SIMULATION OF BUCK AND BOOST CONVERTER FOR THE POWER QUALITY IMPROVEMENT

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***Abstract*: In order to provide continuous power supply from grid, many approaches have been done to improve the power quality of the supply. The power quality includes many parameters like voltage, current, frequency and power factor. In this paper, we are presenting the simulation result and analysis of Buck-Boost converter using MATLAB us credited version. It also compares the result with the grid norms. The supply for this converter circuit is taken from the distributed generation namely Solar PV cells. Achieving higher efficiency and synchronizing to the grid norms in terms of power quality is the main intension of this paper.**

INTRODUCTION

Solar power generation has created a new trend in the power sources which has no pollutant emission and the most efficient form of energy sources. Nowadays many people are showing interest to install the solar panels on their rooftops and forms to produce their own electrical power. The amount of generated electricity from the PV panels is not completely utilized for the residential purposes. So that considerable amount of power is getting wasted in the form of dissipation of heat or it is grounded. This considerable amount of power which is not utilized can be supplied to the grid which helps grid to supply more power to rural as well as remote areas. But before supplying to the grid, power quality must be matched. Also the efficiency must be increased.

In order to do this, here we are using buck and boost converter which controls power by stepping up or stepping down the voltage levels. PID (proportional integral derivation) control technique is used to control the voltage levels by taking feedback from the load. PV(PCS)power conditioning system is used to conditioning the voltage.

As the suns radiation varies with the season, sensor feedback is used to give the feedback to the controlling devices to control the operation of buck and boost mode using MPPT. By the boost mode of operation we can step up the voltage in case of rainy season. This dc-dc converter topologies can operate till 200V (using power MOSFET).Here MOSFET is used as a switching device because it has low switching losses and high switching time which increases the efficiency of the system[1][3].

TOPOLOGIES OF DC-DC CONVERTER

The dc-dc converter is a device which converts fixed voltage dc-source to the variable dc source. The dc-dc converter operates as a regulating device by increasing or decreasing the value of output voltage. This dc-dc converter is classified into 3 types.

1. Buck converter
2. Boost converter
3. Buck-Boost converter

Buck converter and boost converter are combined to form buck-boost converter. Which performs the operation of both buck and boost converter.

DC-DC BUCK CONVERTER

DC-DC Buck converter operates same as the step down transformer with minimum number of components which decreases the DC output voltage than the input voltage. The output DC voltage of Buck converter will always be less than the input voltage. The circuit of DC-DC Buck converter consists of Inductor(L),Capacitor(C), Diode, Power switch(MOSFET) and load. The output of PV array module is connected to the buck converter circuit and to the MPPT (Maximum power point tracking) which senses the voltage level and gives signal to the PID(Proportional integral derivative)controller to control the voltage level by generating the triggering pulses[3].

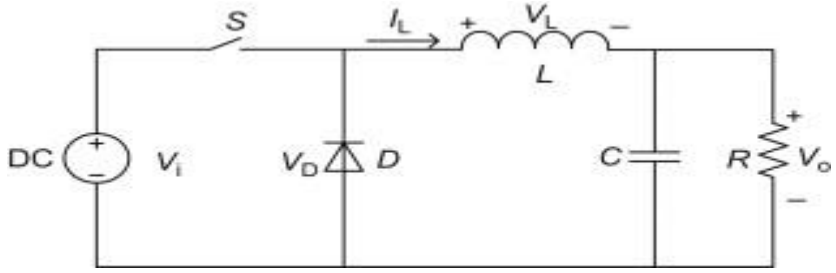

Fig1: Circuit topology of Buck converter

SIMULINK MODEL OF BUCK CONVERTER CIRCUIT

The below figure shows the Simulink model of Buck converter circuit. The input is taken from the Solar panel output .Controller is derived from the PID controlling technique. The gain of the Buck converter circuit is taken as -1. And the duty ratio should be greater than 0.5(K>0.5) so that it operates in the Buck mode. The output of the circuit is obtained at the scope of the model.

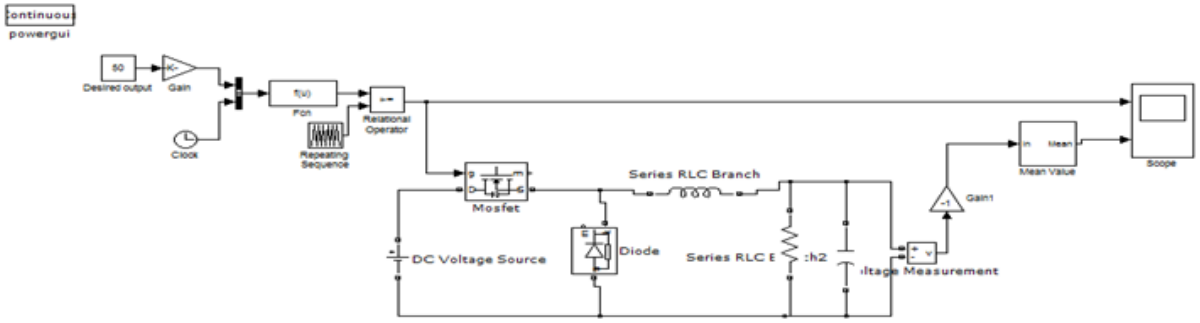

Fig 2: Simulink model of Buck converter

SIMULATION RESULT

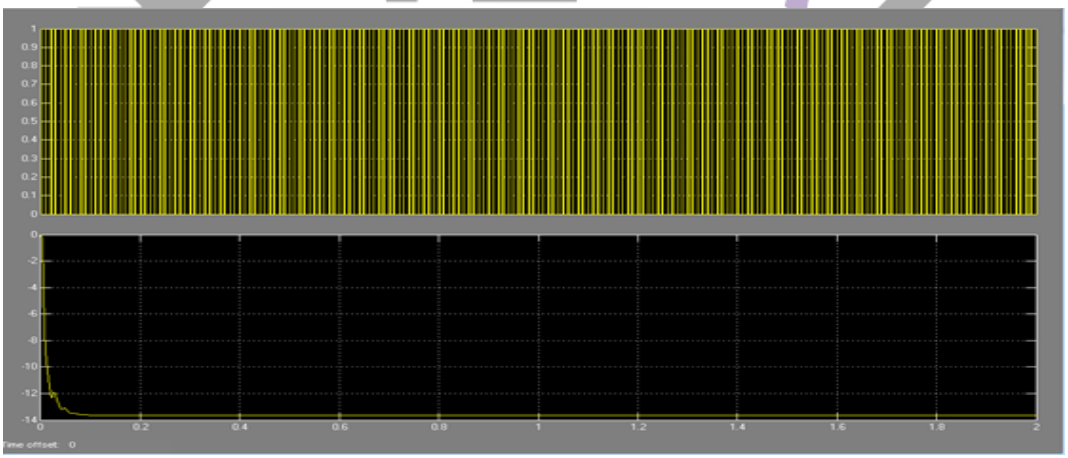

Fig 3: Simulation result of Buck converter

The simulation result of Buck converter circuit is shown in the above figure. The Buck operation has taken place where the output is lesser than the input power DC and it had also provided the pure, undistorted DC.

DC-DC BOOST CONVERTER:

DC-DC Boost converter circuit performs the operation of "step up", the output DC voltage will be always greater than the source input voltage. The Boost converter circuit consists of power supply taken from solar panels, inductor (L), switchingdevice (MOSFET), diode, capacitor and resistive load. The input power can be taken from any DC sources such as batteries, solar panels, rectifiers and DC generators. Boost converters can increase the voltage by reducing the number of cells. Hence the efficiency can be achieved. The Boost converter find applications in Hybrid electric vehicles(HEV) and lighting systems as they are cheap and light in weight[3].

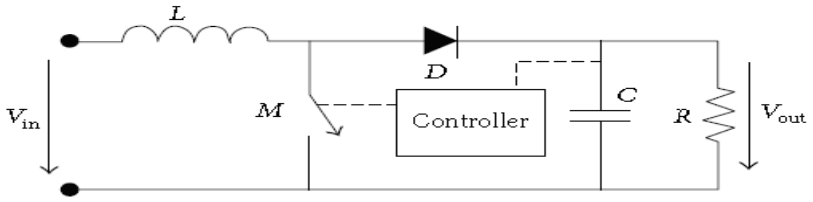

Fig 4: Circuit topology of Boost converter

SIMULINK MODEL FOR BOOST CONVERTER

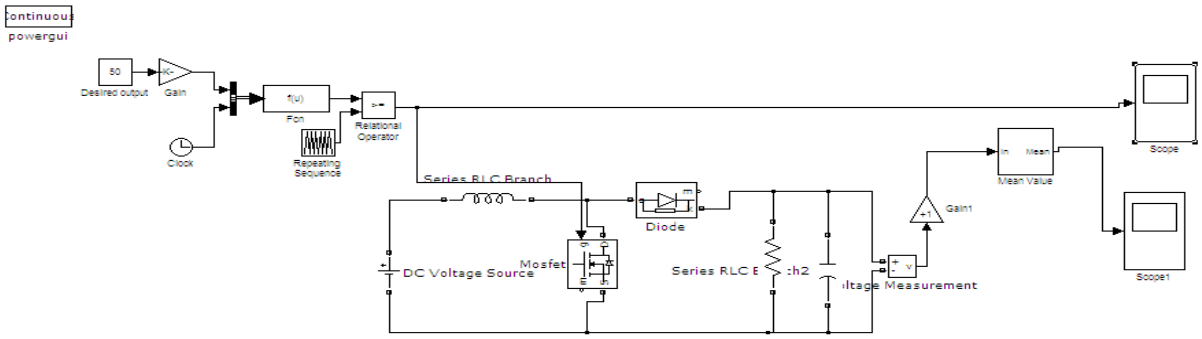

Fig 5: Simulink model of Boost converter

The Simulink model of Boost converter using PID controlling technique with the solar DC input is shown in the above figure. The gain K of +1 is employed into the circuit which influences the ratio of output to the input. The Duty ratio K should be less than 0.5(K<0.5), then it performs the Boost operation and increases the output.

SIMULATION RESULT

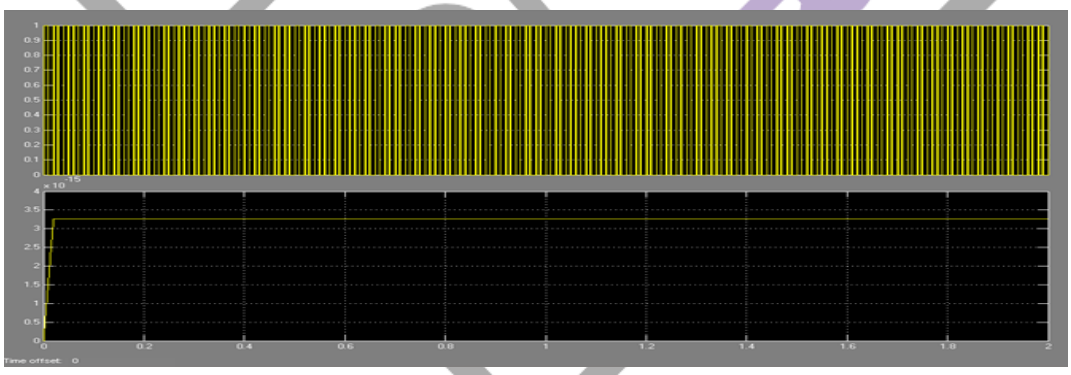

Fig 6: Simulation result of Boost Converter

The simulation result of Boost converter circuit is shown in the above figure. The Boost operation has taken place, where the output is greater than the input power DC and it had also provided the pure and undistorted DC which is free from Harmonics.

CONCLUSION

Implementing Buck-Boost Converter at the output of Solar panels using PID controlling technique and MPPT technique, we can increase the efficiency and power quality successfully of the power coming from the solar panels by reducing the number of solar panels. In this paper, we have discussed about the topologies of DC-DC converter namely Buck and Boost Converter and their simulation model and their simulation result. The power loss from distributed generation like Solar panel can be optimally utilized by connecting it to the grid with increase in the power quality using these converters[4][6].

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