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High Efficiency DC to DC Boost Converter

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ABSTRACT: This paper consists of the development of high efficiency dc to dc boost converter. The boost converter is used to improve the efficiency of the solar panel. The low voltage input of source is boosted into high voltage output. We can achieve the power efficiency of about 90% to 95%. The input current ranges from 4.5% to 52%. Some practical application has been done to verify the result obtained.

KEYWORDS: Solar energy, high efficiency, boost converter

I. INTRODUCTION

The increase in demand for the power potential and the lack of non renewable resources which enable us to shift our focus to renewable resources which are efficient. To prevent pollution of the earth we go for the clean energy like renewable energy [1]-[2]. The main sources of renewable resources are solar and wind energy plays a vital role. There are many onsite and offshore solar panels used to harvest solar energy. The betterment in the solar power projects lies on the grid and half-grid connectivity. The process of selection of site is a crucial factor in which the incident of solar energy is difficult and inclination should be in an appropriate manner. The solar resource assessment should consider the proper area in which the emission of sunlight is more effective and there should be no shadow in the place of implementation of solar. One of the application of the boost converter is LED, an input voltage of 52V is needed to forward bias 15 LEDs are connected in series, as the operating voltage of single-cell lithium-ion battery is 3.6V to 4.2V[3]. The supply voltage is provided by boost regulators [4].

II. METHODOLOGY

A Boost converter is a switch mode DC to DC converter in which the output voltage is greater than the input voltage. It is also called as step up converter. The name step up converter comes from the fact that analogous to step up transformer the input voltage is stepped up to a level greater than the input voltage. By law of conservation of energy the input power has to be equal to output power (assuming no losses in the circuit). The ICs used in the DC – DC boost converters are TSP40210 / TSP40211 in which the current and voltage sensing amplifiers are inbuilt.

Principle Operation of Boost Converters:

The main working principle of boost converter is that the inductor in the input circuit resists sudden variations in input current. When switch is OFF the inductor stores energy in the form of magnetic energy and discharges it when switch is closed. The capacitor in the output circuit is assumed large enough that the time constant of RC circuit in the output stage is high. The large time constant compared to switching period ensures a constant output voltage $V_o(t) = V_o(\text{constant})$

Modes of Operation

There are two modes of operation, they are

- Continuous conduction mode

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- Non continuous conduction mode

Continuous Conduction Mode

In continuous conduction mode the inductor will discharge partially and it will not discharge completely before the switching cycle.

There are two switch cases to be discussed in the continuous conduction mode, they are

- When switch S is in ON condition.
- When switch S is in OFF condition

Switch (S) Is In On Condition

When switch S is in ON condition the diode is open circuited since the n region of the diode has higher voltage when compared to the p region. When this case occurs the inductor current increases.

Switch (S) Is In Off Condition

When switch S is in OFF condition the diode is short circuited. In steady state condition the current through the inductor does not change abruptly, the current at the end of the switch ON state must be equal to the current at the end of the switch OFF state.

Non Continuous Conduction Mode

In non continuous conduction mode the inductor will discharge completely and the charge of the inductor goes to zero before the switching cycle.

Description

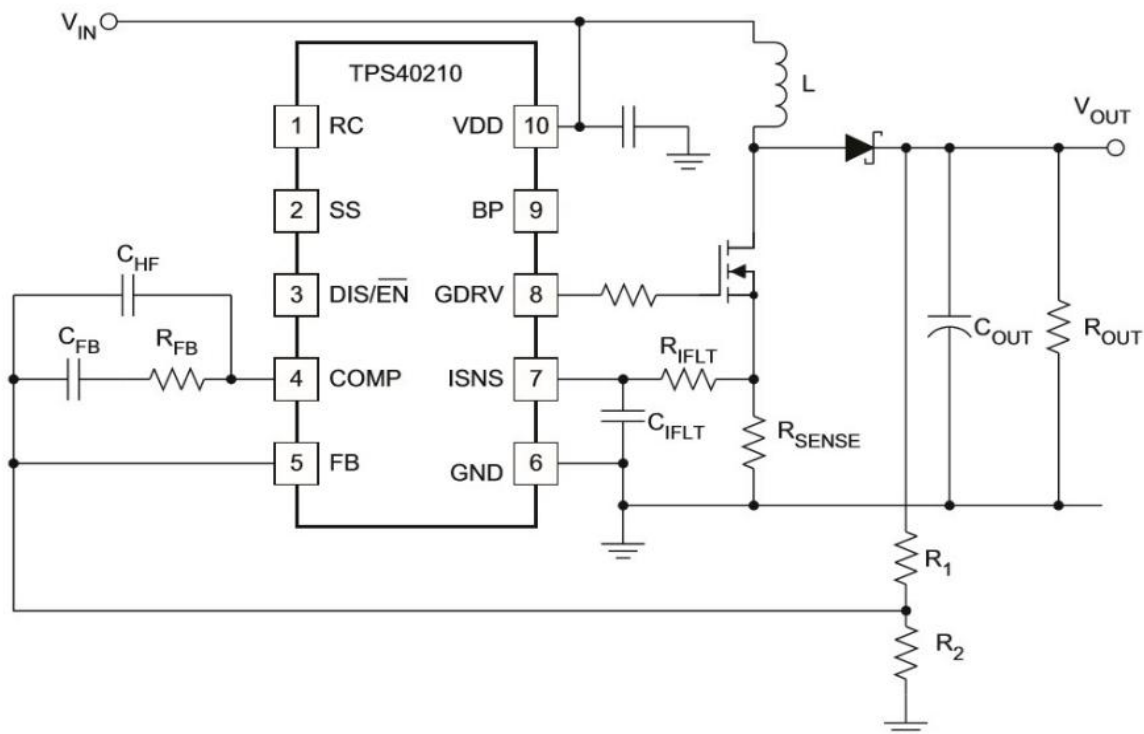


Fig.1. PIN Configuration of TSP40210

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BP PIN Regulator

This regulator provides the power for the internal circuitry for the controller including the gate driver. The nominal voltage to be supplied for the BP regulator is about 8 volt and this BP regulator must be bypassed with a 1 capacitor.

Shut Down Command PIN DIS

This pin provides an active high shut down command for the controller. By pulling this pin above 1.2 volt causes the controller to get shut down and makes the circuit to enter into the low current consumption state.

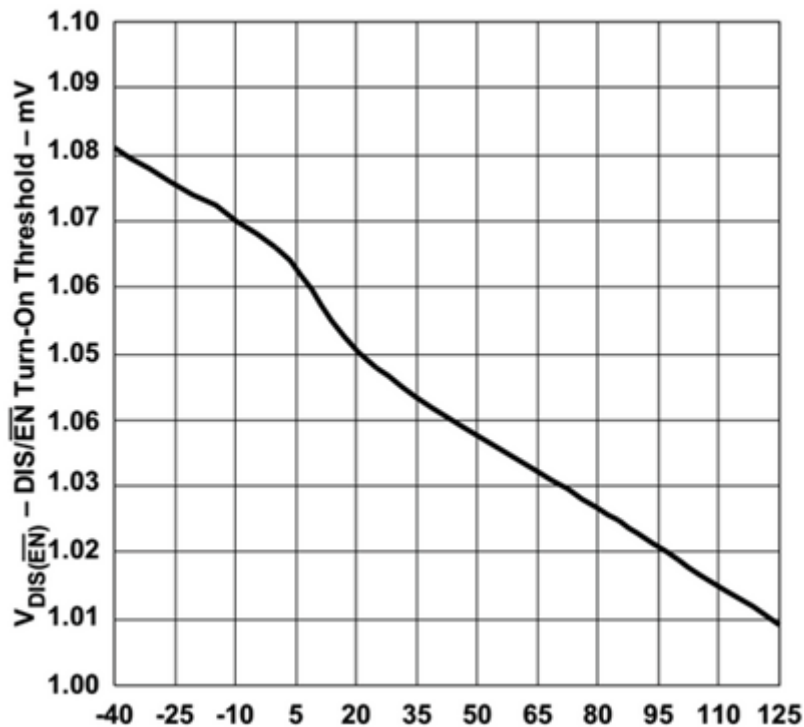


Fig.2.Characteristic Curve between DIS/EN And Junction Temperature

Soft Start SS

The soft start of the TSP40210 is a closed loop soft start , which means that the output voltage follows a linear ramp. The ramp is generated by connecting the external capacitor from SS pin to the GND and by connecting an internal resistor from the BP pin to the SS pin.

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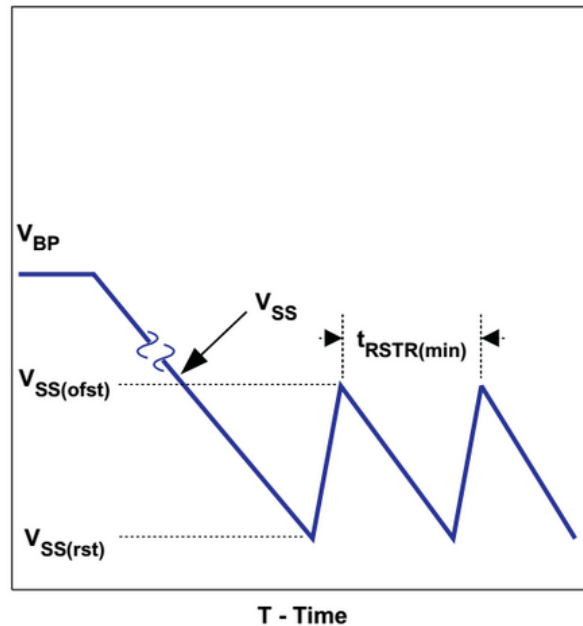


Fig.3.Characteristics Curve of Soft Start

ISNS

This pin is used to sense the current. The components such as R_{CS} and R_{OC} are placed in the ISNS pin to improve the performance of the controller.

Current Sense And Overcurrent

The current mode controllers use resistors in series to detect the current and overcurrent. If the voltage in the ISNS pin exceeds the current limit threshold voltage value then the device enters into the current limit state.

VDD

The overall power supply to the TSP40210 is given only through the VDD pin.

GND

The ground pin provides the grounding for the components which are connected in it

III. RESULT AND DISCUSSION

This paper presents a new resonant DC to DC boost converter topology that uses inductance network and a combination of Schottky diode which act as a switch for maintaining the output voltage. Also the conduction loss is low which also rises the current lower input filter capacitor is used to reduce the stress factor in the circuit. Fewer components are responsible for decreasing in weight and load factor. The major drawback is that the cost is high. Thermal loss occurs due to heating effect.

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IV. CONCLUSION

The proposed system, has overcome the disadvantage of the time delay of the previous system since the power and current amplifiers and BP regulator which supplies for the internal circuitry are inbuilt. The power efficiency in boost converter is obtained in range of 90% to 5%.

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