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Smooth Starter for DC shunt Motor using Buck-Boost Power Converter

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Abstract—***The majority of applications require a power dc-dc converter, including solar systems and microgrids. For these applications, a consistent output voltage with a range of load values is necessary. In order to increase the controller's robustness, dc-dc power converters are necessary for controlling output voltage and current. In this study, PID controllers for buck boost converter load current are developed. PID controllers for output voltage buck boost converters are also being researched. This study also takes into account changing loads and varying input voltage. This project's PID controller proposal has increased system robustness and sped up the process of reaching steady state*****.**

Key words—proposed PID controller, buck boost, load and input voltage change.

INTRODUTION

Buck boost converters are now frequently employed, particularly in applications using renewable energy [1][2]. This converter's output voltage is negative and can be either lower or greater than the input voltage. For buck boost converters and other types of converters, numerous studies have been conducted [3]. A neural network was created in [1] to tune the buck boost converter controller. A better controller and buck boost converter were used to feed the DC motor in [2]. Comparisons between the suggested controller and the in [3] cook converter were made. Fuzzy and sliding mode controllers for two types of converters—boost and buck boost converter—were created in [4].in [5] cuk converter with buck boost was compared with conventional controller. In [6] boost converter with proposed controller was done and implemented. In [7] PID controller was done for buck boost converter only for output voltage control. In [8] buck boost converter with pi controller was investigated and designed. In this paper, buck boost converter with double PID controller is designed and implemented in MATLAB SIMULINK. In addition, load variable and input voltage changing are investigated in this paper.

BUCK BOOST CONVERTER Model

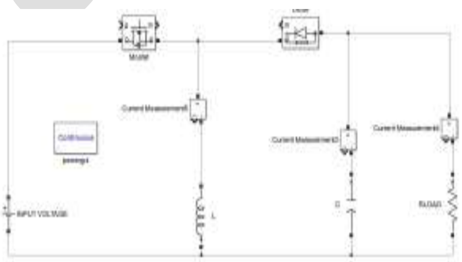

Fig. 1. buck boost converter in MATLAB Simulink

From fig 1, it can be seen that system has one inductor and one capacitor. Operation of the system when switch is on L will charge current and when switch is off Len will discharge current to load and Capacitor. System design parameters are shown in table I. The important equations of buck boost converter design are in [7][8].

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Table I Circuit Parameters

PARAMETERS	VALUES
L	0.03 H
C	220 uF
R	24 Ω
VIN	12 V
VO	24 V
D/ DUTY CYCLE	0.667
FSW	5KHZ

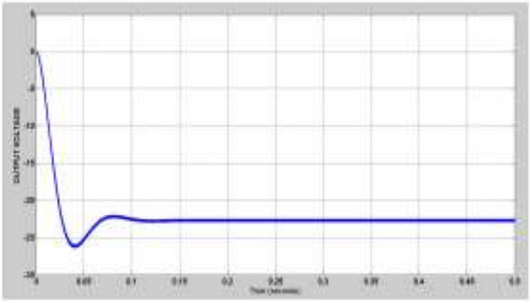

Fig. 2. output voltage of buck boost converter without controller.

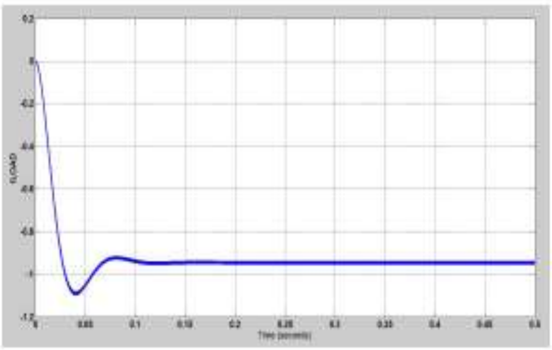

Fig .3. load current of buck boost converter without controller.

From fig 2 and fig 3, it can be seen that the load current around -0.9 A and load voltage around -22 V. from table 1, output voltage of buck boost converter should be 24V with load current 1 A. therefore, current and load voltage of system are very important. The first controller is for load current as inner loop and outer loop is output voltage controller. Each controller for inner and outer loop is PID controller.

PID CONTROLLER DESIGN

In order to let system work in high performance, therefore, current PID controller and load voltage PID controller are designed and PID equation are shown below:

$$U = Kp\, e + Kd\frac{de}{dt} + Ki\int_0^t e(t) \qquad (1)$$

Where ki integral parameter, kd is derivative and kp is proportional parameters. Trial and error are used to tune PID parameters.

PID Controller for load current

After making PID controller for load current of buck boost converter, PID gain parameters are ki=8, kd=0.0005 and kp=0.1. and circuit with pid load current controller are shown in fig 4.

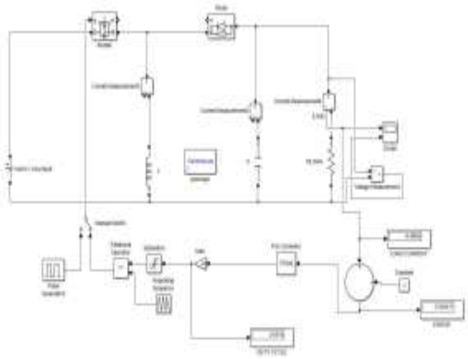

Fig .4. buck boost with current pid controller

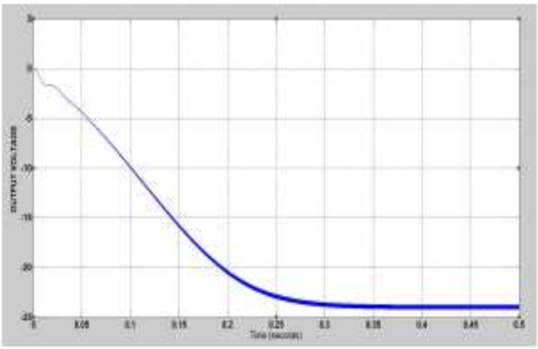

Fig .5. output voltage of buck boost converter

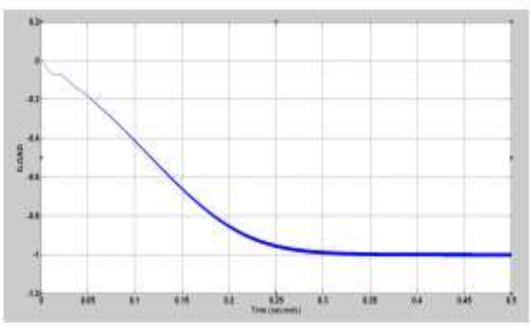

Fig .6. load current of buck boost converter

Figures 5 and 6 show that the system reached steady state after creating a PID controller for load current at 0.3 seconds. In addition, load current was within 1A and output voltage met the desired amount of 24V. That indicates that the system is stable but extremely slow. in order to enable the system to operate at peak efficiency. As the outer controller, a PID controller should be created for load voltage.

PID load voltage controller

In this stage, PID controller for load voltage are designed and PID gain parameters are ki=5,kp=0.02, ki=75. It can be seen that ki parameters is larger than ki PID for current controller. After connected two PID controller in system one for load current and second one for load voltage, the system is shown below in fig 7.

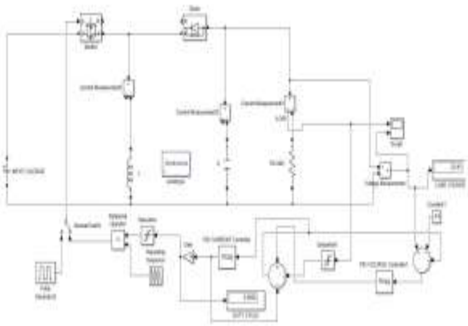

Fig .7. buck boost converter with voltage pad controller

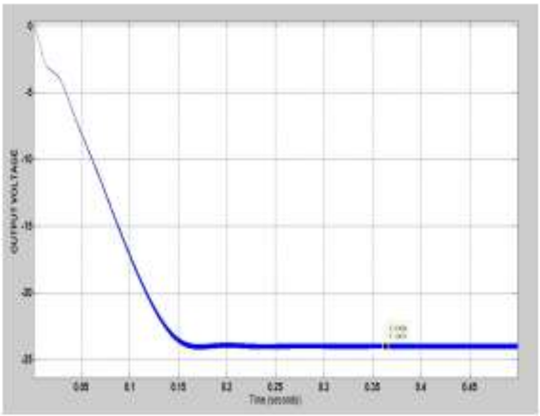

Fig .8. Output voltage of system

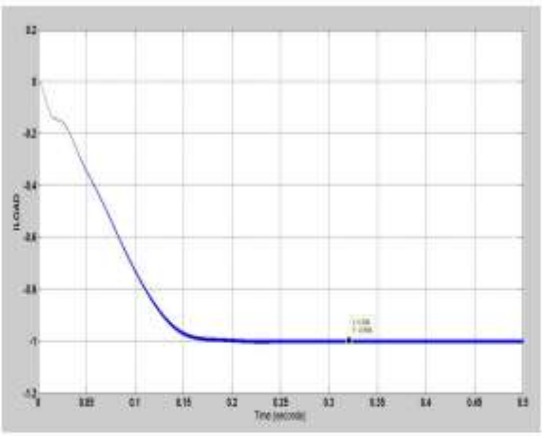

Fig .9. Load current of system

From fig 8 and 9, it is obvious after making PID controller for output voltage that system became sable and reached steady state very fast at 0.16 S. it is noticed that system became more robustness and rugged after making double PID controller.

LOAD CHANGE

In order to test system with disturbance, therefore, changing load is considered as disturbance. From fig 10 and 11 it can be seen that load voltage stayed constant with disturbance

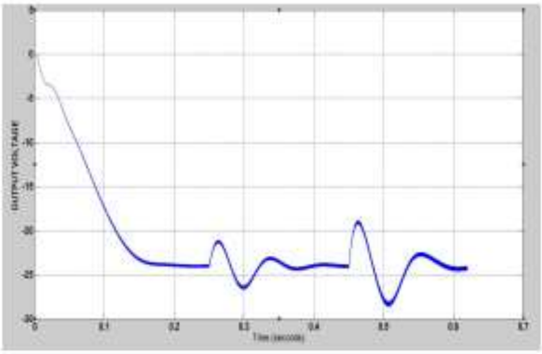

Fig 10. Output voltage of system

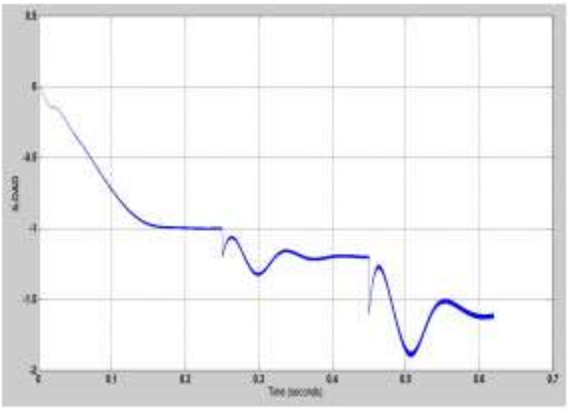

Fig .11. Load current of system

CHANGEING INPUT VOLTAGE

Changing input voltage is considered as disturbance. Therefore, the impact of changing input voltage on system is investigated.

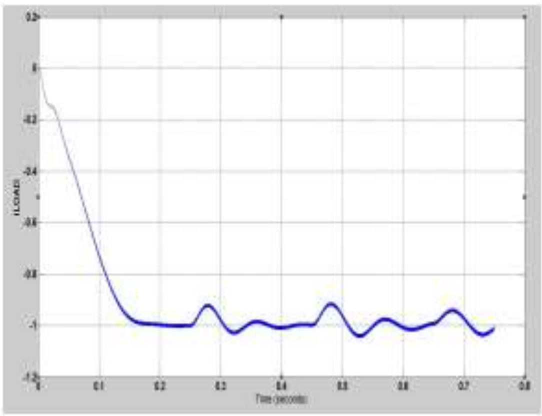

Fig 12. Load current of system

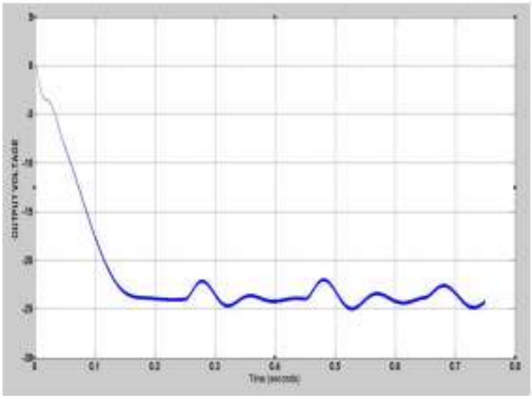

Fig 13. Output voltage of system

From fig 12 and 13, it can be seen that the system is stable and arrived steady state while input voltage is changed.

CONCLUSION

As a result, buck boost converter was created and put into use in Simulink in MATLAB. There are two PID controllers, one for load current and the other for load voltage. Investigated are input voltage and load changes caused by disturbances. According to the researcher's findings, the system quickly reached steady state following the implementation of PID controllers for load voltage and current. where the load voltage PID controller system achieved steady state at 0.15 S, but the load current PID controller system did so at 0.3 S. Additionally, changes in load and input voltage have no impact on the system.

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