SOLAR AND WIRELESS BASED E-VEHICLE CHARGING SYSTEM

ABSTRACT

The objective of this project is to design a solar andwireless e-vehicle battery charging system.The development of automotive technology is increasing day by day. The Future automotive technology the electric vehicle place an important Role. Using Electric vehicle we can avoid spending cost for fuel. Because electric vehicle are powered up with solar and battery it will consume low cost comparing to present vehicle. We are designed microcontroller based charging system and it powered up with solar power get more power for battery. Arduino microcontroller based system is used for controlling a wireless charging a unit of battery using PWN technique.

CHAPTER 1

INTRODUCTION

Battery systems have been widely used in industry, transportation, energy storage applications for more than a century. Battery energy storage has been identified as an enabling technology for transportation electrification and smart grid applications and battery systems can further catalyze the synergy between electric vehicles (EVs) and the electric grid. In high power applications such as EVs and plug-in hybrid electric vehicles (PHEVs), the battery packs are usually formed by battery modules/cells connected in series to increase the voltage, and connected in parallel to increase the capacitance. However, due to manufacturing caused variations and varying operation conditions the imbalances reduce the usable energy. The imbalances of a battery pack could lead to negative outcomes such as early termination of charging and discharging process. Or, it can be even worse that the battery cells over-charged or over-discharged could be permanently damaged. To deal with the imbalance issue of battery packs, various battery balancing topologies and control algorithms have been researched and developed.

Passive balancing is still one of the most widely used methods in battery management systems (BMS) because of the advantage of low cost. The operating principle of passive balancing is simple: When a single cell/module reaches the charge voltage limit, it will be discharged by a power resistor to allow other cells to be fully charged. However, passive balancing is only applied during the charge process instead of for both charge and discharge. In addition to this limitation, the overall efficiency of the battery system with passive balancing is relatively low due to the balancing energy is dissipated as heat. We are creating a Portable charger for electric vehicle battery based electric vehicle battery usage.

EXISTING SYSTEM:

The existing diagram of a conventional two stage isolated EV battery charger based on boost PFC and fullbridge LLC topologies is plotted in Fig. In EV battery charging applications, optimization of the LLC converterover the wide output voltage ranges becomes a challenging issue.

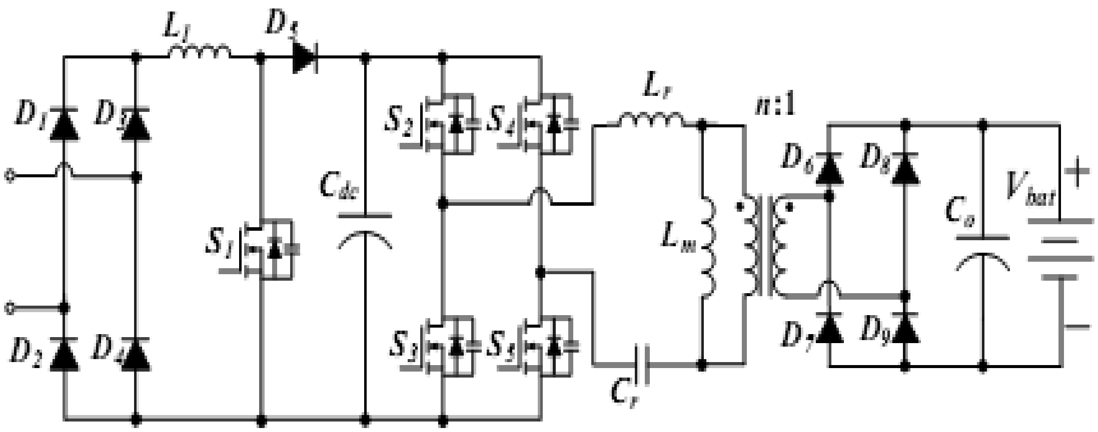


Fig. Existing system

Existing system drawback:

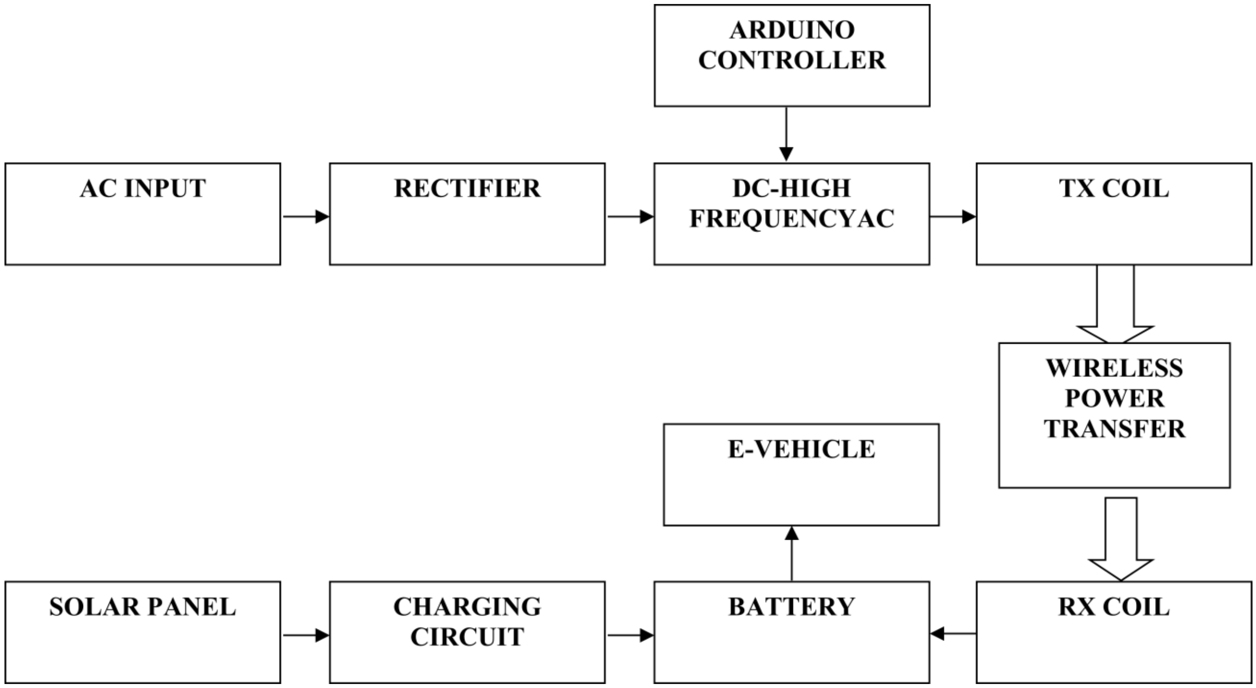
1. This system using more number of switches.
2. They have a higher leakage current than most other types.
3. They are not very good for low frequency applications.

CHAPTER 3

PROPOSED SYSTEM:

A transformer is a device that transfers electrical energy from one circuit to another through inductively coupled conductors—the transformer's coils. A varying current in the first or primary winding creates a varying magnetic flux in the transformer's core, and thus a varying magnetic field through the secondary winding. This varying magnetic field induces a varying electromotive force (EMF) or "voltage" in the secondary winding. This effect is called mutual induction. The voltage we getting is AC in form and it is given to rectifier circuit to convert AC voltage to DC voltage and it is given to the MOSFET Switching Circuit (It is a device used for amplifying or switching electronic signals). Initially PIC microcontroller generate clock pulse is given to the MOSFET driver circuit and it is driven. The DC voltage is transmitted wirelessly through Transmitter Coil. In the Receiver Side, the DC voltage is received through Receiver Coil and it is used to charge the battery. Hence it is useful to the people to charge their battery.

PROPOSED BLOCK DIAGRAM:



HARDWARE REQUIREMENT:

- **ARDUINO MICRO CONTROLLER**
- **SOLAR PANEL**
- **BATTERY**
- **TRANSMITTING AND RECEIVING COIL**
- **E-VEHICLE MODEL**

SOFTWARE REQUIREMENT:

- **ARDUINO IDE**

HARDWARE DESCRIPTION:

Arduino Uno:

Arduino/Genuino Uno is a microcontroller board based on the ATmega328P . It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the

Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

You can find here your board warranty informations.

Getting Started

You can find in the Getting Started section all the information you need to configure your board, use the Arduino Software (IDE), and start tinker with coding and electronics.

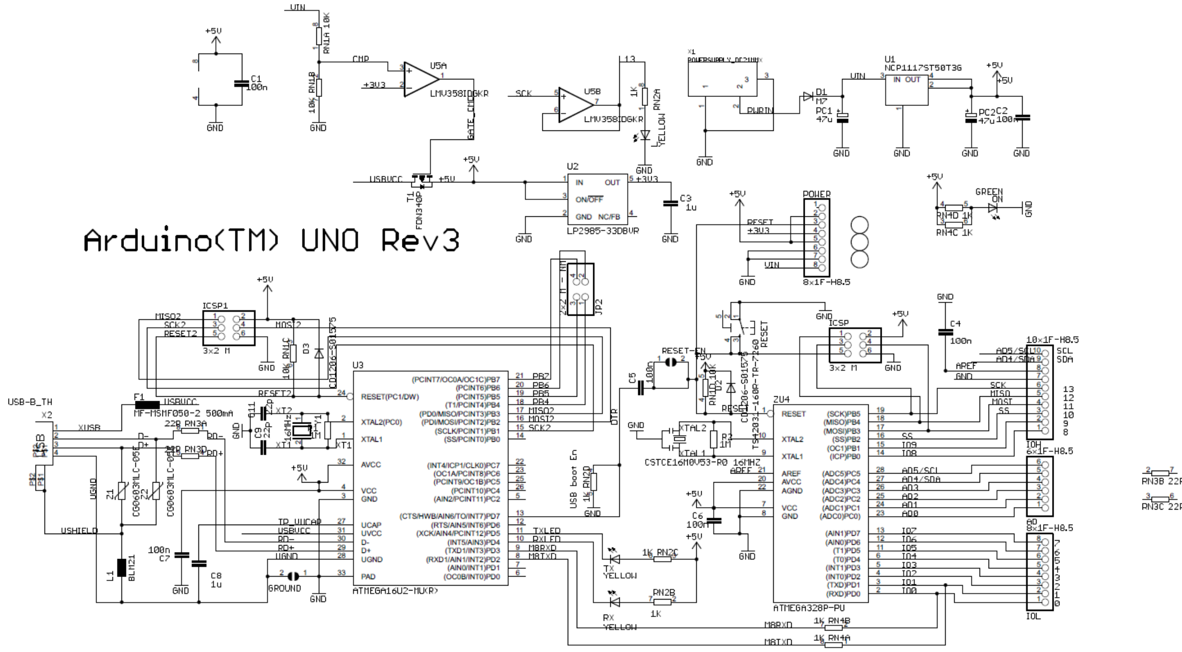
Need Help?

- On the Software on the Arduino Forum
- On Projects on the Arduino Forum
- On the Product itself through our Customer Support

Technical specs

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA

Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
Length	68.6 mm
Width	53.4 mm
Weight	25 g



Power

The Arduino/Genuino Uno board can be powered via the USB connection or with an external power supply. The power source is selected automatically.

External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the GND and Vin pin headers of the POWER connector.

The board can operate on an external supply from 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may become unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

The power pins are as follows:

- Vin. The input voltage to the Arduino/Genuino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- 5V.This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don't advise it.
- 3V3. A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- GND. Ground pins.
- IOREF. This pin on the Arduino/Genuino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs to work with the 5V or 3.3V.

Memory

The ATmega328 has 32 KB (with 0.5 KB occupied by the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

Input and Output

See the mapping between Arduino pins and ATmega328P ports. The mapping for the Atmega8, 168, and 328 is identical.

Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(),digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive 20 mA as recommended operating condition and has an internal pull-up resistor (disconnected by default) of 20-50k ohm. A maximum of 40mA is the value that must not be exceeded on any I/O pin to avoid permanent damage to the microcontroller.

In addition, some pins have specialized functions:

- Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.
- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.
- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.
- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.
- LED: 13. There is a built-in LED driven by digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

- TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.

The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analogReference() function.
There are a couple of other pins on the board:

- AREF. Reference voltage for the analog inputs. Used with analogReference().
- Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

Communication

Arduino/Genuino Uno has a number of facilities for communicating with a computer, another Arduino/Genuino board, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The 16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required. The Arduino Software (IDE) includes a serial monitor which allows simple textual data to be sent to and from the board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1).

A SoftwareSerial library allows serial communication on any of the Uno's digital pins.

The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino Software (IDE) includes a Wire library to simplify use of the I2C bus; see the documentation for details. For SPI communication, use the SPI library.

Automatic (Software) Reset

Rather than requiring a physical press of the reset button before an upload, the Arduino/Genuino Uno board is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (DTR) of the ATmega8U2/16U2 is connected to the reset line of the ATmega328 via a 100 nanofarad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip. The Arduino Software (IDE) uses this capability to allow you to upload code by simply pressing the upload button in the interface toolbar. This means that the bootloader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload.

This setup has other implications. When the Uno is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). For the following half-second or so, the bootloader is running on the Uno. While it is programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives one-time configuration or other data when it first starts, make sure that the software with which it communicates waits a second after opening the connection and before sending this data.

The Uno board contains a trace that can be cut to disable the auto-reset. The pads on either side of the trace can be soldered together to re-enable it. It's labeled "RESET-EN". You may also be able to disable the auto-reset by connecting a 110 ohm resistor from 5V to the reset line; see this forum thread for details.

Revisions

Revision 3 of the board has the following new features:

- 1.0 pinout: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible with both the board that uses the AVR, which operates with 5V and with the Arduino Due that operates with 3.3V. The second one is a not connected pin, that is reserved for future purposes.
- Stronger RESET circuit.
- Atmega 16U2 replace the 8U2.

SOLAR PANEL:


A **solar panel** (**photovoltaic module** or **photovoltaic panel**) is a packaged interconnected assembly of solar cells, also known as photovoltaic cells. The solar panel is used as a component in a larger photovoltaic system to offer electricity for commercial and residential applications.

Because a single solar panel can only produce a limited amount of power, many installations contain several panels. This is known as a photovoltaic array. A photovoltaic installation typically includes an array of solar panels, an inverter, batteries and interconnection wiring.

Solar panels use light energy (photons) from the sun to generate electricity through the photovoltaic effect. The structural (load carrying) member of a module can either be the top layer (superstrate) or the back layer (substrate). The majority of modules use wafer-based crystalline silicon cells or a thin-film cell based on cadmium telluride or silicon. Crystalline silicon, which is commonly used in the wafer form in photovoltaic (PV) modules, is derived from silicon, a commonly used semi-conductor.

In order to use the cells in practical applications, they must be:

connected electrically to one another and to the rest of the system

protected from mechanical damage during manufacture, transport, installation and use (in particular against hail impact, wind and snow loads). This is especially important for wafer-based silicon cells which are brittle.

protected from moisture, which corrodes metal contacts and interconnects, (and for thin-film cells the transparent conductive oxide layer) thus decreasing performance and lifetime.

Most modules are usually rigid, but there are some flexible modules available, based on thin-film cells.

Electrical connections are made in series to achieve a desired output voltage and/or in parallel to provide a desired amount of current source capability.

Diodes are included to avoid overheating of cells in case of partial shading. Since cell heating reduces the operating efficiency it is desirable to minimize the heating.

Very few modules incorporate any design features to decrease temperature, however installers try to provide good ventilation behind the module.[1]

New designs of module include concentrator modules in which the light is concentrated by an array of lenses or mirrors onto an array of small cells. This allows the use of cells with a very high-cost per unit area (such as gallium arsenide) in a cost-competitive way.

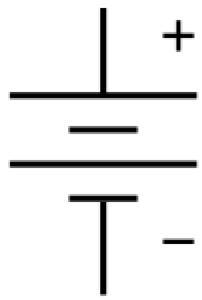
Depending on construction, the photovoltaic can cover a range of frequencies of light and can produce electricity from them, but sometimes cannot cover the entire solar spectrum (specifically, ultraviolet, infrared and low or diffused light). Hence much of incident sunlight energy is wasted when used for solar panels, although they can give far higher efficiencies if illuminated with monochromatic light. Another design concept is to split the light into different wavelength ranges and direct the beams onto different cells tuned to the appropriate wavelength ranges.[2] This is projected to raise efficiency by 50%. Also, the use of infrared photovoltaic cells can increase the efficiencies, producing power at night.

BATTERY:

An electrical **battery** is one or more electrochemical cells that convert stored chemical energy into electrical energy.[1] Since the invention of the first battery (or "voltaic pile") in 1800 by Alessandro Volta, batteries have become a common power source for many household and industrial applications. According to a 2005 estimate, the worldwide battery industry generates US$48 billion in sales each year,[2] with 6% annual growth.[3]

There are two types of batteries: primary batteries (disposable batteries), which are designed to be used once and discarded when they are exhausted, and secondary batteries (rechargeable batteries), which are designed to be recharged and used multiple times. Miniature cells are used to power devices such as hearing aids and wristwatches; larger batteries provide standby power for telephone exchanges or computer data centers.

History



The symbol for a battery in a circuit diagram. It originated as a schematic drawing of the earliest type of battery, a voltaic pile.

Strictly, a battery is a collection of multiple electrochemical cells, but in popular usage *battery* often refers to a single cell.[1] The first electrochemical cell was developed by the Italian physicist Alessandro Volta in 1792, and in 1800 he invented the first battery—for him, a "pile" of cells.[4]

The usage of "battery" to describe electrical devices dates to Benjamin Franklin, who in 1748 described multiple Leyden jars (early electrical capacitors) by analogy to a battery of cannons.[5] Thus Franklin's usage to describe multiple Leyden jars predated Volta's use of multiple galvanic cells.[6]. It is speculated, but not established, that several ancient artifacts consisting of copper sheets and iron bars, and known as Baghdad batteries may have been galvanic cells.[7]

Volta's work was stimulated by the Italian anatomist and physiologist Luigi Galvani, who in 1780 noticed that dissected frog's legs would twitch when struck by a spark from a Leyden jar, an external source of electricity.[8] In 1786 he noticed that twitching would occur during lightning storms.[9] After many years Galvani learned how to produce twitching without using any external source of electricity. In 1791 he published a report on "animal electricity."[10] He created an electric circuit consisting of the frog's leg (FL) and two different metals A and B, each metal touching the frog's leg and each other, thus producing the circuit A-FL-B-A-FL-B...etc. In modern terms, the frog's leg served as both the electrolyte and the sensor, and the metals served as electrodes. He noticed that even though the frog was dead, its legs would twitch when he touched them with the metals.

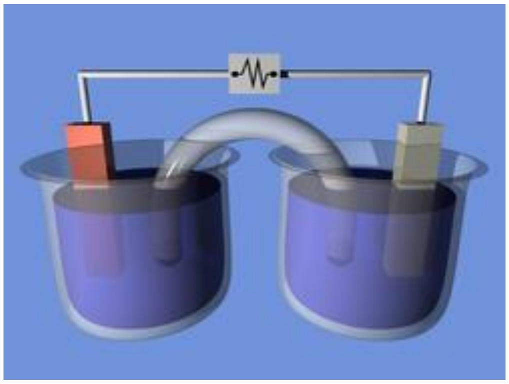
Within a year, Volta realized the frog's moist tissues could be replaced by cardboard soaked in salt water, and the frog's muscular response could be replaced by another form of electrical detection. He already had studied the electrostatic phenomenon of capacitance, which required measurements of electric charge and of electrical potential ("tension"). Building on this experience, Volta was able to detect electric current through his system, also called a Galvanic cell. The terminal voltage of a cell that is not discharging is called its electromotive force (emf), and has the same unit as electrical potential, named (voltage) and measured in volts, in honor of Volta. In 1800, Volta invented the battery by placing many voltaic cells in series, literally piling them one above the other. This voltaic pile gave a greatly enhanced net emf for the combination,[11] with a voltage of about 50 volts for a 32-cell pile.[12] In many parts of Europe batteries continue to be called piles.[13][14]

Volta did not appreciate that the voltage was due to chemical reactions. He thought that his cells were an inexhaustible source of energy,[15] and that the associated chemical effects (e.g. corrosion) were a mere nuisance, rather than an unavoidable consequence of their operation, as Michael Faraday showed in 1834.[16] According to Faraday, cations (positively charged ions) are attracted to the cathode,[17] and anions (negatively charged ions) are attracted to the anode.[18]

Although early batteries were of great value for experimental purposes, in practice their voltages fluctuated and they could not provide a large current for a sustained period. Later, starting with the Daniell cell in 1836, batteries provided more reliable currents and were adopted by industry for use in stationary devices, particularly in telegraph networks where they were the only practical source of electricity, since electrical distribution networks did not exist at the time.[19] These wet cells used liquid electrolytes, which were prone to leakage and spillage if not handled correctly. Many used glass jars to hold their components, which made them fragile. These characteristics made wet cells unsuitable for portable appliances. Near the end of the nineteenth century, the invention of dry cell batteries, which replaced the liquid electrolyte with a paste, made portable electrical devices practical.[20]

Since then, batteries have gained popularity as they became portable and useful for a variety of purposes.[21]

How batteries work



A voltaic cell for demonstration purposes. In this example the two half-cells are linked by a salt bridge separator that permits the transfer of ions, but not water molecules.

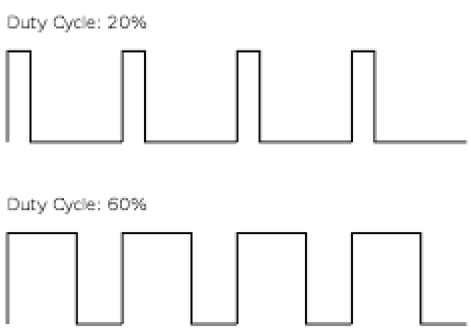
A battery is a device that converts chemical energy directly to electrical energy.[22] It consists of a number of voltaic cells; each voltaic cell consists of two half cells connected in series by a conductive electrolyte containing anions and cations. One half-cell includes electrolyte and the electrode to which anions (negatively charged ions) migrate, i.e., the anode or negative electrode; the other half-cell includes electrolyte and the electrode to which cations (positively charged ions) migrate, i.e., the cathode or positive electrode. In the redox reaction that powers the battery, reduction (addition of electrons) occurs to cations at the cathode, while oxidation (removal of electrons) occurs to anions at the anode.[23] The electrodes do not touch each other but are electrically connected by the electrolyte. Many cells use two half-cells with different electrolytes. In that case each half-cell is enclosed in a container, and a separator that is porous to ions, but not the bulk of the electrolytes, prevents mixing.

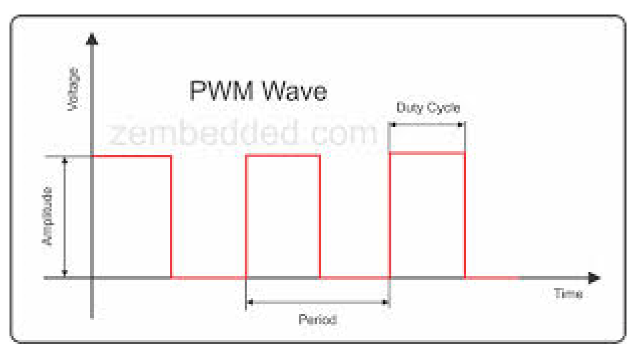
PWM:

Pulse-width modulation (PWM), or **pulse-duration modulation (PDM)**, is a commonly used technique for controlling power to inertial electrical devices, made practical by modern electronic power switches.

The average value of voltage (and current) fed to the load is controlled by turning the switch between supply and load on and off at a fast pace. The longer the switch is on compared to the off periods, the higher the power supplied to the load is.

The PWM switching frequency has to be much faster than what would affect the load, which is to say the device that uses the power. Typically switchings have to be done several times a minute in an electric stove, 120 Hz in a lamp dimmer, from few kilohertz (kHz) to tens of kHz for a motor drive and well into the tens or hundreds of kHz in audio amplifiers and computer power supplies.





The term *duty cycle* describes the proportion of 'on' time to the regular interval or 'period' of time; a low duty cycle corresponds to low power, because the power is off for most of the time. Duty cycle is expressed in percent, 100% being fully on.

The main advantage of PWM is that power loss in the switching devices is very low. When a switch is off there is practically no current, and when it is on, there is almost no voltage drop across the switch. Power loss, being the product of voltage and current, is thus in both cases close to zero. PWM also works well with digital controls, which, because of their on/off nature, can easily set the needed duty cycle.

PWM has also been used in certain communication systems where its duty cycle has been used to convey information over a communications channel.

TRANSFORMER

Transformer

A transformer is a device that transfers electrical energy from one circuit to another through inductively coupled conductors—the transformer's coils. A varying current in the first or *primary* winding creates a varying magnetic flux in the transformer's core, and thus a varying magnetic field through the *secondary* winding. This varying magnetic field induces a varying electromotive force (EMF) or "voltage" in the secondary winding. This effect is called mutual induction.

If a load is connected to the secondary, an electric current will flow in the secondary winding and electrical energy will be transferred from the primary circuit through the transformer to the load. In an ideal transformer, the induced voltage in the secondary winding (V_S) is in proportion to the primary voltage (V_P), and is given by the ratio of the number of turns in the secondary (N_S) to the number of turns in the primary (N_P) as follows:

$$\frac{V_S}{V_P} = \frac{N_S}{N_P}$$

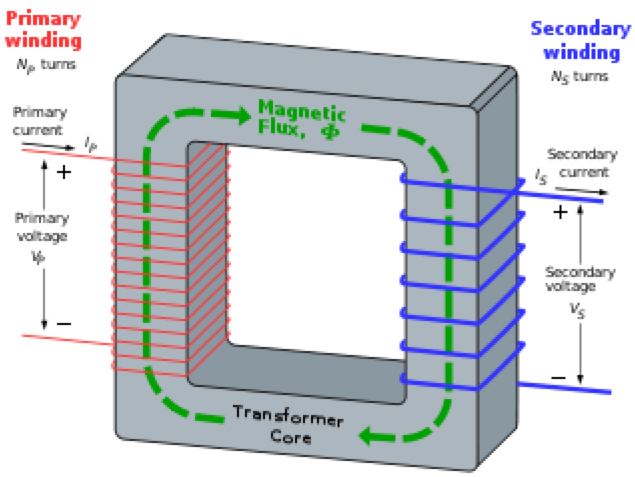
By appropriate selection of the ratio of turns, a transformer thus allows an alternating current (AC) voltage to be "stepped up" by making N_S greater than N_P, or "stepped down" by making N_S less than N_P.

In the vast majority of transformers, the windings are coils wound around a ferromagnetic core, air-core transformers being a notable exception.

Transformers range in size from a thumbnail-sized coupling transformer hidden inside a stage microphone to huge units weighing hundreds of tons used to interconnect portions of power grids. All operate with the same basic principles, although the range of designs is wide. While new technologies have eliminated the need for transformers in some electronic circuits, transformers are still found in nearly all electronic devices designed for household ("mains") voltage. Transformers are essential for high voltage power transmission, which makes long distance

Basic principles

The transformer is based on two principles: firstly, that an electric current can produce a magnetic field (electromagnetism), and, secondly that a changing magnetic field within a coil of wire induces a voltage across the ends of the coil (electromagnetic induction). Changing the current in the primary coil changes the magnetic flux that is developed. The changing magnetic flux induces a voltage in the secondary coil.



An ideal transformer

An ideal transformer is shown in the adjacent figure. Current passing through the primary coil creates a magnetic field. The primary and secondary coils are wrapped around a core of very high magnetic permeability, such as iron, so that most of the magnetic flux passes through both the primary and secondary coils.

Induction law

The voltage induced across the secondary coil may be calculated from Faraday's law of induction, which states that:

$$V_S = N_S \frac{\mathrm{d}\Phi}{\mathrm{d}t},$$

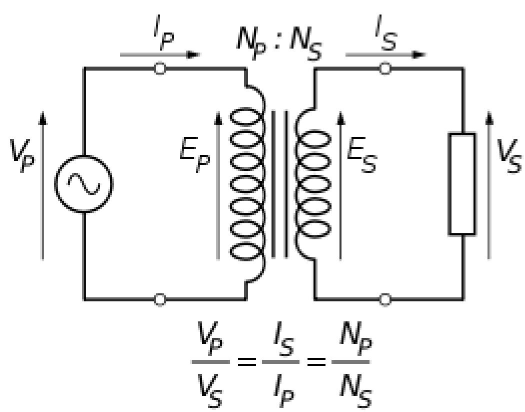
where V_S is the instantaneous voltage, N_S is the number of turns in the secondary coil and Φ is the magnetic flux through one turn of the coil. If the turns of the coil are oriented perpendicular to the magnetic field lines, the flux is the product of the magnetic flux density B and the area A through which it cuts. The area is constant, being equal to the cross-sectional area of the transformer core, whereas the magnetic field varies with time according to the excitation of the primary. Since the same magnetic flux passes through both the primary and secondary coils in an ideal transformer,[26] the instantaneous voltage across the primary winding equals

$$V_P = N_P \frac{\mathrm{d}\Phi}{\mathrm{d}t}.$$

Taking the ratio of the two equations for V_S and V_P gives the basic equation[27] for stepping up or stepping down the voltage

$$\frac{V_S}{V_P} = \frac{N_S}{N_P}.$$

Ideal power equation



The ideal transformer as a circuit element

If the secondary coil is attached to a load that allows current to flow, electrical power is transmitted from the primary circuit to the secondary circuit. Ideally, the transformer is perfectly efficient; all the incoming energy is transformed from the primary circuit to the magnetic field and into the secondary circuit. If this condition is met, the incoming electric power must equal the outgoing power:

$$P_{\text{incoming}} = I_P V_P = P_{\text{outgoing}} = I_S V_S,$$

giving the ideal transformer equation

$$\frac{V_S}{V_P} = \frac{N_S}{N_P} = \frac{I_P}{I_S}.$$

Transformers normally have high efficiency, so this formula is a reasonable approximation.

If the voltage is increased, then the current is decreased by the same factor. The impedance in one circuit is transformed by the *square* of the turns ratio.[26] For example, if an impedance Z_S is attached across the terminals of the secondary coil, it appears to the primary circuit to have an impedance of $Z_S\left(\frac{N_P}{N_S}\right)^2$. This relationship is reciprocal, so that the impedance Z_P of the primary circuit appears to the secondary to be $Z_P\left(\frac{N_S}{N_P}\right)^2$.

Detailed operation

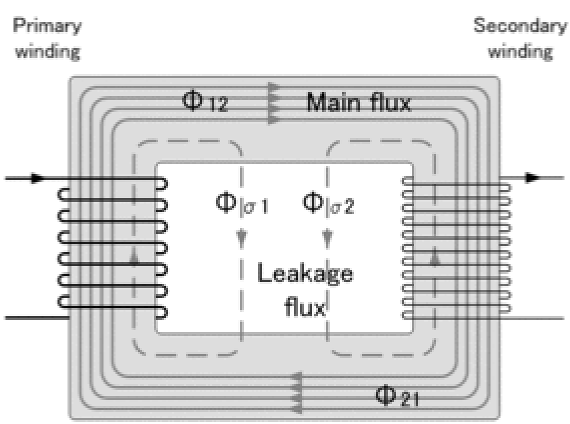
The simplified description above neglects several practical factors, in particular the primary current required to establish a magnetic field in the core, and the contribution to the field due to current in the secondary circuit.

Models of an ideal transformer typically assume a core of negligible reluctance with two windings of zero resistance.[28] When a voltage is applied to the primary winding, a small current flows, driving flux around the magnetic circuit of the core.[28] The current required to create the flux is termed the *magnetizing current*; since the ideal core has been assumed to have near-zero reluctance, the magnetizing current is negligible, although still required to create the magnetic field.

The changing magnetic field induces an electromotive force (EMF) across each winding.[29] Since the ideal windings have no impedance, they have no associated voltage drop, and so the voltages V_P and V_S measured at the terminals of the transformer, are equal to the corresponding EMFs. The primary EMF, acting as it does in opposition to the primary voltage, is sometimes termed the "back EMF".[30] This is due to Lenz's law which states that the induction of EMF would always be such that it will oppose development of any such change in magnetic field.

Practical considerations

Leakage flux



Leakage flux of a transformer

Main article: Leakage inductance

The ideal transformer model assumes that all flux generated by the primary winding links all the turns of every winding, including itself. In practice, some flux traverses paths that take it outside the windings.[31] Such flux is termed *leakage flux*, and results in leakage inductance in series with the mutually coupled transformer windings.[30] Leakage results in energy being alternately stored in and discharged from the magnetic fields with each cycle of the power supply. It is not directly a power loss (see "Stray losses" below), but results in inferior voltage regulation, causing the secondary voltage to fail to be directly proportional to the primary, particularly under heavy load.[31] Transformers are therefore normally designed to have very low leakage inductance.

However, in some applications, leakage can be a desirable property, and long magnetic paths, air gaps, or magnetic bypass shunts may be deliberately introduced to a transformer's design to limit the short-circuit current it will supply.[30] Leaky transformers may be used to supply loads that exhibit negative resistance, such as electric arcs, mercury vapor lamps, and neon signs; or for safely handling loads that become periodically short-circuited such as electric arc welders.[32]

Air gaps are also used to keep a transformer from saturating, especially audio-frequency transformers in circuits that have a direct current flowing through the windings.[*citation needed*]

Leakage inductance is also helpful when transformers are operated in parallel. It can be shown that if the "per-unit" inductance of two transformers is the same (a typical value is 5%), they will automatically split power "correctly" (e.g. 500 kVA unit in parallel with 1,000 kVA unit, the larger one will carry twice the current).[*citation needed*]

RECTIFIER

A **rectifier** is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), current that flows in only one direction, a process known as **rectification**. Rectifiers have many uses including as components of power supplies and as detectors of radio signals. Rectifiers may be made of solid statediodes, vacuum tube diodes, mercury arc valves, and other components.

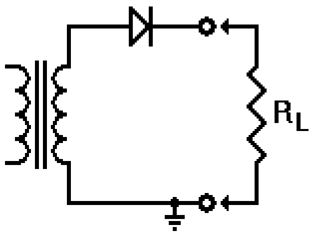
A device which performs the opposite function (converting DC to AC) is known as an inverter.

When only one diode is used to rectify AC (by blocking the negative or positive portion of the waveform), the difference between the term *diode* and the term *rectifier* is merely one of usage, i.e., the term *rectifier* describes a *diode* that is being used to convert AC to DC. Almost all rectifiers comprise a number of diodes in a specific arrangement for more efficiently converting AC to DC than is possible with only one diode. Before the development of silicon semiconductor rectifiers, vacuum tube diodes and copper(I) oxide or selenium rectifier stacks were used.

Early radio receivers, called crystal radios, used a "cat's whisker" of fine wire pressing on a crystal of galena (lead sulfide) to serve as a point-contact rectifier or "crystal detector". Rectification may occasionally serve in roles other than to generate D.C. current per se. For example, in gas heating systems *flame rectification* is used to detect presence of flame. Two metal electrodes in the outer layer of the flame provide a current path, and rectification of an applied alternating voltage will happen in the plasma, but only while the flame is present to generate it.

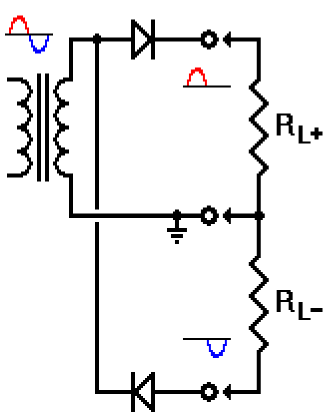
TYPES OF RECTIFIER

The Half-Wave Rectifier



The simplest rectifier circuit is nothing more than a diode connected in series with the ac input, as shown to the right. Since a diode passes current in only one direction, only half of the incoming ac wave will reach the rectifier output. Thus, this is a basic half-wave rectifier.

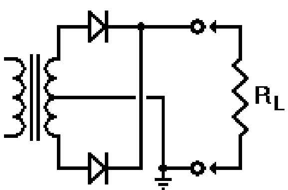
The orientation of the diode matters; as shown, it passes only the positive half-cycle of the ac input, so the output voltage contains a positive dc component. If the diode were to be reversed, the negative half-cycle would be passed instead, and the dc component of the output would have a negative polarity. In either case, the DC component of the output waveform is $v_p/\pi = 0.3183v_p$, where v_p is the peak voltage output from the transformer secondary winding.



It is also quite possible to use two half-wave rectifiers together, as shown in the second figure to the right. This arrangement provides both positive and negative output voltages, with each output utilizing half of the incoming ac cycle.

Note that in all cases, the lower transformer connection also serves as the common reference point for the output. It is typically connected to the common ground of the overall circuit. This can be very important in some applications. The transformer windings are of course electrically insulated from the iron core, and that core is normally grounded by the fact that it is bolted physically to the metal chassis (box) that supports the entire circuit. By also grounding one end of the secondary winding, we help ensure that this winding will never experience even momentary voltages that might overload the insulation and damage the transformer.

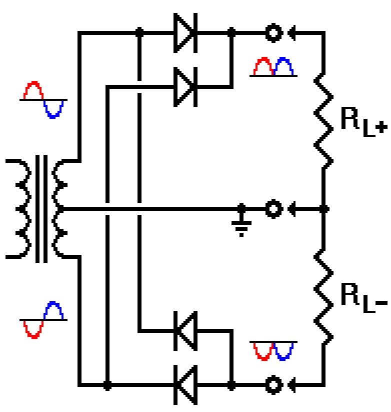
The Full-Wave Rectifier



While the half-wave rectifier is very simple and does work, it isn't very efficient. It only uses half of the incoming ac cycle, and wastes all of the energy available in the other half. For greater efficiency, we would like to be able to utilize both halves of the incoming ac. One way to accomplish this is to double the size of the secondary winding and provide a connection to its center. Then we can use two separate half-wave rectifiers on alternate half-cycles, to provide full-wave rectification. The circuit is shown to the right.

Because both half-cycles are being used, the DC component of the output waveform is now $2v_p/\pi = 0.6366v_p$, where v_p is the peak voltage output from *half* the transformer secondary winding, because only half is being used at a time.

This rectifier configuration, like the half-wave rectifier, calls for one of the transformer's secondary leads to be grounded. In this case, however, it is the center connection, generally known as the *center tap* on the secondary winding.

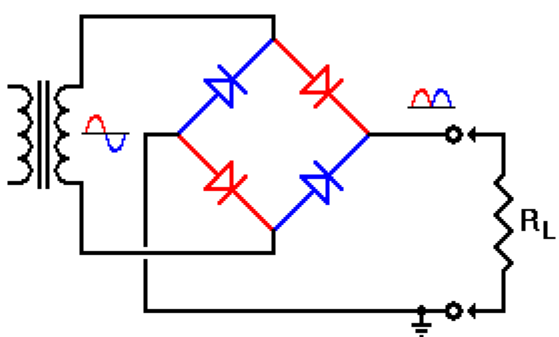


The full-wave rectifier can still be configured for a negative output voltage, rather than positive. In addition, as shown to the right, it is quite possible to use two full-wave rectifiers to get outputs of both polarities at the same time.

The full-wave rectifier passes both halves of the ac cycle to either a positive or negative output. This makes more energy available to the output, without large intervals when no energy is provided at all. Therefore, the full-wave rectifier is more efficient than the half-wave rectifier. At the same time, however, a full-wave rectifier providing only a single output polarity does require a secondary winding that is twice as big as the half-wave rectifier's secondary, because only half of the secondary winding is providing power on any one half-cycle of the incoming ac.

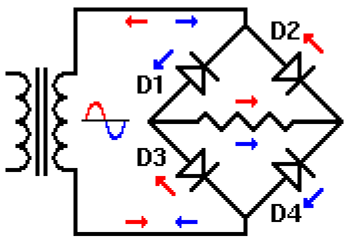
Actually, it isn't all that bad, because the use of both half-cycles means that the current drain on the transformer winding need not be as heavy. With power being provided on both half-cycles, one half-cycle doesn't have to provide enough power to carry the load past an unused half-cycle. Nevertheless, there are some occasions when we would like to be able to use the entire transformer winding at all times, and still get full-wave rectification with a single output polarity.

The Full-Wave Bridge Rectifier



The four-diode rectifier circuit shown to the right serves very nicely to provide full-wave rectification of the ac output of a single transformer winding. The diamond configuration of the four diodes is the same as the resistor configuration in a Wheatstone Bridge. In fact, any set of components in this configuration is identified as some sort of bridge, and this rectifier circuit is similarly known as a *bridge rectifier*.

If you compare this circuit with the dual-polarity full-wave rectifier above, you'll find that the connections to the diodes are the same. The only change is that we have removed the center tap on the secondary winding, and used the negative output as our ground reference instead. This means that the transformer secondary is never directly grounded, but one end or the other will always be close to ground, through a forward-biased diode. This is not usually a problem in modern circuits.



To understand how the bridge rectifier can pass current to a load in only one direction, consider the figure to the right. Here we have placed a simple resistor as the load, and we have numbered the four diodes so we can identify them individually.

During the positive half-cycle, shown in red, the top end of the transformer winding is positive with respect to the bottom half. Therefore, the transformer pushes electrons from its bottom end, through D3 which is forward biased, and through the load resistor in the direction shown by the red arrows.

Electrons then continue through the forward-biased D2, and from there to the top of the transformer winding. This forms a complete circuit, so current can indeed flow. At the same time, D1 and D4 are reverse biased, so they do not conduct any current.

During the negative half-cycle, the top end of the transformer winding is negative. Now, D1 and D4 are forward biased, and D2 and D3 are reverse biased. Therefore, electrons move through D1, the resistor, and D4 in the direction shown by the blue arrows. As with the positive half-cycle, electrons move through the resistor from left to right.

In this manner, the diodes keep switching the transformer connections to the resistor so that current always flows in only one direction through the resistor. We can replace the resistor with any other circuit, including more power supply circuitry (such as the filter), and still see the same behavior from the bridge rectifier.

MOSFET

MOSFET operation

For the operation of MOS devices discussed next, an authoritative reference is Tsividis[2].

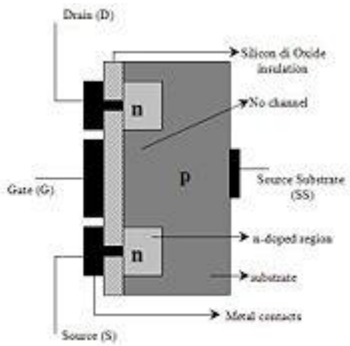
Metal–oxide–semiconductor structure

A traditional metal–oxide–semiconductor (MOS) structure is obtained by depositing a layer of silicon dioxide (SiO_2) and a layer of metal (polycrystalline silicon is commonly used instead of metal) on top of a semiconductor die. As the silicon dioxide is a dielectric material its structure is equivalent to a planar capacitor, with one of the electrodes replaced by a semiconductor.

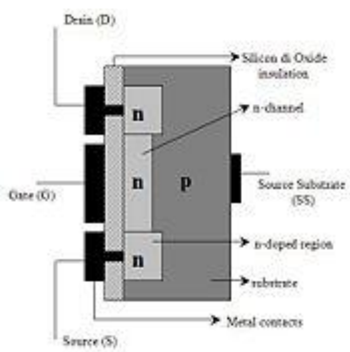
When a voltage is applied across a MOS structure, it modifies the distribution of charges in the semiconductor. If we consider a P-type semiconductor (with N_A the density of acceptors, p the density of holes; $p = N_A$ in neutral bulk), a positive voltage, V_{GB}, from gate to body (see figure) creates a depletion layer by forcing the positively charged holes away from the gate-insulator/semiconductor interface, leaving exposed a carrier-free region of immobile, negatively charged acceptor ions. See doping (semiconductor). If V_{GB} is high enough, a high concentration of negative charge carriers forms in an inversion layer located in a thin layer next to the interface between the semiconductor and the insulator. (Unlike the MOSFET, discussed below, where the inversion layer electrons are supplied rapidly from the source/drain electrodes, in the MOS capacitor they are produced much more slowly by thermal generation through carrier generation and recombination centers in the depletion region.) Conventionally, the gate voltage at which the volume density of electrons in the inversion layer is the same as the volume density of holes in the body is called the threshold voltage.

This structure with P-type body is the basis of the N-type MOSFET, which requires the addition of an N-type source and drain regions.

MOSFET structure and channel formation



Cross section of an NMOS without channel formed: OFF state



Cross section of an NMOS with channel formed: ON state

A metal–oxide–semiconductor field-effect transistor (MOSFET) is based on the modulation of charge concentration by a MOS capacitance between a body electrode and a gate electrode located above the body and insulated from all other device regions by an oxide. The MOSFET includes two additional terminals (source and drain), each connected to individual highly doped regions that are separated by the body region. These regions can be either p or n type, but they must both be of the same type, and of opposite type to the body region. The highly doped source and drain regions typically are denoted by a '+' following the type of doping. The body is not highly doped, as denoted by the lack of a '+' sign.

If the MOSFET is an n-channel or nMOS FET, then the source and drain are 'n+' regions and the body is a 'p' region. As described above, with sufficient gate voltage, above a threshold voltage value, electrons from the source (and possibly also the drain) enter the inversion layer or *n-channel* at the interface between the p region and the oxide. This conducting channel extends between the source and the drain, and current is conducted through it when a voltage is applied between source and drain.

For gate voltages below the threshold value, the channel is lightly populated, and only a very small subthreshold leakage current can flow between the source and the drain.

If the MOSFET is a p-channel or pMOS FET, then the source and drain are 'p+' regions and the body is a 'n' region. When a negative gate-source voltage (positive source-gate) is applied, it creates a *p-channel* at the surface of the n region, analogous to the n-channel case, but with opposite polarities of charges and voltages. When a voltage less negative than the threshold value (a negative voltage for p-Channel) is applied between gate and source, the channel disappears and only a very small subthreshold current can flow between the source and the drain.

The source is so named because it is the source of the charge carriers (electrons for n-channel, holes for p-channel) that flow through the channel; similarly, the drain is where the charge carriers leave the channel.

Modes of operation

The operation of a MOSFET can be separated into three different modes, depending on the voltages at the terminals. In the following discussion, a simplified algebraic model is used that is accurate only for old technology. Modern MOSFET characteristics require computer models that have rather more complex behavior. For example, see Liu [3] and the device modeling list in [1].

For an enhancement-mode, n-channel MOSFET the three operational modes are:

Cut-off or Sub-threshold or Weak Inversion Mode

When $V_{GS} < V_{\mathrm{th}}$:

where V_{th} is the threshold voltage of the device.

According to the basic threshold model, the transistor is turned off, and there is no conduction between drain and source. In reality, the Boltzmann distribution of electron energies allows some of the more energetic electrons at the source to enter the channel and flow to the drain, resulting in a subthreshold current that is an exponential function of gate–source voltage. While the current between drain and source should ideally be zero when the transistor is being used as a turned-off switch, there is a weak-inversion current, sometimes called subthreshold leakage.

In weak inversion the current varies exponentially with gate-to-source bias V_{GS} as given approximately by:[4][5]

,

whereI_{D0} = current at $V_{GS} = V_{th}$ and the slope factor n is given by

$n = 1 + C_D / C_{OX}$,

withC_D = capacitance of the depletion layer and C_{OX} = capacitance of the oxide layer. In a long-channel device, there is no drain voltage dependence of the current once $V_{DS} >> V_T$, but as channel length is reduced drain-induced barrier lowering introduces drain voltage dependence that depends in a complex way upon the device geometry (for example, the channel doping, the junction doping and so on). Frequently threshold voltage V_{th} for this mode is defined as the gate voltage at which a selected value of current I_{D0} occurs, for example, I_{D0} = 1 µA, which may not be the same V_{th}-value used in the equations for the following modes.

CHAPTER 4

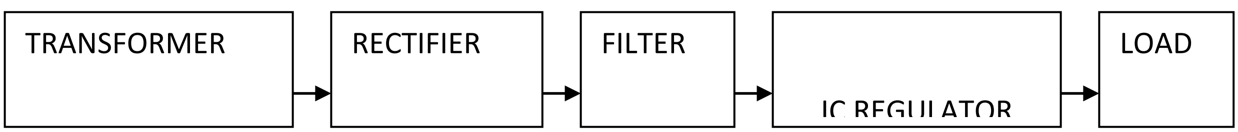
CIRCUIT DIAGRAM DESCRIPTION

POWER SUPPLY:

Block diagram

The ac voltage, typically 220V rms, is connected to a transformer, which steps that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation.

A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.



Block diagram (Power supply)

Working principle

Transformer

The potential transformer will step down the power supply voltage (0-230V) to (0-6V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, which is constructed with the help of op–amp. The advantages of using precision rectifier are it will give peak voltage output as DC, rest of the circuits will give only RMS output.

Bridge rectifier

When four diodes are connected as shown in figure, the circuit is called as bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners.

Let us assume that the transformer is working properly and there is a positive potential, at point A and a negative potential at point B. the positive potential at point A will forward bias D3 and reverse bias D4.

The negative potential at point B will forward bias D1 and reverse D2. At this time D3 and D1 are forward biased and will allow current flow to pass through them; D4 and D2 are reverse biased and will block current flow.

The path for current flow is from point B through D1, up through RL, through D3, through the secondary of the transformer back to point B. this path is indicated by the solid arrows. Waveforms (1) and (2) can be observed across D1 and D3.

One-half cycle later the polarity across the secondary of the transformer reverse, forward biasing D2 and D4 and reverse biasing D1 and D3. Current flow will now be from point A through D4, up through RL, through D2, through the secondary of T1, and back to point A. This path is indicated by the broken arrows. Waveforms (3) and (4) can be observed across D2 and D4. The current flow through RL is always in the same direction. In flowing through RL this current develops a voltage corresponding to that shown waveform (5). Since current flows through the load (RL) during both half cycles of the applied voltage, this bridge rectifier is a full-wave rectifier.

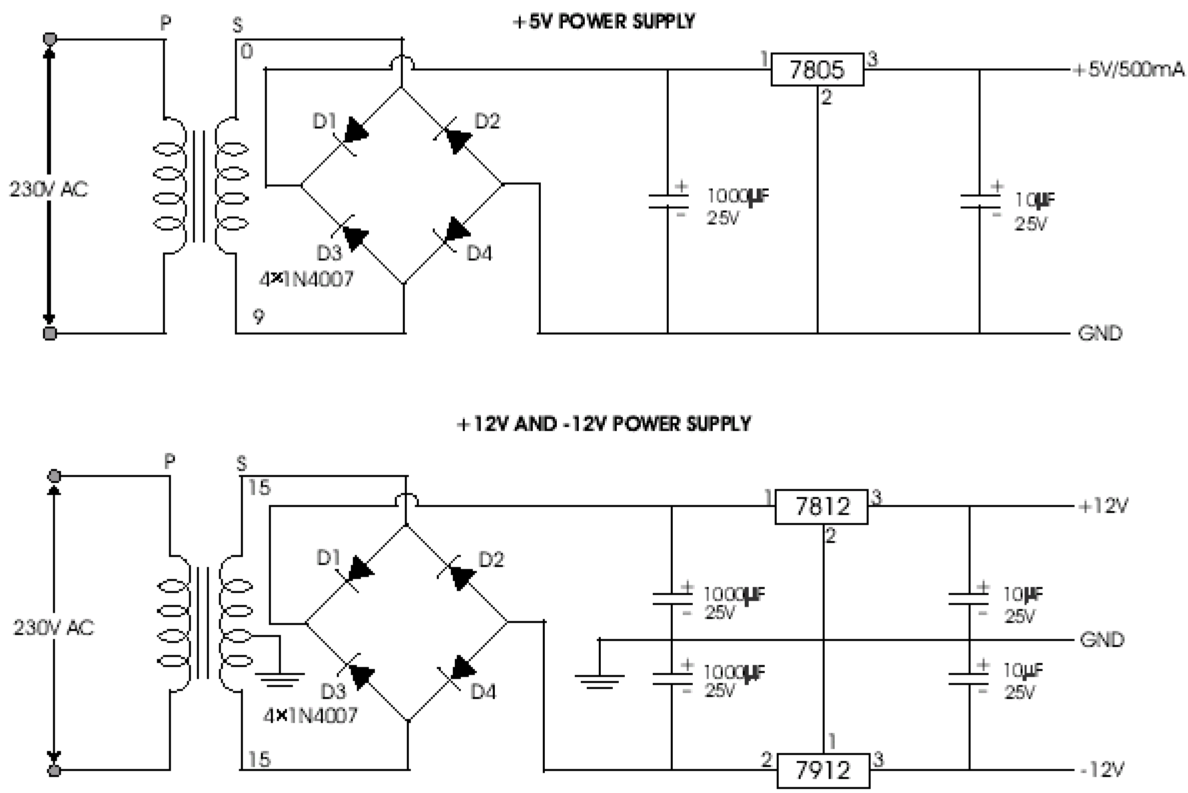
One advantage of a bridge rectifier over a conventional full-wave rectifier is that with a given transformer the bridge rectifier produces a voltage output that is nearly twice that of the conventional full-wave circuit.

This may be shown by assigning values to some of the components shown in views A and B. assume that the same transformer is used in both circuits. The peak voltage developed between points X and y is 1000 volts in both circuits. In the conventional full-wave circuit shown—in view A, the peak voltage from the center tap to either X or Y is 500 volts. Since only one diode can conduct at any instant, the maximum voltage that can be rectified at any instant is 500 volts.

The maximum voltage that appears across the load resistor is nearly-but never exceeds-500 v0lts, as result of the small voltage drop across the diode. In the bridge rectifier shown in view B, the maximum voltage that can be rectified is the full secondary voltage, which is 1000 volts. Therefore, the peak output voltage across the load resistor is nearly 1000 volts. With both circuits using the same transformer, the bridge rectifier circuit produces a higher output voltage than the conventional full-wave rectifier circuit.

IC voltage regulators

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustably set voltage. The regulators can be selected for operation with load currents from hundreds of milli amperes to tens of amperes, corresponding to power ratings from milli watts to tens of watts.



Circuit diagram (Power supply)

A fixed three-terminal voltage regulator has an unregulated dc input voltage, Vi, applied to one input terminal, a regulated dc output voltage, Vo, from a second terminal, with the third terminal connected to ground.

The series 78 regulators provide fixed positive regulated voltages from 5 to 24 volts. Similarly, the series 79 regulators provide fixed negative regulated voltages from 5 to 24 volts.

- For ICs, microcontroller, LCD --------- 5 volts
- For alarm circuit, op-amp, relay circuits ---------- 12 volts

ADVANTAGES

- Higher efficiency
- Low cost
- Reliable

APPLICATION

This project very useful E-vehicles like two wheeler and four wheelers.

CHAPTER 6

CONCLUSION

In this effective way we are designing a solar andwireless electric vehicle charging and improving battery life and efficiency. In our project main objective is charging battery in wireless method, used battery power is recharged a certain amount. The electric vehicle place important Role in Feature. For that we are creating a new method of improving a performance Electric vehicle. The main reason using a electric vehicle since the fuel prices becoming more expensive. Due to this scenario, many vehicle manufacturers looking for alternatives of energy sources other than gas. The use of electrical energy sources may improve the environment since there is less pollution. For that we need improvement of electric vehicle feature. For hat we are created project for improving a performance of Electric Vehicle using solar power.

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