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Improved Power Quality Switched Inductor Cuk Converter for Battery Charging Application

P Mallikarjun [1] ,M Akhila Reddy[2], P Kumar [3], S Jaya Krishna[4]
(Assistant professor [1] , EEE Students [2,3,4])
Electrical and Electronics Engineering, St.Peter's Engineering College Opp.Forest Academy, Kompally Road, Dulapally, Maisammaguda, Medchal,Hyderabad-500100,Telangana,India

Abstract:

The main aim of the project is switched inductor Cuk converter based improved power Quality AC-DC converter for battery charging application. In this project, a single- stage switched inductor Cuk converter based power factor correction converter is proposed which offers high step-down gain, low current stress, and high efficiency and reduced component counts. The project makes a use of PIC microcontroller which is used for battery application and which provide the sufficient voltage to the loads by triggering the mosfet with the help of pic microcontroller.

Keywords:
Cuk converter, PIC Microcontroller, LCD display.

1. INTRODUCTION:

The purpose of the project is in order to charge the electrical vehicle battery we develop an efficient charger .It can charge the battery in time without any power lose.

In the present scenario, emissions of greenhouse gases and other toxic elements are due to overuse of petroleum fuels fed automobiles which have caused significant amount of environmental hazards, health issues and degradation of non-renewable resources. In last decades, electric vehicles/electric hybrid vehicles are the alternate choice for inter-city transport which have several advantages like low maintenance, high efficiency, no greenhouse gas emission and cost effectiveness. However, due to rapid increase in the growth of electric vehicles in future, there will be a probability of power quality problems in the charging stations. The power quality problems causes increased risk in harmonic level in power distribution a system which reduces the life of distribution transformers in battery charging stations. Conventionally, existing system consist of diode bridge rectifier followed by bulky filter capacitor draws a highly distorted non-sinusoidal and peaky supply current with high harmonic current THD of 70-80%, from single phase ac mains with low power factor of order 0.75 - 0.8 lagging and high crest factor.

2. Implementation:

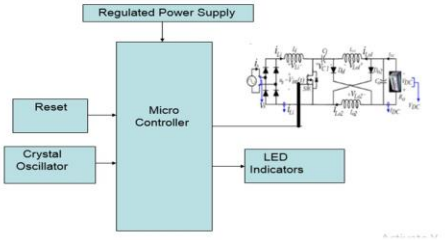
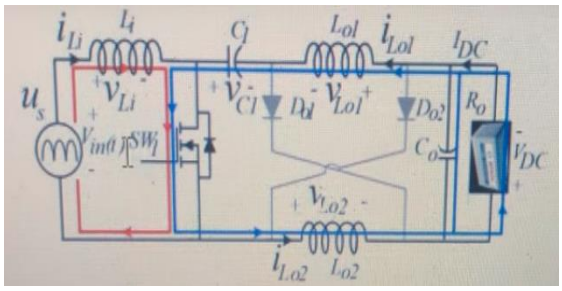


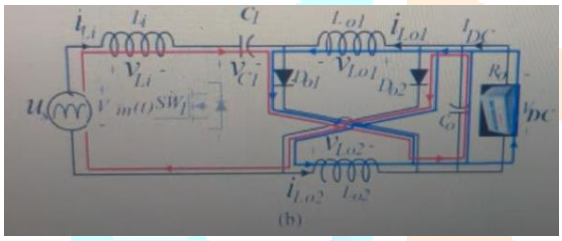
Fig: Block Diagram of power quality, continuity and Load Monitoring over IOT

Mode-1:



At the time instant t=0, when switch mosfet, turns ON, diodes D1, D2 turn off. The inductor current increase from their respective initial value .Therefore, this mode is called as inductor charging mode.

Mode-2:



When switch MOSFET turns off at t, the diodes D1, D2 turns on. The equivalent circuit depicting current paths.

Finally the design of switched inductor based PFC converter includes selection of circuit parameters such as inductors, and capacitors. This converter is designed to provide regulated DC output voltage with power factor correction at the AC supply mains and operates in continuous current mode (CCM) in all operating conditions. In this project we are using PIC Microcontroller to trigger the MOSFET. The system can be programmed using Embedded 'C' language.

3. Related Work:

The brief introduction of different modules used in this project is discussed below:

3.1. PIC microcontroller:

Fig PIC Microcontroller

A microcontroller can be considered a self-contained system with a processor, memory and peripherals and can be used as an embedded system.

The 16f72 micro controller is powerful (200 nanosecond instruction execution) yet easy-to-program (only 35 single word instructions) CMOS FLASH-based 8-bit microcontroller.

The PIC 16F72 is a 28 pin IC in the physical structure with 3 ports like port A (6 pins), port B (8 pins), port C (8 pins) excluding the supply pins(4 pins).

3.2. Cuk converter working principle:

A Ćuk converter transforms a DC voltage at the input to a DC voltage at the output with reversed polarity. Compared to the Buck, Boost and Buck-Boost converters the Ćuk converter uses an additional inductor and capacitor to store energy. Consider the following sequence of the MOSFET conduction state:

1. On-state: The current through the inductor L1 increases linearly and the diode blocks.

2. Off-state: Since the current through the inductor L1 cannot abruptly change the diode must carry the current so it commutates and begins conducting. Energy is transferred from the inductor L1 to the middle capacitor C2 resulting in a decreasing inductor current.

3. On-state: The current through the inductor L1 again increases linearly and the diode blocks. The middle capacitor discharges and supplies the RC load through the inductor L2. The induced voltage across the resistor R has the opposite polarity of the input voltage.

The circuit has two limits of operation. For a PWM duty cycle D →0 the output voltage equals zero, and for D → 1 the output voltage grows toward negative infinity. In between those limits the output voltage in continuous conduction mode is given by: Vout = -D/(1-D) · Vin. The combination of inductors and capacitors acts as a second order low pass

filter reducing the voltage ripple at the output.

Compared to the previous DC to DC voltage converters (Buck, Boost and Buck-Boost) the Ćuk converter always allows continuous current flow through the inductors, and therefore, no discontinuous conduction mode is possible.

3.3. LCD display:

A liquid crystal display (LCD) is a thin, flat electronic visual display that uses the light modulating properties of liquid crystals .Liquid crystal display is very important device in embedded system. It offers high flexibility to user as he can display the required data on it.

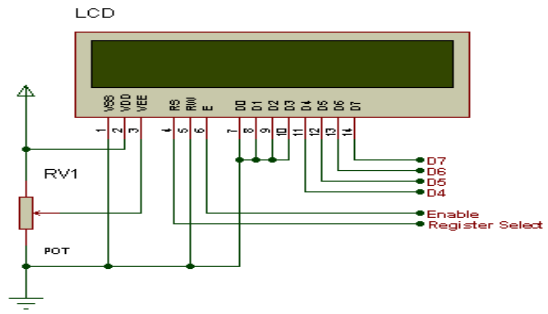


Fig : LCD display

In this project we are using 16*2 LCD module to display the voltage values on LCD module.

5. RESULTS:

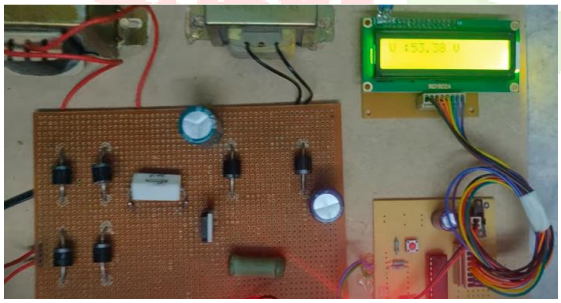


Fig: Voltage Monitoring on LCD module

CONCLUSION:

The switched inductor Cuk converter based improved power quality AC-DC converter is proposed for battery charging application. The proposed converter is able to provide regulated output voltage irrespective of supply and load variations. The power quality indices like THD and PF at ac side are evaluated to assess the power quality performance of the converter. The converter is evaluated both under steady state and transient conditions.

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