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Model of Converter System of Interleaved Buck Boost with Proportional Integral Derivative

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A B S T R A C T

The role of power generation plays an important factor in day today life. Generation of power for utilization makes the power system a vital role in the economical world. To satisfied the need of power many novel methods of generating power using renewable energy sources are discussed in the trend. A model with software simulation in small scale production is made. The design of buck boost converter using interleaved connection were made and applied with the proportional integral derivative in the power generating system. The novel design is used with closed loop system of proportional integral derivative. The developed simulation results of the model give an optimal reach in power generation.

Keywords: Interleaved Buck Boost Converter (IBBC), Maximum power point trackers (MPPT), Proportional Integral Derivative Controller (PIDC), Pulse Width Modulation (PWM), MatLab - Sim Power Systems

1. Introduction

A compact model in generation of power system with a buck boost converter applied in photovoltaic system gives an optimal result in generation of power with avoiding pollution and saves the environment from global warming. The general model of photovoltaic system gives less efficiency results; to overcome this many new methodologies are applied to get an optimal output. In this article we try to get an optimal power output using photovoltaic system generation of power applied with Proportional Integral Derivative with controller of Interleaved Buck Boost Converter.

The photovoltaic system is generally termed as transformation of energy source from heat energy to electrical power to be utilized. The power produced in photovoltaic system depends up on the intensity and temperature level of the solar power. In general the production of electricity was made using the transformation from solar system and saved in the battery cells to be utilized. A parallel arrangement of the battery cells in an ordered way the power generated can be stored with huge capacity and can be applied to small and large equipment.

The transformation of the energy sources is done by applying the converters. Many topologies for model of converters are used in photovoltaic system. Interleaved Buck Boost Converter is a novel model used in the conversion of energies. The voltage polarity was inversed to maintain the magnitude stability in the case of increase or decrease in the voltage. This conversion ratio of the model of interleaved buck boost converter is stated as M (D) = - D/ (1-D).In order to increase the efficiency of the generated power using photovoltaic system a buck boost converter model is required. The novel model of interleaved buck boost converter gives a best output compared with the most of the existing models. A brief discussion of photovoltaic system and converter is made from the literature and a new model of proportional integral derivative with interleaved buck boost converter is designed, simulated and results were executed.

Suman Dwari [1] designed a model of DC - DC converter with step up high efficiency model in common active clamp and illustrated the model. T.Sundar [2] given a novel approach in photovoltaic system using cascaded buck boost converter with closed loop system controlled by parallel arrangement and results was simulated. D.Lakshmi [3] modeled an improved conversional step down converter to maintain the loss in low switch controller using buck converter. Il-Oun Lee [4] stated an improvement in conversional ratio reduction using low switch and buck converter with an illustration.

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S. Sugumar [5] applied an interleaved buck converter with less voltage in production of current and illustration was made. Bor - Ren Lin [6] designed a model of ZVS converter with interleaved to maintain the ripple current in the power generation system. Ching - Ming Lai [7] applied an interleaved boost converter in photovoltaic system to get a high efficiency DC micro grid step up converter in energy production. Jingquan Chen [8] modeled a buck boost converter with low stress in the input of PFC designs and analyzed the methodology of the design.Hamed Mashinchi Mahery [9] modeled a mathematical design for a buck boost converter with DC - DC output and examined the properties of steady state respond and transient models. Geetha. M.R [10] designed parallel model of connected converter of LUO type with standalone photovoltaic power generation system. Gómez-Olguín. F [11] proposed a two phase converter model of interleaved buck boost type dual designed in Power generation using photovoltaic system. Gupta. T [12].

The application interleaved buck boost converter in the closed loop model in power generation using Proportional Integral Derivative was not applied in the discussed literature. By applying closed loop system in Proportional Integral Derivative as an interleaved buck boost converter in solar system is done and executed with a simulated result. The Block Diagram of Proportional Integral Derivative Controller with interleaved buck boost converter for solar system is shown in Fig. 1.

An interleaved buck boost converter gives an output with step up photovoltaic system of DC output. The DC output is converter to AC load by using H - bridge inverter. A comparison for the voltage reference of the output with the error of proportional integral derivative is made.

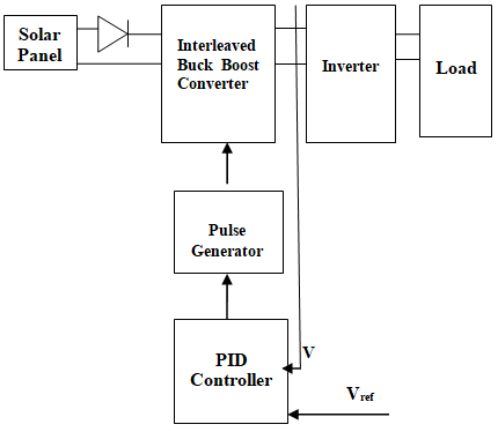

Fig. 1: PID Controller in Photovoltaic ILBBCI system

2. Analysis

The Fig. 2 is shows the design of PID controller Flow design.

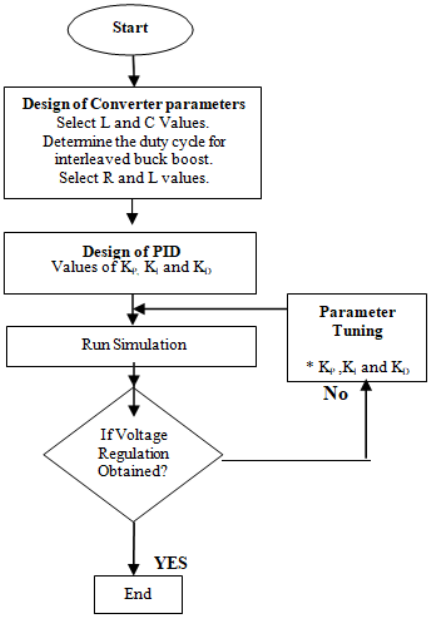

Fig. 2. Flow Chart for Design of PID Controller

I. Simulation Results

The result of closed loop proportional integral derivative Controlled Interleaved Buck Boost Converter system is presented.

A. Proportional Integral Derivative Controller for Closed Loop System

Fig. 3 shows the Proportional Integral Derivative controller in a closed loop system using Interleaved Buck Boost Converter. The voltage output produced by DC model in interleaved buck boost converter design is compared with the reference voltage. The application of proportional derivate controller gives a small change in the error. The proportional derivate controller with interleaved buck boost system updates the pulse width modulation. The Input voltage waveform of Photovoltaic System is represented in the Fig. 4.

The DC link voltage waveform of Converter Output is shown in Fig. 5. The Output voltage of inverter with PID controller is represented in the Fig. 6. The Output current of Inverter with PID Controller is shown in Fig. 7. The Table – I is the comparison of the output load resistance with the Current and Power. The parameters with respect to time domain of Proportional Integral Derivative Controller are shown in Table – II. The simulation results with requirements of Interleaved Buck Boost Converter are represented in Table – III. The Summary of Kp, KI and KD is shown in Table – IV.

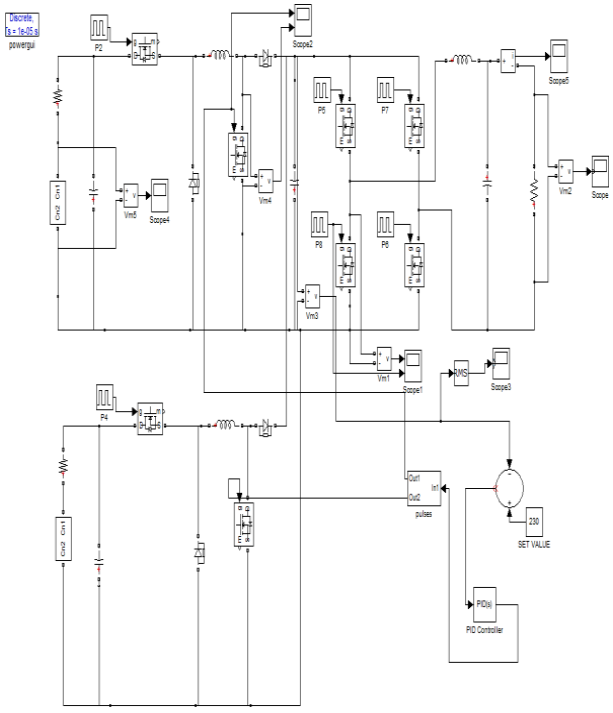

Fig. 3 PID controller in a closed loop system using Interleaved Buck Boost Converter

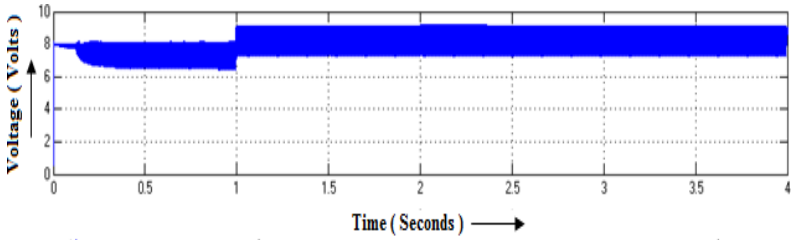

Fig. 4 Input voltage waveform of Photovoltaic System

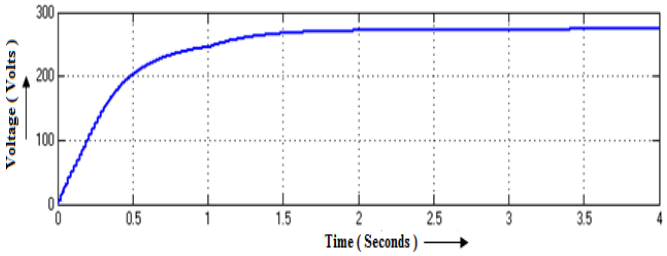

Fig. 5 DC link voltage waveform of Converter Output

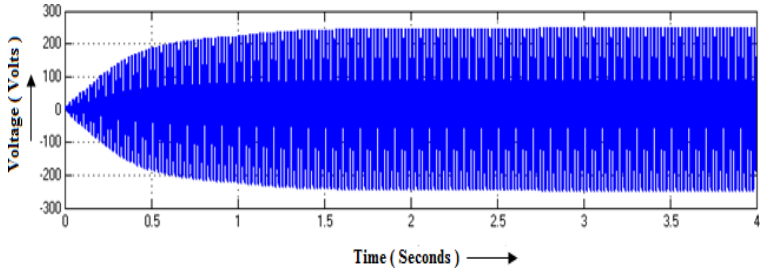

Fig. 6 Output voltage of inverter with PID controller

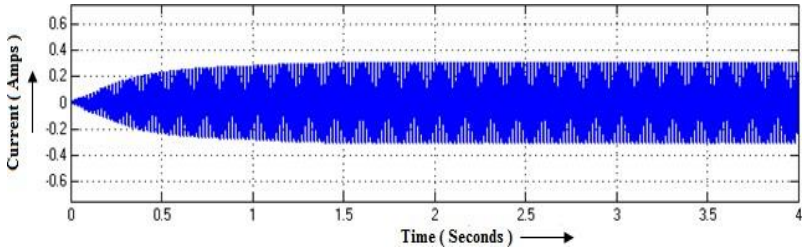

Fig. 7 Output current of Inverter with PID Controller

Table – I Comparison of the Output Load Resistance - Current / Power

Sl.No	RL (Ohms)	Current (Amps)	Power (Watts)
1.	100	1.5	238
2.	200	0.77	120
3.	300	0.5	80
4.	400	0.39	60
5.	500	0.31	48.5
6.	600	0.26	40
7.	700	0.22	34
8.	800	0.19	30
9.	900	0.17	27
10.	1000	0.15	24.2

Table – II Time Domain Parameters using PID Controller

Type of Controller	Rise Time	Peak Time	Settling Time	Steady State Error
	Sec	Sec	Sec	Volts
PID	1.2	1.5	1.9	1.3

Table – III Requirement and Simulation results of Interleaved Buck Boost Converter

Sl.No	Description	Simulation
1.	Solar Power PV Output	9V
2.	IGBT	G4BC305
3.	Power Diode	IN4007
4.	Inductor	7 MH
5.	DC Capacitor	2000MF/250V
6.	Capacitor Filter	55µF
7.	Inductor Filter	0.8µH
8.	Output Voltage of Converter	240V
9.	Output Voltage of Inverter	238V
10.	Inverter Frequency	50HZ

Table – IV Summary of Kp, KI & KD

Sl.No	Types of Controller	Kp	KI	KD
1.	PID	0.1	1	0.9

3. Conclusion

The design of proportional integral derivative is modeled to an interleaved buck boost converter with closed loop system were the converters are arranged in parallel. For the closed loop system with proportional integral derivative controller applied in the converter are presented as an output values. The closed loop system applied with interleaved buck boost converter in the parallel arrangement reduces the error with proportional integral derivative controller. The designed model of proportional integral derivative controller in interleaved buck boost converter is simulated using Matlab Sim Power system and outputs were presented. The proposed design can be applied for the appliances using low power system and the results gives an optimal power usage.

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