Journal Of Harmonized Research (JOHR)

Journal Of Harmonized Research in Engineering
2(1), 2014, 20-24

ISSN 2347 – 7393

Original Research Article

UNINTERRUPTIBLE POWER SUPPLY USING BIDIRECTIONAL CYCLOCONVERTER

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Abstract- A new configuration of UPS using Bidirectional Cycloconverter is discussed in this paper. Here the cycloconverter acts as an inverter during the absence of ac mains and it acts as an battery charger during the presence of ac mains. Thus reducing the size and weight of the UPS and improving the efficiency of UPS.

I. Introduction:-

Nowadays demands have rapidly increased for low power uninterruptible power supply (UPS) less than 5KVA to protect equipment such as personal computers, word processors from temporary disturbances of commercial AC power supply. We got an idea of new configuration and control mechanism for an uninterruptible power supply (UPS) with a bidirectional cycloconverter from an IEEE paper by the authors Tadahito Aoki, Katsuichi Yotsumoto, Seiichi Muroyama, Yoshitaka Kenmochi. Since the bidirectional energy flow concept is increasingly coming in demand. We decided to implement this noval idea as our BE project. When commercial AC power is operating normally, the load is supplied by commercial AC power and the bidirectional cycloconverter operates as battery charger. During the interruption of commercial AC power, bidirectional cycloconverter operates as inverter and supplies AC power to load. Unlike a conventional UPS, this new configuration does not requires battery charger, so it can be small, lightweight, cost effective, and highly efficient.

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Received on: February 2014
Accepted after revision: February 2014

II. Literature survey

Conventional UPS has battery charger. This battery charger supplies DC power to an inverter while charging battery, and the inverter supplies AC power to the load. This system cannot provide small, lightweight, cost effective, and highly efficient UPS because it has battery charger as well as an inverter.

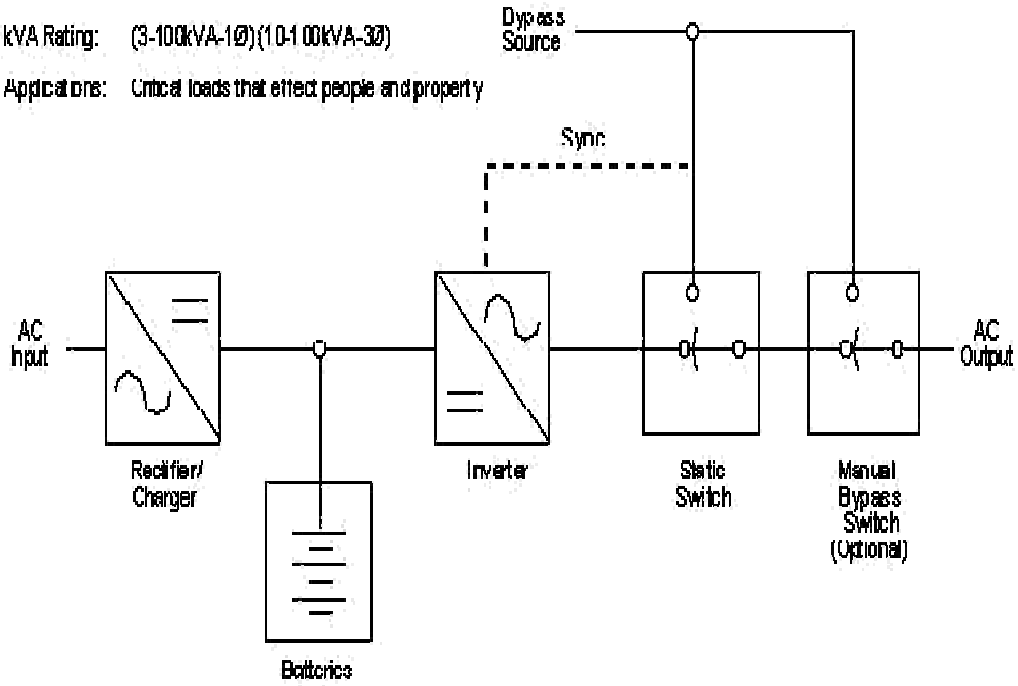

Fig. 1 Conventional approach

To reduce the size and weight and to improve the efficiency, a new UPS with bidirectional cycloconverter operates as battery as well as inverter. The battery charger is not needed in this UPS, and the load is supplied directly by commercial AC power except during commercial AC power interruptions.

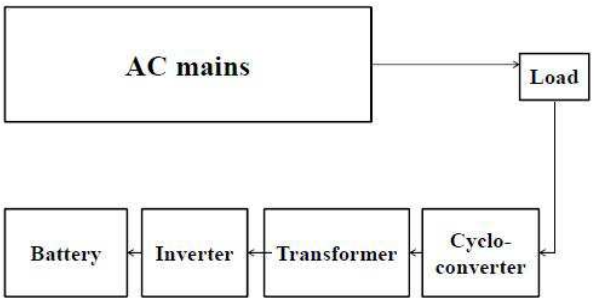

Fig. 2 New UPS configuration

The new UPS configuration consisting of bidirectional cycloconverter, a battery and line interrupter. When commercial AC power is operating normally, the load is supplied through line interrupt and bidirectional line. Then, bidirectional cycloconverter operates as an inverter and supplies AC power to load. The operation mode is changed by switching the control sequence. This configuration does not require a battery charger and load is supplied directly by commercial AC normally.

cycloconverter operates as a battery charger. The battery is charged by the bidirectional cycloconverter. When the commercial AC power fails or is temporarily disturbed, the line interrupter instantly cuts off commercial AC

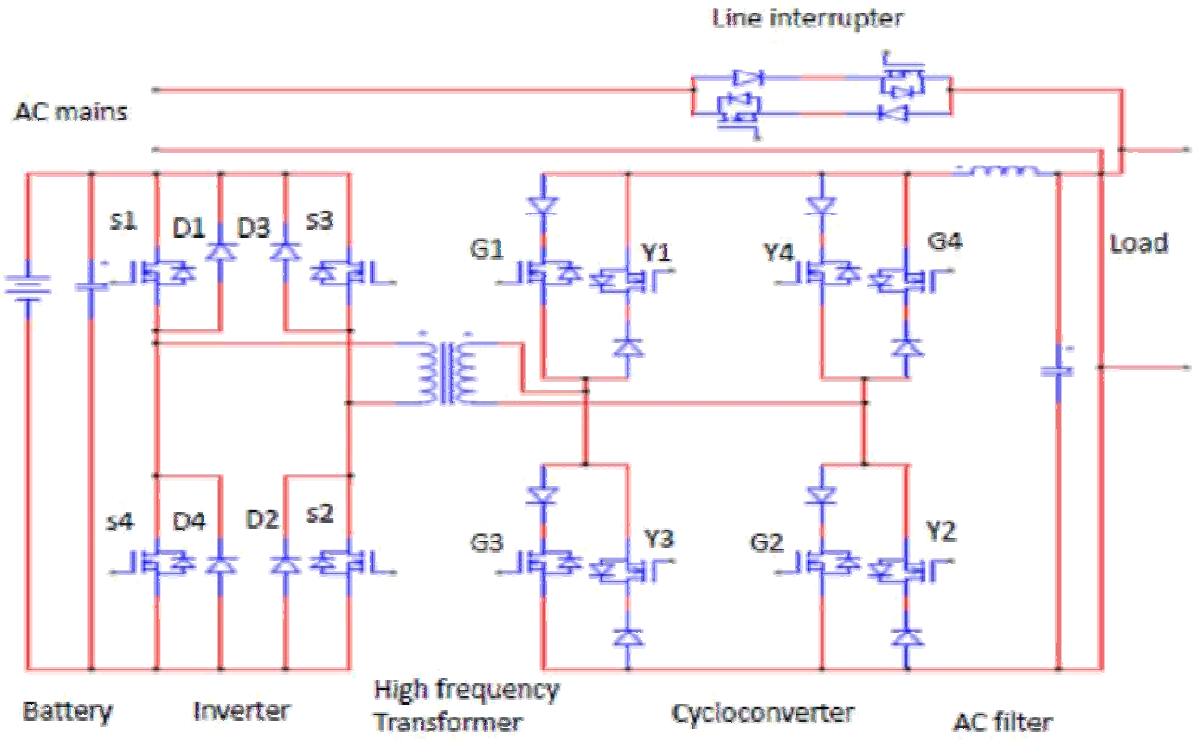

Fig. 3 Experimental circuit for new UPS

III. Circuit Diagram

The output specification of the UPS are 230V, 50Hz, whereas the battery voltage is 48V and inverter frequency is 40 KHz.

In the above figure ac mains are provided with a line interrupter to the load as well as cycloconverter. When the mains are present they are directly fed to load as well as the cycloconverter for the charging operation of the battery. Here during charging operation four switching devices are operated from the cycloconverter circuit they are G1, Y1, G2, and Y2. The transformer will step down the voltage and give the output to rectifier which will perform rectification and charge the battery.

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When the mains are interrupted the load will be supplied through the battery, inverter, transformer and cycloconverter.

IV. Control methods for bidirectional cycloconverter

For the pulse generations that are provided to the switching devices for switching purposes we have used two techniques.

1. Analog pulse generation
2. Using microcontroller

For the inverter circuit four devices are to be switched in a full bridge operation therefore we used pulse generation using SG 3524 pulse modulation IC.

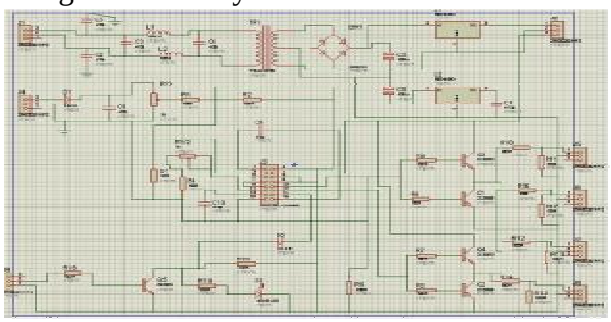

Fig. 4 Analog pulse generation circuit.

The fig. 4 shows the pulse generating circuit for the inverter bridge using SG3524.It also consist of 12v powersupply on it. The circuit is having over current protection also using the shut down pin (8) of the SG2524.the circuit gives four pulses in the output two positive pulses and two negative pulses. Here we only use one positive pulse which is given to mosfet driver PWM input pin for the operation of inverter.

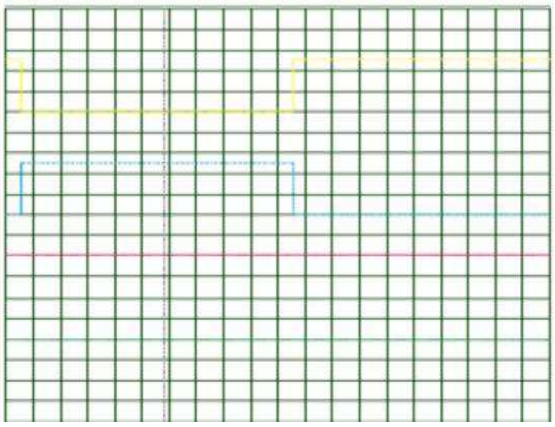

Fig. 5 microcontroller pulses

In bidirectional cycloconverter which consist of four bidirectional switches. We need to control switching of eight devices, four for battery charging operation when mains are present and four for the frequency step down operation when the ac mains are absent and the load is fed supply through the battery.

Therefore we used a microcontroller which gives the pulses as shown in the fig.5 given below for the control of switching of the devices.

Applications

1. In large business environments where reliability is of great importance, a single huge UPS can also be a single point of failure that can disrupt many other systems.
2. To provide greater reliability, multiple smaller UPS modules and batteries can be integrated together to provide redundant power protection equivalent to one very large UPS.
3. These UPSs are often installed in offices, in personal computers and word processor.

VI. Experimental results

As shown in the experimental circuit diagram power MOSFETS are used for the inverter circuit and the power diodes are used for the rectification purpose. The high frequency transformer is designed as per the specification. The cycloconverter circuit is designed using bidirectional power MOSFETs. The pulses for triggering the MOSFETs are as shown in the fig. 5.

Thus this new configuration can provide improved efficiency and light weight UPS.

VII. Acknowledgement

We are very thankful to our project guide Prof. V.M.Aranake, who helped us to develop this idea and kept us on track throughout the project by providing constant guidance and all the support we needed. Without their full support and cheerful encouragement the project would not have existed. We also wish to thank our HOD Prof. P.D.Khandeker for the never ending support. Last, but not the least, we would like to thank each & every person who helped us directly or indirectly to complete this project.

VIII. References

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