PROJECT REPORT

SESSION:2021-2025

ELECTRIC TRANSFORMER

Prepared For

DIPLOMA STUDENT GROUP 3TH SEM

Project Guide by
SKMP PROJECT
MANAGEMENT TEAM
AND SUPERVISER
OFFICE

Through Balasore
School Of
Engineering
Computer Sc. &
Eng.DEPT

CHAPTER - I

INTRODUCTION OF MINI INVERTER

1. INTRODUCTION

In today's world, where portability, efficiency, and versatility are paramount, mini inverters stand out as indispensable devices. Whether you're on a camping trip, traveling in an RV, or facing a power outage at home, mini inverters provide a reliable solution to keep your essential electronics running smoothly..

A mini inverter is a compact power conversion device that converts direct current (DC) from a battery or solar panel into alternating current (AC) suitable for powering small appliances, electronics, and tools. Unlike larger inverters, which are designed for heavy-duty applications, mini inverters are specifically engineered for lightweight, on-the-go usage.
These pint-sized powerhouses come in various sizes and capacities, ranging from pocket-sized models capable of charging smartphones and laptops to slightly larger units that can run small household appliances like fans, lights, and televisions. Their compact design makes them easy to carry in backpacks, glove compartments, or emergency kits, ensuring you're always prepared for unexpected power disruptions or outdoor adventures.
Mini inverters typically feature multiple AC outlets and USB ports, allowing you to connect a variety of devices simultaneously. They also incorporate advanced safety features such as overload protection, short circuit protection, and thermal shutdown mechanisms to safeguard both the inverter and your connected devices.

CHAPTER - *2*

BLOCK DIAGRAM OF MINI INVERTER

2.0 BLOCK DIAGRAM:

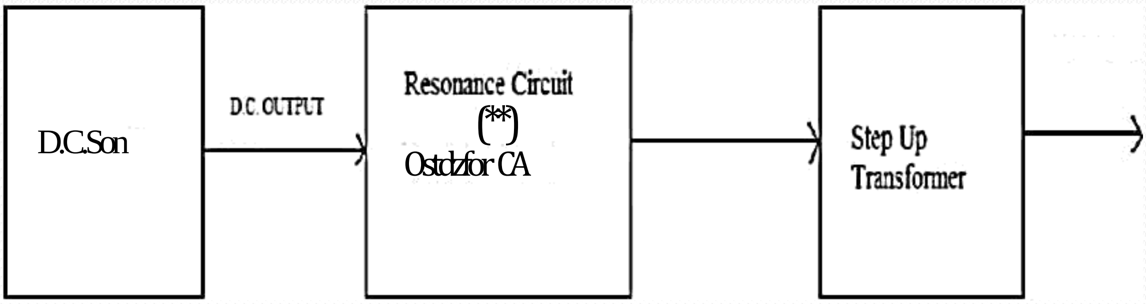


Fig: bock Diaʂrani of iViini Irn•erter.

Resonance circuit or the oscillator circuit is know'n as the tank circuit. It is biiill up by iisinʂ suitable power traiisislor and a combination of inductor and capacitor ivilli res isiors of rcqiiired value. Tlic rcsist or, capacitor, inductor etc. Used for building up the oscillations arc called the Resonant Element.The D.C is fed to the oscil lalor from d.c soiirce. The oscillalor builds up oscillation at the dcsipncd frequency nt low voltage. The basic condition for producing daiiiped oscillation by the tank circuit.

(It')< [4L/C]

The low' voltage a.c oiilpia from the oscillator is then fed to a step up transformer for raising the oiitptit a.c. voltage at ilie required voltage. The explanalion about the cach part in tlic block diagram of mini inx•erter.

2.1 D.C SOURCE:

Direct current (DC) is the tinidirection.al flow of electric charge. Direct current is prodiiccd by sourccs such as baltcries, po»'er supplics, ilieriiiocoiiples, solar cells, or dynamos. Direct current may flo»' in a conductor such as a wire, but can also flow through semiconductors, insulators, or e ven through a vacuum as in electron or ion beams. The electric current flows in a constant direction, distinguishing it from alternating current (AC). A term fonnerly used for this type of current was galvanic current."'

The abbreviations AU and *DC* are often used to mean simply *‹iltei-ti‹itiiig* and *rfi/* cci, as when they modify *curreru* or *i oltnge.* ' '

Direct current may be obtained from an alternating current supply by use of a rectifier, which contains electronic elements (usually) or electromecRonica[elements (historically) that allow current lo flow only in one direction. Direct current may be converted into alternating current wilh an inverter or a inolor-generator set.

Direct current is used to charge batteries and as power supply for electronic systems. Very laige quantities of direct-current power are used in production of aluminum and other electrocheinical processes. li is also used for some railways, especially in urban areas. High-voltage direct current is used to transmit large amounts of power from remote generation sites or to interconnect alternating current power grids.

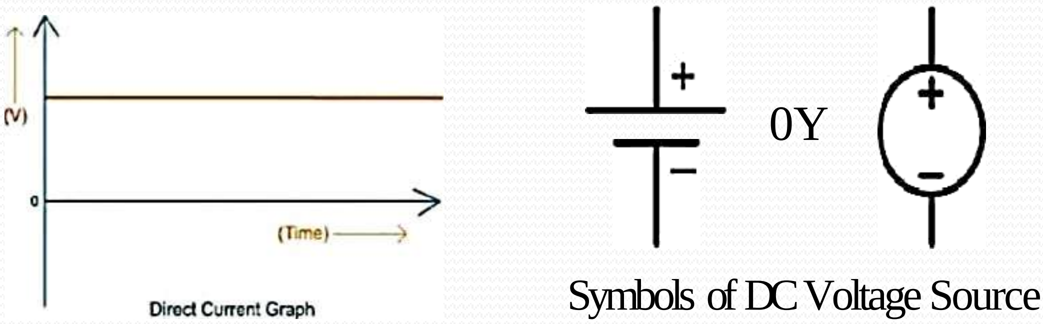


Fig: Current Grapli & Symbols of DC Voltages Sources.

2.2 OSCILLATOR CIRCHIT:

An electronic circuit that generates a sine wave is called an oscillator. To oscillate means to move back and forth continuously between io'o points. A sine wave signal also oscillates continuously between its maximum and minimum value. Oscillators designed to produce a high-power AC output from a DC suypIy are usually called Inverters.

An electronic oscillator is an electronic circuit that produces a periodic, oscillating electronic signal, oflen a sine wave or a sqtiam wave. Oscillators convert direct current (DC) from a power supply to an alternating current (AC) signal. They are widely used in many electronic devices. Common examples of signals generated by oscillators include signals broadcast by radio and television transmitters, clock signals that regulate computers and quartz clocks, and the sounds produced by electronic beepers and video games.

1. Oscillator are often characterized by the frequency of their output signal:

- A low-frequency oscillator (LFO) is an electronic oscillator that genemtes a frequency below -20 Hz. This term is typically used in the field of audio synthesizers, to distinguish it from an audio frequency oscillator.

- An audio oscillator produces frequencies in the audio mnge, about l6 Hz to 20 kHz.”’

- An RF oscillator produces signals in the rndio frequency (RF) mnge of about 100 kHz to 100 GHz.

1. There ore h›'o **main** apes of electronic **oscillator:**

2.2.2. I Linear or Harmonic Oscillator.

2.2.2.2 Nonlinear or Relaxation Oscillator.

2.2.2.1 Harmonic Oscillator:

The hannonic or linear oscillator produces a sinusoidal output.

There are two types:

1. Feedback oscillator:

The most common form of Iinear oscillator is an electronic amplifier such as a amp op or transistor connected in a feedback loop »•itli its output fed back into its input through a frequency selective electronic filter to provide positive feedback. \Vhen the power supply to the amplifier is first switched on. electronic noise in ilie circuit provides a non-zero signal to get osci[lations started. The noise travels around the loop and is amplified and filtered until very quickly it converges on a sine wave at a single frequency.

Some of the many Feedback Oscillator circuits are listed below:

- UC oscillator circuit,
- LC oscillator circuit
- Crystal oscillator circuit

2. Negative resistance oscillator:

Negative resistance oscillators, a resonant circuit, such as an LC circuit, crystal, or cavity resonator, is connected across a device u-ith negative differential resistance, and a DC bias voltage is applied to supply energy. A resonant circuit by itself is ”almost" an oscillator; it can store energy in the form of electronic oscillations if excited, but because it has electrical resistance and other losses the oscillations are damped and decay to zero. The negative resistance of the active device cancels ihe (positive) internal loss resistance in ihe resonator, in effect creatinp• a resonator with no damping, which generates spontaneous continuous oscillations at its resonant frequency.

Some of ihe many Negative Resistance Oscillator circuits are listed below:

- Annstrong oscillator
- Clapp oscillator
- Colpitts oscillator
- Cross-coupled oscillator
- Dynamos oscillator
- Hartley oscillator
- Meissner oscillator
- Opto-electronic oscillator

- Pierce oscillator
- Phase-shi ft oscillator
- Robinson oscillator
- Tri-tet oscillator
- Vackář oscillator
- \Vicn bridyc oscillator

*.2.2.2 ltclnxnti‹›n cscillstor:

A wont iiiear or relaxation oscillator pr‹xliiccs a non-sinusoidal oiitpiiL such os a square, sawtootli or triangle wave. 3 It consists of' att energy-storing element (a capacitor or, tnore rarely, an inductor) and a nonl incar switchin device (a latch. Scliiiiiit iripSer, or negative resistance element) connected in a feedback loop. The sw • ' s device periodically charges end discharges the cncrgy stored in the storage eminent thus causing abrupt changes in the output w'avefomi.

Some of the more common Relaxation Oscillator circuits are lislctl below:

- Mtlliivibrntor
- Pearson-Anson oscillator
- ' s oscillator
- Dela)' line oscillator
- Roycr oscillator

2.3 2'ltAI'4SFORhlElt:

A transformer is an electrical device that transfers electrical energy between iivo or more circuits through electromagnetic induction. Electromagnetic induction produce.s an electroinotive force within a conductor which is exposed to time varying magnetic fields. Transformers are used to increase or decrease the altcrnsting voltages in electric power applications.

2.3.1 Step-Up Transformer:

A step-tip lransforiricr i.s Îhe direct opposilc of a step-down Îransforiiier. There are niany Îiirns ori Îlic sccoriAary w indinp llian in the pri iiiary ii'indinp i n the step-iip Îransforincrs. Tliiis. thc voltape .stipplied in llie secondary lransforiiicr is preatcr lhan llie one stipplicd ncross the priinary ivindinș. ThaÎ nicaiis Slep-tip transformer concert 12V AC inptil inlo 230V AC oiiÎptil at 50HZ.

Becatise of the principlc of conservation of energy, the transformer couverts low volÎape, high-ciirrcnt to liigji volÎage-low current. In olher svords, the vollage has been stcpped rip.

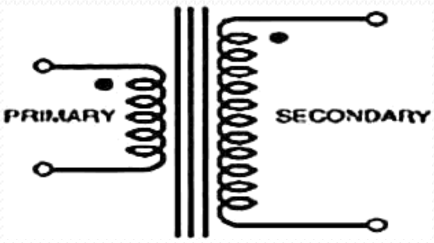


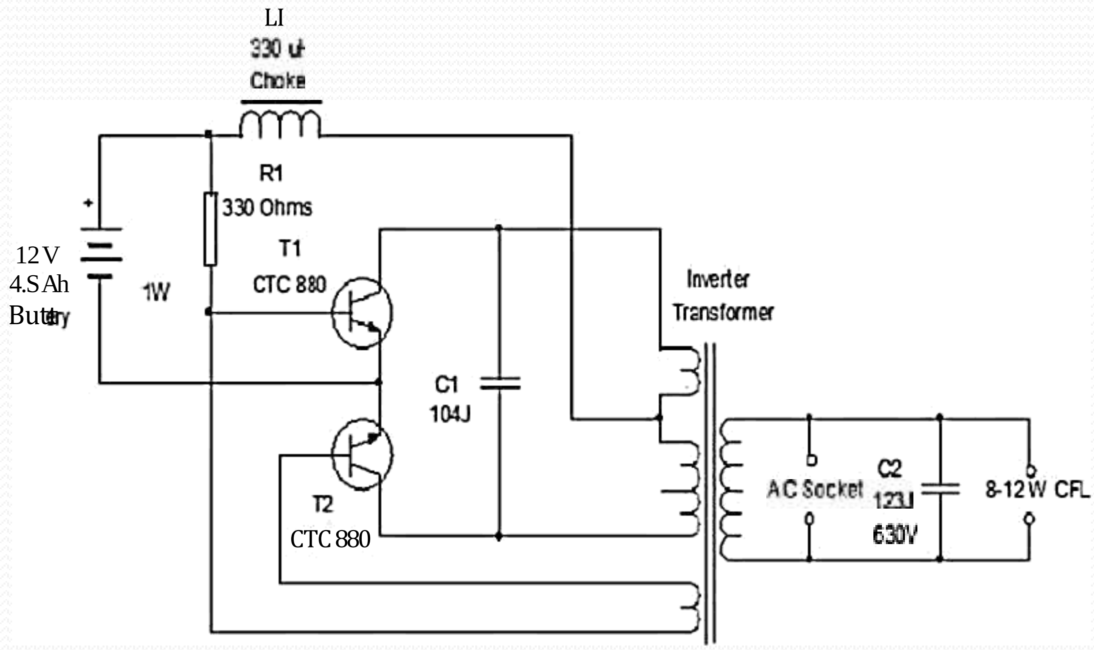
Fig. Step-tip Transfoniier

You can find step-up transformers located near power plants that arc designed to operatc megawatts of power. Apart from the poivcr plants. stcp-up transfomicrs can also be iiscd for local and snia[ler applications such as x-ray machine which rcqiiires about 50,000 volts to work. Even a micro-wave oven requires a smatl step-rip transformer to openite.

CHAPTER - *IM*

CIRCUIT DIAGRAM AND WORKING PRINCIPLE

3.1 CIRCUIT DIAGRAiYI:



3.2 U'ORKING PRINCIPLE:

li is a Mini Inverter lliat converts 12 volt DC in 230 volt AC. Two high power NPN Iraiisisiots.TI and T2 acts as a simple oscillator to generate the frequency. The oscillating pulses arc fed io the iiwerier imnsforiner and front iIs secondary winding, AC will be available.The !2 volt DC froM the battery first passc.s through the 330 iiH cliche that eliminates noise front i!ic circuit during the switching of the inverter transformer. Resistor RI biases T1 directly and T2 through the winding of transfomier. So with Cl. Transistors TI and T2 oscillate aim the oscillations are fed to the winding of iransfomicr with a center tap thai gets DC from the battery through the choke. So the oscillations of TI and T2 induce AC current in the secondary of tmnsformer which lights the CFL.

CHAPTER - IN

COMPONENTS DESCRIPTION OF MINI INVERTER

1. COMPONENTS USED IN MINI INVERTER:

1. Battery I2V DC.
2. Inductor 33ouH.
3. Resistor 330ohms.
4. Capacitors l23J & l04J.
5. Transistors CTC 880
6. Step-up Transformer.
7. CFL Bulb.

4.1.1 I2V DC BATTERY:

A battery converts chemical energy to electrical energy. This conversion enables electrical yowcr to be stored. An electric battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights, smart yhoncs, and electric cars. When a battery is suyylying electric yower, its positive terminal is the cathode and its negative terminal is ‹he anode. The terminal marked negative is the source of electrons that when connected to an external circuit will flow and deliver energy to an external device. lVhen a battery ir connected to an external circuit, electrolytes arc able to move as ionr within, allowing the chemical reactions to be comylcled at the separate terminals and so deliver energy to the external circuit. It is the movement of those ions within the battery which allows current to flow ocit of the battery to perform work. Historically the term "battery" specifically referred to a device composed of muI\iyle cells, however the usage has evolved io additionally include devices composed of a single cell. ’

Primary (single-use or "disposable") batteries are used once and discarded; the electrode materials are irrevcisibly changed during discharge. Common examples are the alkaline battery used for flashlights and a multitude of portable electronic devices. Secondary (rechargeable) batteries can be discharged and recharged multiple times using mains power from a wall **socket;** the original composition of the electrodes can be restored by reverse current. Examples include the lead-acid batteries used in vehicles and lithium-ion batteries used for portable electronics such as laptops and smart yhones.

Batteries come in many shapes and sizes, from miniature cells used to power hearing aids and wristwatches to small, thin cells used in smart phones, to large lead acid batteries used in cars and trucks, and ai the largest extreme, huge banery banks the size of rooms that provide standby or emergency power for telephone exchanges and computer data centers.

4.I.I.I Principle of Operation:

An electric battery is a device consisting of one or more electrochemical cells wiih external connections provided to power electrical devices such as flashlights, smartphones, and electric cars. When a banery is supplying electric power. its positive terminal is the cathode and ils negative termini is the anode. The terminal marked negative is the source of electrons that when connected to an external circuit will fiow and deliver energy io an external device. When a battery is connected to an external circuit, electrolytes are able to move as ions within, allowing the chemical reactions to be completed at the separate terminals and so deliver energy to lhe external circuit. lt is the movement of lliose ions within the battery which allows current to flow out of the battery to perform work. Historically the term "battery" specifically referred lo a device composed of multiple cells, however the usage has evolved io additionally include devices composed of a single cell.

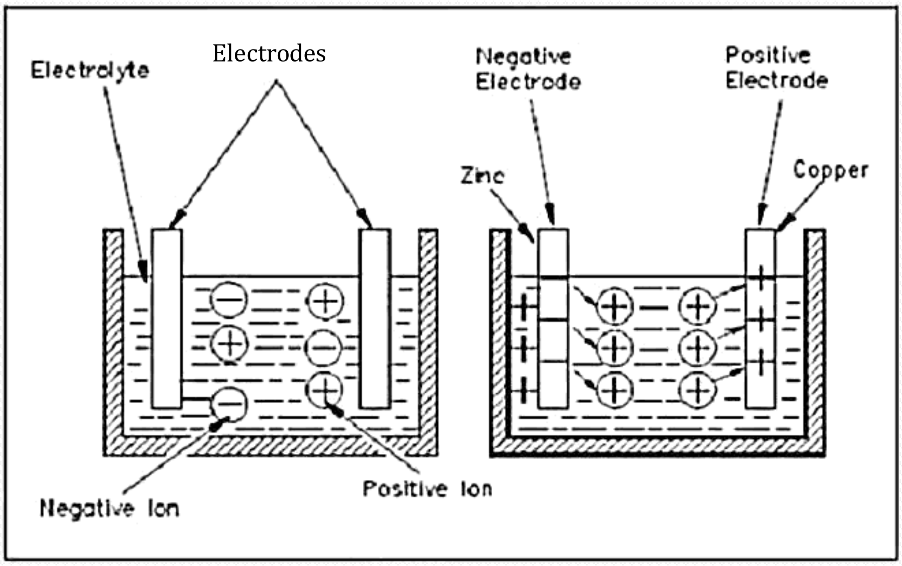


Fig.' Basic Chemical Production OF Electrical Power.

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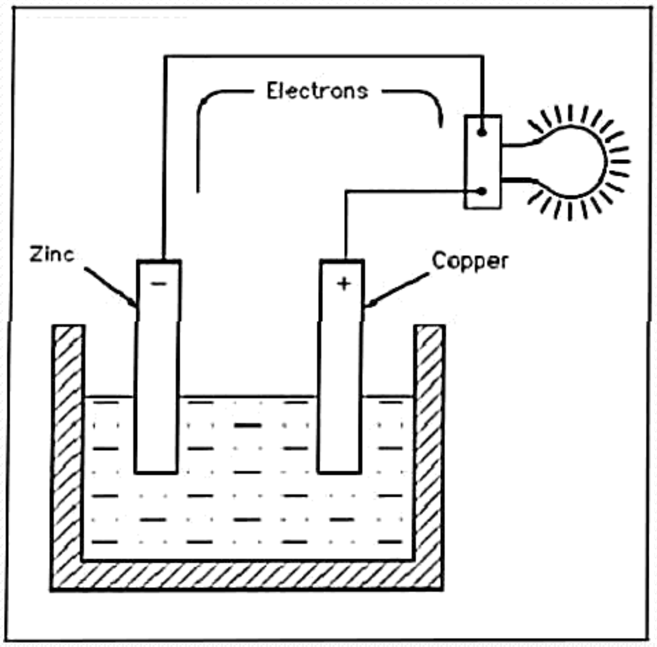


Fig. Electron Flow through a Battery.

Each half-cell has an electromotive force (or cmfl, determined by its ability to drive electric current from the interior to the exterior ot' the cell. The net einf of the cell is the difference between the emfs of its half-cells. " Thtis, if the clcclroiles have emfs El and E2, then the net cuff is E2-E1. In other words, the net enlf is the tliffcrcncc between the reduction ꜰotentialsof the half-reactions.

4.1.1.2 Battc Testing:

Battery testil2g ciln be done in more than one way. The most accurate method is measurement of specific gravity and battery voltage. To measure specific gr‹pt'ity buy a temperature eoiiipcnsating liydrometer, to liieasure volta¡;e use o digital D C. Voltmeter. A quality load tester may be a ootl purchase if you need to test settled batteries.

fix. Battery Levels & a 12V *DC* bitt C

State of Charge	SpeciF< Gzavit:y	Voltage	
		12V	0V
100°4	1.265	12.7	6.3
75^A	1.225	12.4	6.2
50%	1.190	12.2	6.1
25%	1.155	12.0	6.0
DBcharged	1.120	11.9	6.0

For any of these methods, you must first fully charge the battery and then remove the surface charge. If the battery has been sitting at least several hours (I prefer al least 12 hours) yoii i@ay begin testing.

4.1.2 **INDUCTOR:**

An iixJiictor. aLso called a coil or reactor, is a passive two-ter@nal electrical component which reliefs changes in electric current passing through it. It consists of a conductor such as a wire, usually svotin‹l into a coil. Energy is stored in a magnetic field in the coil as long as current Cows. \Vlieii the current flowing through on inductor changes. the time-varying magnetic field induces a voltage iii the conductor, according; lo Faraday'.s law of electromagnetic induction. According; to Lenz's law the direction of induced eleciroinotive force (or ”c in f.") is always siicli that it opposes the change in current that created it. As a result, inductors always oppose a change in current. in the some way Hint a flyvlicel opposes a change iii rotational velocity. Care should be taken not to confuse this with the resistance provided by n resistor.

Ati inductor is characterized by iis inductance. llie ratio of llie volia¡ie io the rate of change of current. which his units or lienries (H). Inductors have values that typically mnge from 1 pH (10 "H) to I H. Many inductors have a magnetic core made of iron or ferrite inside the coil. which serves to increase Ilie iiiagnetic field and thus the inductance. A1oii¡; with capacitors and resistors, inductors are one of rite three passive linear circuit elements that make up electric circuits. Inductors are widely iised in alternating current (AC) electronic equipment, particularly in radio equipment. They are used to block AC while allowing DC to pass; inductors designed for this purpose are called chokes. They are also used in electronic filters to separate signals of different frequencies, and in combination with capacitors to make tuned circuits, used to tune radio and TV receivers.

Fig: a 330uH Inductor.

4.1N RESISTOR:

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses. High-power resistors that can dissipate many watts of electrical power as heat may be used as ꓑart of motor controls, in power distribution systems, or as test loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage. Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity.

Resistors are common elements of electrical networks and electronic circuits and are ubiquitous in electronic equipment. Poetical resistors as discrete components can be composed of various compounds and forms. Resistors are also implemented within circuits. The electrical function of a resistor is specified by its resistame: common commercial fDSiStOFS ilFG 1llil1I¥1flC1tlFR OVR1' il Oiln3c of niore l$ltlll IIime ordcr r nia¿nniliidc. The noininiil value of the resistance falls within the manufacturing; lolcrancc, indicated on the component.

4.\.3.I Theos' of operation:

The behavior of an ideal resistor is dieiiiied by the relationship specified by Ohm's law:

V —I ft

Ohiii'S 1‹iiv Ualt2S I$IFtt I lR VO)lilac (V) across ii resisIor is proportioDil 10 the ctirrcnt (I), wlicre the const‹int of' proporlioniil ity is the resistance (R). kOfi RXilfR/lR i f ii 300 ohm resistor is ali‹iched ‹icross the td dilglls Of 12 olt battery, then a current of 12 / 300 = 0.fl4 arripcrc5 tloiws through that rc5isIor.

Pniclical resistors also have some intltlClilDCc anti capacitance which affcct the relation bctivecn vOllit¡;c tints CtlfTcDt iFI il$lcEllill ing current circuits.

The oliiii (symbol: Al) is the SI unit of clcclrical resistance. named :iflcr Georg Sinton Ohm. An ohm is cqti ivalcnt to ii volt per ampere. Since resistors arc spccificd and inaniifiicttircd over ‹i very large raw or ›. s, t co› eti tinits of' atillirhs (1 on —io -' n), kilohm (I in —1o' n), : d mcgaohni (1 Mn - ic• n› arc iilso in commoH Heave.

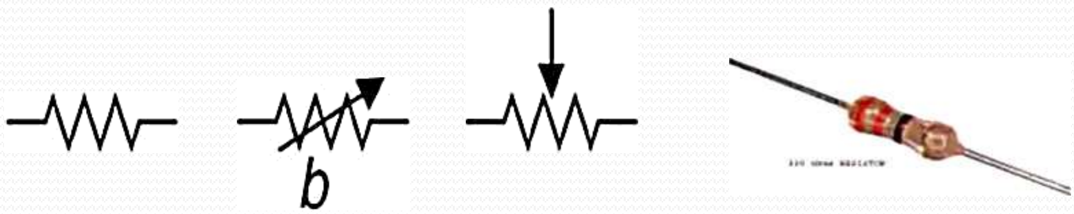


Fig: different types of kcsision. & 33on resistor.

4.1.4 CAPAC lTOR:

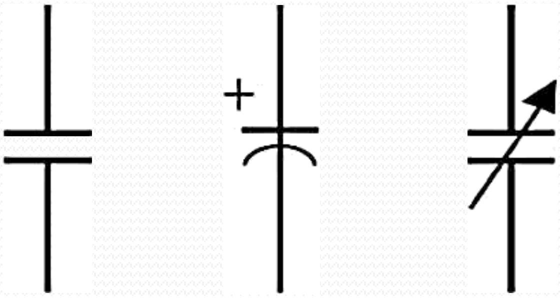
A capacitor (originally kntns'ii as a condenser) is a passive Iwo-terminal clectrical componenl tised to tctnpomrily sltire electrical cnergy Ifl iIn electric ficld. The forme of practiclll Cil ilCitors vary widely, but inost cont:iin at least tw'o clectrical contlttctors (platcs) separated by ii dielectric (i.c. an insulator that cnn slorc enerpy by bccoining polarized). The condtictors can be thin filuis, foils or sinÎcred beads of metal or condiictive electrolyte. etc. The non-condticting dielectric acts to incrcase the capacitor's charge capacity. Miitcrials coininonly uscd as dielectrics include glass. ccraniic, plastic film, paper, mica, and oxidc laycrs. Capacitors are widely tisctl as parts of elcctrical circiiils in many coiuiiion electrical dcvices. Unlike iI l'CSistor, an idciil capacitor docs not dissipaÎe cnergy. Insteatl, ii capacitor slorc.s energy in the forin of an electrosialic field betwccii its plates.

\Vhen there is a potential diftcrcnce across the contluctors (e.g., when a capacitor is attached ocross a b:ticry), an electric ficld develops across the dielectric, cattsing positive charbc +Q to collect on true plaie and nc¿uiitivc charge —Q to collect on the other plate. If a battery hls beeri attached t‹i a capacitor *for* a sttffjcient *airiount* of tiittc, *no current* can *Dvvt!* through the capacitor. However, i(a iiiNe-varying voltage is applied acrtiss the leads of the capacitor, ii tlisplacement current can flow.

An itlcal capacitor is cll£lFtlCtcrized by a single conii$ilnt valtie, its capacitance. Capacit‹incc is defined as the ratio of tlic clcclric charge Q on each conductor to the potential difference V between ihein. The SI unit of capacitance is the farad (F), which is equal to one couloiiib per vt›1t (I C/V). Typical capacitance valiics range from about I pF (10 " F) to about 1 inF (10 ' F).

The larger the StlFfilCC area of the "plates" (conductors) and the narrower the gap between them, the greater the capacitance is. In practice, the dielectric between the plates passes a small amotlDt Of Milk 1@2 Ctlfffllt rind olso has an electric field strength limit. known as fhe breakdown voltage. The conductors and feuds irttroduce an undesired inductance ‹tnd resistance.

Capacitors are widely used in electronic circuits fiir blocking direct current while allowing; alternating ciirrent to pass. In analog filter networks. they siiiootli the output of power supplies. In resonant circuits they tune radios to particular frequencies. In electric POlvcr trilnslllission sysleMs, they stabilize voltage and power flow,



Fixed Capacitor Polarlzed Capacitor Variable Capacitor

Fig. Symbols of Different Capacitors.

Fig: l23J & l04J Capacitors.

The value *I23J* indicates the value 12 with 3 zeros added afler it. This means that the value is *I2 TOO ›F.* and 704J indicates ilie x•alue 10 with 3 zeros added after it. This means that value is *I4000pF.* The letter “J” followin$_S$ indicates the tolerance of the part (5% in this **case).**

4.1.5 TRANSISTOR:

A transistor is a semiconductor device used to amplify or switch electronic signals and electrical power. It is composed of seniicondiiclor material usually ii ith at least three terminals for connection to an extenial circuit. A voltage or current applied to one pair of the transistor's terminals changes the current through another pair of terminals. Because the controlled (output) power can be higher than the controlling (input) power, a transistor can amplify a signal. Today, some transistors are packaged individually, but many more are found embedded in integrated circuits.

4.1.5.1 Bipolar Junction Transistor:

A bipolar junction transistor (bipolar transistor or BJT) is a type of transistor that uses both electron and hole charge carriers. In contrast, unipolar transistors. such as field-effect transistors, only use one kind of charge carrier. For their operation, BJTs tise two junctions between two semiconductor types, n-type and p-type.

BfTs are manufactured in two types, NPN and PNP, and are available as individual components, or fabricated in integrated circuits, oñen in large numbers. The basic function of a BJT is to amplify current. This allows BJTs to be used as amplifiers or switches, giving them wide applicability in electronic equipment. including computers, televisions, mobile phones, audio amplifiers, industrial control, and radio transmitters.

4.\.5.2 \Yorking:

BJTs come in two types, or polarities, known as PNP and NPN based on ihe doping types of the three main terminal regions. An NPN transistor comprises two semiconductor junctions that share a thin p-doped anode region and a PNP transistor comprises two semiconductor junctions that share a thin n-doped cathode region.

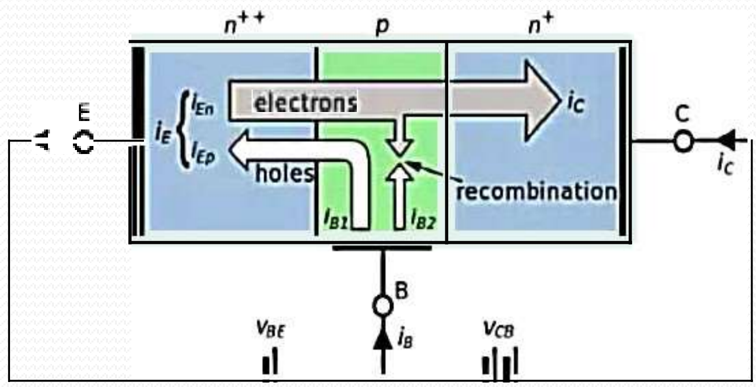


Fig. NPN BIT with forward-biased ~~E–B~~ junction and reverse-biased ~~B–C~~ junction.

Charge flo»' in a BIT is due to diffusion of charge carriers across a junction between two regions of different charge concentratioris. The repiorLs of a BJT are called emitter, collector, and base. "°' " A discrete transistor has three leads for connection to these regions. Typically, the emitter region is heavily doped compared to the other two layers, whereas the majority charge carrier concentrations in base and collector layers are about the saiNe. By design most of the BIT collector current is due to the flow of charges injected from a high-concentration emitter into the base where they are minority carriers that diffuse toward the collector, and so BJTs are classified as minority-carrier devices.

In typical oFeration, the base—emitter junction is foinvmd biased, w'Iiich means that the p-doped side of the junction is at a more positix'e potential than the n-doped side, and the base-collector junction is reverse biased. In an NPN transistor, when positive bias is applied to the base—emitter junction, the equilibrium is disturbed bet»een the therinally generated carriers and the repelling electric field of the n-doped emitter depletion region. This allow s tliermally excited electrons to inject from the errñtter into the base region. These electrons diffuse through the base from the re ion of high concentration near the emitter towards the region of low concentration near the collector. The electrons in the base are called minority carriers because the base is d Fed p-type, which makes holes the majority carrier in the base.

To minimize the Fercentape of carriers that recombine before reaching the collector—base junction, the transistor's base region must be thin enough that carriers can diffuse across it in much less time than the semiconductor's minority carrier lifetime. In particular, the thickness of the base must be much less than the diffusion length of the electrons. The collector—base junction is reverse-biased, and so little electron injection occurs from the collector to the base, brit electrons that diffuse through the base towards the collector are swept into the collector by the electric field in the depletion region of the collector—base junction. The thin shared base and asymmetric collector—emitter doping are what differentiates a bipolar transistor front two separate and oppositely biased diodes connected in series.

4.1.5d NPN Transistor:

Fin. Thc symbol ufan Nf'N BJT.

NPN is onc of the two typcs of bipolar transisiors, consisting of:i laycr of P-dt›pcd sciBictintliiclor (Ilic "basc") bctivccn two N-tlopctl laycrs. A smaíl current cnicring the basc is ‹iinplifictl to prodtice a largc collccltir antl cinitlcr current. That is. whcn thcre is a po.sili ve /O1G1II iíI tlI ffcrcncc nlcílÜtlfC)ïoni the ciniltcr o1' aiI N PN lfilDÜÍSÍOE lii Hs basc (i.c., wlicn Ilic basc is liigli relativa to the ciiiitlcr) as it'C$ Ub /OSiIÍ¥'C QOlCfltial dÍ ffcrcncc mcasuretl front the basc to tlic ctillcclor. Ilic Iransistor bcctiincs aclive. ln this "on" st:ric, ch‹irgc flows bctwccn the collcctor antl cMittcr ‹if the transisior. Most of the currcnt is carrictl by clcclrons inoving from ciniltcr lo ctillCÚlUf íls inint›rily carricrs in the P-lypc b:isc rc¡;itin. To allolV fOP @fCíltRfi CUITRH1 ílDt$ $‹l!iICf t3 cfíllioti, most II ÜÍRF fíÎÈlsistom tiscd today ílrc N PN bccatisc cícctron mobility is liiglier Ilian liolc inobilily.

A mnemonic device for the NPN transistor symbol is "not pointing in". based on the arrows in llic symbol and the letters in the name.

4.1.5.4 Active-mode NPN transistor:

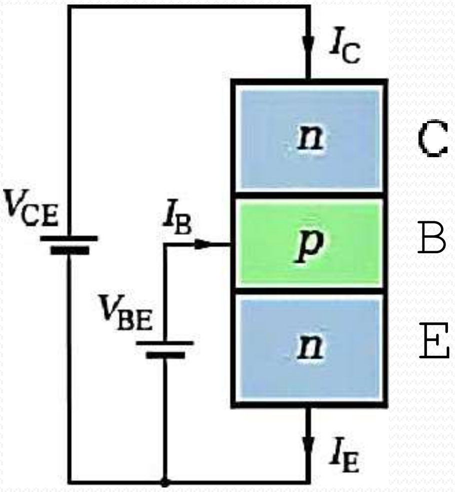


Fig: Stricture and rise of NPN transistor.

The diagram sho›•s a schematic representation of an NPN transistor connected to hvo voltage sources. To make the transistor conduct appreciable current (on the order of 1 inA) from C to E, VBEmust be above a minimum value sometimes referred to as the cut-in voltage. The cut-in voltage is usually about 650 mV for silicon BJTs at room tempemture but can be different depending on the type of transistor and its biasing. This applied voltage causes the lower P-N junction to 'tuni on', allo»'ing a flow of electrons from the emitter into the base. In active mode. the electric field existiii¿g between base and collector (caused by Vcx) 1S'ill cause the majority of these electrons to cross the ripper P-N junction into the collector to form the collector current Ic. The remainder of the electrons recombines with holes, the majority carriers iii the base, making a current through the base connection to form the base current, IB. As shown in the diagram, the emitter current, IE, is the total transistor current, »•hich is the sum of the other terminal currents. (i.e.. *Iz —IB* ?C).

In the diagram the arro»z representing current point in the direction of conventional current —the flow of electrons is in the opposite direction of the arrows because electrons carry negative electric charge. In actix'e mode, the ratio of the cotlector current to the base current is called the DC current gain. This gain is usually 100 or more, but robust circuit designs do not depend on the exact value (for example see op-amp).

The value of this gain for DC signals is referred 10 ils *hrs G*Rd the value of this Main for sni‹ill signals is referred to as /ʃ ,,. That is, hen a siii‹ill clhlnpc in the currents occurs, and su fticicnl time h:is piissetl liii' file nciv ctiiiditi‹iii to rc:ich ii stciitly stiile is /o. the ratio of the change in collector current to thc ch.ingc in base current. The symbol /J is iisctl Stir both fur and fi,,. The emitter ciirrent is related to 1* r exponenti:illy. At room temperature, an incre.ise in *UB* by approximately 60 i@V increases the emitter current by a fnctor of 10. Because the base current is approximately proportional to the collector and emitter currents, lhey vary in the same way.

CTC 880 NPN Transistor is tised Mini Inverter. The Pin diagram of CTC 550 as shown below figure.

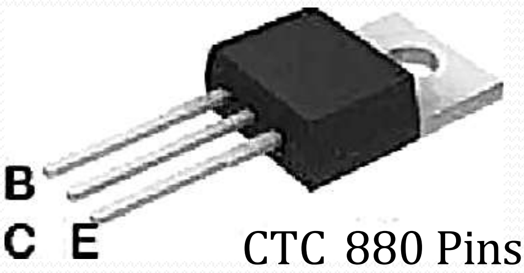


Fig: pins of CTC 880 Transistor.

4.1.ti STEP-UP TRANSFORMER:

A transformer is an electrical device tINt transfers electrical cncrgy between two or inoi"c circ iiu through clcctrcm:ignctic induction. Elcctrunz‹ignctic ind ictiun produces ‹in electroiiiotive force n itiiin a conductor which is exposed to time varying magnetic fields. Transformers are used to increase or decrease the alternating voltages in electric power applications.

On ii step-up trunsliiripcr tlicrc are more turns on the scctindiiry coil tlmin the primary coil. The induced voltnJue across the secondary coil is greater than the applied voltage across the primary coil or in other words the voltage has been “stepped-up”.

A step-up transformer is the direct opposite of a step-do«'n lransforiiier. There are many turns on the second.ary iv ñidinp than in the primary ivindi•s in the step-up transformers. Thus, the voltage supplied in the second:my ii‹insftirincr is greater than the tone supplied across the primary iv inding. Because of the principle of conservation of energy, the transforiiicr converts lo» voltage, high-current to high voltage-low current. In other ords, the voltage has been stepped up.

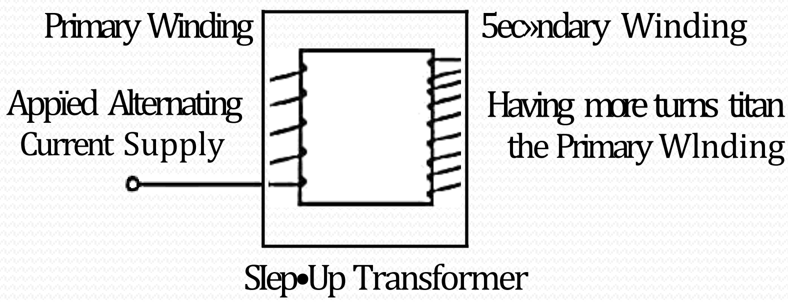


Fig. o Step-up transfonner.

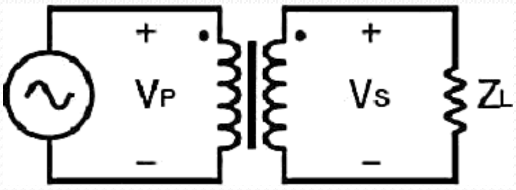
You can firid step-up transformers locaied near poiver plants that are desigiied to operate megawatts of posver. Apart from the power plonis. step-tip traiisformers can nlso be uscd for loc:i1 iind sniallcr applications siich ns x-riiy iniichinc whicli rcqtiircs aboiit 50,000 volts to work. Evcn ii inicro-ivavc oven rcqiiircs ii sniall stcp-tip lriinsroniicr to opcratc.

4.1.fi.1 Dasic Principlc:

For simpl ification or approximation piirposes, it is very coiniuon to analyze the trnnsftirincr as an idcii l triuisforiDcr inodcl as prcscntctl in the two iinapcs. An idcal transformer is ii theoretical, linear triinsforiiier tl1‹t is lossless and perfectly couplet; that is, there are no energy losses and flux is coinpletely confined » ithin the magnetic core. Perfect cotipling iiNpl ics infinitcly high core iiiagnci ic pcrmcability :ind w intlÎlÿ Île LtC tillJCCiS élit) zero net magnetomotive force.

a:1

) No:Ns



Ideal tmnsformer connected with source Vp on primary and load impedance Zc on secondary, where 0 < ZL* .

A varying current in the tmnsformer's primary winding creates a varying magnetic flux in the core and a varying magnetic field impinging on the seeondary winding. This varying magnetic field at the secondary induces a varying electromotive force (EMF) or voltage in the secondary winding. The primary and secondary windings are wrapped around a core of infinitely high magnetic penrieability so that all of the magnetic fltix passes through both the primary and secondary windings. \Vith a voltage source connected to the primary winding and load impedance connected to the secondary winding, the tmnsformer currents flow in the indicated directions. (See also Polarity.)

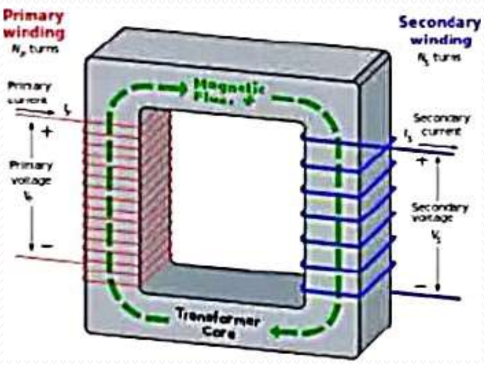


Fig: an Ideal transformer and induction law.

According to Faraday's Law, since the same magnetic flux passes through both the primary and secondary windings in an ideal tmnsformer, a voltage is induced in each winding, according to eq. (1) in the secondary winding case, according to eg. (2) in the primary winding case." The primary EMF is sorrietimes termed counter EMF. This is in accordance with Lenz's law, which states that induction of EMF always opposes development of any such change in magnetic field.

The transformer minding voltage ratio is tliiis shown to be directly proportional to the winding turns rotio according to eg. (3). According to the law of conservation oi' energy, any load i inpedance connected to the ideal transformer's secondary winding results in conservation of apparent, real and reactive power consistent with eq. (4).

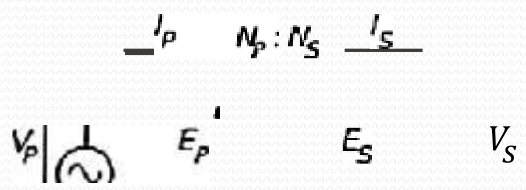
The ideal transformer identity shown in eq. (5) is a reasonable approximation for the typical commercial transformer. with voltage ratio and winding turns ratio bodi being inversely proportional to the corresponding ciii rent mtio.

By Oliin's law and tlie ideal transformer identity:

- The secondary circuit load impedance can be expressed as eq. (6)
- The appiircnt to:id ilTlpcdancc rcfcrrcil to the primary circuit is dcrivctl in eg. (7) to be cqri‹iI t‹› tloc turns mitio sq mrc‹l times the SCCOÎ1/iă Circuit miami iinpcdancc.

4. I.fì.2 Rcl:iti‹›nsliiy l›ct» ccn ›'nltnt\c and CtirrcMt:

Tito rclutionsliiy anzung ›'olt‹igcs, c irrcnts and number of finns is shown in the following fi;;tire for an ideal tmnsforiner with NP turns in the Friinary windin and NS turns in the secondary winding. VP and VS are respectively the primary and secondary voltages.



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

Nr/Ns is the ttimr ratio or tranr£ormer ratio.

Ideal transformer oquotl<tns jo4-ł

py F arado\"a law of induction

$V_S = -N_S \frac{d\Phi}{dt}$ . . . (1)

$V_P = -N_P \frac{d\Phi}{dt}$ . . . (2)

Combining ratio of (1) & (2)

Turns ratio $= \frac{V_P}{V_S} = \frac{-N_P}{-N_S} = a$ . . . (3)

Hhtre

for step-doa'n transfarmers, a > 1

for step-up transformers, a < 1

Eły Inzv of c 9r a4n.atioa oł c ncrgy. oppnrcrt. rea and i+acłn'• puwer aie each coris erved in tłie rrput ard ovtput

$S = I_P V_P = I_S V_S$ . . . (4)

C'onłSirHag ('2j A I-j) uith tfii+ erxlncx +'^! yields the iąe*f !r•n aformcr idcn"ity

$\frac{}{V_S} = \frac{}{I_P} = \frac{}{N_S} = \sqrt{\frac{L_P}{L_S}} =$

Dy Onm's law anJ idea! tians*o mer identty

$Z_L = \frac{V_S}{I_S}$ (6)

Apparent laod imoedan:e 2"r /2c referred to the p'imaryf

$Z'_L = \frac{V_P}{I_P} = \frac{aV_S}{I_S/a} = a^2 \frac{V_S}{I_S} = a^2 Z_L$. (7)

The voltage ratio is directly proportional to the mms ratio, but the current ratio is inversely proportional to the turns ratio. The secondary voltage is given by:

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

In a step-rip transformer the secondary voltage Vs is higher than the primary voltage Vp. This is achieved by using a secondary windings with more trims than the primary winding. The voltage increase is determined by the trims ratio.

In a step-dow'n transformer the secondary voltage V_S is smaller than the primary volta e Ve. The secondary winding has fe»•er turns than the primary winding. The voltage decrease is determined by the trims ratio.

In an ideal transformer the input and output pow'ers are the same:

P=Vp) Vs Is

4.1.6J Applications of Transformer:

Transformers are used to increase (or step-up) voltage before transmitting electrical energy over Ions distances through »•ires. \Vires have resistance which loses energy through joule heatins at a rate corresponding to square of the current. By transformin power to a higher voltage transformers enable economical transmission and distribution. Consequently, transformers have shaped the electricity supply industry, permitting generation to be located remotely from points of demand. All but a tiny faction of the world's electrical power has passed through a series of transformers by the time it reaches the consumer.

Since the high volt•ses carried iii the wires are significantly greater than what is needed in-horne, transfonners are also used extensively in electronic products to decrease (or step-down) the supply voltage to a level suitable for the low voltage circuits they contain. The transformer also electrically isolates ihe end user from contact with the supply voltage. Signal and audio transformers are used to couple stages of amplifiers and to match devices such as microphones and record players to the input of amplifiers. Audio transformers allowed telephone circuits to carry on a hvo-way conversation over a single pair of wires.

A baliin tmnsformer converts a signal that is referenced to Ground to a signal that has balanced voltages to ground, such as between external cables and interrial circuits.

Trans forners made lo iiicdÍCil Jfiíl C SIílD HFt s ISOlatc the iiscrs from the dirCCl CtliTcrll. TliCSc ílfc fotlntl ctHnnionly tisctl in ctinjtinclion with llos/ilíl b0ds, dcntisi chairs, and olhcr mctlical lab cqtiipincnl.

i@.' íI SÍC -up Iransformcr.

4.1.7 CFL BULB:

A compact fltiorcsc0lll ilfH/ (CFL) il SO Cil)R) COiDpiict fluorcsccnl light. energy-saving light, and comp:ict fltiorcscml tube, is ii fluorescent liimp designctl to rcplacc iin incantlesccnt liiMp; soMc type.s fit into light fixtures nori@ally used for incandescent laMps. The lil1Tt/S USC il I£t C ¥¥$liC11 is curvctl or folded tti fit info the S ilCC Of ilR iIlC:indcsccnt bulb, ilfl il COmpact clccironiC bil1$ilSI if1 1 lC bilSC Of tlic ilFD .

ComparcJ to gcncral-scn'icc incanJcsccnt Iamps gix'in tlic sanse anzotint o£ ›'isibIc liglit, CFLS risc unc-fif\h to unc-tliirJ tlic clcctric yo vcr, :mJ Iast cişlzt tn Iif\ccn timcr lungcr. A CrL has ‹i implica piircliasc pricc than an incandescent larrip. bin can savc ovcr five liiiics its purCllílSR Ficc in clcclricily ct›sts t» cr the lainp's lifctimc. " LikC íU JtiOFCSCOflt íllll(lS CFLs COHlíliH tOXiC lTl0fiCLlJ ' wíiich conipliciiilcs tíieir dispos:il. ln nJany counlrics, govcrnmcnls have barined the disposal of CFLs together with regular garbage. These coimtries have established special collection systems for CFLs and other hazardous waste.

Fig. a CFL bulb

The principle of operation in a CFL bulb remains the same as in other fluorescent lighting: electrons that are bound to mercury atoms are excited to states where they will radiate iiltraviolet light as they retiim to a lo»'er energy level; this emitted ultraviolet 1'S it is corn•erted into x'isibIe light as it strikes the fluorescent coati•s on the bulb (as well as into heat when absorbed by other materials such as glass).

CFLs radiate a spectral power distribution that is different from that of incandescent lamps. Improved phosphor formulations have improved the perceived color of the light emitted by CFLs. such that some sources rate the best "soft white" CFLs as subjectively similar in color to standard incandescent lamps. \Vhite LED lamps now compete with CFLs for higl-efficiency house lighting.

4.1.7.1 Encr Efficiency:

Because the eye's sensitivity chanSes with the wavelength, the output of lamps is commonly measured in lumens, a measure of the power of light as perceived by the human eye. The luminous efficacy of lamps is the number of lumens Froduced for each watt of electrical power used. The luminous efficacy of a typical CFL is 50-70 lumens per watt (lmfiV) and that of a typical incandescent lamp is I 0—17 lin/\V. Compared to a theoretical

100%-efficient lamp (680 lm/W), CFL lamps have lighting efficiency ranges of 7—10%, versus 1.5-2.5% for incandescents.

Because of their higher efficacy, CFLs use between one-seventh and one-third of the power of equivalent incandescent lamps. Fifty to seventy percent of the world's total lighting market sales were incandescent in 2010. Replacing all inefficient lighting with CFLs woiild save 409 terawalt-hotirs (1.47 exajoules) per year, 2.5% of the world's electricity consumption. In the US, it is estimated that replacing all the incandescent would save 80 T\Vh yearly. Since CFLs use much less energy than incandescent lamps (ILs), a phase-otit of ILs wotild result in less carbon dioxide (CO_) being emitted into the atmosphere. Exchanging ILs for efficient CFLs on a global scale would achieve annual **CO,** reductions of 230 MI (million tons), more than the combined yearly **CO,** emissions of the Netherlands and Portugal.

Electrical power equivalents for differing Ia«ips

yinim mltgtt	Ele‹bical power ronsvription (watt›)		
^&’!(!**®^*l	Incandescent	Coo|›actflvarexent	MD
CD	TD	9-1J	6-8
800	60	13-IS	9-12
1,t66	7S	1B-26	13-16
1,608	10D	25-28	15-22
2,606	ISD	3A2	24-28
3,100	200	49–75	30
4,DD0	300	75–100	N/A

CHAPTER - V

APPLICATIONS OF MINI INS'ERTER

5.0 APPLICATIONS:

» Inverser desi*ned to provide 230V AC from the l2V DC source provided in an automobile. The unit show'n provides up to 3 aiNperes of alternating ciirrent, or jtist enou*h to power Eighteen (1 fi) watt light btilbs.
» Titis circuit can be used in cars and other vehicles to charge small batteries.
- This circuit can be used to drive low power AC motors
- Ii can be used iii solar power system.

* An inverter converts the DC electricity from sources such as batteries, solar panels, or fiiel cells to AC electricity. The electricity can be at any required x'oltage in particular it can operate AC equipment designed for mains operation, or rectified to produce DC at any desired voltage.

* Micro-inverters convert direct current from individual solar panels into alternating current for the electric grid.

1. UNINTERRUPTIBLE POWER SUPPLIES (UPS):

- An iininterniplible power siipply (UPS) rises batteries and an inverter to supply AC po» er when iiinin power is not available. \Vhen main power is restored, a rectifier is used to supply DC Forter to recharge the batteries.

5.0.2 INDUCTION HEATING:

- Inverters con› ert low frequency mnin AC po» er to a higher frequency for used in induction healing. To do this, AC power is first rectified to provide DC Foz'er. The inverter then changes. The DC power to high frequency AC power.

5.0.3 HVDC POWER TRANSMISSION:

- \Viih HVDC power transInission. AC power is rectified and hitch › olta¿ve DC power is triinsiiiitted to another location. Al the receiving location an inverter in a static inverter plant converts the Fosverback to AC.

5.0.4 VARIABLE-FREQUENCY DRIVES:

- A variable-frequency drive controls the opemting speed of an AC motor by controlling the frequency and voltage of the power supplied to the iliotor. An inverter provides tire controlled power.

- In iiiost cases, the vari:ible-freyiency drive includes a rectifier so that DC power for the inverter can be provided front main AC power. Since an inverter is the key coniFonent, variable-frequency drives are soilietiiries called inverter drives or jiist inverters.

5.0.5 ELECTRIC VEHICLE DRIVES:

- Adjustable speed motor control inverters are currently used to power the traction motors in some electric and diesel-electric rail vehicles as wet 1 as some battery electric vehicles and electric •'s •*'•y vehicles such as the Toyota Prius. hybrid Various improvements in inverter technology are being developed specifically for electric vehicle applications In vehicles with resenerative braking, the ins•erter also takes power from the motor (now acting as a generator) and stores it in the batteries.

1. LI6JITATIONS:

- If there is no power supply at all in an area, if the power in the battery is drained, then the Inverter will be of no use. Iriverter can be used only for a few hours as otherwise the battery will be drained ont.
- Battery maintenance is required. Some electronic goods like computer will get reset even if on an inverter, because there is a small disniption in pois'er supply.
- Not applicable for above 20 \Vatt load
- It is damage if gix-en above the l2Volt input power supply

CHPATSR - M

CONCLUSION

6.0 CONCLUSION:

I think we're uncomfortable when problems don't have neat solutions. \Vhen the real world frustrates us, we make assumptions and propose simple models that iiiay or may not capture the ture behavior \Vitli all the work done so far, I believe some progress has been made in settlins the problem with systems addressed in the introduction.

The simple circuit topology supports a low cost and high efficiency power converter.

The proposed ins•erter circuitry has a low component count »•ith only Evo transistors, resistors, inductors, capacitors and step-up transformer.

An inverter is used to produce an tin-interrupted 220V AC (depending on the line voltage of the particular country) supply to the device connected as the load at the output socket. The inverter gives constant AC voltage at its output socket when the AC mains power supply is not as•ailable. The 18 \Vatt inverter applicable for MOBILE CHARGING and LIGHT LOAD.


Thank you.