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DESIGN AND IMPLEMENTATION OF MINI UPS SYSTEM

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ABSTRACT

This project is carried out to investigate the viability of and analyze relative power conception of a system to supply DC power directly to selected office/ household electronic devices commonly connected to the main supply for operation, maintaining operation from the mains but on power outage supply should be directed as DC to the device. It is basically a means to maintain power supply to devices connected to the mains thereby avoiding any interruptions due to power outage.

KEYWORDS: Transformer, Battery, Resistor, Capacitor, LED, Transistor, Diode, Zener Diode, IC's, switch, Variacs.

I. INTRODUCTION

The term Uninterruptible Power Supplies (UPS) has been applied both to an uninterruptible power system and to the specific battery-inverter equipment incorporated into the system. In this chapter, we will use the term UPS for the specific equipment.The UPS was developed in parallel with digital computers and other IT equipment to provide a reliable uninterruptible electric power source to create a standard the electric-utility industry could not provide. The computer industry would not have developed without some type of UPS, which either used engine-generator sets or static inverters employing power electronic devices. If the concept of an independent UPS had not been developed, then all electronic equipment sensitive to disturbances in source voltage would have had toincorporate energy storage means—for example, batteries to counteract such disturbances in the source voltage.

II. BLOCK DIAGRAM

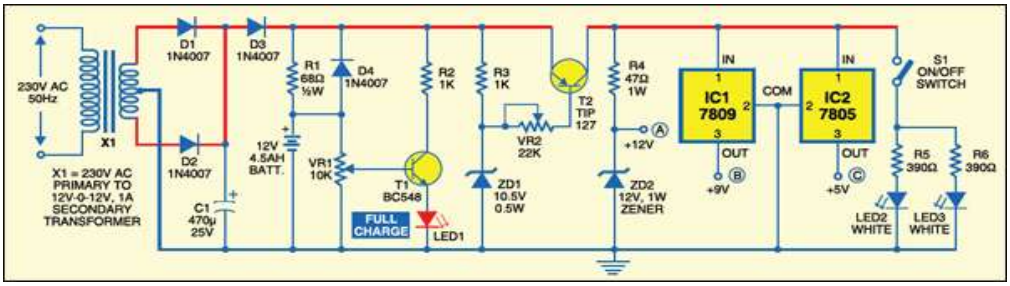


Fig.1 Circuit diagram of Mini UPS System (Theoretical)

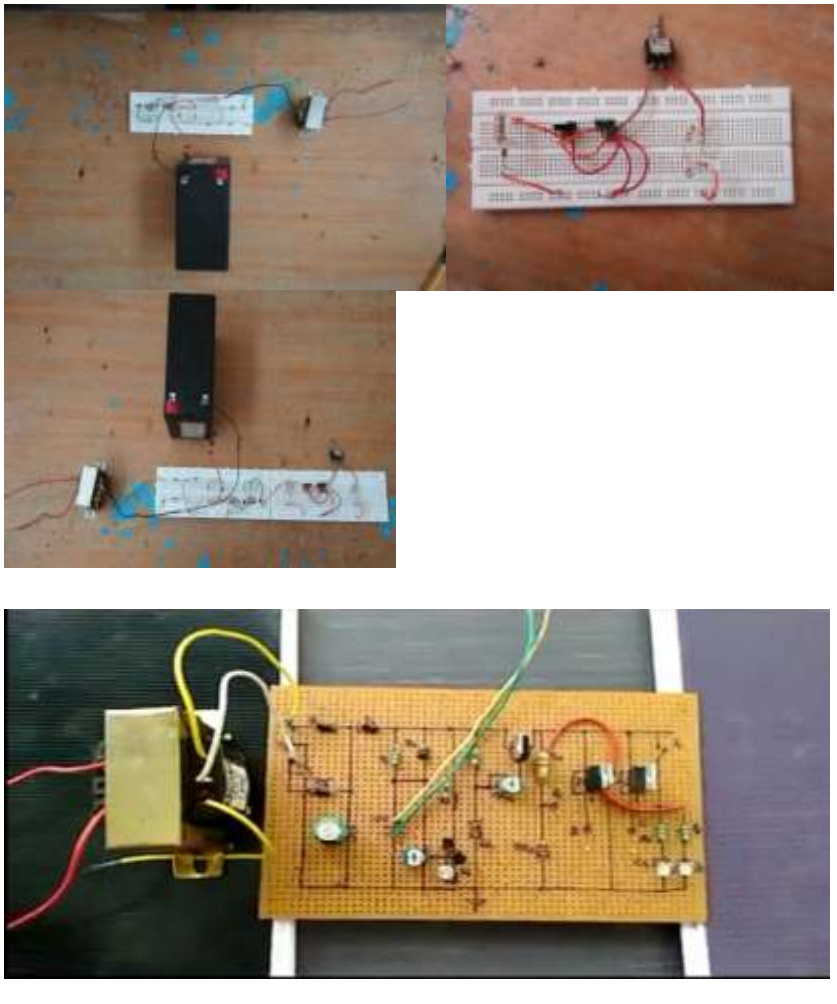


Fig.2 Practical view (Testing done first in Bread Board then replaced in PCB Board)

III. COMPONENTS REQUIRED:

Transformer 12-0-12V

Resisters R1=68ohm, R2=R3=1k, R4=47ohm, R5=R6=390ohm

Diode IN4007

LED

Transistors T1=BC548, T2=BC54

Capacitor C1=470micro

IC'S 7809, 7805

Zener Diode

Variance 10k, 22k

Battery 12V, 4.5Ah

Switch

3.1. PRINTED CIRCUIT BOARD (PCB):



Fig.3.1 Printed Circuit Board

A printed circuit board (PCB) is the board base for physically supporting and wiring the surface-mounted and socketed components in most electronics. In applications where fine conductive traces are needed, such as computers, PCBs are made by a photolithographic process, in a larger scale version of the way conductive paths in processors are made. Electronic components are typically placed by machine onto a finished PCB that has solder dabs in place. The PCB bakes in an industrial oven to melt the solder, which joins the connections. Most PCBs are made from fiberglass or glass-reinforced plastics with copper traces.PCBs can be single-layer for simple electronic devices. Printed circuit boards for complex hardware, such as computer graphics cards and motherboards, may have up to twelve layers. PCBs are most often green but they can come in any color. Other methods of PCB manufacturing include silk-screening and CNC-milling.

3.2. INTEGRATED CIRCUIT:

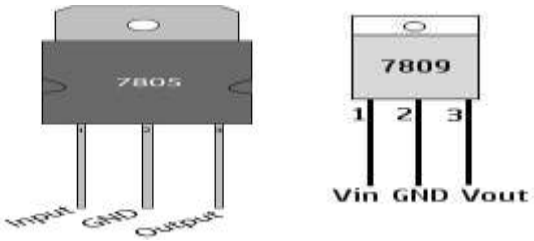


Fig.3.2 Integrated Circuit

An integrated circuit (IC), sometimes called a chip or microchip, is a semiconductor wafer on which thousands or millions of tiny resistors, capacitors, and transistors are fabricated. An IC can function as an amplifier, oscillator, timer, counter, computer memory, or microprocessor. A particular IC is categorized as either linear (analog) or digital, depending on its intended application.Linear ICs have continuously variable output (theoretically capable of attaining an infinite number of states) that depends on the input signal level. As the term implies, the output signal level is a linear function of the input signal level. Ideally, when the instantaneous output is graphed against the instantaneous input, the plot appears as a straight line. Linear ICs are used as audio-frequency (AF) and radio-frequency (RF) amplifiers. The operational amplifier (op amp) is a

common device in these applications.Digital ICs operate at only a few defined levels or states, rather than over a continuous range of signal amplitudes. These devices are used in computers, computer networks, modems, and frequency counters. The fundamental building blocks of digital ICs are logic gates, which work with binary data, that is, signals that have only two different states, called low (logic 0) and high (logic 1).

3.3. RESISTOR:

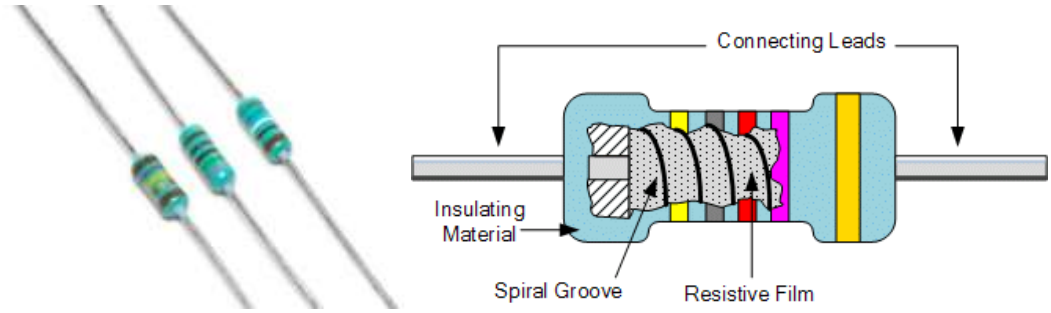


Fig.3.3Resistor

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 wattsof electrical power as heat may be used as part 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. Practical 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 resistance: common commercial resistors are manufactured over a range of more than nine orders of magnitude. The nominal value of the resistance falls within the manufacturing tolerance, indicated on the component.

3.4. DIODE:

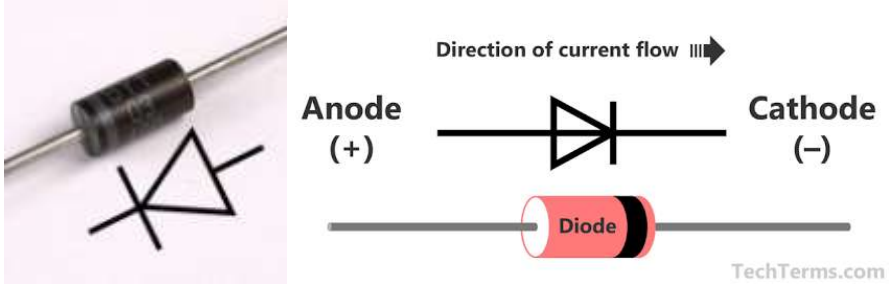


Fig.3.4 Diode

A diode is a two-terminal electronic component that conducts current primarily in one direction (asymmetric conductance); it has low (ideally zero) resistance in one direction, and high (ideally infinite) resistance in the other. A semiconductor diode, the most common type today, is a crystalline piece of semiconductor material with a p–n junction connected to two electrical terminals.[5] A vacuum tube diode has two electrodes, a plate (anode) and a heated cathode. Semiconductor diodes were the first semiconductor electronic devices. The discovery of crystals' rectifying abilities was made by German physicist Ferdinand Braun in 1874. The first semiconductor diodes, called cat's whisker diodes, developed around 1906, were made of mineral crystals such as galena. Today, most diodes are made of silicon, but other materials such as selenium and germanium are sometimes used.

3.5. LED(LIGHT EMITTING DIODE):

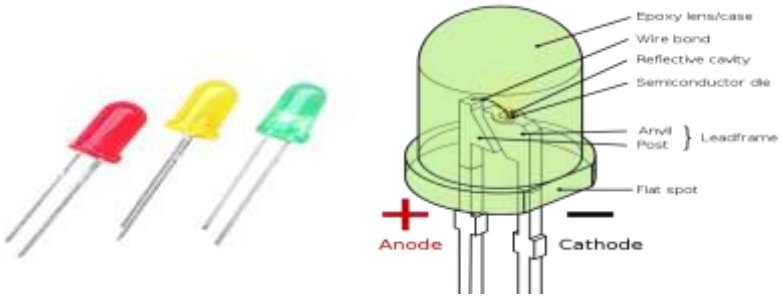
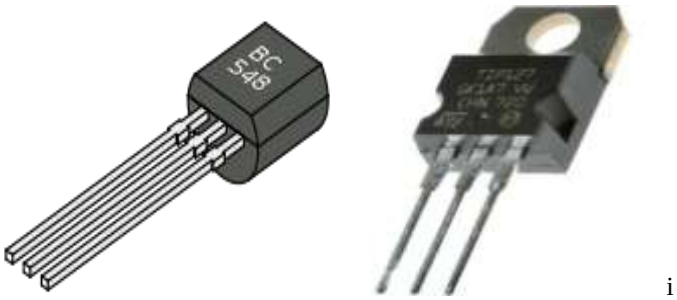


Fig.3.5 Light Emitting Diodes

A light-emitting diode (LED) is a two-lead semiconductor light source. It is a junction diode that emits light when activated when a suitable voltage is applied to the leads; electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the color of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor. LEDs are typically small (less than 1 mm^2) and integrated optical components may be used to shape the pattern. Appearing as practical electronic components in 1962, the earliest LEDs emitted low-intensity infrared light. Infrared LEDs are still frequently used as transmitting elements in remote-control circuits, such as those in remote controls for a wide variety of consumer electronics. The first visible-light LEDs were also of low intensity and limited to red. Modern LEDs are available across the visible, ultraviolet, and infrared wavelengths, with very high brightness. Early LEDs were often used as indicator lamps for electronic devices, replacing small incandescent bulbs. They were soon packaged into numeric readouts in the form of seven-segment displays and were commonly seen in digital clocks. Recent developments have produced LEDs suitable for environmental and task lighting. LEDs have led to new displays and sensors, while their high switching rates are useful in advanced communications technology.LEDs have many advantages over incandescent light sources, including lower energy consumption, longer lifetime, improved physical robustness, smaller size, and faster switching. Light-emitting diodes are used in applications as diverse as aviation

lighting, automotive headlamps, advertising, general lighting, traffic signals, camera flashes, and lighted wallpaper. They are also significantly more energy efficient and, arguably, have fewer environmental concerns linked to their disposal. Unlike a laser, the color of light emitted from an LED is neither coherent nor monochromatic, but the spectrum is narrow with respect to human vision, and for most purposes the light from a simple diode element can be regarded as functionally monochromatic.

3.6. TRANSISTOR:



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Fig.3.6 Transistor

The BC548 is a general-purpose NPN bipolar junction transistor commonly used in European and American electronic equipment. It is notably often the first type of bipolar transistor hobbyists' encounter, and is often featured in designs in hobby electronics magazines where a general-purpose transistor is required. The BC548 is low in cost and widely available.BC558 is a general purpose PNP transistor. It is used in switching and amplifier applications. The DC current gain varies in range 110 to 800. It is also used as a complement for transistors BC546 to BC550.

3.7. CAPACITOR:

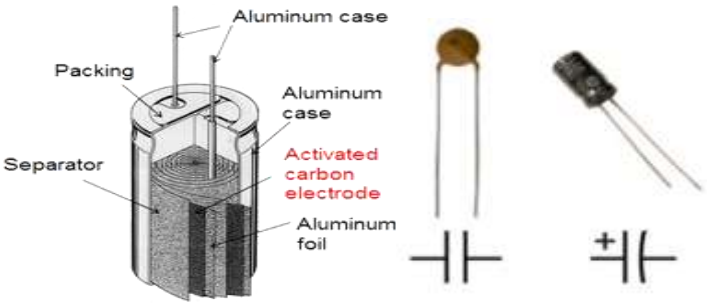


Fig.3.7 Capacitor

A capacitor is a passive two-terminal electrical component that stores electrical energy in an field. The effect of a capacitor is known as capacitance. While some capacitance exists between any two electrical conductors in proximity in an circuit, a capacitor is a component designed to add capacitance to a circuit. The capacitor was originally known as a condenser. The physical form and construction of practical capacitors vary widely and

many capacitor types are in common use. Most capacitors contain at least two electrical conductors often in the form of metallic plates or surfaces separated by a dielectric medium. A conductor may be a foil, thin film, sintered bead of metal, or an electrolyte. The no conducting dielectric acts to increase the capacitor's charge capacity. Materials commonly used as dielectrics include glass, ceramic, plastic film, paper, mica, and oxide layers. Capacitors are widely used as parts of electrical circuits in many common electrical devices. Unlike a resistor, an ideal capacitor does not dissipate energy. When two conductors experience a potential difference, for example, when a capacitor is attached across a battery, an electric field develops across the dielectric, causing a net positive charge to collect on one plate and net negative charge to collect on the other plate. No current actually flows through the dielectric; however, there is a flow of charge through the source circuit. If the condition is maintained sufficiently long, the current through the source circuit ceases. However, if a time-varying voltage is applied across the leads of the capacitor, the source experiences an ongoing current due to the charging and discharging cycles of the capacitor. Capacitance is defined as the ratio of the electric charge on each conductor to the potential difference between them. The unit of capacitance in the International System of Units (SI) is the farad (F), defined as one coulomb per volt (1 C/V). Capacitance values of typical capacitors for use in general electronics range from about 1 microfarad (pF) (10^{-12} F) to about 1 mill farad (mF) (10^{-3} F).The capacitance of a capacitor is proportional to the surface area of the plates (conductors) and inversely related to the gap between them. In practice, the dielectric between the plates passes a small amount of leakage current. It has an electric field strength limit, known as the breakdown voltage. The conductors and leads introduce an undesired inductance and resistance.

Capacitors are widely used in electronic circuits for blocking direct current while allowing alternating current to pass. In filter networks, they smooth the output of power supplies. In resonant circuits they tune radios to particular frequencies. In electric power transmission systems, they stabilize voltage and power flow.[3] The property of energy storage in capacitors was exploited as dynamic memory in early digital computers.

3.8. TRANSFORMER:



Fig.3.8Transformer

It is a general purpose chassis mounting mains transformer**.** Transformer has 240 V primary windings and centre tapped secondary winding. The transformer has flying colored insulated connecting leads (Approx 100 mm

long). The Transformer act as step down transformer reducing AC - 240V to AC - 12V.The Transformer gives two outputs of 24V, 12V and 0V. The Transformer's construction is written below with details of Solid Core and Winding. The transformer is a static electrical device that transfers energy by inductive coupling between its winding circuits. A varying current in the primary winding creates a varying magnetic flux in the transformer's core and thus a varying magnetic flux through the secondary winding. This varying magnetic flux induces a varying electromotive force (E.M.F) or voltage in the secondary winding. The transformer has cores made of high permeability silicon steel. The steel has a permeability many times that of free space and the core thus serves to greatly reduce the magnetizing current and confine the flux to a path which closely couples the windings.

3.9. ZENER DIODE:

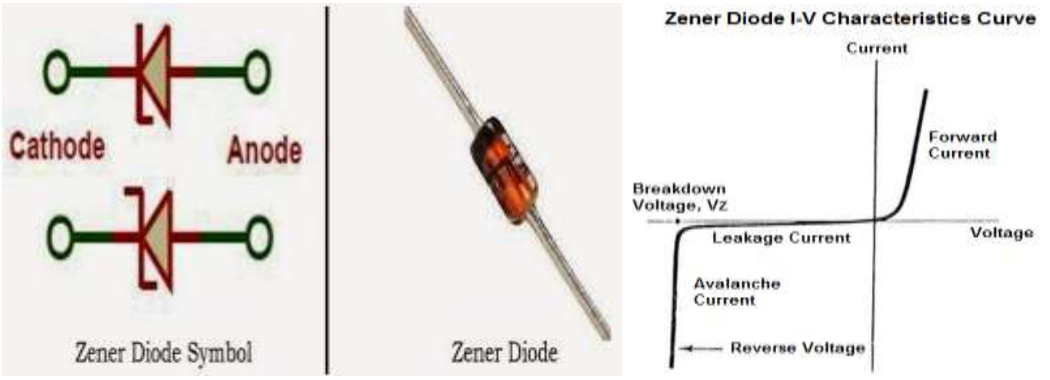


Fig.3.9Zener Diode

A Zener diode is a particular type of diode that, unlike a normal one, allows current to flow not only from its anode to its cathode, but also in the reverse direction, when the *Zener voltage* is reached.Zener diodes have a highly doped p-n junction. Normal diodes will also break down with a reverse voltage but the voltage and sharpness of the knee are not as well defined as for a Zener diode. Also normal diodes are not designed to operate in the breakdown region, but Zener diodes can reliably operate in this region.The device was named after Clarence Melvin Zener, who discovered the Zener effect. Zener reverse breakdown is due to electron quantum tunnelling caused by a high-strength electric field. However, many diodes described as "Zener" diodes rely instead on avalanche breakdown. Both breakdown types are used in Zener diodes with the Zener effect predominating under 5.6 V and avalanche breakdown above.

A conventional solid-state diode allows significant current if it is reverse-biased above its reverse breakdown voltage. When the reverse bias breakdown voltage is exceeded, a conventional diode is subject to high current due to avalanche breakdown. Unless this current is limited by circuitry, the diode may be permanently damaged due to overheating. A Zener diode exhibits almost the same properties, except the device is specially designed so as to have a reduced breakdown voltage, the so-called Zener voltage. By contrast with the conventional device, a reverse-biased Zener diode exhibits a controlled breakdown and allows the current to keep the voltage

across the Zener diode close to the Zener breakdown voltage. For example, a diode with a Zener breakdown voltage of 3.2 V exhibits a voltage drop of very nearly 3.2 V across a wide range of reverse currents. The Zener diode is therefore ideal for applications such as the generation of a reference voltage (e.g. for an amplifier stage), or as a voltage stabilizer for low-current applications. Another mechanism that produces a similar effect is the avalanche effect as in the avalanche diode.[1] The two types of diode are in fact constructed the same way and both effects are present in diodes of this type. In silicon diodes up to about 5.6 volts, the Zener effect is the predominant effect and shows a marked negative temperature coefficient. Above 5.6 volts, the avalanche effect becomes predominant and exhibits a positive temperature coefficient. In a 5.6 V diode, the two effects occur together, and their temperature coefficients nearly cancel each other out, thus the 5.6 V diode is useful in temperature-critical applications. An alternative, which is used for voltage references that need to be highly stable over long periods of time, is to use a Zener diode with a temperature coefficient (TC) of +2 mV/°C (breakdown voltage 6.2–6.3 V) connected in series with a forward-biased silicon diode (or a transistor B-E junction) manufactured on the same chip. The forward-biased diode has a temperature coefficient of −2 mV/°C, causing the TCs to cancel out. Modern manufacturing techniques have produced devices with voltages lower than 5.6 V with negligible temperature coefficients. But as higher-voltage devices are encountered, the temperature coefficient rises dramatically. A 75 V diode has 10 times the coefficient of a 12 V diode. Zener and avalanche diodes, regardless of breakdown voltage, are usually marketed under the umbrella term of "Zener diode".Under 5.6 V, where the Zener effect dominates, the IV curve near breakdown is much more rounded, which calls for more care in targeting its biasing conditions. The IV curve for Zeners above 5.6 V (being dominated by Avalanche), is much sharper at breakdown.

IV. BASIC WORKING PRINCIPLE:

The Working principle of UPS from basic principles in terms of application, UPS is a device that contains stored energy in order to inverter as the main component regulated stable frequency output power protection equipment mainly by the rectifier, batteries, power inverters and static switch of several components 1) rectifier: rectifier is a rectifier device simply means that the exchange of (AC) into direct current (DC) devices it has two mains functions: First, the alternating current (AC) into Direct current (DC) through the supply of filtered load, or the supply inverter; second, to provide battery charging voltage. Therefore it is also play a role in charger.

V. LINE INTERACTIVE ADVANTAGES:

1. AC to DC converter / battery charger does not have to provide full load power (potentially cheaper)
2. Less stress on dc to ac inverter since it runs at no load until ups switches to battery power (potentially cheaper)

VI. ON-LINE ADVANTAGES:

1. Zero switchover time from main line to battery power.
2. Always isolated from power disturbances on the main line.

VII. RESULT AND CONCLUSION:

It is shown that in most fields studied the DC UPS compares advantageously over AC UPS. Because of the advances in electronics, a mains frequency inverter is seldom a necessary part of a UPS system. Such an inverter in the UPS system contributes negatively to efficiency, cost and reliability of the system. Various types of by-

pass switches often included also make the system complicated and vulnerable. The simple implementation of DC UPS systems makes better use of energy and other resources which in the end will contribute to meeting the challenge of global warming as well as it gives clear advantages in security and operation of advanced technology equipment.

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