relationships, and components that you need to know about. What follows is a brief introduction to those terms. An electrical circuit is made up of two elements: We build electrical circuits to do work, or to sense activity in the physical world. Switches, knobs, light and motion sensors all fit in this category. Actuators are components that convert electrical energy into other forms. Light bulbs, motors, LEDs, and heaters are all actuators. For example, a microphone changes sound pressure waves in the air to a changing electrical voltage. This process of changing one energy into another is called transduction, and devices that do it are called transducers. Much of the technical work of physical computing is about figuring out what forms of energy a person is generating, and what kind of transducer you can buy or build to read that energy. It is measured in Volts. Current is a measure of the magnitude of the flow of electrons through a particular point in a circuit. It is measured in Amperes, or Amps. It is measured in Ohms. To understand the relationship between voltage, current, and resistance, imagine an avalanche of snow on a mountain. The amount of snow and rocks in the avalanche is analogous to the current. And the steepness of the mountain is analogous to the resistance: Below is a very basic circuit, consisting of a lamp, a pushbutton, and a battery. The battery is the source and the lamp is the load. The electrical energy coming from the battery is converted to heat and light energy by the light bulb. All of the energy is used up in the process. AA Battery connected to a button switch and lamp in series There are two common kinds of circuits: In a DC circuit, current always flows one direction. Schematic diagrams are diagrams of circuits that represent the electrical relationships between the components in the circuit. Below are two schematics of the light bulb circuit above. In both, the important parts to note are the functional components, namely the lamp and the switch, and the power and ground terminals. In the diagram on the right, the whole circuit is shown as a loop, with the battery marked V1 to the left of the loop. In the diagram on the left, the circuit is not shown as a loop. Instead, the power source is at the top, and the point of lowest energy, or ground, is at the bottom. This diagram shows the flow of energy from the top of the diagram to the bottom. Intro to Schematics Two schematics of a 1. Many of the typical symbols are shown below. Components Conductors are materials through which electrical current moves freely. Insulators are materials which prevent the flow of electricity. Resistors resist, but do not totally block, the flow of electricity. They are used to control the flow of current. They are symbolized like this: Four resistor types, from left to right: Resistors, variable resistors, and photocells ; Potentiometer Capacitors store up electricity while current is flowing into them, then release the energy when the incoming current is removed. Sometimes they are polarized, meaning current can only flow through them in a specific direction, and sometimes they are not. If a capacitor is polarized, it will be marked as such on the diagram. Capacitors are also rated by their maximum voltage. Capacitors are symbolized like this: Schematic symbols of a polarized capacitor and a non-polarized capacitor Related video: Capacitors Diodes permit the flow of electricity in one direction, and block it in the other direction. Because of this, they can only be placed in a circuit in one direction. Diodes are symbolized like this:

Chapter 2 : Electronic Circuit Symbols - Components and Schematic Diagram Symbols

Grid engineers plan for this and rapidly activate special power stations that can boost electricity supply to the grid quickly to meet this demand. For example, during the Royal Wedding in the United Kingdom, the electricity demand increased by 2,, watts which is the equivalent of nearly one million kettles being turned on at the same time.

The ampere, often shortened to "amp" or A, is the base unit of electric current in the International System of Units. Electricity consists of the flow of electrons through a conductor, for example, an electric wire or cable. We measure the rate of flow of electricity as an electric current just as we think of the rate of flow of water in a river as the river current. The letter used to represent current in an equation is I. Electric current is measured in Amperes, shortened to Amps or simply the letter A. A current of 2 Amps can be written as 2A. The bigger the current the more electricity is flowing. Ohms are the base unit of resistance in an electrical system. The ohm is defined as "an electrical resistance between two points of a conductor when a constant potential difference of one volt, applied to these points, produces in the conductor a current of one ampere, the conductor not being the seat of any electromotive force. In our battery diagram above, if we remove the bulb and reconnected the wire so the battery was short circuited, the wire and battery would get very hot and the battery would soon be flat because there would be virtually no resistance in the circuit. Without any resistance, a huge electrical current would flow until the battery was empty. Once we add a bulb to the circuit, resistance is created. There is now a local "blockage" or narrowing of the pipe, per our water pipe analogy where the current experiences some resistance. This greatly reduces the current flowing in the circuit, so the energy in the battery is released more slowly. In other words, the current carries stored energy from the battery to the bulb, where it is turned into light and heat energy. The image above shows a light bulb as the main cause of electrical resistance. A watt is the base unit of power in electrical systems. It can also be used in mechanical systems. It measures how much energy is released per second in a system. In our battery diagram, the size of both the voltage and the current in the bulb determine how much energy is released. In the diagram above, the light bulb would get brighter as the power, measured in watts, increases. We can calculate the power released in the bulb, and of the electrical system as a whole, by multiplying the voltage by the current. So, to calculate watts, the following formula is used. How to Calculate with Watts, Amps, Volts, and Ohms If you want to do an electrical calculation involving voltage, current, resistance, or power, reference the formulae circle below. For example, we can calculate the power in watts by referencing the yellow area in the circle. This formulae circle is very useful for many electrical engineering tasks. Keep it handy the next time you are dealing with an electrical system. Below are some example equations that are solved using the formulae. What is the resistance in an electrical system with a voltage of V and a current of 5A?

Chapter 3 : Power Supply Basics

Power supplies in recent times have greatly improved in reliability but, because they have to handle considerably higher voltages and currents than any or most of the circuitry they supply, they are often the most susceptible to failure of any part of an electronic system.

These are approximate values for the cables typically used in theatre. Other types and methods may be rated differently. Connectors Connectors allow temporary connections to be made and broken quickly and safely. Male connectors have exposed contacts. Female connectors have internal contacts inside an insulating shell with holes for plugging the two together. The male is always on the load side of a connection, the female on the line side; "the female has the power! The standard configuration, two parallel blades and a U-ground, is rated at 15 a. Usually the"hot" terminal is copper colored and the "neutral" is silver colored, and the "ground" is green. Most common dedicated stage connector. Rated at 20 a. The center pin is "ground", the outside pin nearest the ground is the "neutral", and the other is the "hot". One blade has a tab bent towards center; that is the ground. The slightly larger blade with silver screw is "neutral", and the small blade with the copper screw is "hot". Comes in colors to indicate which leg is which. Rated at over a. In most common size on stage. Also available in a mini-cam size for 1 cable, rated at a. Y-cord with one male and two female connectors, for plugging two devices into one outlet. Used to plug a device into a different type of outlet. Direct Current is the type of electricity supplied by a battery. One terminal is positively charged, the other negatively charged, and electricity flows from one to the other, always in the same direction. However, while it is simple to make and control, DC does not travel well over long distances; it gets used up by the resistance in the transmission lines, and is gone before it gets to where it is needed. Alternating Current also has a positive and a negative terminal, but the polarity and the direction of flow alternates many times per second. In the United States, electricity alternates polarity times per second, or 60 full cycles per second, i. AC can travel well over long distances, and so it the choice for power distribution lines. There is no difference between amps or volts between AC or DC. Some devices can ONLY operate on one type of system or the other, but otherwise a volt is a volt. Road shows and concert tours typically bring in their own lighting and sound rigs, which means their dimmer racks and sound distribution boxes must be tied in to a power source able to supply large amounts of current. Power is usually generated at a distance from where it is used. It is supplied as 3-phase power at very high voltages. This allows many kilowatts to flow through fairly small conductors because amperage is effectively small. There are 3 hots, each degrees out-of-phase with the next when their sine waves are plotted against each other, hence the term "3 phase". There is no neutral. This configuration is called Delta, and is the same type at much lower voltages use to run 3-phase motors. The power level is brought down through a series of substations. At each step transformers reduce the voltage and increase the amperage until it reaches the line transformers outside the building. At that point, the Delta service is converted to a Wye service, and is brought into the building at the "service entrance". The Wye service has the same three hot legs, plus an electrical neutral created at the transformer. By this time in either Wye or Delta, the line voltage has been brought down to where each hot terminal is volts above earth potential, called "ground", and in the case of a Wye service, each hot is also v. However, due to the geometry of the hot phases, there is a difference of v. This is different from the Single-phase system found in some older theatres, and commonly in private homes. In this service two hots are drawn from each end of one phase of a Delta hence Single phase , and a neutral created at the transformer. These are brought into the building at the service entrance. Between either hot and the neutral there is v. However, there is v. Single phase is rarely found in industry, including theatre, because it is not as efficient for supplying the large amounts of power needed. At the service entrance the Neutral of the Wye or of a single phase system must be bonded to a grounding system buried in the earth outside. Tying in Power When in comes to permanent commercial wiring, the Electrical Code requires that only licensed electricians do the work. However, the Code has an exemption for the Entertainment industry. The key phrase is "Qualified personnel". Only stagehands have who been trained to do so are allowed to make hookups. The Code also grants another exemption to theatre not found in other industries. Theatre is allowed to use single conductors and connectors that is feeder cable with Camlock connectors. But as it is VITAL that the connections be made in the proper order, only trained and qualified personnel are permitted to make those connections. The distribution box where temporary equipment is tied in to the electrical supply is called a Company Switch, a Distro, or a "Bull switch". Inside the distro are lugs for connecting the wires. There are three lugs for connecting the "hot" wires, each of which is connected to a fuse or a circuit breaker. There is also a lug for the Neutral, which does NOT have a fuse or breaker, which MUST be marked white or light grey, and a lug for the Ground wire, which is usually bolted directly to the metal distro box. According to Code, the box and its conduit are suppose to be grounded, but if they are not, a separate grounding wire, marked with green, must be run to the box. There will also be an access hole through which the temporary wires are passed. The hole should have a bushing to prevent the box from cutting through the insulation of the wire. The proper procedure MUST be followed when connecting the cables, or an unsafe situation can occur. Lay out the feeder tails so they are ready to be connected. Code requires the use tails which can be disconnected within 10 feet of the distro box. The tails should NOT be connected to the feeder cables yet. Turn off the bull switch if it is not already off the box will not open if the switch is on unless the box is broken. Insert the Green tail wire and fasten securely to the ground lug. Insert the White wire and fasten to the Neutral lug. Insert the Hot tails one at a time and attach them securely to the three "hot" terminals, the ones attached to the fuses or breakers. These wires are usually marked with Black, Red, and Blue. It does not really matter at this point which wire is connected to which hot terminal, but the convention is usually in the order: Close the box and make sure the connectors on the tails are clear. Turn on the Bull switch. Test each wire with a meter by carefully inserting the leads from the meter into the open feeder connectors. Between Neutral and Ground: Between each Hot wire and Neutral: Between each Hot wire and the Ground: Between each Hot and any other Hot: If everything checks OK, turn off the Bull switch and inform the road electrician. Connect them with the power turned off but always treat them as though the power is on anyway. Someday it may be! The equipment may try to close a circuit through two hots and put v. Many rigging motors are three-phase motor, using three hots and NO neutral. Occasionally a motor may run backwards. In that case, simply swap any two hots and the motor will run the other way.

Chapter 4 : Electronics - Mobile Friendly

A tutorial on the basics of resistance, resistors, and Ohm's law which describes the relationship between voltage, current and resistance. I also show you how to build a simple resistor + LED circuit.

In this section Power supply specifications Power supplies or power supply units, PSU, form an essential part of very many items of electronics equipment. The most common form takes in AC power from the mains supply and delivers a DC voltage to the item requiring power. Accordingly power supplies are widely used in a variety of forms - some large supplying high levels of current, other power supplies, much smaller providing lower levels of power. Power supply basics The aim of a DC power supply is to provide the required level of DC power to the load using an AC supply at the input. Different applications require different attributes, but more often than not these days DC power supplies provide an accurate output voltage - this is regulated using electronic circuitry so that it provides a constant output voltage over a wide range of output loads. In most power supplies there are number of different elements. These may not all be present in every design. The input transformer is used to transform the incoming line voltage down to the required level for the power supply. Typically the input transformer provides a step down function. It also isolates the output circuit from the line supply. The power supply rectifier converts the incoming signal from an AC format into raw DC. Either half wave or more commonly full wave rectifiers may be used as they make use of both halves of the incoming AC signal. The raw DC from the rectifier is far from constant falling to zero when the AC waveform crossed the zero axis, and then rising to its peak. The addition of a reservoir capacitor here fills in the troughs in the waveform, enabling the next stage of the power supply to operate. Large value capacitors are normally used within this stage. This stage of the power supply takes the smoothed voltage and uses a regulator circuit to provide a constant output virtually regardless of the output current and any minor fluctuations in the input level. Power supply regulation There are two basic forms of power supply used in electronics equipment: This form of power supply was the only type used many years ago. It simply consisted of a rectifier section and this was followed by capacitor or capacitor and inductor smoothing. There was no regulation to steady the voltage. If a large current was drawn the voltage would fall as a result of the resistive losses, and also the smoothing would not be as effective and the level of hum would rise. As transistor circuitry became more commonplace, regulated power supplies became more common. Today they are almost universally used. They typically incorporate a voltage reference, and the output voltage is compared to this and altered accordingly by control circuitry within the regulated power supply. In addition to this, regulated power supplies may be further subdivided: Linear regulated power supply: Linear regulated power supplies use an analogue approach. A series element - a semiconductor transistor or FET - is controlled allow the correct voltage at the output for any current within the operating range. Note on Linear Power Supplies: Linear power supplies are widely used for applications where low noise and ripple are required. As the name suggests, they use linear technology - typically a series linear regulator element to drop voltage. As such they dissipate power, but without any switching mode, they are able to offer high levels of eprformance Click on the link for a Linear power supply tutorial Switching regulator power supply: The switching regulator format for a power supply uses a large output reservoir capacitor. A series element - a transistor or FET - is switched on and off to keep the voltage on the capacitor within the required limits. Note on Switch Mode Power Supplies: Switch mode power supplies and switch mode regulators have many advantages in terms of efficiency, size and weight. Their design can be more involved than might be thought at first. Yet with a good understanding, these switch mode power supplies, SMPSs, switch mode regulators and switch mode controllers can be successfully designed and built.. Click on the link for a Switch Mode Power Supply tutorial Each type of power supply regulation technique has its own advantages and disadvantages. As a result different types of regulator are used in different applications, although with technology improving, switching regulators are being used increasingly.

Chapter 5 : Electric power system - Wikipedia

1 Power Supplies Chapter 7 Overview â€¢ In this chapter, you will learn to - Explain the basics of electricity - Provide proper power and cooling to the PC - Troubleshoot electrical problems.

Functional[edit] Power supplies are categorized in various ways, including by functional features. For example, a regulated power supply is one that maintains constant output voltage or current despite variations in load current or input voltage. Conversely, the output of an unregulated power supply can change significantly when its input voltage or load current changes. Adjustable power supplies allow the output voltage or current to be programmed by mechanical controls e. An adjustable regulated power supply is one that is both adjustable and regulated. An isolated power supply has a power output that is electrically independent of its power input; this is in contrast to other power supplies that share a common connection between power input and output. Packaging[edit] Power supplies are packaged in different ways and classified accordingly. A bench power supply is a stand-alone desktop unit used in applications such as circuit test and development. Open frame power supplies have only a partial mechanical enclosure, sometimes consisting of only a mounting base; these are typically built into machinery or other equipment. Rack mount power supplies are designed to be secured into standard electronic equipment racks. An integrated power supply is one that shares a common printed circuit board with its load. Power conversion method[edit] Power supplies can be broadly divided into linear and switching types. Linear power converters process the input power directly, with all active power conversion components operating in their linear operating regions. In switching power converters, the input power is converted to AC or to DC pulses before processing, by components that operate predominantly in non-linear modes e. Power is "lost" converted to heat when components operate in their linear regions and, consequently, switching converters are usually more efficient than linear converters because their components spend less time in linear operating regions. Depending on its design, a DC power supply may be powered from a DC source or from an AC source such as the power mains. Such power supplies will employ a transformer to convert the input voltage to a higher or lower AC voltage. A rectifier is used to convert the transformer output voltage to a varying DC voltage, which in turn is passed through an electronic filter to convert it to an unregulated DC voltage. The filter removes most, but not all of the AC voltage variations; the remaining AC voltage is known as ripple. In some applications, high ripple is tolerated and therefore no filtering is required. For example, in some battery charging applications it is possible to implement a mains-powered DC power supply with nothing more than a transformer and a single rectifier diode, with a resistor in series with the output to limit charging current. Switched-mode power supply[edit] Main article: The resulting DC voltage is then switched on and off at a high frequency by electronic switching circuitry, thus producing an AC current that will pass through a high-frequency transformer or inductor. After the inductor or transformer secondary, the high frequency AC is rectified and filtered to produce the DC output voltage. If the SMPS uses an adequately insulated high-frequency transformer, the output will be electrically isolated from the mains; this feature is often essential for safety. Switched-mode power supplies are usually regulated, and to keep the output voltage constant, the power supply employs a feedback controller that monitors current drawn by the load. The switching duty cycle increases as power output requirements increase. SMPSs often include safety features such as current limiting or a crowbar circuit to help protect the device and the user from harm. PC power supplies often provide a power good signal to the motherboard; the absence of this signal prevents operation when abnormal supply voltages are present. Some SMPSs have an absolute limit on their minimum current output. In a no-load condition the frequency of the power slicing circuit increases to great speed, causing the isolated transformer to act as a Tesla coil , causing damage due to the resulting very high voltage power spikes. Switched-mode supplies with protection circuits may briefly turn on but then shut down when no load has been detected. A very small low-power dummy load such as a ceramic power resistor or watt light bulb can be attached to the supply to allow it to run with no primary load attached. The switch-mode power supplies used in computers have historically had low power factors and have also been significant sources of line interference due to induced power line harmonics and transients. In simple switch-mode power supplies, the input stage may distort the line voltage waveform, which can adversely affect other loads and result in poor power quality for other utility customers , and cause unnecessary heating in wires and distribution equipment. Furthermore, customers incur higher electric bills when operating lower power factor loads. To circumvent these problems, some computer switch-mode power supplies perform power factor correction, and may employ input filters or additional switching stages to reduce line interference. Linear regulator[edit] The function of a linear voltage regulator is to convert a varying DC voltage to a constant, often specific, lower DC voltage. In addition, they often provide a current limiting function to protect the power supply and load from overcurrent excessive, potentially destructive current. A constant output voltage is required in many power supply applications, but the voltage provided by many energy sources will vary with changes in load impedance. Furthermore, when an unregulated DC power supply is the energy source, its output voltage will also vary with changing input voltage. To circumvent this, some power supplies use a linear voltage regulator to maintain the output voltage at a steady value, independent of fluctuations in input voltage and load impedance. Linear regulators can also reduce the magnitude of ripple and noise on the output voltage. AC power supplies[edit] An AC power supply typically takes the voltage from a wall outlet mains supply and uses a transformer to step up or step down the voltage to the desired voltage. Some filtering may take place as well. In some cases, the source voltage is the same as the output voltage; this is called an isolation transformer. Other AC power supply transformers do not provide mains isolation; these are called autotransformers ; a variable output autotransformer is known as a variac. Other kinds of AC power supplies are designed to provide a nearly constant current , and output voltage may vary depending on impedance of the load. In cases when the power source is direct current, like an automobile storage battery , an inverter and step-up transformer may be used to convert it to AC power. Portable AC power may be provided by an alternator powered by a diesel or gasoline engine for example, at a construction site, in an automobile or boat, or backup power generation for emergency services whose current is passed to a regulator circuit to provide a constant voltage at the output. Some kinds of AC power conversion do not use a transformer. If the output voltage and input voltage are the same, and primary purpose of the device is to filter AC power, it may be called a line conditioner. If the device is designed to provide backup power, it may be called an uninterruptable power supply. In modern use, AC power supplies can be divided into single phase and three phase systems.

Chapter 6 : Teaching Some Basic Concepts of Electricity

Basic electricity: Electricity is the flow of electrons from one place to another. Electrons can flow through any material, but does so more easily in some than in others.

Electrical Power Systems in Buildings Electrical Power Systems in Buildings This article covers electrical distribution systems in buildings at a very basic level. We will discuss the general principles for how electricity is moved from the utility lines to a convenience outlet in a room. The system components vary depending on the size of the building so we will address systems for small and large buildings. Electricity from the Power Company Electric utilities transmit power from the power plant most efficiently at very high voltages. In the United States, power companies provide electricity to medium or large buildings at 13, volts For small commercial buildings or residential customers, power companies lower the voltage with a transformer on a power pole or mounted on the ground. From there, the electricity is fed through a meter and into the building. Power Distribution in Small Buildings Small commercial or residential buildings have a very simple power distribution system. The utility will own the transformer, which will sit on a pad outside the building or will be attached to a utility pole. The transformer reduces the voltage from After leaving the meter, the power is transmitted into the building at which point all wiring, panels, and devices are the property of the building owner. Wires transfer the electricity from the meter to a panel board, which is generally located in the basement or garage of a house. In small commercial buildings, the panel may be located in a utility closet. The panel board will have a main service breaker and a series of circuit breakers, which control the flow of power to various circuits in the building. Each branch circuit will serve a device some appliances require heavy loads or a number of devices like convenience outlets or lights. Ad - Article Continues Below Power Distribution in Large Buildings Large buildings have a much higher electrical load than small buildings; therefore, the electrical equipment must be larger and more robust. Large building owners will also purchase electricity at high voltages in the US, This transformer can be mounted on a pad outside the building or in a transformer room inside the building. The electricity is then transmitted to switchgear. The role of the switchgear is to distribute electricity safely and efficiently to the various electrical closets throughout the building. The equipment has numerous safety features including circuit breakers, which allow power to be disrupted downstream - this may occur due to a fault or problem, but it can also be done intentionally to allow technicians to work on specific branches of the power system. It should be noted that very large buildings or buildings with complex electrical systems may have multiple transformers, which may feed multiple pieces of switchgear. We are keeping this article simple by sharing the basic concepts. The electricity will leave the switchgear and travel along a primary feeder or bus. The bus or feeder is a heavy gauge conductor that is capable of carrying high amperage current throughout a building safely and efficiently. The bus or feeder is tapped as needed and a conductor is run to an electric closet, which serves a zone or floor of a building. That transformer will feed a branch panel, which controls a series of branch circuits that cover a portion of the building. Each branch circuit covers a subset of the electrical needs of the area - for instance: Help make archtoolbox better. If you found an error or out of date information in this article, please let us know.

Chapter 7 : Electricity: the Basics â€“ ITP Physical Computing

Understanding Basic Electrical Theory. No single discovery has affected our lives, our culture and our survival more than electricity. Electricity is everywhere; it lights our way, cooks our food and can even brush your teeth.

Just read the brief blocks of text, view the videos, and check out some of the screened internet links. This is the easiest, fastest way to learn basic electronics. No sign-up requirements and it is free. The menu table above provides easy access to many interesting electronics topics. Take your time and enjoy. Everyone today is exposed to electronic devices in one way or another. The computer revolution is a good example. Everyone can benefit from additional knowledge of electronics. Even a quick scanning of this page will help. Obtain and study various books on electronics - this is really a must as each author will explain things in a little different way to help you grasp the concepts. All the internet links to other web sites found on science. This will save you many hours of searching for good educational material. This site is for everyone from the beginner to expert electrical engineering professional. There is something here for every level of expertise in the world of electronics. If you just need information on one specific area, use the table above to navigate to the information you need. If you need more instruction - read on. Maybe you already know some basic electronics and want to test yourself to see exactly how much you do know. Electricity is the movement of electrical charge from one place to another. Electric charges do not exist without their associated electric and magnetic fields. This module will introduce you to many of the basic concepts involved with electricity and magnetism. Matter consists of atoms. Now we will introduce you to the structure of atoms, talk about electrons and static charge, moving charges, voltage, resistance, and current. All matter can be classified as being either a pure substance or a mixture. Matter can exist as either a solid, liquid, or a gas and can change among these three states of matter. In electronics the most important matter are conductive metals, and non-conductive insulators. Here we will stick to thinking in classical physics terms. Nobody completely understands what this charge consists of but we do know a lot about how it reacts and behaves. The smallest known charge of electricity is the charge associated with an electron. This charge has been called a "negative" charge. An atoms nucleus has a positive charge. These two un-like charges attract one another. Like charges oppose one another. If you had 6,,,,,, electrons in a box you would have what has been named; one coulomb of charge. An easier way of thinking about a large number like that is called "powers of ten" and it would look like this 6. It is simply a way to let you know to move the decimal point to the right 18 places. When electrical charges are at rest, meaning they are not moving, we call that static electricity. If charges are in motion we then have a flow of charge called electrical current. We have given the force that causes this current a name called electromotive force and it is measured by a unit called a volt V. The unit of measurement of the current I or movement of the charge is called an ampere. The resistance, or opposition, to current flow is called an ohm R. With every electric field there is a magnetic field. We can then use this knowledge to our benefit. The design and construction of electric motors, computers, radios, televisions, stereos, and many other electrical and electronic devices depend upon a knowledge of these basic principles of electricity. As you can see we have given names to these phenomenon to make it easier for us to study and use. We could have called them Dick, Jane and Mary but instead we named them for the scientists that discovered or first studied them; Volt, Ampere, and Ohm. Ohm spent many years of their lives studying electricity. They were not alone however as many other scientist were studying and learning more about electricity as well. A watt is the International System unit of power equal to one joule per second. The symbol used for a watt is "P" for power. Power in watts is found by multiplying a circuits current I times its voltage V. You will learn more about power in watts in the ohms law section below. We will cover that shortly. Moving electric charges are the heart of basic electronics. Knowing what moving charges are and how various electronic components affect the moving charges is the foundation of basic electronics. View the videos and continue on down the page. These are the basic building blocks of understanding "Basic Electronics". Electronics puts a knowledge of electricity to useful work. Electronics applies electrical current flow of electrical charges to circuits to accomplish specific tasks. Amplifiers can be constructed from glass "tubes" containing metal elements, or more commonly today with solid state diodes, transistors, or integrated circuits. An amplifier is simply a device or circuit that takes a small signal input and controls a larger current as it output. The input signal voltage is small and the output voltage is larger - amplified. A circuit containing wire conductors, resistors, capacitors, inductors and amplifiers can be configured in many ways to build various electronic circuits like oscillators, digital logic circuits, computer circuits, television and video circuits and much more. An oscillator by the way is just an amplifier with some of the output fed back into the input. Basic electronics is all about electrical components and the circuits consisting of those components. Common components are resistors, capacitors, inductors, transistors, and integrated circuits. You will find each of these components described in detail in the following numbered sections. The components are interconnect with conductors, either physical wires or printed circuits. The components make up linear analog amplifiers, oscillators, and filters as examples. They also can be configured to create digital logic circuits such as memories, gates, arithmetic units, and central processing units. So you will find basic electronics in every computer, mp3 player, radio, TV and may other appliances in your home, car, or on your body. Each circuit has a job. Components are interconnected to perform a specific task. First learn about each individual component and how it works then learn about how to interconnect them to make useful end products. Continue your study by reading the numbered sections to follow. Get the Malvino books below if you need an easy to read but excellent book to learn electronics as a technician.

Chapter 8 : Power supply - Wikipedia

Accordingly power supplies are widely used in a variety of forms - some large supplying high levels of current, other power supplies, much smaller providing lower levels of power. Power supply basics The aim of a DC power supply is to provide the required level of DC power to the load using an AC supply at the input.

It was powered by two waterwheels and produced an alternating current that in turn supplied seven Siemens arc lamps at volts and 34 incandescent lamps at 40 volts. The Pearl Street Station initially powered around 3, lamps for 59 customers. Direct current power could not be transformed easily or efficiently to the higher voltages necessary to minimise power loss during long-distance transmission, so the maximum economic distance between the generators and load was limited to around half a mile m. Perhaps the most serious was connecting the primaries of the transformers in series so that active lamps would affect the brightness of other lamps further down the line. Budapest perfected the secondary generator of Gaulard and Gibbs, providing it with a closed iron core, and thus obtained the first true power transformer, which he dubbed with its present name. Kennedy in , in which several power transformers have their primary windings fed in parallel from a high-voltage distribution line. The system was presented at the National General Exhibition of Budapest. In George Westinghouse , an American entrepreneur, obtained the patent rights to the Gaulard-Gibbs transformer and imported a number of them along with a Siemens generator, and set his engineers to experimenting with them in hopes of improving them for use in a commercial power system. These networks were effectively dedicated to providing electric lighting. In , after a protracted decision-making process, alternating current was chosen as the transmission standard with Westinghouse building the Adams No. In the first experimental high voltage direct current HVDC line using mercury arc valves was built between Schenectady and Mechanicville, New York. It consisted of a layer of selenium applied on an aluminum plate. In , a General Electric research group developed a solid-state p-n-p-n switch device that was successfully marketed in early , starting a revolution in power electronics. In , also Siemens demonstrated a solid-state rectifier, but it was not until the early s that solid-state devices became the standard in HVDC, when GE emerged as one of the top suppliers of thyristor-based HVDC. For example, the development of computers meant load flow studies could be run more efficiently allowing for much better planning of power systems. Basics of electric power[edit] An external AC to DC power adapter used for household appliances Electric power is the product of two quantities: These two quantities can vary with respect to time AC power or can be kept at constant levels DC power. Most refrigerators, air conditioners, pumps and industrial machinery use AC power whereas most computers and digital equipment use DC power the digital devices you plug into the mains typically have an internal or external power adapter to convert from AC to DC power. AC power has the advantage of being easy to transform between voltages and is able to be generated and utilised by brushless machinery. DC power remains the only practical choice in digital systems and can be more economical to transmit over long distances at very high voltages see HVDC. Firstly, power can be transmitted over long distances with less loss at higher voltages. So in power systems where generation is distant from the load, it is desirable to step-up increase the voltage of power at the generation point and then step-down decrease the voltage near the load. Secondly, it is often more economical to install turbines that produce higher voltages than would be used by most appliances, so the ability to easily transform voltages means this mismatch between voltages can be easily managed. Nevertheless, devices utilising solid state technology are often more expensive than their traditional counterparts, so AC power remains in widespread use. If more power is produced than consumed the frequency wil rise and vice versa. Even small deviations from the nominal frequency value will damage synchronous machines and other appliances. Making sure the frequency is constant is usually the task of a transmission system operator. In some countries for example in the European Union this is achieved through a balancing market using ancillary services. For some power systems, the source of power is external to the system but for others, it is part of the system itselfâ€"it is these internal power sources that are discussed in the remainder of this section. Direct current power can be supplied by batteries , fuel cells or photovoltaic cells. Alternating current power is typically supplied by a rotor that spins in a magnetic field in a device known as a turbo generator. The speed at which the rotor spins in combination with the number of generator poles determines the frequency of the alternating current produced by the generator. All generators on a single synchronous system, for example, the national grid , rotate at sub-multiples of the same speed and so generate electric current at the same frequency. If the load on the system increases, the generators will require more torque to spin at that speed and, in a typical power station, more steam must be supplied to the turbines driving them. Thus the steam used and the fuel expended are directly dependent on the quantity of electrical energy supplied. An exception exists for generators incorporating power electronics such as gearless wind turbines or linked to a grid through an asynchronous tie such as a HVDC link â€" these can operate at frequencies independent of the power system frequency. Depending on how the poles are fed, alternating current generators can produce a variable number of phases of power. A higher number of phases leads to more efficient power system operation but also increases the infrastructure requirements of the system. However, there are other considerations. These range from the obvious: How much power should the generator be able to supply? What is an acceptable length of time for starting the generator some generators can take hours to start? Is the availability of the power source acceptable some renewables are only available when the sun is shining or the wind is blowing? To the more technical: How should the generator start some turbines act like a motor to bring themselves up to speed in which case they need an appropriate starting circuit? What is the mechanical speed of operation for the turbine and consequently what are the number of poles required? What type of generator is suitable synchronous or asynchronous and what type of rotor squirrel-cage rotor, wound rotor, salient pole rotor or cylindrical rotor? Toasters typically draw 2 to 10 amps at to volts consuming around to watts of power. Power systems deliver energy to loads that perform a function. These loads range from household appliances to industrial machinery. Most loads expect a certain voltage and, for alternating current devices, a certain frequency and number of phases. An exception exists for centralized air conditioning systems as these are now typically three-phase because this allows them to operate more efficiently. All devices in your house will also have a wattage, this specifies the amount of power the device consumes. At any one time, the net amount of power consumed by the loads on a power system must equal the net amount of power produced by the supplies less the power lost in transmission. However it is not the only challenge, in addition to the power used by a load to do useful work termed real power many alternating current devices also use an additional amount of power because they cause the alternating voltage and alternating current to become slightly out-of-sync termed reactive power. The reactive power like the real power must balance that is the reactive power produced on a system must equal the reactive power consumed and can be supplied from the generators, however it is often more economical to supply such power from capacitors see "Capacitors and reactors" below for more details. In addition to sustained overvoltages and undervoltages voltage regulation issues as well as sustained deviations from the system frequency frequency regulation issues , power system loads can be adversely affected by a range of temporal issues. These include voltage sags, dips and swells, transient overvoltages, flicker, high-frequency noise, phase imbalance and poor power factor. For an AC supply, the ideal is the current and voltage in-sync fluctuating as a perfect sine wave at a prescribed frequency with the voltage at a prescribed amplitude. For DC supply, the ideal is the voltage not varying from a prescribed level. Power quality issues can be especially important when it comes to specialist industrial machinery or hospital equipment. Conductors[edit] Conductors carry power from the generators to the load. In a grid , conductors may be classified as belonging to the transmission system , which carries large amounts of power at high voltages typically more than 69 kV from the generating centres to the load centres, or the distribution system , which feeds smaller amounts of power at lower voltages typically less than 69 kV from the load centres to nearby homes and industry. Copper , with lower resistivity than Aluminum , was the conductor of choice for most power systems. However, Aluminum has a lower cost for the same current carrying capacity and is the primary metal used for transmission line conductors. Overhead line conductors may be reinforced with steel or aluminium alloys. Overhead conductors are usually air insulated and supported on porcelain, glass or polymer insulators. Cables used for underground transmission or building wiring are insulated with cross-linked polyethylene or other flexible insulation. Large conductors are stranded for ease of handling; small conductors used for building wiring are often solid, especially in light commercial or residential construction. As current flow increases through a conductor it heats up. For insulated conductors, the rating is determined by the insulation. Since the voltage and current are out-of-phase, this leads to the emergence of an "imaginary" form of power known as reactive power. Reactive power does no measurable work but is transmitted back and forth between the reactive power source and load every cycle. This reactive power can be provided by the generators themselves, through the adjustment of generator excitation, but it is often cheaper to provide it through capacitors, hence capacitors are often placed near inductive loads to reduce current demand on the power system i. Power factor correction may be applied at a central substation, through the use of so-called "synchronous condensers" synchronous machines which act as condensers which are variable in VAR value, through the adjustment of machine excitation or adjacent to large loads, through the use of so-called "static condensers" condensers which are fixed in VAR value. Reactors consume reactive power and are used to regulate voltage on long transmission lines. In light load conditions, where the loading on transmission lines is well below the surge impedance loading , the efficiency of the power system may actually be improved by switching in reactors. Reactors installed in series in a power system also limit rushes of current flow, small reactors are therefore almost always installed in series with capacitors to limit the current rush associated with switching in a capacitor. Series reactors can also be used to limit fault currents. Capacitors and reactors are switched by circuit breakers, which results in moderately large steps in reactive power. A solution comes in the form of static VAR compensators and static synchronous compensators. Briefly, static VAR compensators work by switching in capacitors using thyristors as opposed to circuit breakers allowing capacitors to be switched-in and switched-out within a single cycle. This provides a far more refined response than circuit breaker switched capacitors. Static synchronous compensators take a step further by achieving reactive power adjustments using only power electronics. Power electronics[edit] Power electronics are semiconductor based devices that are able to switch quantities of power ranging from a few hundred watts to several hundred megawatts. Despite their relatively simple function, their speed of operation typically in the order of nanoseconds [32] means they are capable of a wide range of tasks that would be difficult or impossible with conventional technology. The classic function of power electronics is rectification , or the conversion of AC-to-DC power, power electronics are therefore found in almost every digital device that is supplied from an AC source either as an adapter that plugs into the wall see photo in Basics of Electric Power section or as component internal to the device. HVDC is used because it proves to be more economical than similar high voltage AC systems for very long distances hundreds to thousands of kilometres. HVDC is also desirable for interconnects because it allows frequency independence thus improving system stability. Power electronics are also essential for any power source that is required to produce an AC output but that by its nature produces a DC output. They are therefore used by many photovoltaic installations both industrial and residential. Power electronics also feature in a wide range of more exotic uses. They are at the heart of all modern electric and hybrid vehiclesâ€"where they are used for both motor control and as part of the brushless DC motor. So the batteries must be recharged while driving using DC power from the engineâ€"a feat that is typically accomplished using power electronics. Whereas conventional technology would be unsuitable for a modern electric car, commutators can and have been used in petrol-powered cars, the switch to alternators in combination with power electronics has occurred because of the improved durability of brushless machinery. In the middle twentieth century, rectifier locomotives were popular, these used power electronics to convert AC power from the railway network for use by a DC motor. The use of power electronics to assist with the motor control and with starter circuits cannot be overestimated and, in addition to rectification, is responsible for power electronics appearing in a wide range of industrial machinery. Power electronics even appear in modern residential air conditioners. Power electronics are also at the heart of the variable speed wind turbine.

Chapter 9 : Power Supply Basics Tutorial :: racedaydvl.com

An electric circuit is a closed loop with a continuous flow of electric current from the power supply to the load. Here are ten simple electric circuits commonly found around the home.

It uses standard symbols for the components in the circuit and does not show the physical arrangements of the components. In this article we discuss 10 simple electrical circuits. From homes to big industries, we all depend on electricity. We know that electric current flows in a closed circuit. An electrical circuit is a closed loop in which continuous electrical current goes from the supply to the load. If you are trying to describe an electrical circuit to your friend or neighbor, it is likely that you have to draw the connection. For example, if you want to explain a lighting circuit, it can take more time to draw the bulb, battery, and wires because different people draw various components of the circuit in different ways and this may take a long time to explain. Therefore, a better way is to learn how to show simple electrical circuits. In this article we give the drawings for some simple electric circuits: AC lighting circuit, battery charging circuit, energy meter, switch circuit, air conditioning circuit, thermocouple circuit, DC lighting circuit, multimeter circuit, current transformer circuit, and single phase motor circuit. These two wires are connected from the lamp to the main supply panel. It is advisable to use different colours for live wires and neutral wires. The universal practice is to use the colour red for live wires and a black colour for the neutral wire. For switching ON and OFF the lamp we need a control called a switch - provided in the live wire between the main supply and lamp. If the switch is ON, the electric circuit is closed and the lamp glows, and if the switch is OFF, it will disconnect the power supply to the lamp. For safe operation this wiring is placed in a box called a switch box. The switch wire and live wire are a single wire; it is just cut in between to connect the switch. The main function of the rectifier is to convert AC alternating current into DC direct current. The rectifier shown in the diagram is the bridge rectifier, which has four diodes connected in the form of a bridge. Resistance is added in the circuit to limit the flow of current. When the supply is given to the rectifier through a step down transformer, it converts the AC supply into DC supply and this flows to the battery, thereby charging it. Usually this circuit is enclosed in a battery charger unit or inverter and only the terminals emerge out of the charger unit to be connected to the battery for charging. Air Conditioning Electric Circuit Air conditioning is a process that heats, cools, cleans, and circulates air together with the control of its moisture content. The electric aspect of AC comprises the power equipment for motors and starters for the compressor and condenser fans. Associated electric equipment includes solenoid valves, high and low pressure switch, and high and low temperature switch, together with the safety cut-outs for over current, under voltage etc. The compressor and condenser fans are driven by a simple fixed speed 3 phase AC induction motor, each with its own starter and supplied from a distribution board. Routine electric maintenance and fault finding on the motor and starters involves cleaning, checking of connections, insulation tests, etc. The function of the switch is to connect or complete the circuit going to the load from the supply. It has moving contacts which are normally open. As shown in the diagram, the power supply to the load is through the switching circuit, and therefore the power supply can be cut by keeping the switch open. This circuit is very simple. The battery has two points, anode and cathode. The anode is positive and cathode is negative. A lamp has two terminals - one is positive and the other is negative. The positive terminal of the lamp is connected to the anode and the negative terminal of the lamp is connected to the cathode of the battery. Once the connection is made the lamp will glow. More simple electrical circuits and simple electrical devices are discussed on the next page. The circuit functioning and uses of these devices are specifically discussed in this part. When the junctions formed from two dissimilar homogenous materials are exposed to the temperature difference, an EMF is generated. This is called the Seebeck effect. The figure shows a thermocouple, which consists of two wires, one iron and the other made of constantan, with a voltmeter. This voltmeter will measure the EMF generated and this can be calibrated to measure the temperature. The temperature difference between the hot and cold junction will produce an EMF proportional to it. If the cold junction temperature is kept constant, then the EMF is proportional to the temperature of the hot junction. The power consumed over a period of time can be measured by a motor meter or energy meter.

Energy meters are used in all power supply lines to every house in order to measure the power consumed in both DC and AC circuits. It is measured in watt-hour or kilowatt hour. For DC circuits, the meter may be an ampere hour or a watt-hour meter. There is an aluminium disc which rotates continuously when power is consumed. The speed of rotation is proportional to the power consumed in watt-hour by the load. Energy meters have a pressure coil and a current coil. When the voltage is applied across the pressure coil, current flows through the coil and produces a flux which exerts torque on the disc. Load current flows through the current coil and produces another flux which exerts an opposite torque on the aluminium disc. The resultant torque acts on the disc and results in a rotation on the disc which is proportional to the energy utilized and which is recorded in the energy meter.