HIGH LIGHT LOAD EFFICIENCY POWER CONVERSION SCHEME USING FLY BACK CONVERTER

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***Abstract*-** This paper presents the high light load efficiency power conversion scheme. Normally, only one power supply is used for any purpose. The voltage and current can be flow from supply to load. However, the overall efficiency is still low under a very light load condition. For example, the efficiency at 1% load condition is about 50% in output. Therefore, in this paper, to improve the overall efficiency under very light load condition, a new power conversion scheme is proposed. Nowadays, high efficiency is valued for power supplies. Especially, high efficiency under a light load condition is becoming important to reduce the power consumption. To obtain this condition, the bidirectional fly back converter is used for power conversion purpose. So, the power can be flowing on both sides, and also the proposed converter is to step up and step down the voltage. The operating components used in this process are reduced, because, the MOSFET, diode and capacitor are in-builder in the converter. The redundant power supplies are also connected in parallel, to improve the power handling capability and overall reliability. This converter can be operated in wide range of input voltage to easily generating the multiple output voltages. This paper provides the electrical isolation, low switching and core losses, and low power consumption. Thus, the light load efficiency is very important in future.

Index Terms- Bidirectional integrated fly back converter, light load efficiency, power conversion, electrical isolation, wide range of input voltage.

1. INTRODUCTION

In the current social atmosphere promoting energy savings, high efficiency is valued for server power supplies and to reduce the power consumption. Especially, high efficiency under a light load condition is very important, because most of the power systems are operate that condition. So, many programs and regulations require high light load efficiency. Further, many manufacturers of computer, telecommunication and network equipment require high light load efficiency. Additionally, redundant power supplies are normally adopted in this structure to increases the power handling capability and the overall efficiency. These enable the power to be supplied continuously even when an arbitrary power supply is turned off due to faults, which improves overall reliability. The proposed scheme is mainly used for design the power supplies for light load efficiency. Each power supply has two power conversion stages. The first one is input filter and AC/DC converter. The input

filter is used to remove unwanted noise, the AC/DC converter which converts from AC voltage to DC voltage. The second one is DC to DC power conversion circuits, which use an isolated transformer and regulate the output voltage at above 20v. A fly back converter is used to meet the high step down voltage and low output voltage. In DC to DC power conversion, many components, including switch, diode, and capacitor are integrated. So, no need external components. Furthermore, in the proposed concept, the converter can be operated in wide range of input voltage source and to generate multiple output voltages. Today, as consumer electronic devices and IT equipment have grown explosively, the high efficiency in power supplies is becoming more and more important in order to suppress global warming. Consequently, the efficiency requirement, defined by Energy Star [I], 80Plus incentive program [2], Climate Saver Computing Initiative [3], and European Code of Conduct [4], is focused on the light load as well as the heavy load. Therefore, manufacturers for power supply have as significant challenge to improve conversion efficiencies of their products. Power supplies are required to meet stringent specifications on its efficiency, power factor, harmonic distortion, and voltage regulation. The fly back converter used in server power applications is designed to be operated in continuous conduction mode (CCM), when the converter is operating in light load condition, it will operate in DCM condition. While there are many applications for step-down DC-DC converters, there are also a large number of topologies for these converters. All these converters can generally be divided into two groups depending on what kind of regulation they use - fixed frequency with pulse width modulation (PWM) or converters with variable frequency. Converters with PWM provide good regulation from minimum power (<5% of nominal power) to maximum power with good efficiency. In power electronics switching losses typically contribute a significant amount to the total system losses. Therefore, omitting switching losses in the calculation or weighting the conduction losses with an estimated factor to take into account switching losses might result in large errors concerning the total losses. If one plans to calculate the junction temperature time behavior to improve reliability of the design, it is necessary to accurately calculate the switching losses. The method is to calculate conduction and switching losses analytically based on the on-times of the switches. This gives good results for PWM systems where the modulation scheme is known.

2. PROPOSED SYSTEM

In this proposed system, the fly back converter is used to design the power supplies. This converter is also known as isolated power converter and buck boost converter. The converter with inductor split to form a transformer, so, that the voltage ratios are multiplied with an additional advantage of isolation. Two loads are used in this proposed system and reduce the power consumption then improve the efficiency above 90%. Additional components are not required so the cost of this system is low.

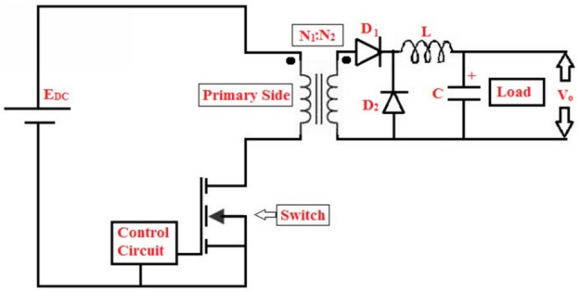

Fig1. Circuit diagram of fly back converter

The fly back converter is used in both AC to DC and DC to DC conversion with electric isolation between the inputs and outputs. The fly back converter is a buck-boost converter with the inductor split to form a transformer, so, that the voltage ratios are multiplied with an additional advantage of isolation. In this, switch, diode and capacitor are in-builder.

PRINCIPLE OF OPERATION

There are two configurations in fly back converter.

1. ON-state 2. OFF-state

ON- state:

When MOSFET is closed, the primary of transformer is directly connected to the input voltage source. The primary current and magnetic flux in the transformer increases, the energy is stored. The voltage induced in the secondary is negative. So, the diode is reverse biased. The capacitor supplies energy to the output load.

OFF-state:

When MOSFET is opened, the primary current and magnetic flux drops. The secondary voltage is positive, the diode is forward biased. The current flow from transformer and supplies to the load.

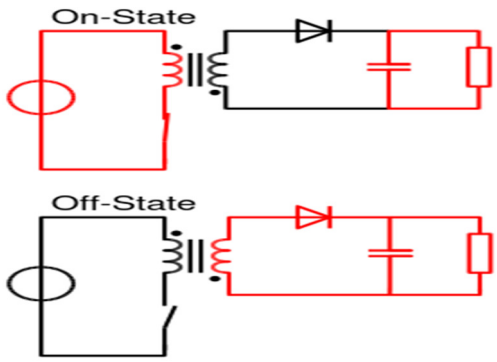

Fig 2. Operating principle of fly back converter

3 BLOCK DIAGRAM

The AC supply is given to the AC-DC converter which converts from AC to DC. After given to the input filter which is used to eliminate the unwanted noise and ripples. Then the loads are used in both sides of fly back converter. The fly back converter is one of the most advanced converters in power electronics. In both loads, one load taken the power from power supply and

other load taken the power reverse from fly back converter. The pulses are given to fly back converter by pulse width modulation (PWM) and it is controlled by controller.

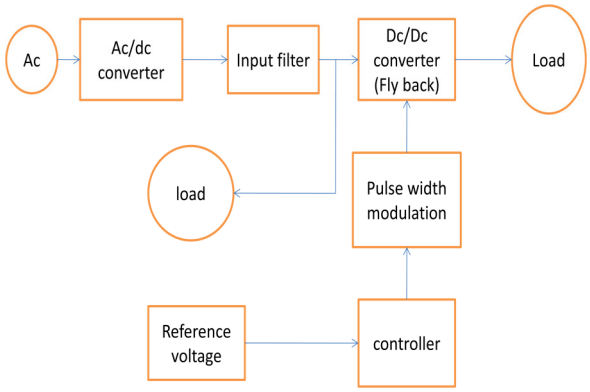

Fig3. Block diagram of proposed system

4 CIRCUIT DIAGRAM

In above figure the single phase transformer is used to step down the voltage for light load. The diode IN4007 is used to converts form AC to DC. The input filter like capacitor is used to filter the ripple and unwanted noise from DC voltage. The IC 7805 is used to maintain the output voltage at 5v for microcontroller. The microcontroller 16F877a is used to giving control pulses for MOSFET in fly back converter through gate driver circuit. In this, two loads are used. One load is connected after the proposed converter and other load is connected before the proposed converter. The MOSFET and inductor and integrated from fly back converter. If switching the MOSFET, the inductor is charged to given the AC supply by using rectifier; the AC can be converting to DC for loads. The potential and current transformers are connected across the load, because it can be used to avoid short circuit and giving power flow continuously.

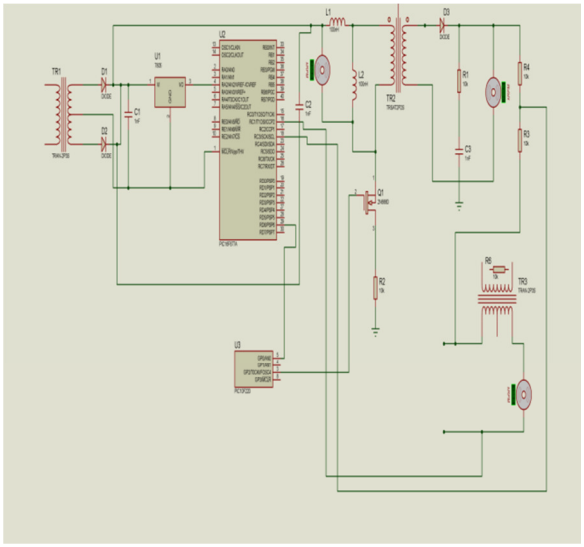

Fig4. Circuit diagram of high light load efficiency power conversion scheme

5 EXPERIMENTAL RESULTS

To verify the operation of the proposed converter, it can be implemented with the specifications of Vs=230V, Vo/Io=40v/16v/1.25A and f=50 Hz under 50W. When compare the proposed converter with conventional converter, to improve the efficiency at 95% under light load condition with help of fly back converter. The fly back converter is the recent type converter in power electronics with bi-directional power flow. The pulse width modulation (PWM) technique is used in proposed converter. The main use of this technique is to allow the control of power supplied to electrical devices, especially inertial load like motor. The electrical isolation is provided by the fly back converter.

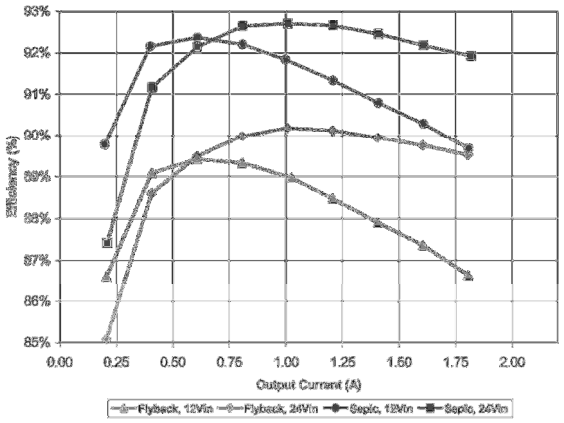

Fig5. Measured and expected Efficiency

6 CONCLUSIONS

This paper presented a power electronics integrated into a high efficiency power conversion for saving the power. Wide range, electrical isolation, multiple output voltages, Better power factor, less components were the main advantages of fly back converter. The proposed power conversion system reduced power consumption and improves the efficiency of the power.

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