TRICHY

# MIET
## ENGINEERING
## COLLEGE

## ELECTRICAL AND ELECTRONICS ENGINEERING

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MIET
INSTITUTIONS
Since 1984

# M.I.E.T Engineering College

## EEE MAGAZINE 2K16

**Er. A. Mohamed Yunus**

*Chairman*

*M.I.E.T Institutions*

### *Chairman's Message:*

It is my pleasure to greet the readers of the EEE Department magazine. I extend my wishes to all the for the meticulous work done by the blessings of the Almighty.

M.I.E.T Educational Institutions strives to excel by providing unparalleled excellence in academic prospective in a congenial atmosphere. The budding pillars here are given scrupulous value based education to mould themselves as diligent citizens. To build a harmonious society, M.I.E.T fosters comprehensive and collective practices uncompromising on the quality of education that is installed positively. The focus is also to nature intellectual and cognitive developments in the changing scenario as a catalyst to grow with the transformation in the country. A holistic essence of positive sign has spread throughout for Engineering and management education. The learning practices with innovation and interest will definitely upscale the standards to serve the future generation. This has been proved here through the immense programs conducted and attended by our staff and students. The continual involvement disseminated in our campus to keep abreast of all the advancement emerging globally is appreciable. I am here to encourage you to explore and seek great opportunities available to reach the pinnacle of eminence in all endeavors.

**Dr. S.Guharaja**

**Principal**

**M.I.E.T. Engineering College**

## Principal's message:

Nurturing creativity and inspiring innovation are two of the key elements of a successful education, and a college news letter is the perfect amalgamation of both. I am very much delighted to learn that our college is bringing out a college magazine "Digest". The college Newsletter will definitely help to showcase the activities that are happening in the campus. It provides a platform for exposing the merits and academic achievements of the students and faculty. This would definitely create an impact in the minds of readers, by way of providing larger visibility and dimension to the campus. I take this opportunity to congratulate the all the faculty coordinators and editorial members for their tireless efforts that have come to fruition in the form of this newsletter. I wish it all success and hope that this tradition will be carried through by the following generation of students to come.

**Dr.L.Jebaraj**

**HOD**

**EEE Department**

# HOD  Message:

Welcome to the Electrical and Electronics Engineering (EEE) department, M.I.E.T Engineering College, Trichy. It gives me an immense pleasure to lead the EEE Department of this prestigious institution. We take pride in our faculty; a self disciplined team with dedication and is a mixture of both academic and industrial experience working towards the growth of the students and organization. The field of Electrical and Electronics Engineering plays a key role in the national economic growth in terms of power sector, transport, industrialization and automation. In EEE department, we provide several opportunities to our faculty and students, through in-house training, workshops and training outside the college for further growth and development in their areas of expertise. We are creating a platform for students to achieve their dream jobs in Government sectors such as NTPC, Power Grid, Genco, Transco, NPDCL, SPDCL etc., and also in software and electronics design sectors. We are committed towards creating professional graduate community, which is capable to handle contemporary challenges required by the employer and society.

We welcome students, alumni, parents, industries, corporate companies and faculty to go through the website for more detail information and want to hear from you. Your suggestions, comments and even complaints will definitely help us to improve in moving to the next level of academic achievements and excellence.

## Institution Vision:

- *To be a center of excellence in Technical Education through Technical, Ethical and Professional skills for meeting the diverse needs of the Society, in particular Muslim minority community and the Nation.*

## Institution Mission:

- *To impart Quality Education, Training and Research in the fields of Engineering and Technology.*
- *To provide a conducive learning environment that enables the students to achieve professional and personal growth.*
- *To expose the contemporary issues of society, ethical practices and to create environmental awareness.*
- *To provide the required infrastructural facilities for developing the professional and innovative skills.*

## Department Vision:

- *To be recognized as centre of excellence in Electrical and Electronic Engineering, contribution to the needs of stakeholders.*

## Department Mission:

- *To impart quality education through comprehensive exposure, value additions and effective teaching learning process.*
- *To facilitate learning environment in view of challenges in the field of Electrical and Electronics Engineering.*
- *To provide platform for students to update the contemporary knowledge with professional quality and commitment to lifelong learning.*

# Technical Guest Lecture

We have organized a Technical guest lecture for our Final year Electrical and Electronics Engineering Students (67 students) as per academic schedule for one day in our Engineering College "B" Block – Training and Placement wing.

Dr.P.SivaKumar.BE ., Associate Professor/EEE/ RajaLakshmi college of engineering and Technology, Chennai has delivered the technical guest lecture on "Recent Trends in Power System" for final year students organized by Electrical Electronics Engineering department on 31/07/2015

This lecture helps to escalate the knowledge of students in recent trends in power system . Technical guest lecture topics covered the various aspects of advanced Facts techniques implemented in recent technology. The feedback received from the participants is in positive and useful manner about the program.

We have organized a Technical guest lecture for our third year Electrical and Electronics Engineering Students (60 students) as per academic schedule for one day in our Engineering college "C" Block – Seminar hall.

Dr.K.Sathyanarayanan.BE ., Service head (South Zone), EMT megathermpvt, LTD,Chennai has delivered the technical guest lecture on "Royal Of Power Electronics In Electrical Applications " for third year students organized by Electrical Electronics Engineeringdepartment on 12/08/2015

This lecture enhanced the student's knowledge in Royal Of Power Electronics In Electrical Applications . Guest lecture topics covered in the area of operation of various components used for Electrical Applications .  The feedback received from the participants is in positive and useful manner about the program.

# Passive infrared sensor

## G.Gurumoorthy

## (ASSISTANT PROFESSOR/EEE)

### Introduction:

*A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion detectors.*

### Operating principles :

*All objects with a temperature above absolute zero emit heat energy in the form of radiation. Usually this radiation isn't visible to the human eye because it radiates at infrared wavelengths, but it can be detected by electronic devices designed for such a purpose.*

*The term passive in this instance refers to the fact that PIR devices do not generate or radiate energy for detection purposes. They work entirely by detecting infrared radiation (radiant heat) emitted by or reflected from objects.*

### Construction:

*Infrared radiation enters through the front of the sensor, known as the 'sensor face'. At the core of a PIR sensor is a solid state sensor or set of sensors, made from pyroelectric materials— materials which generate energy when exposed to heat.*

*Typically, the sensors are approximately 1/4 inch square (40 mm$^2$), and take the form of a thin film. Materials commonly used in PIR sensors include gallium nitride (GaN), caesium nitrate (CsNO$_3$), polyvinyl fluorides, derivatives of phenylpyridine, and cobaltphthalocyanine. The sensor is often manufactured as part of an integrated circuit.*

*A PIR-based motion detector is used to sense movement of people, animals, or other objects. They are commonly used in burglar alarms and automatically-activated lighting systems. They are commonly called simply "PIR", or sometimes "PID", for "passive infrared detector".*

### Operation:

*An individual PIR sensor detects changes in the amount of infrared radiation impinging upon it, which varies depending on the temperature and surface characteristics of the objects in front of the sensor.*

# Product design:

The PIR sensor is typically mounted on a printed circuit boardcontaining the necessary electronics required to interpret the signals from the sensor itself. The complete assembly is usually contained within a housing, mounted in a location where the sensor can cover area to be monitored.



PIR motion sensor design

The housing will usually have a plastic "window" through which the infrared energy can enter. Despite often being only translucent to visible light, infrared energy is able to reach the sensor through the window because the plastic used is transparent to infrared radiation.

The plastic window reduces the chance of foreign objects (dust, insects, etc.) from obscuring the sensor's field of view, damaging the mechanism, and/or causing false alarms.

The window may be used as a filter, to limit the wavelengths to 8-14 micrometres, which is closest to the infrared radiation emitted by humans. It may also serve as a focusing mechanism; see below.

# Focusing:

Different mechanisms can be used to focus the distant infrared energy onto the sensor surface.

# Lenses:

The plastic window covering may have multiple facets molded into it, to focus the infrared energy onto the sensor. Each individual facet is a Fresnel lens.

# Security applications:

When used as part of a security system, the electronics in the PIR typically control a small relay. This relay completes the circuit across a pair of electrical contacts connected to a detection input zone of the burglar alarm control panel.

The system is usually designed such that if no motion is being detected, the relay contact is closed—a 'normally closed' (NC) relay. If motion is detected, the relay will open the circuit, triggering the alarm; or, if a wire is disconnected, the alarm will also operate.

# Placement:

Manufacturers recommend careful placement of their products to prevent false alarms (i.e., any detection not caused by an intruder).

They suggest mounting the PIRs in such a way that the PIR cannot "see" out of a window.

Although the wavelength of infrared radiation to which the chips are sensitive does not penetrate glass very well, a strong infrared source (such as from a vehicle headlight or sunlight) can overload the sensor and cause a false alarm. A person moving on the other side of the glass would not be "seen" by the PID. That may be good for a window facing a public sidewalk, or bad for a window in an interior partition.

It is also recommended that the PIR not be placed in such a position that an HVAC vent would blow hot or cold air onto the surface of the plastic which covers the housing's window. Although air has very low emissivity (emits very small amounts of infrared energy), the air blowing on the plastic window cover could change the plastic's temperature enough to trigger a false alarm.

Sensors are also often designed to "ignore" domestic pets, such as dogs or cats, by setting a higher sensitivity threshold, or by ensuring that the floor of the room remains out of focus.

Since PIR sensors have ranges of up to 10 meters (30 feet), a single detector placed near the entrance is typically all that is necessary for rooms with only a single entrance. PIR-based security systems are also viable in outdoor security and motion-sensitive lighting; one advantage is their low power draw, which allows them to be solar-powered.

## *PIR remote-based thermometer*

Designs have been implemented in which a PIR circuit measures the temperature of a remote object .In such a circuit, a non-differential PIR output is used. The output signal is evaluated according to a calibration for the IR spectrum of a specific type of matter to be observed.

By this means, relatively accurate and precise temperature measurements may be obtained remotely. Without calibration to the type of material being observed, a PIR thermometer device is able to measure changes in IR emission which correspond directly to temperature changes, but the actual temperature values cannot be calculated.

PIR sensor

Fresnel lens

Detecting area
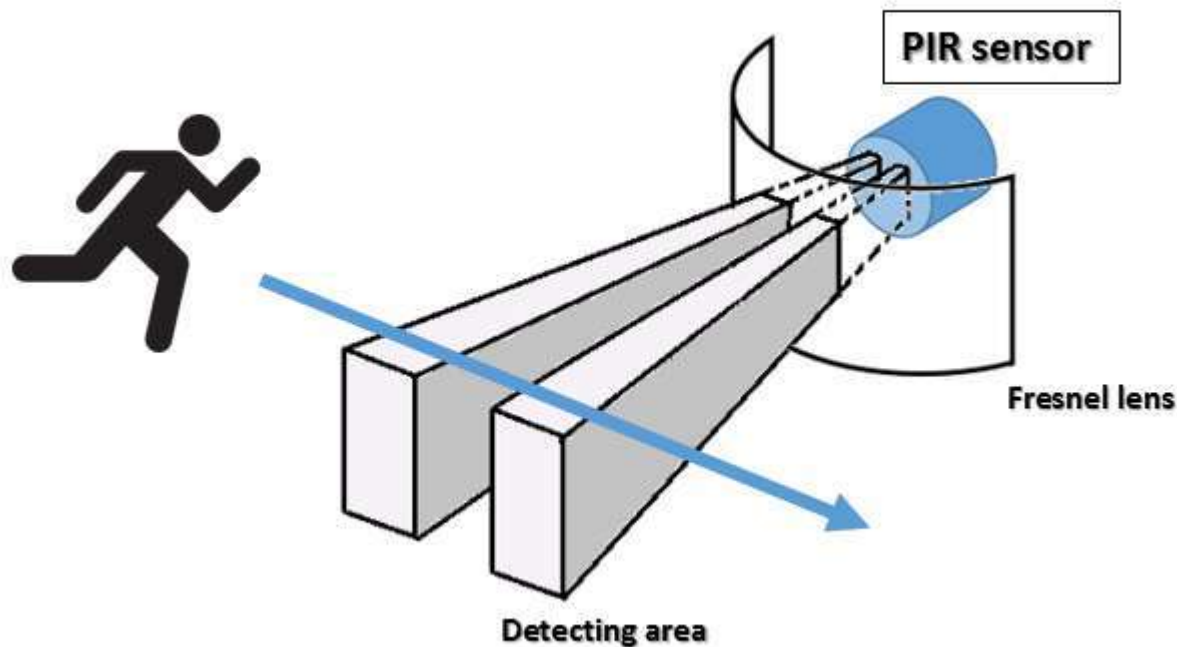
## Practical Implementation

*When a PIR sensor is configured in a differential mode, it specifically becomes applicable as a motion detector device. In this mode when a human movement is detected within the "line of sight" of the PIR sensor, a pair of complementary pulses are processed at the output pin of the PIR sensor. In order to implement this output signal for a practical triggering of a load such as a relay or a data logger, or an alarm, the differential signal is rectified using a bridge rectifier and fed to a transistorized relay driver circuit. The contacts of this relay close and open in response to the signals from the PIR, activating the attached load across its contacts, acknowledging the detection of a human being within the predetermined restricted area.*

## Conclusion:

*An infrared sensor is an electronic device, that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion.These types of sensorsmeasures only infrared radiation, rather than emitting it that is called as a passive IR sensor.*

# SCADA

## E.Muthukumaran

## (ASSISTANT PROFESSOR/EEE)

*Supervisory control and data acquisition (SCADA) is a control system architecture that uses computers, networked data communications and graphical user interfaces for high-level process supervisory management, but uses other peripheral devices such as programmable logic controller (PLC) and discrete PID controllers to interface with the process plant or machinery. The use of SCADA has been also considered for management and operations of project-driven-process in construction.*

## Explanation:

*The operator interfaces that enable monitoring and the issuing of process commands, such as controller set point changes, are handled through the SCADA computer system. However, the real-time control logic or controller calculations are performed by networked modules that connect to the field sensors and actuators.*

*The SCADA concept was developed as a universal means of remote access to a variety of local control modules, which could be from different manufacturers allowing access through standard automation protocols. In practice, large SCADA systems have grown to become very similar to distributed control systems in function, but using multiple means of interfacing with the plant.*

*They can control large-scale processes that can include multiple sites, and work over large distances as well as small distance. It is one of the most commonly-used types of industrial control systems, however there are concerns about SCADA systems being vulnerable to cyberwarfare/cyberterrorism attacks.*

## The SCADA concept in control operations:
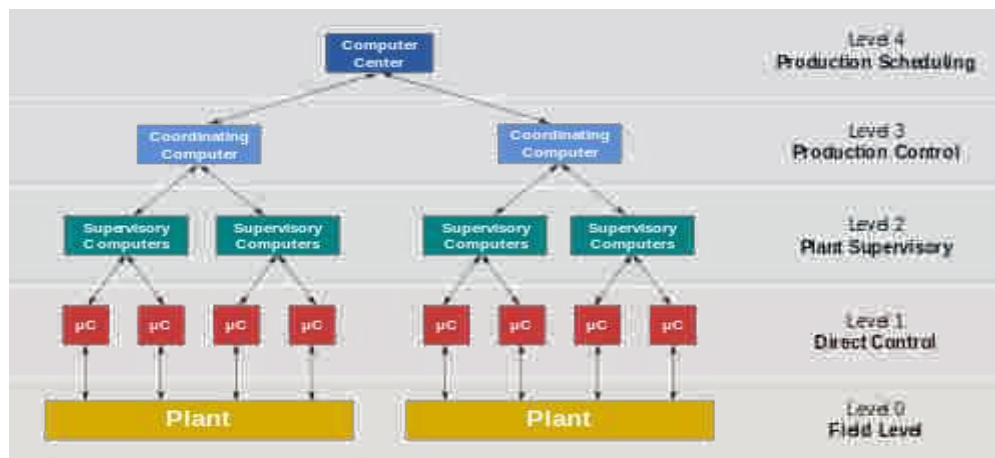
# Functional levels of a manufacturing control operation:

The key attribute of a SCADA system is its ability to perform a supervisory operation over a variety of other proprietary devices.

The accompanying diagram is a general model which shows functional manufacturing levels using computerised control.

## Referring to the diagram,

- Level 0 contains the field devices such as flow and temperature sensors, and final control elements, such as control valves.
- Level 1 contains the industrialised input/output (I/O) modules, and their associated distributed electronic processors.
- Level 2 contains the supervisory computers, which collate information from processor nodes on the system, and provide the operator control screens.
- Level 3 is the production control level, which does not directly control the process, but is concerned with monitoring production and targets.
- Level 4 is the production scheduling level.

**Level 1** contains the programmable logic controllers (PLCs) or remote terminal units (RTUs).

**Level 2** contains the SCADA software and computing platform. The SCADA software exists only at this supervisory level as control actions are performed automatically by RTUs or PLCs. SCADA control functions are usually restricted to basic overriding or supervisory level intervention. For example, a PLC may control the flow of cooling water through part of an industrial process to a set point level, but the SCADA system software will allow operators to change the set points for the flow. The SCADA also enables alarm conditions, such as loss of flow or high temperature, to be displayed and recorded. A feedback control loop is directly controlled by the RTU or PLC, but the SCADA software monitors the overall performance of the loop.

**Levels 3** and **4** are not strictly process control in the traditional sense, but are where production control and scheduling takes place.

Data acquisition begins at the RTU or PLC level and includes instrumentation readings and equipment status reports that are communicated to level 2 SCADA as required. Data is then compiled and formatted in such a way that a control room operator using the HMI (Human Machine Interface) can make supervisory decisions to adjust or override normal RTU (PLC) controls. Data may also be fed to a historian, often built on a commodity database management system, to allow trending and other analytical auditing.

SCADA systems typically use a tag database, which contains data elements called tags or points, which relate to specific instrumentation or actuators within the process system accordingto such as the Piping and instrumentation diagram. Data is accumulated against these unique process control equipment tag references.

# SCADA system components:
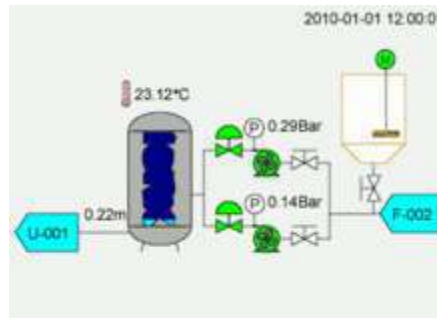


## Supervisory computers:

This is the core of the SCADA system, gathering data on the process and sending control commands to the field connected devices. It refers to the computer and software responsible for communicating with the field connection controllers, which are RTUs and PLCs, and includes the HMI software running on operator workstations. In smaller SCADA systems, the supervisory computer may be composed of a single PC, in which case the HMI is a part of this computer.

In larger SCADA systems, the master station may include several HMIs hosted on client computers, multiple servers for data acquisition, distributed software applications, and disaster recovery sites. To increase the integrity of the system the multiple servers will often be configured in a dual-redundant or hot-standby formation providing continuous control and monitoring in the event of a server malfunction or breakdown.

## PLC/RTU programming:

"Smart" RTUs, or standard PLCs, are capable of autonomously executing simple logic processes without involving the supervisory computer. They employ standardized control programming languages such as under, IEC 61131-3 (a suite of 5 programming languages including function block, ladder, structured text, sequence function charts and instruction list), is frequently used to create programs which run on these RTUs and PLCs.

Unlike a procedural language such as the C programming language or FORTRAN, IEC 61131-3 has minimal training requirements by virtue of resembling historic physical control arrays. This allows SCADA system engineers to perform both the design and implementation of a program to be executed on an RTU or PLC.

A programmable automation controller (PAC) is a compact controller that combines the features and capabilities of a PC-based control system with that of a typical PLC. PACs are deployed in SCADA systems to provide RTU and PLC functions. In many electrical substation SCADA applications, "distributed RTUs" use information processors or station computers to communicate with digital protective relays, PACs, and other devices for I/O, and communicate with the SCADA master in lieu of a traditional RTU.

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# PLC commercial integration:

*Since about 1998, virtually all major PLC manufacturers have offered integrated HMI/SCADA systems, many of them using open and non-proprietary communications protocols. Numerous specialized third-party HMI/SCADA packages, offering built-in compatibility with most major PLCs, have also entered the market, allowing mechanical engineers, electrical engineers and technicians to configure HMIs themselves, without the need for a custom-made program written by a software programmer.*

*The Remote Terminal Unit (RTU) connects to physical equipment. Typically, an RTU converts the electrical signals from the equipment to digital values such as the open/closed status from a switch or a valve, or measurements such as pressure, flow, voltage or current. By converting and sending these electrical signals out to equipment the RTU can control equipment, such as opening or closing a switch or a valve, or setting the speed of a pump.*

## Ladder Logic:

*Ladder logic is a programming language that creates and represents a program through ladder diagrams that are based on circuit diagrams. It is mainly used in developing programs or software for programmable logic controllers (PLCs), which are used in industrial applications.*
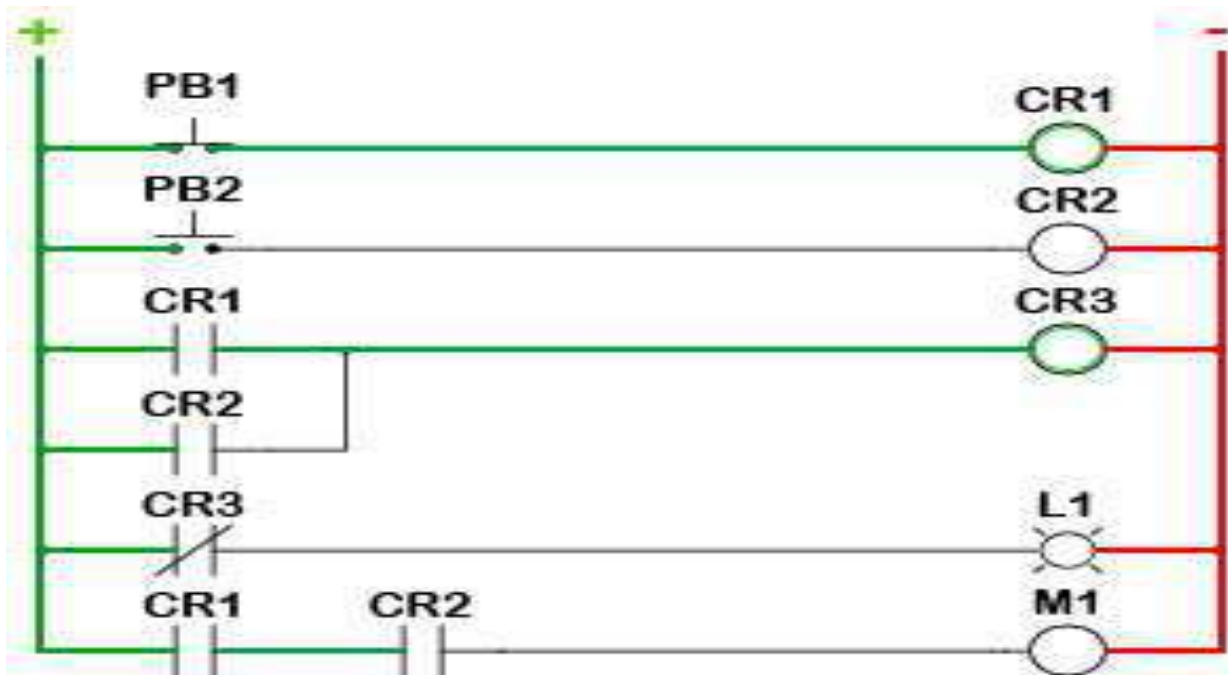


## CONCLUSION:

*SCADA systemsare used to monitor and control a plant or equipment in industries such as telecommunications, water and waste control, energy, oil and gas refining and transportation.*

# Power electronics

## D.Tamilselvan

## (ASSISTANT PROFESSOR/EEE)

*Power electronics is the application of solid-state electronics to the control and conversion of electric power.*

*The first high power electronic devices were mercury-arc valves. In modern systems the conversion is performed with semiconductor switching devices such as diodes, thyristors and transistors, pioneered by R. D. Middlebrook and others beginning in the 1950s. In contrast to electronic systems concerned with transmission and processing of signals and data, in power electronics substantial amounts of electrical energy are processed.*

*An AC/DC converter (rectifier) is the most typical power electronics device found in many consumer electronic devices, e.g. television sets, personal computers, battery chargers, etc. The power range is typically from tens of watts to several hundred watts. In industry a common application is the variable speed drive (VSD) that is used to control an induction motor. The power range of VSDs start from a few hundred watts and end at tens of megawatts.*

*The power conversion systems can be classified according to the type of the input and output power*

- *AC to DC (rectifier)*
- *DC to AC (inverter)*
- *DC to DC (DC-to-DC converter)*
- *AC to AC (AC-to-AC converter)*

## History:

*Power electronics started with the development of the mercury arc rectifier. Invented by Peter Cooper Hewitt in 1902, it was used to convert alternating current (AC) into direct current (DC). From the 1920s on, research continued on applying thyratrons and grid-controlled mercury arc valves to power transmission. Uno Lamm developed a mercury valve with grading electrodes making them suitable for high voltage direct current power transmission. In 1933 selenium rectifiers were invented.*

*In 1947 the bipolar point-contact transistor was invented by Walter H. Brattain and John Bardeen under the direction of William Shockley at Bell Labs. In 1948 Shockley's invention of the bipolar junction transistor (BJT) improved the stability and performance of transistors, and reduced costs. By the 1950s, higher power semiconductor diodes became available and started replacing vacuum tubes. In 1956 the silicon controlled rectifier (SCR) was introduced by General Electric, greatly increasing the range of power electronics applications.*

*By the 1960s the improved switching speed of bipolar junction transistors had allowed for high frequency DC/DC converters. In 1976 power MOSFETs became commercially available. In 1982 the Insulated Gate Bipolar Transistor (IGBT) was introduced.*

# Devices:

The capabilities and economy of power electronics system are determined by the active devices that are available. Their characteristics and limitations are a key element in the design of power electronics systems. Formerly, the mercury arc valve, the high-vacuum and gas-filled diode thermionic rectifiers, and triggered devices such as the thyratron and ignitron were widely used in power electronics. As the ratings of solid-state devices improved in both voltage and current-handling capacity, vacuum devices have been nearly entirely replaced by solid-state devices.

Power electronic devices may be used as switches, or as amplifiers. An ideal switch is either open or closed and so dissipates no power; it withstands an applied voltage and passes no current, or passes any amount of current with no voltage drop. Semiconductor devices used as switches can approximate this ideal property and so most power electronic applications rely on switching devices on and off, which makes systems very efficient as very little power is wasted in the switch. By contrast, in the case of the amplifier, the current through the device varies continuously according to a controlled input. The voltage and current at the device terminals follow a load line, and the power dissipation inside the device is large compared with the power delivered to the load.

Several attributes dictate how devices are used. Devices such as diodes conduct when a forward voltage is applied and have no external control of the start of conduction. Power devices such as silicon controlled rectifiers and thyristors (as well as the mercury valve and thyratron) allow control of the start of conduction, but rely on periodic reversal of current flow to turn them off. Devices such as gate turn-off thyristors, BJT and MOSFET transistors provide full switching control and can be turned on or off without regard to the current flow through them. Transistor devices also allow proportional amplification, but this is rarely used for systems rated more than a few hundred watts. The control input characteristics of a device also greatly affect design; sometimes the control input is at a very high voltage with respect to ground and must be driven by an isolated source.

As efficiency is at a premium in a power electronic converter, the losses that a power electronic device generates should be as low as possible.

Devices vary in switching speed. Some diodes and thyristors are suited for relatively slow speed and are useful for power frequency switching and control; certain thyristors are useful at a few kilohertz. Devices such as MOSFETS and BJTs can switch at tens of kilohertz up to a few megahertz in power applications, but with decreasing power levels. Vacuum tube devices dominate high power (hundreds of kilowatts) at very high frequency (hundreds or thousands of megahertz) applications. Faster switching devices minimize energy lost in the transitions from on to off and back, but may create problems with radiated electromagnetic interference. Gate drive (or equivalent) circuits must be designed to supply sufficient drive current to achieve the full switching speed possible with a device.

A device without sufficient drive to switch rapidly may be destroyed by excess heating. Practical devices have non-zero voltage drop and dissipate power when on, and take some time to pass through an active region until they reach the "on" or "off" state. These losses are a significant part of the total lost power in a converter.

*Power handling and dissipation of devices is also a critical factor in design. Power electronic devices may have to dissipate tens or hundreds of watts of waste heat, even switching as efficiently as possible between conducting and non-conducting states. In the switching mode, the power controlled is much larger than the power dissipated in the switch. The forward voltage drop in the conducting state translates into heat that must be dissipated. High power semiconductors require specialized heat sinks or active cooling systems to manage their junction temperature; exotic semiconductors such as silicon carbide have an advantage over straight silicon in this respect, and germanium, once the main-stay of solid-state electronics is now little used due to its unfavorable high temperature properties.*

*Semiconductor devices exist with ratings up to a few kilovolts in a single device. Where very high voltage must be controlled, multiple devices must be used in series, with networks to equalize voltage across all devices. Again, switching speed is a critical factor since the slowest-switching device will have to withstand a disproportionate share of the overall voltage. Mercury valves were once available with ratings to 100 kV in a single unit, simplifying their application in HVDC systems.*

*The current rating of a semiconductor device is limited by the heat generated within the dies and the heat developed in the resistance of the interconnecting leads. Semiconductor devices must be designed so that current is evenly distributed within the device across its internal junctions (or channels); once a "hot spot" develops, breakdown effects can rapidly destroy the device. Certain SCRs are available with current ratings to 3000 amperes in a single unit.*

## DC/AC converters (inverters):

*DC to AC converters produce an AC output waveform from a DC source. Applications include adjustable speed drives (ASD), uninterruptible power supplies (UPS), Flexible AC transmission systems (FACTS), voltage compensators, and photovoltaic inverters. Topologies for these converters can be separated into two distinct categories: voltage source inverters and current source inverters. Voltage source inverters (VSIs) are named so because the independently controlled output is a voltage waveform. Similarly, current source inverters (CSIs) are distinct in that the controlled AC output is a current waveform.*

*DC to AC power conversion is the result of power switching devices, which are commonly fully controllable semiconductor power switches. The output waveforms are therefore made up of discrete values, producing fast transitions rather than smooth ones. For some applications, even a rough approximation of the sinusoidal waveform of AC power is adequate. Where a near sinusoidal waveform is required, the switching devices are operated much faster than the desired output frequency, and the time they spend in either state is controlled so the averaged output is nearly sinusoidal. Common modulation techniques include the carrier-based technique, or Pulse-width modulation, space-vector technique, and the selective-harmonic technique.*

# AC/AC converters:

Converting AC power to AC power allows control of the voltage, frequency, and phase of the waveform applied to a load from a supplied AC system . The two main categories that can be used to separate the types of converters are whether the frequency of the waveform is changed.AC/AC converterthat don't allow the user to modify the frequencies are known as AC Voltage Controllers, or AC Regulators. AC converters that allow the user to change the frequency are simply referred to as frequency converters for AC to AC conversion. Under frequency converters there are three different types of converters that are typically used: cycloconverter, matrix converter, DC link converter (aka AC/DC/AC converter).

AC voltage controller: The purpose of an AC Voltage Controller, or AC Regulator, is to vary the RMS voltage across the load while at a constant frequency. Three control methods that are generally accepted are ON/OFF Control, Phase-Angle Control, and Pulse Width Modulation AC Chopper Control (PWM AC Chopper Control). All three of these methods can be implemented not only in single-phase circuits, but three-phase circuits as well.

- ON/OFF Control: Typically used for heating loads or speed control of motors, this control method involves turning the switch on for n integral cycles and turning the switch off for m integral cycles. Because turning the switches on and off causes undesirable harmonics to be created, the switches are turned on and off during zero-voltage and zero-current conditions (zero-crossing), effectively reducing the distortion.
- Phase-Angle Control: Various circuits exist to implement a phase-angle control on different waveforms, such as half-wave or full-wave voltage control. The power electronic components that are typically used are diodes, SCRs, and Triacs. With the use of these components, the user can delay the firing angle in a wave which will only cause part of the wave to be in output.
- PWM AC Chopper Control: The other two control methods often have poor harmonics, output current quality, and input power factor. In order to improve these values PWM can be used instead of the other methods. What PWM AC Chopper does is have switches that turn on and off several times within alternate half-cycles of input voltage

# Inverters:

In general, inverters are utilized in applications requiring direct conversion of electrical energy from DC to AC or indirect conversion from AC to AC. DC to AC conversion is useful for many fields, including power conditioning, harmonic compensation, motor drives, and renewable energy grid-integration.

In power systems it is often desired to eliminate harmonic content found in line currents. VSIs can be used as active power filters to provide this compensation. Based on measured line currents and voltages, a control system determines reference current signals for each phase. This is fed back through an outer loop and subtracted from actual current signals to create current signals for an inner loop to the inverter. These signals then cause the inverter to generate output currents that compensate for the harmonic content.

This configuration requires no real power consumption, as it is fully fed by the line; the DC link is simply a capacitor that is kept at aconstant voltage by the control system. In this configuration, output currents are in phase with line voltages to produce a unity power factor. Conversely, VAR compensation is possible in a similar configuration where output currents lead line voltages to improve the overall power factor
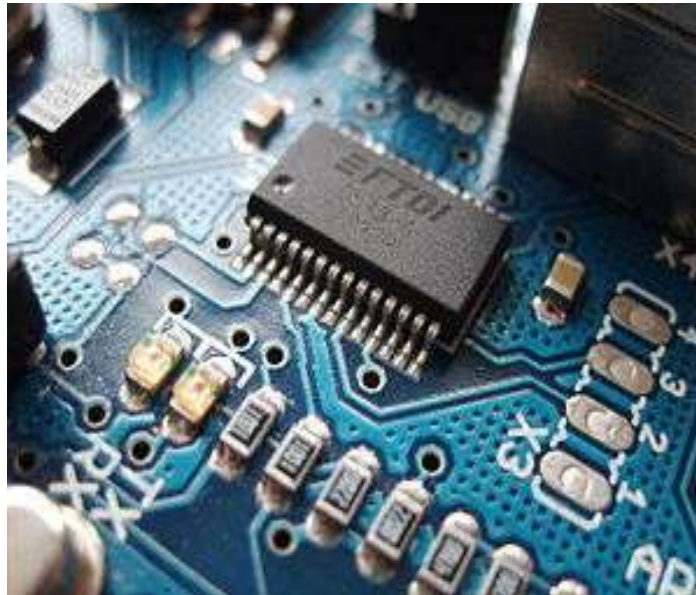


## Applications:

- DC/DC converters are used in most mobile devices (mobile phones, PDA etc.) to maintain the voltage at a fixed value whatever the voltage level of the battery is. These converters are also used for electronic isolation and power factor correction. A power optimizer is a type of DC/DC converter developed to maximize the energy harvest from solar photovoltaic or wind turbine systems.
- AC/DC converters (rectifiers) are used every time an electronic device is connected to the mains (computer, television etc.). These may simply change AC to DC or can also change the voltage level as part of their operation.
- AC/AC converters are used to change either the voltage level or the frequency (international power adapters, light dimmer). In power distribution networks AC/AC converters may be used to exchange power between utility frequency 50 Hz and 60 Hz power grids.
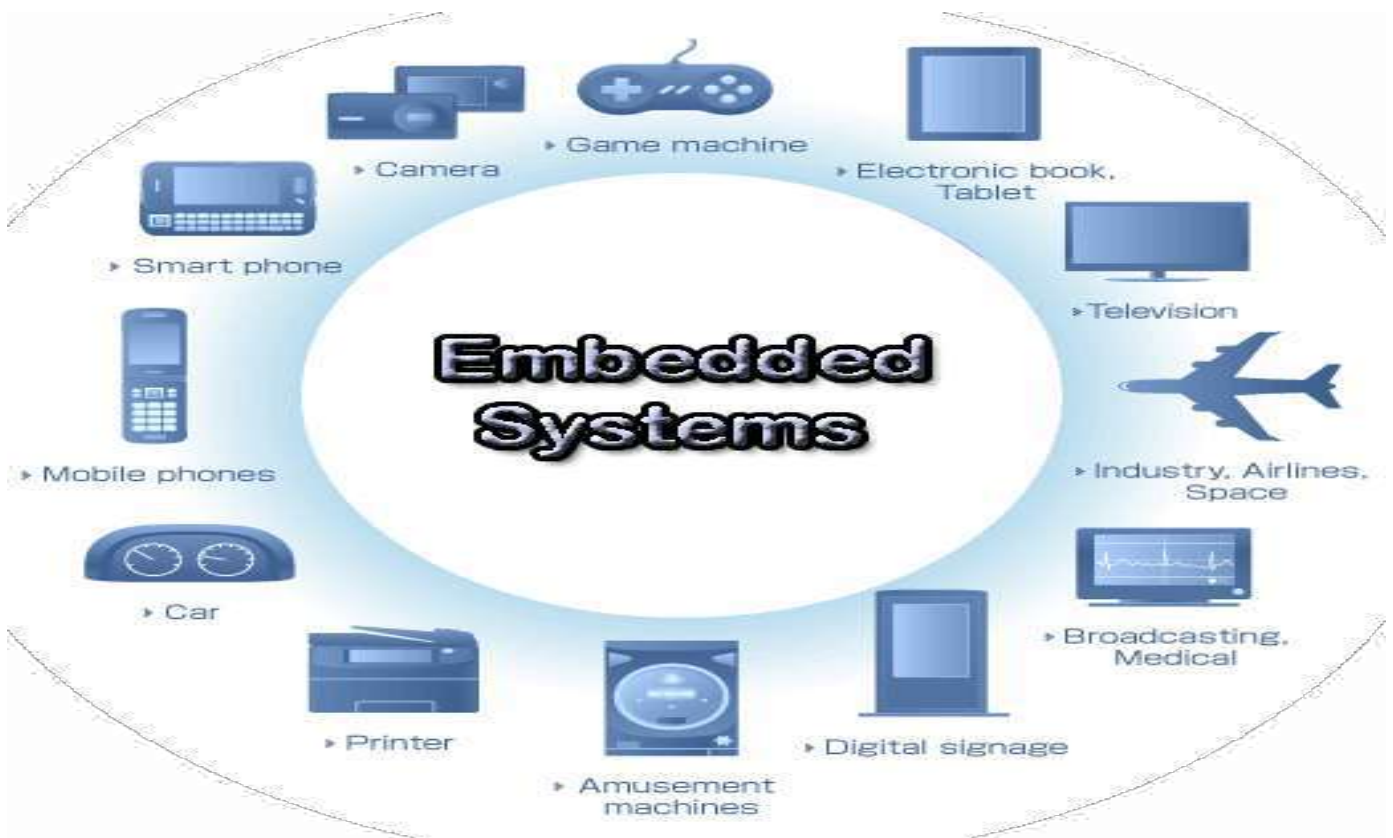
## conclusion:

As the trend towards electrification and renewable energies increases, enabling technologies such as power electronics are becoming ever more important. Power electronics is an umbrella term that encompasses the systems and products involved in converting and controlling the flow of electrical energy.

# Embedded system

## G.Ramya

## IV year EEE



*Modern embedded systems are often based on microcontrollers (i.e. CPUs with integrated memory or peripheral interfaces), but ordinary microprocessors (using external chips for memory and peripheral interface circuits) are also common, especially in more complex systems. In either case, the processor(s) used may be types ranging from general purpose to those specialized in certain class of computations, or even custom designed for the application at hand. A common standard class of dedicated processors is the digital signal processor (DSP).*

*Since the embedded system is dedicated to specific tasks, design engineers can optimize it to reduce the size and cost of the product and increase the reliability and performance. Some embedded systems are mass-produced, benefiting from economies of scale.*

*Embedded systems range from portable devices such as digital watches and MP3 players, to large stationary installations like traffic lights, factory controllers, and largely complex systems like hybrid vehicles, MRI, and avionics. Complexity varies from low, with a single microcontroller chip, to very high with multiple units, peripherals and networks mounted inside a large chassis or enclosure.*

# Applications:



*Embedded Computer Sub-Assembly for Accupoll Electronic Voting Machine*

*Embedded systems are commonly found in consumer, industrial, automotive, medical, commercial and military applications.*

*Telecommunications systems employ numerous embedded systems from telephone switches for the network to cell phones at the end user. Computer networking uses dedicated routers and network bridges to route data.*

*Consumer electronics include MP3 players, mobile phones, video game consoles, digital cameras, GPS receivers, and printers. Household appliances, such as microwave ovens, washing machines and dishwashers, include embedded systems to provide flexibility, efficiency and features. Advanced HVAC systems use networked thermostats to more accurately and efficiently control temperature that can change by time of day and season. Home automation uses wired-and wireless-networking that can be used to control lights, climate, security, audio/visual, surveillance, etc., all of which use embedded devices for sensing and controlling.*

*Transportation systems from flight to automobiles increasingly use embedded systems. New airplanes contain advanced avionics such as inertial guidance systems and GPS receivers that also have considerable safety requirements. Various electric motors brushless DC motors, induction motors and DC motors use electric/electronic motor controllers.*

*Automobiles, electric vehicles, and hybrid vehicles increasingly use embedded systems to maximize efficiency and reduce pollution. Other automotive safety systems include anti-lock braking system (ABS), Electronic Stability Control (ESC/ESP), traction control (TCS) and automatic four wheel drive.*

*Medical equipment uses embedded systems for vital signs monitoring, electronic stethoscopes for amplifying sounds, and various medical imaging (PET, SPECT, CT,and MRI) for non-invasive internal inspections. Embedded systems within medical equipment are often powered by industrial computers.*

Embedded systems are used in transportation, fire safety, safety and security, medical applications and life critical systems, as these systems can be isolated from hacking and thus, be more reliable, unless connected to wired or wireless networks via on-chip 3G cellular or other methods for IoT monitoring and control purposes. For fire safety, the systems can be designed to have greater ability to handle higher temperatures and continue to operate. In dealing with security, the embedded systems can be self-sufficient and be able to deal with cut electrical and communication systems.

A new class of miniature wireless devices called motes are networked wireless sensors. Wireless sensor networking, WSN, makes use of miniaturization made possible by advanced IC design to couple full wireless subsystems to sophisticated sensors, enabling people and companies to measure a myriad of things in the physical world and act on this information through IT monitoring and control systems. These motes are completely self-contained, and will typically run off a battery source for years before the batteries need to be changed or charged.

Embedded Wi-Fi modules provide a simple means of wirelessly enabling any device that communicates via a serial port.

## Characteristics:
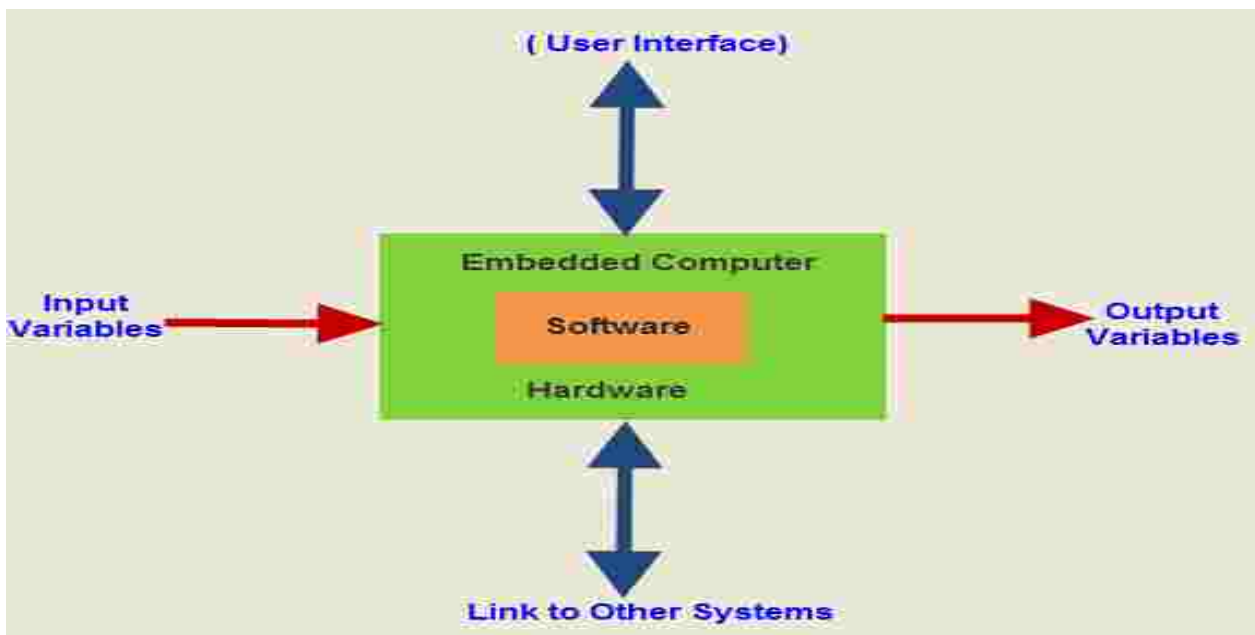


Embedded systems are designed to do some specific task, rather than be a general purpose computer for multiple tasks. Some also have real-time performance constraints that must be met, for reasons such as safety and usability; others may have low or no performance requirements, allowing the system hardware to be simplified to reduce costs.

Embedded systems are not always standalone devices. Many embedded systems consist of small parts within a larger device that serves a more general purpose. For example, the Gibson Robot Guitar features an embedded system for tuning the strings, but the overall purpose of the Robot Guitar is, of course, to play music. Similarly, an embedded system in an automobile provides a specific function as a subsystem of the car itself.

## _e-con Systems eSOM270 & eSOM300 Computer on Modules_

_The program instructions written for embedded systems are referred to as firmware, and are stored in read-only memory or flash memory chips. They run with limited computer hardware resources: little memory, small or non-existent keyboard or screen._

## Debugging :

- _Interactive resident debugging, using the simple shell provided by the embedded operating system (e.g. Forth and Basic)_
- _External debugging using logging or serial port output to trace operation using either a monitor in flash or using a debug server like the Remedy Debugger that even works for heterogeneous multicore systems._
- _An in-circuit debugger (ICD), a hardware device that connects to the microprocessor via a JTAG or Nexus interface. This allows the operation of the microprocessor to be controlled externally, but is typically restricted to specific debugging capabilities in the processor._
- _An in-circuit emulator (ICE) replaces the microprocessor with a simulated equivalent, providing full control over all aspects of the microprocessor._
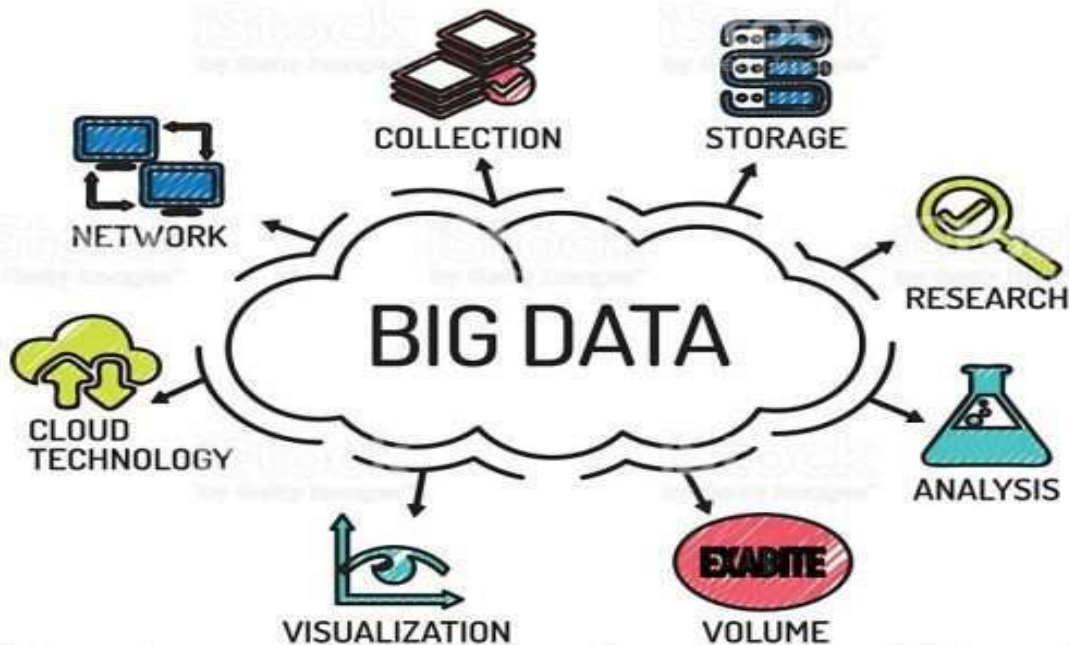
## Conclusion:

_An embedded system is a computer system with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. Embedded systems control many devices in common use today._
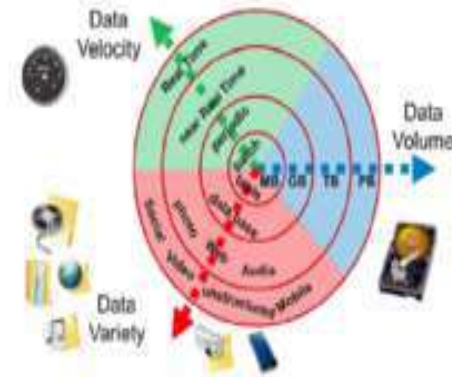
# Big Data

## S.SUDHAKAR

## IV year EEE



Big data is a term used to refer to data sets that are too large or complex for traditional data-processingapplication software to adequately deal with. Data with many cases (rows) offer greater statistical power, while data with higher complexity (more attributes or columns) may lead to a higher false discovery rate. Big data challenges include capturing data, data storage, data analysis, search, sharing, transfer, visualization, querying, updating, information privacy and data source. Big data was originally associated with three key concepts: volume, variety, and velocity. Other concepts later attributed with big data are veracity (i.e., how much noise is in the data) and value.

Current usage of the term "big data" tends to refer to the use of predictive analytics, user behavior analytics, or certain other advanced data analytics methods that extract value from data, and seldom to a particular size of data set. "There is little doubt that the quantities of data now available are indeed large, but that's not the most relevant characteristic of this new data ecosystem." Analysis of data sets can find new correlations to "spot business trends, prevent diseases, combat crime and so on." Scientists, business executives, practitioners of medicine, advertising and governments alike regularly meet difficulties with large data-sets in areas including Internet search, fintech, urban informatics, and business informatics. Scientists encounter limitations in e-Science work, including meteorology, genomics, connectomics, complex physics simulations, biology and environmental research.

# Characteristics:



*Shows the growth of big data's primary characteristics of volume, velocity, and variety.*

*Big data can be described by the following characteristics:*

## Volume:

*The type and nature of the data. This helps people who analyze it to effectively use the resulting insight. Big data draws from text, images, audio, video; plus it completes missing pieces through data fusion.*

## Velocity:

*In this context, the speed at which the data is generated and processed to meet the demands and challenges that lie in the path of growth and development. Big data is often available in real-time. Compared to small data, big data are produced more continually. Two kinds of velocity related to Big Data are the frequency of generation and the frequency of handling, recording, and publishing*

## Veracity:

*It is the extended definition for big data, which refers to the data quality and the data value The data quality of captured data can vary greatly, affecting the accurate analysis.*

*Data must be processed with advanced tools (analytics and algorithms) to reveal meaningful information. For example, to manage a factory one must consider both visible and invisible issues with various components. Information generation algorithms must detect and address invisible issues such as machine degradation, component wear, etc. on the factory floor.*

## Manufacturing

*Based on TCS 2013 Global Trend Study, improvements in supply planning and product quality provide the greatest benefit of big data for manufacturing. Big data provides an infrastructure for transparency in manufacturing industry, which is the ability to unravel uncertainties such as inconsistent component performance and availability. Predictive manufacturing as an applicable approach toward near-zero downtime and transparency requires vast amount of data and advanced prediction tools for a systematic process of data into useful information.*

*A conceptual framework of predictive manufacturing begins with data acquisition where different type of sensory data is available to acquire such as acoustics, vibration, pressure, current, voltage and controller data. Vast amount of sensory data in addition to historical data construct the big data in manufacturing. The generated big data acts as the input into predictive tools and preventive strategies such as Prognostics and Health Management (PHM).*

## Applications:
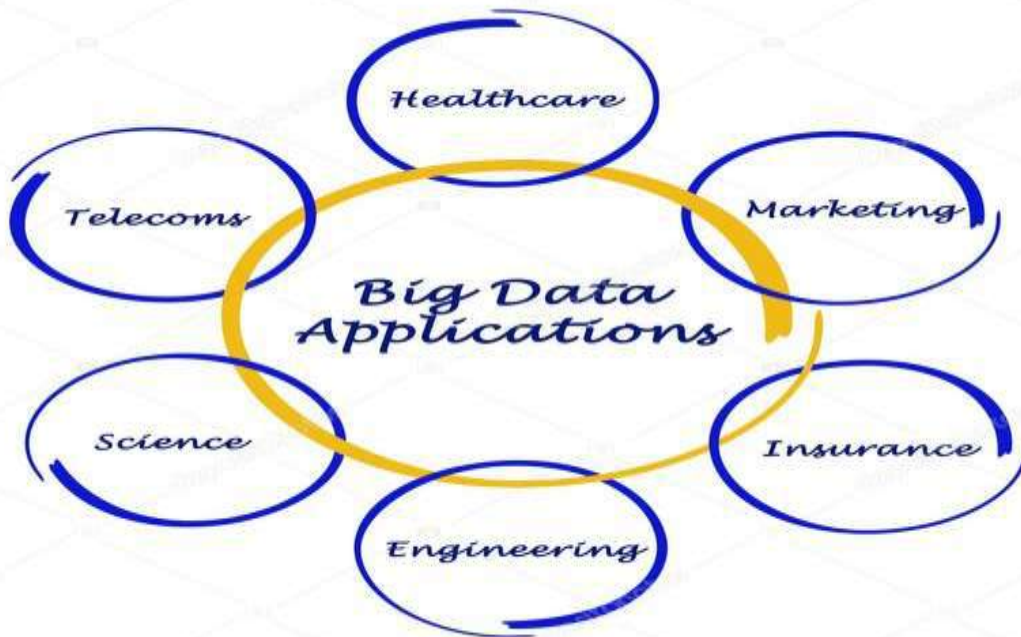


*Big data has increased the demand of information management specialists so much so that Software AG, Oracle Corporation, IBM, Microsoft, SAP, EMC, HP and Dell have spent more than $15 billion on software firms specializing in data management and analytics. In 2010, this industry was worth more than $100 billion and was growing at almost 10 percent a year: about twice as fast as the software business as a whole*

## Conclusion:

*Big data is a term that describes the large volume of data – both structured and unstructured – that inundates a business on a day-to-day basis. ... It's what organizations do with the data that matters. Big data can be analyzed for insights that lead to better decisions and strategic business moves.*

# Electric power transmission

## S.Samaya Sanjeevi

## (ASSISTANT PROFESSOR/EEE)



**Electric power** *transmission is the bulk movement of electrical energy from a generating site, such as a power plant, to an electrical substation. The interconnected lines which facilitate this movement are known as a transmission network. This is distinct from the local wiring between high-voltage substations and customers, which is typically referred to as electric power distribution.*

*The combined transmission and distribution network is known as the "power grid" in North America, or just "the grid". In the United Kingdom, India, Malaysia and New Zealand, the network is known as the "National Grid".*

*A wide area synchronous grid, also known as an "interconnection" in North America, directly connects a large number of generators delivering AC power with the same relative frequency to a large number of consumers. For example, there are four major interconnections in North America (the Western Interconnection, the Eastern Interconnection, the Quebec Interconnection and the Electric Reliability Council of Texas (ERCOT) grid). In Europe one large grid connects most of continental Europe.*

*Historically, transmission and distribution line*

*s were owned by the same company, but starting in the 1990s, many countries have liberalized the regulation of the electricity market in ways that have led to the separation of the electricity transmission business from the distribution.*

# *System*
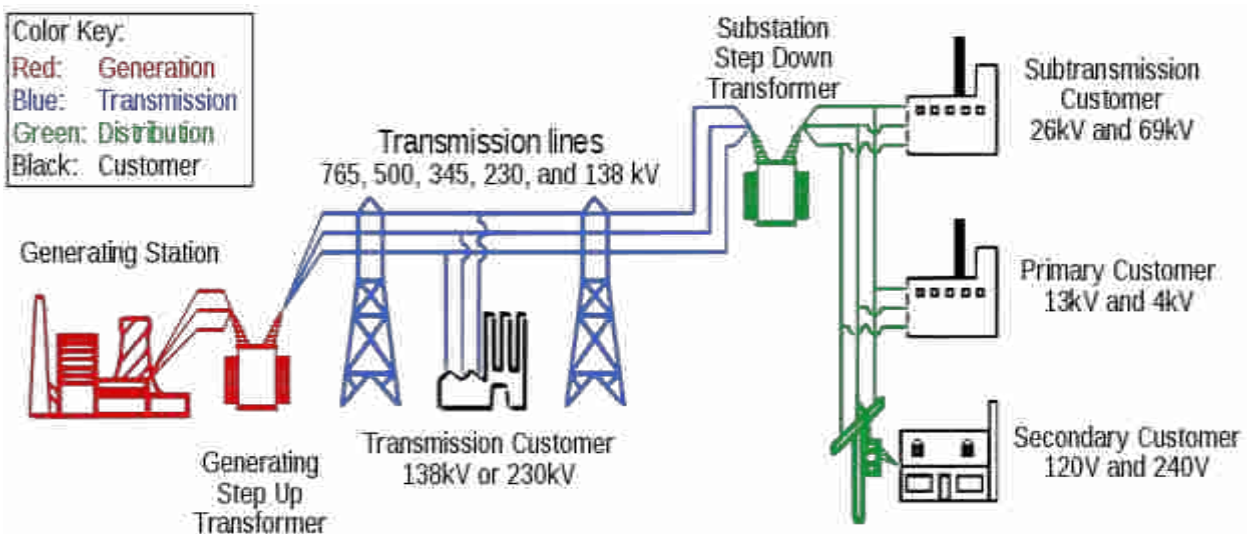


*Most transmission lines are high-voltage three-phasealternating current (AC), although single phase AC is sometimes used in railway electrification systems. High-voltage direct-current (HVDC) technology is used for greater efficiency over very long distances (typically hundreds of miles). HVDC technology is also used in submarine power cables (typically longer than 30 miles (50 km)), and in the interchange of power between grids that are not mutually synchronized. HVDC links are used to stabilize large power distribution networks where sudden new loads, or blackouts, in one part of a network can result in synchronization problems and cascading failures.*

*Electricity is transmitted at high voltages (115 kV or above) to reduce the energy loss which occurs in long-distance transmission. Power is usually transmitted through overhead power lines. Underground power transmission has a significantly higher installation cost and greater operational limitations, but reduced maintenance costs. Underground transmission is sometimes used in urban areas or environmentally sensitive locations.*

## Subtransmission

Subtransmission is part of an electric power transmission system that runs at relatively lower voltages. It is uneconomical to connect all distribution substations to the high main transmission voltage, because the equipment is larger and more expensive. Typically, only larger substations connect with this high voltage. It is stepped down and sent to smaller substations in towns and neighbour hoods. Sub transmission circuits are usually arranged in loops so that a single line failure does not cut off service to a large number of customers for more than a short time. Loops can be "normally closed", where loss of one circuit should result in no interruption, or "normally open" where substations can switch to a backup supply. While sub transmission circuits are usually carried on overhead lines, in urban areas buried cable may be used.

# Overhead transmission



High-voltage overhead conductors are not covered by insulation. The conductor material is nearly always an aluminum alloy, made into several strands and possibly reinforced with steel strands. Copper was sometimes used for overhead transmission, but aluminum is lighter, yields only marginally reduced performance and costs much less. Overhead conductors are a commodity supplied by several companies worldwide.

Improved conductor material and shapes are regularly used to allow increased capacity and modernize transmission circuits. Conductor sizes range from 12 mm$^2$ ( American wire gauge) to 750 mm$^2$ (1,590,000 circular mils area), with varying resistance and current-carrying capacity. For normal AC lines thicker wires would lead to a relatively small increase in capacity due to the skin effect (which causes most of the current to flow close to the surface of the wire). Because of this current limitation, multiple parallel cables (called bundle conductors) are used when higher capacity is needed. Bundle conductors are also used at high voltages to reduce energy loss caused by corona discharge.

Today, transmission-level voltages are usually considered to be 110 kV and above. Lower voltages, such as 66 kV and 33 kV, are usually considered subtransmission voltages, but are occasionally used on long lines with light loads. Voltages less than 33 kV are usually used for distribution. Voltages above 765 kV are considered extra high voltage and require different designs compared to equipment used at lower voltages.

Since overhead transmission wires depend on air for insulation, the design of these lines requires minimum clearances to be observed to maintain safety. Adverse weather conditions, such as high wind and low temperatures, can lead to power outages.

# Bulk power transmission
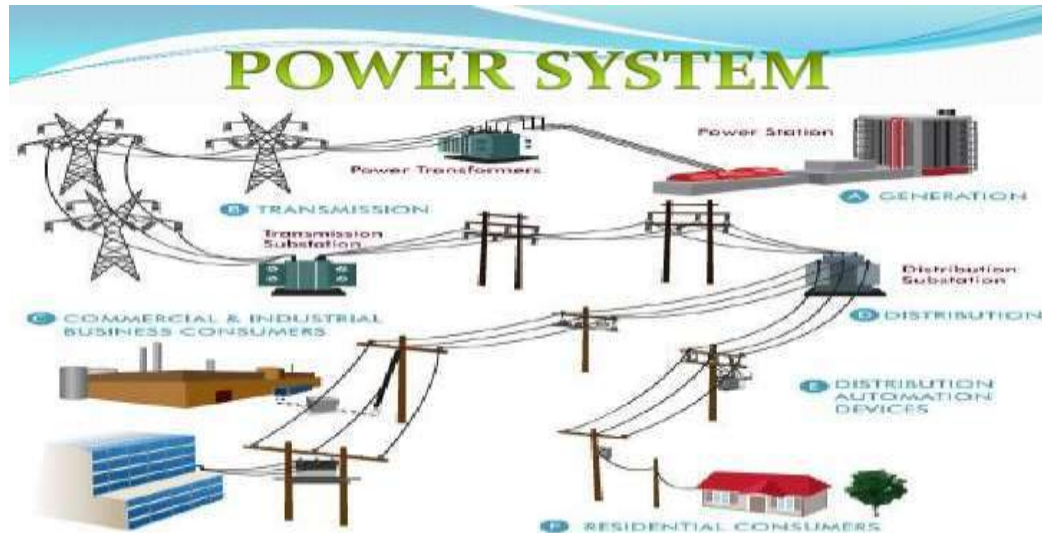


Engineers design transmission networks to transport the energy as efficiently as feasible, while at the same time taking into account economic factors, network safety and redundancy. These networks use components such as power lines, cables, circuit breakers, switches and transformers.

The transmission network is usually administered on a regional basis by an entity such as a regional transmission organization or transmission system operator.

Transmission efficiency is greatly improved by devices that increase the voltage (and thereby proportionately reduce the current), in the line conductors, thus allowing power to be transmitted with acceptable losses.The reduced current flowing through the line reduces the heating losses in the conductors.

According to Joule's Law, energy losses are directly proportional to the square of the current. Thus, reducing the current by a factor of two will lower the energy lost to conductor resistance by a factor of four for any given size of conductor.

The optimum size of a conductor for a given voltage and current can be estimated by Kelvin's law for conductor size, which states that the size is at its optimum when the annual cost of energy wasted in the resistance is equal to the annual capital charges of providing the conductor.

At times of lower interest rates, Kelvin's law indicates that thicker wires are optimal; while, when metals are expensive, thinner conductors are indicated: however, power lines are designed for long-term use, so Kelvin's law has to be used in conjunction with long-term estimates of the price of copper and aluminum as well as interest rates for capital.

# Modern Amplifier

## *A.Kausaraza*

## *IV year EEE*
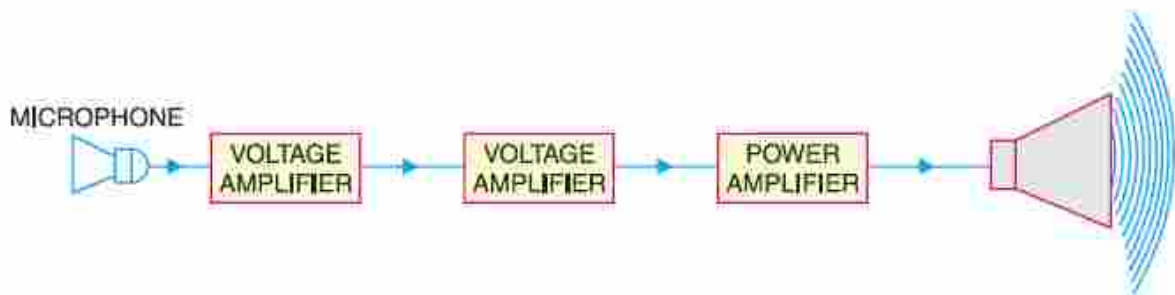


An amplifier, electronic amplifier or (informally) amp is an electronic device that can increase the power of a signal (a time-varying voltage or current). It is a two-port electronic circuit that uses electric power from a power supply to increase the amplitude of a signal applied to its input terminals, producing a proportionally greater amplitude signal at its output. The amount of amplification provided by an amplifier is measured by its gain: the ratio of output voltage, current, or power to input. An amplifier is a circuit that has a power gain greater than one.

An amplifier can either be a separate piece of equipment or an electrical circuit contained within another device. Amplification is fundamental to modern electronics, and amplifiers are widely used in almost all electronic equipment. Amplifiers can be categorized in different ways. One is by the frequency of the electronic signal being amplified. For example, audio amplifiers amplify signals in the audio (sound) range of less than 20 kHz, RF amplifiers amplify frequencies in the radio frequency range between 20 kHz and 300 GHz, and servo amplifiers and instrumentation amplifiers may work with very low frequencies down to direct current.

# Power amplifiers



*A power amplifier is an amplifier designed primarily to increase the power available to a load. In practice, amplifier power gain depends on the source and load impedances, as well as the inherent voltage and current gain. A radio frequency (RF) amplifier design typically optimizes impedances for power transfer, while audio and instrumentation amplifier designs normally optimize input and output impedance for least loading and highest signal integrity.*

*An amplifier that is said to have a gain of 20 dB might have a voltage gain of 20 dB and an available power gain of much more than 20 dB (power ratio of 100)—yet actually deliver a much lower power gain if, for example, the input is from a 600 Ω microphone and the output connects to a 47 kΩ input socket for a power amplifier. In general the power amplifier is the last 'amplifier' or actual circuit in a signal chain (the output stage) and is the amplifier stage that requires attention to power efficiency.*

*Efficiency considerations lead to the various classes of power amplifier based on the biasing of the output transistors or tubes: see power amplifier classes below.*

*Audio power amplifiers are typically used to drive loudspeakers. They will often have two output channels and deliver equal power to each. An RF power amplifier is found in radio transmitter final stages. A Servo motor controller: amplifies a control voltage to adjust the speed of a motor, or the position of a motorized system.*

## Operational amplifiers (op-amps)
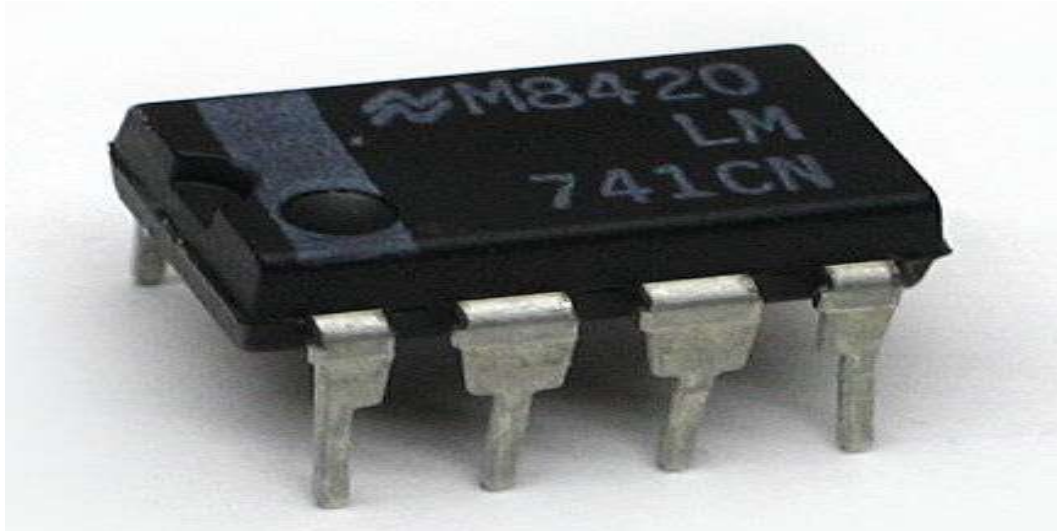


An operational amplifier is an amplifier circuit which typically has very high open loop gain and differential inputs. Op amps have become very widely used as standardized "gain blocks" in circuits due to their versatility; their gain, bandwidth and other characteristics can be controlled by feedback through an external circuit. Though the term today commonly applies to integrated circuits, the original operational amplifier design used valves, and later designs used discrete transistor circuits.

A fully differential amplifier is similar to the operational amplifier, but also has differential outputs. These are usually constructed using BJTs or FETs.

## Microwave amplifiers

Traveling wave tube amplifiers (TWTAs) are used for high power amplification at low microwave frequencies. They typically can amplify across a broad spectrum of frequencies; however, they are usually not as tunable as klystrons.

Klystrons are specialized linear-beam vacuum-devices, designed to provide high power, widely tunable amplification of millimeter and sub-millimeter waves. Klystrons are designed for large scale operations and despite having a narrower bandwidth than TWTAs, they have the advantage of coherently amplifying a reference signal so its output may be precisely controlled in amplitude, frequency and phase.

Solid-state devices are used such as GaAs FETs, IMPATT diodes, and others, especially at lower microwave frequencies and power levels on the order of watts.

The maser is a non-electronic microwave amplifier.

# Inverting or non-inverting:



$R_f = 100k\Omega$

$R_{in} = 10k\Omega$

$V_{in}$

A

$V_{out}$

0v
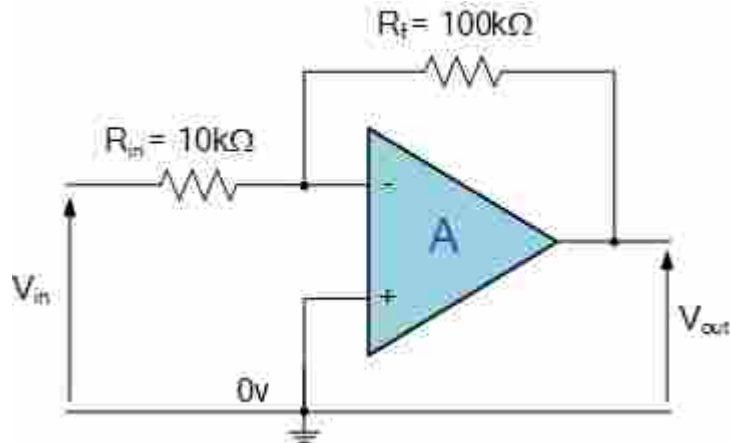
Non-Inverting Amplifier. Non-Inverting amplifier is one in which the output is in phase with respect to the input. The feedback is applied at the inverting input. ... The gain of the non-inverting amplifier circuit for the operational amplifier is easy to determine.

Another way to classify amplifiers is by the phase relationship of the input signal to the output signal. An 'inverting' amplifier produces an output 180 degrees out of phase with the input signal (that is, a polarity inversion or mirror image of the input as seen on an oscilloscope)

. A 'non-inverting' amplifier maintains the phase of the input signal waveforms.

An emitter follower is a type of non-inverting amplifier, indicating that the signal at the emitter of a transistor is following (that is, matching with unity gain but perhaps an offset) the input signal. Voltage follower is also non inverting type of amplifier having unity gain.

## properties

Amplifier properties are given by parameters that include:

- Gain, the ratio between the magnitude of output and input signals
- Bandwidth, the width of the useful frequency range
- Efficiency, the ratio between the power of the output and total power consumption
- Linearity, the extent to which the proportion between input and output amplitude is the same for high amplitude and low amplitude input
- Noise, a measure of undesired noise mixed into the output
- Output dynamic range, the ratio of the largest and the smallest useful output levels
- Slew rate, the maximum rate of change of the output

# Advancement Alternator

## *D.Vignesh*

### *IV Year EEE*



An alternator is an electrical generator that converts mechanical energy to electrical energy in the form of alternating current. For reasons of cost and simplicity, mostalternators use a rotating magnetic field with a stationary armature.

Early 20th-century alternator made by Ganz Works in 1909 in Budapest, Hungary, in the power generating hall of the biggest hydroelectric station of the Russian Empire (photograph by Prokudin-Gorsky, 1911)

An alternator is an electrical generator that converts mechanical energy to electrical energy in the form of alternating current.

For reasons of cost and simplicity, most alternators use a rotating magnetic field with a stationary armature.

Occasionally, a linear alternator or a rotating armature with a stationary magnetic field is used. In principle, any ACelectrical generator can be called an alternator, but usually the term refers to small rotating machines driven by automotive and other internal combustion engines. An alternator that uses a permanent magnet for its magnetic field is called a magneto.

Alternators in power stations driven by steam turbines are called turbo-alternators. Large 50 or 60 Hz three-phase alternators in power plants generate most of the world's electric power, which is distributed by electric power grids.

# Principle of operation:
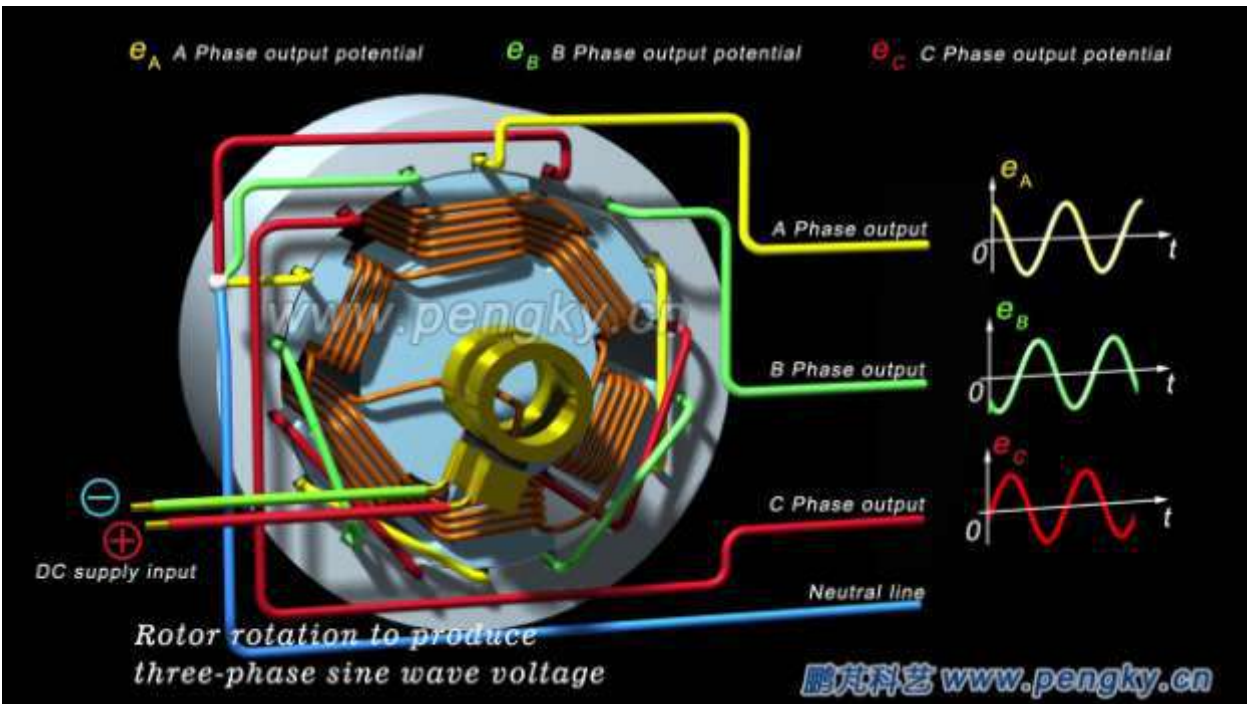


A conductor moving relative to a magnetic field develops an electromotive force (EMF) in it (Faraday's Law). This EMF reverses its polarity when it moves under magnetic poles of opposite polarity. Typically, a rotating magnet, called the rotor turns within a stationary set of conductors wound in coils on an iron core, called the stator. The field cuts across the conductors, generating an induced EMF (electromotive force), as the mechanical input causes the rotor to turn.

The rotating magnetic field induces an AC voltage in the stator windings. Since the currents in the stator windings vary in step with the position of the rotor, an alternator is a synchronous generator.

The rotor's magnetic field may be produced by permanent magnets, or by a field coil electromagnet. Automotive alternators use a rotor winding which allows control of the alternator's generated voltage by varying the current in the rotor field winding. Permanent magnet machines avoid the loss due to magnetizing current in the rotor, but are restricted in size, due to the cost of the magnet material.

Since the permanent magnet field is constant, the terminal voltage varies directly with the speed of the generator. Brushless AC generators are usually larger than those used in automotive applications.

# Brushless alternators:
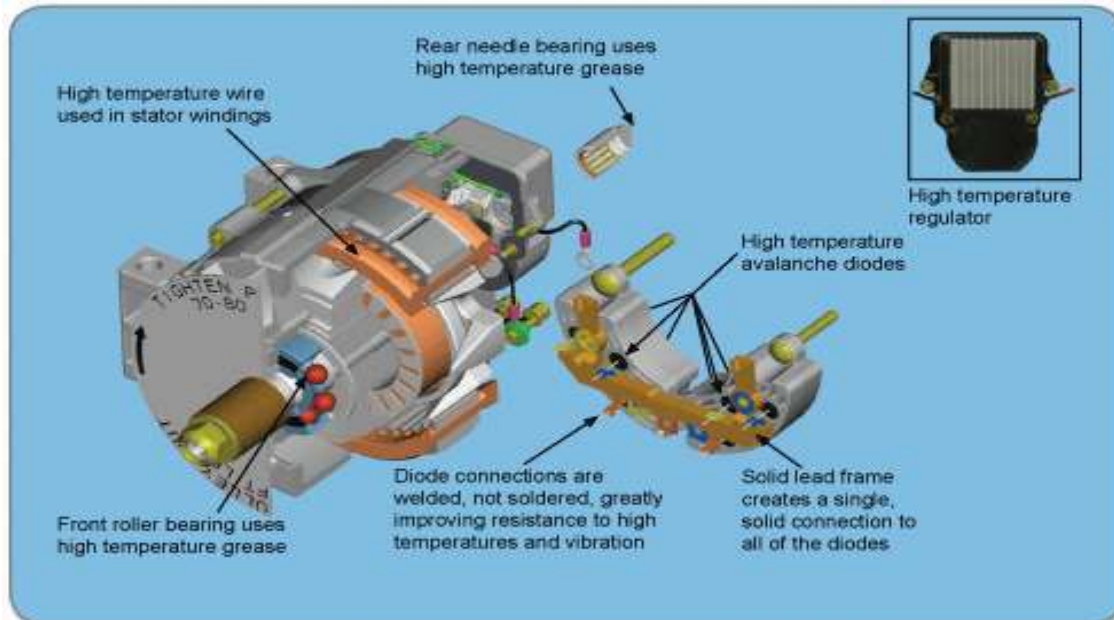


The primary difference between brushless and brush generators lies in their method for transferring DC power from the exciting current to the generator's magnetic fields. Generators produce current by moving an exciter, or mobile electromagnet, against the field generated by a stator, or stationary, electromagnet.

A brushless alternator is composed of two alternators built end-to-end on one shaft. Smaller brushless alternators may look like one unit but the two parts are readily identifiable on the large versions. The larger of the two sections is the main alternator and the smaller one is the exciter.

The exciter has stationary field coils and a rotating armature (power coils). The main alternator uses the opposite configuration with a rotating field and stationary armature. A bridge rectifier, called the rotating rectifier assembly, is mounted on the rotor.

Neither brushes nor slip rings are used, which reduces the number of wearing parts. The main alternator has a rotating field as described above and a stationary armature (power generation windings).

Varying the amount of current through the stationary exciter field coils varies the 3-phase output from the exciter. This output is rectified by a rotating rectifier assembly, mounted on the rotor, and the resultant DC supplies the rotating field of the main alternator and hence alternator output. The result of all this is that a small DC exciter current indirectly controls the output of the main alternator.

## By rotating part:

The revolving part of alternators can be the armature or the magnetic field. The revolving armature type has the armature wound on the rotor, where the winding moves through a stationary magnetic field. The revolving armature type is not often used. The revolving field type has magnetic field on the rotor to rotate through a stationary armature winding.

The advantage is that then the rotor circuit carries much less power than the armature circuit, making the slip ring connections smaller and less costly; only two contacts are needed for the direct-current rotor, whereas often a rotor winding has three phases and multiple sections which would each require a slip-ring connection. The stationary armature can be wound for any convenient medium voltage level, up to tens of thousands of volts; manufacture of slip ring connections for more than a few thousand volts is costly and inconvenient.

## Brush less excitation system:

Brushless Exciters. WEG Electric Machinery's (WEM) brushless excitation system consists of a high frequency AC generator (armature & field) and rotating rectifier bridge. ... Rotating rectifier redundancy with detection of diode failure which in operation allows for more convenient maintenance intervals.

## Cooling methods:

Many alternators are cooled by ambient air, forced through the enclosure by an attached fan on the same shaft that drives the alternator. In vehicles such as transit buses, a heavy demand on the electrical system may require a large alternator to be oil-cooled. In marine applications water-cooling is also used. Expensive automobiles may use water-cooled alternators to meet high electrical system demands.

## Diesel electric locomotive alternators

In later diesel electric locomotives and diesel electric multiple units, the prime mover turns an alternator which provides electricity for the traction motors (AC or DC).

The traction alternator usually incorporates integral silicon diode rectifiers to provide the traction motors with up to 1200 volts DC (DC traction, which is used directly) or the common inverter bus (AC traction, which is first inverted from dc to three-phase ac).

The first diesel electric locomotives, and many of those still in service, use DC generators as, before silicon power electronics, it was easier to control the speed of DC traction motors. Most of these had two generators: one to generate the excitation current for a larger main generator.

# Hydroelectricity
## *P.Pothumponnu*

## *III year EEE*



India is the 7th largest producer of hydroelectric power in the world. As of 30 April 2017, India'sinstalled utility-scale hydroelectric capacity was 44,594 MW, or 13.5% of its total utility powergeneration capacity. ... India's hydroelectric power potential is estimated at 148,700 MW at 60% load factor.

**Hydro electricity** is electricity produced from hydropower. In 2015, hydropower generated 16.6% of the world's total electricity and 70% of all renewable electricity, and was expected to increase about 3.1% each year for the next 25 years.

Hydropower is produced in 150 countries, with the Asia-Pacific region generating 33 percent of global hydropower in 2013. China is the largest hydroelectricity producer, with 920 TWh of production in 2013, representing 16.9 percent of domestic electricity use.

The cost of hydroelectricity is relatively low, making it a competitive source of renewable electricity. The hydro station consumes no water, unlike coal or gas plants. The average cost of electricity from a hydro station larger than 10 megawatts is 3 to 5 U.S. cents per kilowatt-hour.

With a dam and reservoir it is also a flexible source of electricity since the amount produced by the station can be changed up or down very quickly to adapt to changing energy demands. Once a hydroelectric complex is constructed, the project produces no direct waste, and in many cases, has a considerably lower output level of greenhouse gases than fossil fuel powered energy plants.

## Generating methods



     *Most hydroelectric power comes from the potential energy of dammed water driving a water turbine and generator. The power extracted from the water depends on the volume and on the difference in height between the source and the water's outflow. This height difference is called the head. A large pipe (the "penstock") delivers water from the reservoir to the turbine.*

# Pumped-storage



     *This method produces electricity to supply high peak demands by moving water between reservoirs at different elevations. At times of low electrical demand, the excess generation capacity is used to pump water into the higher reservoir. When the demand becomes greater, water is released back into the lower reservoir through a turbine.*

     *Pumped-storage schemes currently provide the most commercially important means of large-scale grid energy storage and improve the daily capacity factor of the generation system. Pumped storage is not an energy source, and appears as a negative number in listings.*

# Run-of-the-river
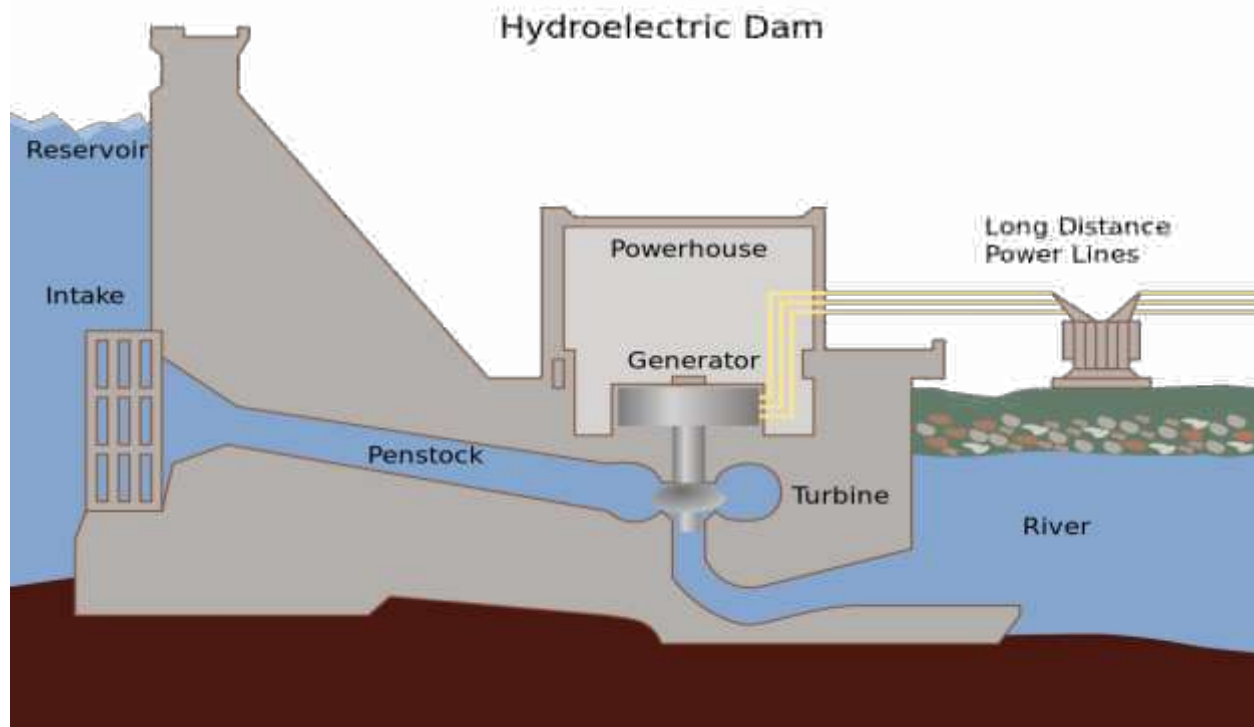


## Pico

Pico hydro is a term used for hydroelectric power generation of under 5 kW. It is useful in small, remote communities that require only a small amount of electricity. For example, to power one or two fluorescent light bulbs and a TV or radio for a few homes. Even smaller turbines of 200-300W may power a single home in a developing country with a drop of only 1 m (3 ft). A Pico-hydro setup is typically run-of-the-river, meaning that dams are not used, but rather pipes divert some of the flow, drop this down a gradient, and through the turbine before returning it to the stream

Run-of-the-river hydroelectric stations are those with small or no reservoir capacity, so that only the water coming from upstream is available for generation at that moment, and any oversupply must pass unused. A constant supply of water from a lake or existing reservoir upstream is a significant advantage in choosing sites for run-of-the-river. In the United States, run of the river hydropower could potentially provide 60,000 megawatts (80,000,000 hp) (about 13.7% of total use in 2011 if continuously available).

In India, the National Hydroelectric Power Corporation is constructing the Upper Siang Hydroelectric Project on the Siang tributary of the Brahmaputra in Arunachal Pradesh and the 2000 MW Lower Subansiri project on Subansiri, another tributary of the Brahmaputra on the Arunachal Pradesh, Assam border.

# Tide
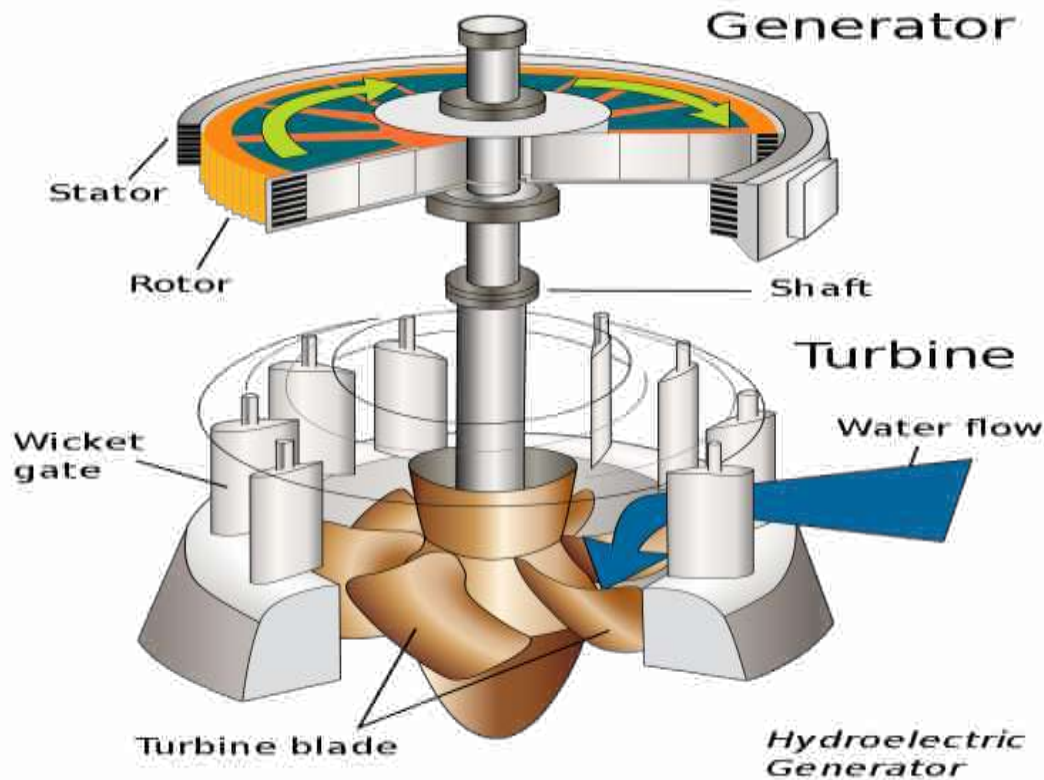


A tidal power station makes use of the daily rise and fall of ocean water due to tides; such sources are high. predictable, and if conditions permit construction of reservoirs, can also be dispatchable to generate power during high demand periods. Less common types of hydro schemes use water's kinetic energy or undammed sources such as undershot water wheels. Tidal power is viable in a relatively small number of locations around the world. In Great Britain, there are eight sites that could be developed, which have the potential to generate 20% of the electricity used in 2012.

## *Pykara*

*Pykara is the name of a village and river 19 kilometres (12 mi) from Ooty in the Indian State of Tamil Nadu. The Pykara River is considered very sacred by the Todas. It rises at Mukurthi peak, flows northwards, and then turns to the west after reaching the edge of the plateau. The river flows through Murkurti, Pykara and Glenmorgan dams, and forms part of an important hydro-electric power project.*

*The river flows over a series of waterfalls, the last two of 55 metres (180 ft) and 61 metres (200 ft) being known as Pykara Falls. The falls are approximately 6 kilometres (4 mi) from the bridge on the main road. There is a forest rest house at Pykara. A boat house on the Pykara reservoir is an added attraction for tourists. Pykara boasts well-protected, fenced sholas, Toda settlements, large grassy meadows and good wildlife habitat.*

# Guest lecture:



- *Dr.P.Sivakumar, Associate Professor/ EEE, Rajalakshmi Engineering College, Chennai, delivered this lecture on" Recent trends in power system".*
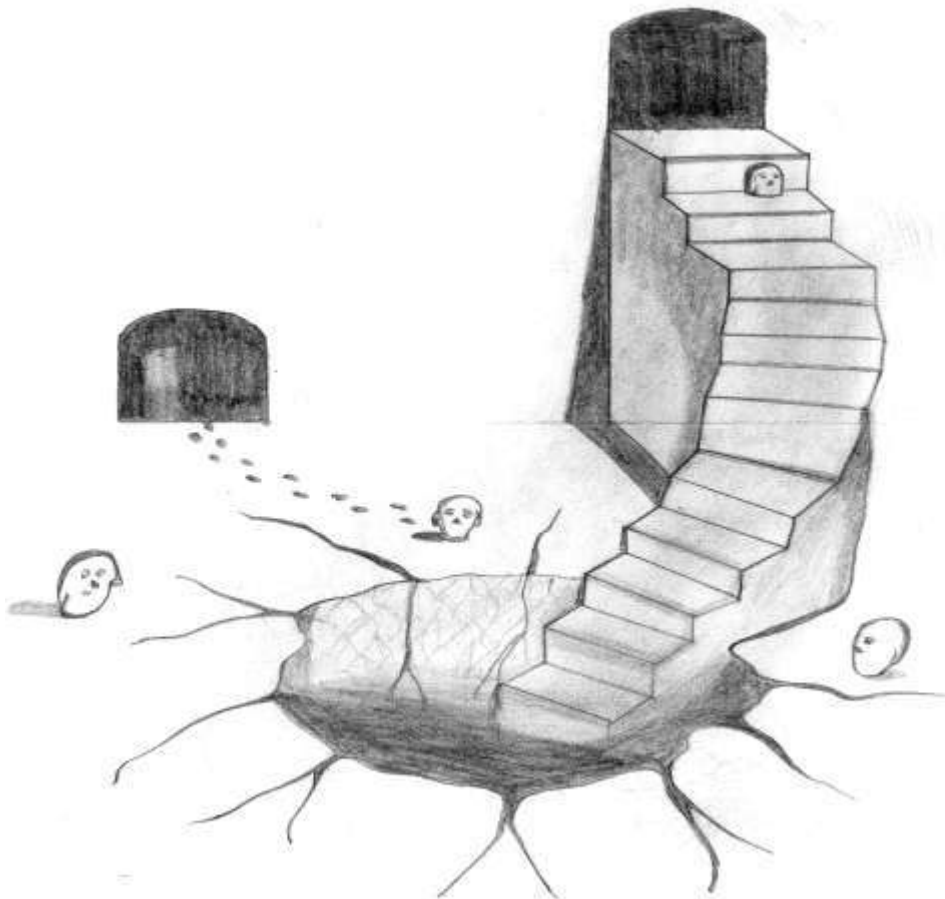


- *K.Sathiyanarayanan, B.E.,Service Head (South Zone), EMT Megatherm Pvt. Ltd,Chennai delivered this lecture on "Role of Power Electronics In Electrical Applications"*

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# Innovative images



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