

# Novel DC Power Feed Inverter-Less On / Off Line UPS for All Electronic Home / Industrial Equipment

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**Abstract:** *The very important technology discovered by the author in the year 2009 is reported first in this paper. The technology is, most of all the electronic equipments today used in homes and industries can be operated directly with DC 230 volts supply instead of AC 230 volts normal traditional supply. This dual source operation of the equipments is not known to the public, professors, teachers, students, engineers, researchers and technicians so far, since the manufacturers labeled only AC is the source for operation. They may not also aware about the operation of the equipments by 230 volts DC source (HVDC). The technical reason for the possibility of dual source operation is due to the Switched Mode Power Supply (SMPS) used in the equipments..Based on the discovery, the work presented a novel inverter less, on/off line DC power feed Uninterrupted Power Supply (UPS) system suitable for homes, computers/data centers and industries. The UPS feeds power to the loads when the main supply failure. DC micro grid concept is applied for fabricating the UPS. The cost of fabrication, installation and maintenance is less .Easy to replace the required defective components since all are available in the nearby electronic/electrical shops. The reliability, quality of the system is well improved in comparison with existing inverter UPS system. Electrical energy is also saved Hence the manufactures of the equipments must demonstrate their social responsibility by labeling the dual source operation on the equipments for the awareness of the society. This will lead in implementing the proposed innovated HVDC micro grid UPS technology universally which saves lot of electrical energy. Already a trend is going on in bringing the technology of HVDC power feeds to international standardization. Therefore the technology has to be included in the curriculum of all science and technical universities worldwide for further developments in the field of power engineering.*

**Keywords:** Uninterrupted Power Supply, Direct Current supply, Inverter, DC micro grid, Switched mode Power Supply, Bridge Rectifier, Half wave Rectifier, HVDC power feeds, LTDC, DC to DC converter, Inverter

## 1. Introduction

UPS are two types 1.On line and 2.Off line. In the on line system, the main input supply is provided through the UPS, if the input supply fails, UPS continuously feeds power to the loads without any switching operation/interruption.The UPS is always in operation.In the off line system, the UPS is idle till the input supply failure.Once input power fails, the loads are connected to UPS by switching operation. This change over may cause power interruption some times. The best UPS system has 1.no interruption when feeding power to the loads during input power failure or low and higher input voltage situations. 2.less energy loss 3.smaller in size 4.reduced fabrication and installation cost 5.good reliability and stability 6.maintenance free 7..easy to replace defective components with less effort and cost 8.good quality (no harmonics) Based on the above requirements, the paper [1] describes/compares the merits and demerits of various UPS technologies developed during the last 10 to 15 years in providing AC power from the different sources to the loads. The diesel generator based back power ups system is completely automated/ supervised [2] .by using mobile technology in order to avoid manual control operations. Transformer less voltage stabiliser for 4 Kw is proposed [3] to avoid damages on electrical and electronics equipments due to voltage fluctuations. Design concept and construction of an inverter which converts from low voltage DC of batteries to standard AC supply UPS [4] are explained. The MOSFET transistor,relay, transformer and change over circuit are used. It is used to protect computers, data centres and telecommunications equipments from unexpected power disruption.The method of combining power from solar,mains,inverters,and generators is presented to avoid

break of power supply is presented [5].The automation achieved by using microcontroller ARDUINO.

The technology discovery of operating electronic equipments by 230V AC or 230V DC leads to develop a inverter less HVDC feed UPS system. Normally DC voltage above 50 V is considered as High Voltage DC. The HVDC power feeds is a trend in international global standardization [6]. The work presented utilizes microgrid concepts also in developing such UPS for achieving best performance in all requirements. Low Tension DC (below 50V) can be also used as input for the UPS.It needs a LTDC to HVDC converters available in the market.But energy loss and cost increases in this case.

The proposed UPS is suitable today for televisions, personal computers, fluorescent lamps with electronic ballast, CFL and LED lights, mobile chargers, lap top adapters, digital set top boxes, DVD players, electronic table & ceiling fans, and VFD control devices (List may increase further). The input is the HVDC. Inverter is avoided. The UPS can feed power to the above loads directly in on line or off line mode. The technical reason for the feasibility of operating the above equipments/devices either by AC or DC is explained and. thereby block diagram representation of the UPS system is given with explanation..The comparison of the UPS with conventional UPS system is presented with proper validatory technical points. The conclusion exposed the importance and need for immediate application of this UPS technology

Volume 12 Issue 12, December 2023

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**Technical reason for Dual Source Operation (230VAC or DC)**

The discovery is from the basic principle of current flow through the diodes (Fig.1) used in the bridge rectifier present in the second stage of AC to DC Switched Mode Power supply (SMPS) provided in all the today electronic devices/equipments as shown in Fig.2.

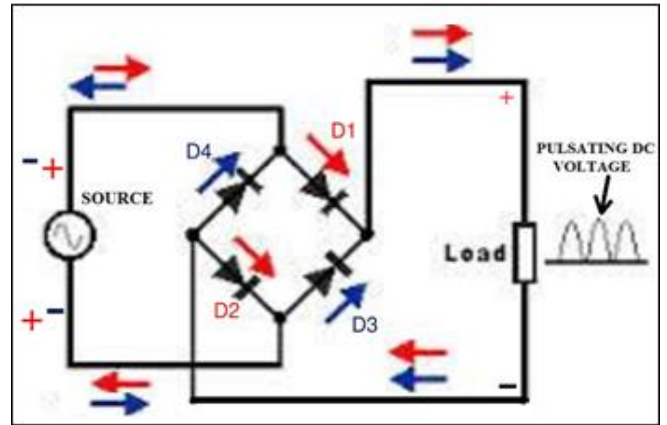
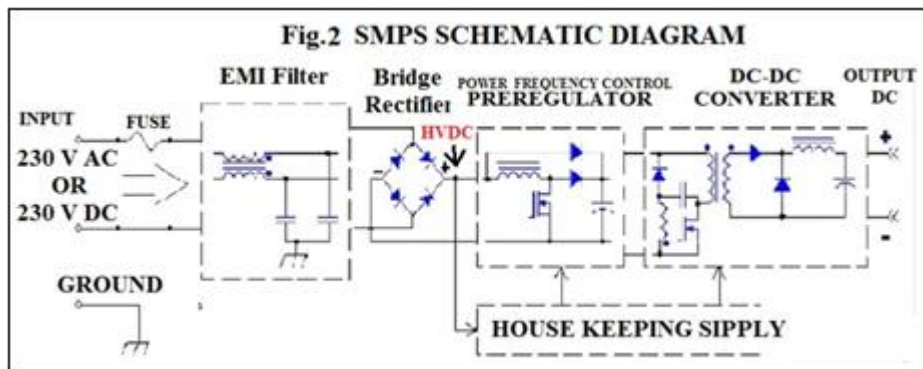


Figure 1: Current Flow

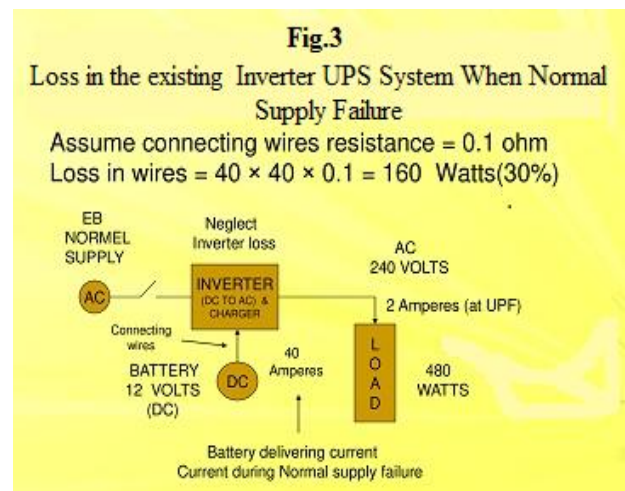


230V DC supply is given as an input instead of 230V AC, the Electro Magnetic Interference (EMI) filter in the first stage by passes the input 230V DC and the output of the bridge rectifier is also HVDC near to 230V since drop in two diodes 1.2 volts. This HVDC is the prime power source for the SMPS circuit. Therefore AC to DC SMPS is a DC to DC SMPS. The output DC voltage of the SMPS is constant for wide variation of input AC voltage and load current. This is same for the variation of input DC voltage. Also, if the input DC voltage polarity reversed, the HVDC polarity of the bridge rectifier output not changed. Hence the bridge rectifier is called as reverse voltage protection circuit.

However, in certain electronic equipment like laser printers, the input AC is not only used for obtaining HVDC, also used for some other operating purpose of the equipment. In this case, the equipment can't be powered directly by 230V DC source.

**Disadvantage of Inverter UPS existing AC system**

The loss is 160 watts (30%) when existing UPS with inverter feeds power to the 480 watts load as shown in the Fig.3 during the normal power failure. Loss calculation is also given by neglecting the DC to AC conversion loss (Inverter loss). This loss in the conductors increases the EB bill since the energy loss is consumed by the 12 volt battery when it is being charged from the resumed AC power supply. Also, battery connectors will be heated up and the heat is radiated to the atmosphere which increases global warming. Hence, low voltage high current operation creates more losses. If 24 and 48 volts inverters are used, the conductor loss will be reduced but cost and number of batteries increases.

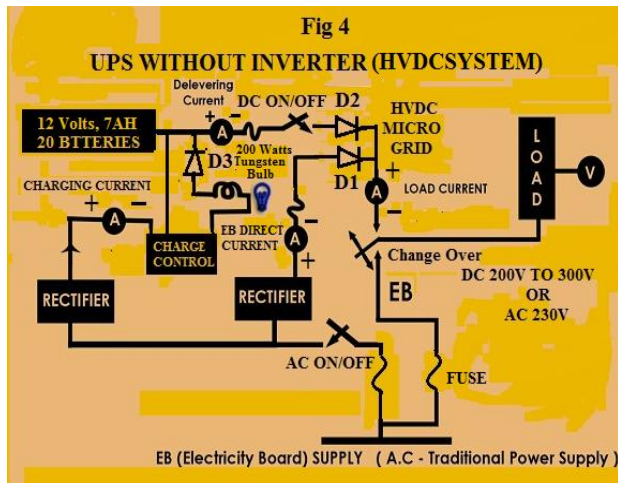


**Proposed Inverter less UPS System**

The Fig.4 shows the details of the UPS system. The aspect of the present invention is to provide a HVDC Micro Grid that gets power from two power sources helps in electrifying the household/Industrial electrical appliances as a reliable, efficient for on-grid operation, cost effective and easily maintainable.

The two power sources can be a rectified normal AC of 230V, 50Hz and the second source is 12V,7AH battery of at least 20 numbers connected in series (240V). The connection of rectified AC and DC 240V is through the diodes D1 and D2 respectively forms the HVDC micro grid as shown in the Fig.4. The load is connected to the micro grid. Separate ON/Off switch is provided for AC and DC 240V. The DC switch is closed permanently for on-line operation which feeds DC power to the load through the

diode D2 immediately during AC power cut. Electro Magnetic Relay (EMR) with no voltage protection circuit is replaced for the DC switch leads to Off-line operation. The relay is normally opened when normal supply is available. It is closed when the supply goes off and DC backup feeds power to the load. Another rectifier is used for charging the batteries with simple bulb charging method. The charging circuit is having charge controller to avoid over charging and discharging. The UPS feeds 1000 watts for about one hour. Half wave rectifiers with 10A,1000 volt silicon diodes are used.



The Table 1 compares the existing UPS system with proposed UPS HVDC power feed system which is having many advantages in various aspects.

2. Conclusion

A novel innovated HVDC micro grid power feed UPS system for on-line and off-line operation is presented. The UPS technology is feasible because of the possibility of operating the today electronic equipments/devices by 230V AC or 230V DC without any hardware changes. The reason is most of the devices are having SMPS power supply. This technology will eventually be put with its inherent advantages to practical use in many homes and industries of India and worldwide in future because it achieves better efficiency due to fewer power conversion stages (Sans Inverter) which incurred less energy loss than with an AC power feed. International standardization of HVDC power feeds is going on [6]. As a first step, the manufacturing companies should label on their products about the HVDC power feeds in addition to the normal AC power operation. Labeling must be carried out immediately since most of them in the world are not aware about the dual source operation of the today devices. The UPS is installed and tested for 8 computers in the computer laboratory of Electrical and Electronics Engineering Department of Thiagarajar college of engineering during the year 2009. Exposing this innovated Technology is being delayed.. So, it is very important to include the UPS system in Engineering /Science Curriculum of all the Arts, science & Technical Institutions and Universities worldwide for further development in the technology. It opens a new a new channel for doing research in the field of Power Engineering and its applications

Table 1: Comparison

AC SUPPLY SYSTEM (Existing UPS System) (AC POWER FEED)	DC SUPPLY SYSTEM (Proposed UPS System) (HVDC POWER FEED)
<ul style="list-style-type: none"> <li>• Low voltage , high current operation</li> <li>• Inverters required</li> <li>• Energy conversion loss is high( Four Stages)</li> <li>• Harmonics problem are encounter</li> <li>• Wire loss is high</li> <li>• Cable thickness is higher</li> <li>• Heating of cable&amp; inverter is higher</li> <li>• Presence of Sine wave problem</li> <li>• Electronic distortion is high</li> <li>• Normal Battery life</li> <li>• With excess load, inverters are damaged</li> <li>• Large size and heavy Battery is used</li> <li>• EB bill is increased (higher)</li> <li>• Investment cost is high</li> <li>• Energy saving is less</li> <li>• Global warming present</li> <li>• Applicable for inductive loads (like induction fan, laser</li> </ul>	<ul style="list-style-type: none"> <li>• High voltage ,low current operation</li> <li>• Not required</li> <li>• Absolutely minimum (Two stages).</li> <li>• No such problem.</li> <li>• Very less</li> <li>• Very less</li> <li>• Very less</li> <li>• No such problem</li> <li>• Distortion less</li> <li>• Enhanced battery life</li> <li>• Secured and excess load trips the system with ease.</li> <li>• Small size maintenance free batteries are used</li> <li>• Normal (not increased)</li> <li>• Comparatively less</li> <li>• Energy saving is very high</li> <li>• Not present</li> <li>• Not applicable</li> </ul>

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## Author Profile



**Dr. P. S. Kannan** obtained BE degree in electrical and electronics engineering (EEE), M.Sc (Engg.) in Power Systems and Ph.D in Power System optimization from Madurai Kamaraj University during the years 1976,1979 and 1996 respectively. He worked 32 years in Thiagarajar college of Engineering, Madurai, Tamil Nadu, India as Professor and head of EEE Department and Dean Student affairs. First Principal of Vaigai Engineering college at Madurai and served three years as Professor Emeritus in Kings Engg, College near Thanjavur . He guided PG students & research scholars more than 25 years and produced 12 Ph.D. Served as Chief investigator in the project of Defense Research Development Laboratory, Hyderabad. Published 35 papers in National/International Journals and 55 in National/ International conferences. Got Indian and German patents (2021 & 2022) for DC Micro-grid application in utilizing solar energy. Received more than 6 best research paper awards. Acted as member in academic councils and research committees of various Universities. Examiner and reviewer for journal papers/Ph.D Thesis Power system optimization & control is his field of interest.