International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 01, January-2022

Single Input Multiple Output DC DC Converter with High Efficiency

Pandimdevi Ganesan[1],Thushara Hameed[2] , Maheswari Maruthakutti[3]
[1,2,3] Department of Engineering
University of Technology & Applied Sciences
Nizwa, Sultanate of Oman

***Abstract*— When one has to satisfy different loads at the same time, Single Input Multi output dc-dc converter is essential. The aim of this study is to develop a high efficiency single-input multiple-output (SIMO) dc–dc converter. The proposed converter can boost the voltage of a low-voltage input to high-voltage dc bus and middle-voltage output terminals. A coupled inductor based single input multiple output dc –dc converter circuits that uses only one power switch are analysed in Matlab Simulink and their efficiencies are evaluated. This proposed converter gives high efficiency in different level of output.**

***Index Terms*: Boost converter, Coupled inductor, Mosfet switch, soft switching, voltage clamping.**

I. INTRODUCTION

In today's society the necessity for renewable energy sources is in high demand. Over the past few years technological advances are made within the wind generation systems, photovoltaics, fuel cells, and hydroelectric power systems, just to call a couple of. With these advances comes the question of the way to interface these for standalone power generation, whether it's one or all of those sources simultaneously. alongside interfacing multiple inputs, a growing need for interfacing multiple outputs has become a stimulating topic in hybrid vehicles. a method to interface multiple inputs and multiple outputs is thru the utilization of DC-DC converters. A dc chopper may be a dc-to-dc voltage converter. it's a static switching electrical appliance that in one conversion, changes an input fixed dc voltage to an adjustable dc output voltage with inductive intermediate energy storage. The name chopper is connected with the very fact that the output voltage may be a 'chopped up' quasi-rectangular version of the input dc voltage. Thyristor devices were utilized in conjunction with an ac supply that causes thyristor turn-off at ac supply current reversal. this type of thyristor natural commutation is termed line or source commutation. When a dc source is employed with a thyristor circuit, source facilitated commutation is clearly impossible. If the load is an R-C or L-C circuit, the load current falls to zero and therefore the thyristor serial with the dc supply turns off. Such a natural turn-off process is termed load commutation. If the availability is dc and therefore the load current has no natural zero current periods, like with the RL load, the load current can only be commutated employing a self-commutating switch, like a GTO thyristor, CGT, IGBT or MOSFET. An SCR isn't suitable since once the device is latched on during this dc supply application, it remains on. A buck converter may be a voltage step down and current intensify converter. the essential operation of the buck converter has the present in an inductor controlled by two switches (usually a transistor and a diode). within the idealized converter, all the components are considered to be perfect. Specifically, the switch and therefore before the diode have zero drop when on and 0 current flow when off and the inductor has zero series resistance. Further, it's assumed that the input and output voltages don't change over the course of a cycle a lift converter may be a DC-to-DC power converter with an output voltage greater than its input voltage. it's a category of switched-mode power supply (SMPS) containing a minimum of two semiconductors (a diode and a transistor) and a minimum of one energy storage element, a capacitor, inductor, or the 2 together Power for the boost converter can come from any suitable DC sources, like batteries, solar panels, rectifiers and DC generators. a lift converter is usually called a step-up converter since it "steps up" the source voltage. The output current is less than the source current. [1]

Multiple output converters are widely utilized in the economic applications. therefore, the designing multi-output converters presents an interesting challenge for the facility supply designer. Converters utilizing one primary power stage and generating quite one isolated output voltage are called multi-output converters. the essential requirements are small size and high efficiency. High switching frequency is important for achievement of small size. If the switching frequency is increased, then the switching loss will increase. This decreases the efficiency of the facility supplies. to unravel this problem, some sorts of soft switching techniques got to be wont to operate under high switching frequency. Zero Voltage Switched (ZVS) technique and 0 Current Switched (ZCS) technique are two commonly used soft switching methods. By using these techniques, either voltage or current is zero during switching transition, which largely reduce the switching loss and also increase the reliability for the facility supplies. Applications may require step-up, or sometimes even a bipolar supply from an equivalent battery supply. Bipolar supplies also find a good range of application in organic light emitting diodes. As a result, the planning of an influence management IC typically comprises boost to step-up, buck-boost to get negative supply, and linear regulators to satisfy different supplies for various circuit applications. Several methods are proposed to manage the multiple outputs, to scale back the conduction loss, the MOSFET switch with low turn-on resistance is used; dc–dc converters are widely utilized in low and high power applications [2-4]. the facility generated by the non-conventional energy resources like wind energy, fuel cell, etc

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 01, January-2022

is greatly suffering from the climate or it shows slow response or the output voltage is influenced by the load variations and therefore the frequency component generation system is one among the effective solutions to environment pollution problem but different voltage levels are needed within the power converter of the frequency component generation system. Different single input single output (SISO) dc-dc converters with different voltage gains are combined then the system control becomes more complicated, the value also increases [5]. the most aim of this study is to develop one input multiple output converter with increased conversion efficiency, high intensify ratio, saving the manufacturing cost.

II. SINGLE INPUT MULTI PUTPUT DC DC CONVERTER

A. Block Diagram

Block diagram of single input multi output dc-dc Converter is shown in Fig. 1.

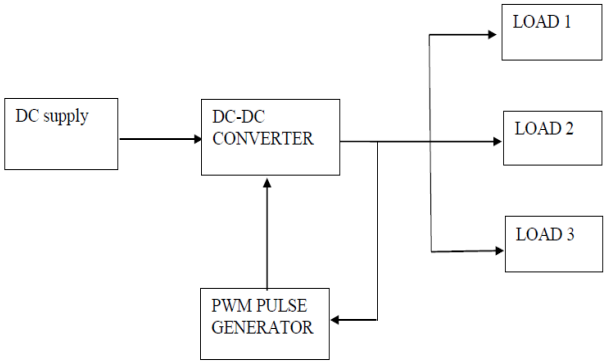

Fig1.Block diagram

DC supply: This is often used to give the input voltage for the circuit. Input voltage used is 12V.

DC-to-DC converter: is an electronic circuit or robot that converts a source of DC (DC) from one voltage level to a special. it is a quite electric power converter. DC to DC converters are utilized in portable electronic devices like cellular phones and laptop computers, which are provided with power from Batteries primarily

PWM: could also be how of describing a digital (binary/discrete) signal that was created through a modulation technique, which involves encoding a message into a pulsing signal.

Working

In this, the dc voltage from the source is fed into dc-dc converter, it could boost the input voltage and thus the boosted voltage is connected to varied loads. This converter has some multiple output voltages. that's low voltage and middle voltage and high voltage output terminals. A PWM controller is used to control the converter.

B. Circuit Diagram

The system configuration of the proposed high-efficiency SIMO converter topology to generate two different voltage levels from a single-input power source is depicted in Fig. 2.

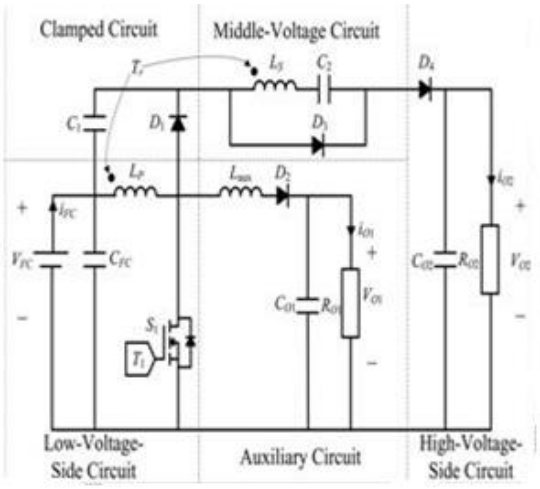

Fig 2. Circuit Diagram

A high voltage circuit, middle voltage circuit, a clamper, low voltage circuit and an auxiliary circuit are used in the single input multioutput converter. The Representation of symbols used in the circuit are mentioned in Table 1

Table 1.Terms

Symbol	Terms
V_{FC}	Input power source Voltage
I_{FC}	Input power source current
V_{01}	Voltage at LVSC
I_{01}	Auxiliary current
V_{02}	Voltage at HVSC
I_{02}	Current at HVSC
C_{FC}	Filter Capacitor
C_{01}	Auxilary side capacitor
C_{02}	Capacitor at HVSC
C_1	Clamper capacitor
C_2	Auxiliary capacitor
R_{01}	Equivalent Load resistance at auxiliary side
R_{02}	Output Load at HVSC
LP	Primary Inductor
LS	Secondary Inductor
Laux	Auxilary Inductor
S1	Main Switch

Voltage polarities and the direction of currents are defined using the equivalent circuit(Fig2). A n ideal transformer with magnetizing inductor and leakage inductor can be used to design the coupled inductor(Fig3).

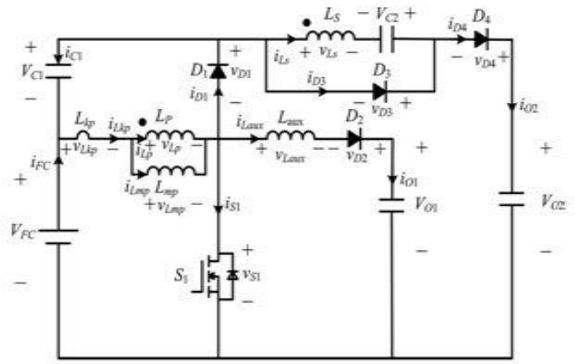

Fig3.Equivallent Circuit

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 01, January-2022

III. MATLAB SIMULATION

The single input multi output DC DC converter circuit is simulated using MATLAB Simulink. The PWM waveform and the output waveforms are obtained. And also the efficiency is calculated by using the input and output power.

A. Single input and Double Output DC DC Converter

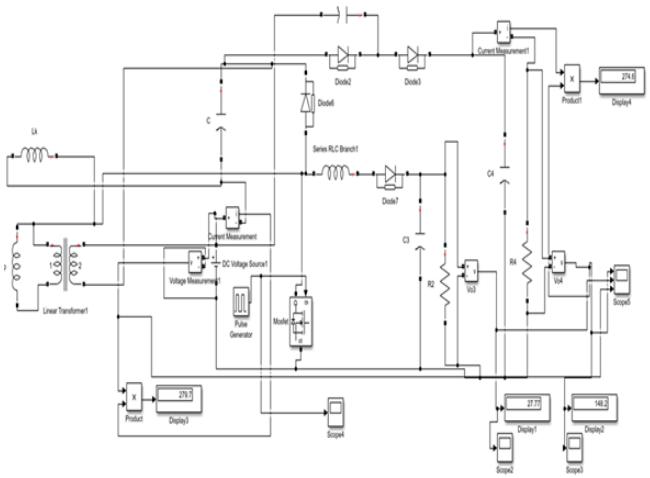

Fig4.Single Input Double Output DC DC Converter Simulink Model

The given input voltage is 12V. The output voltages are 27.77V, 148.2V. The PWM waveform and the input output wave form are shown in fig [5-6]

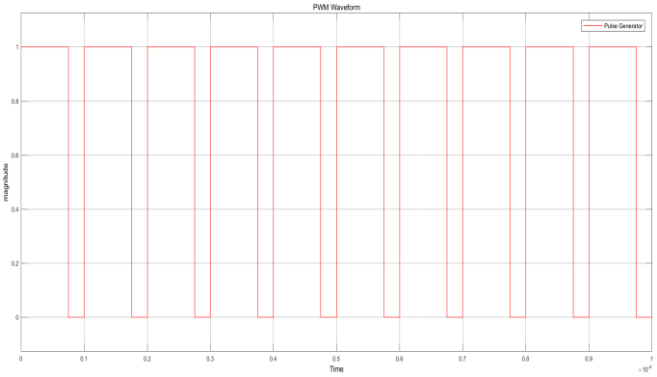

Fig5.PWM Waveform

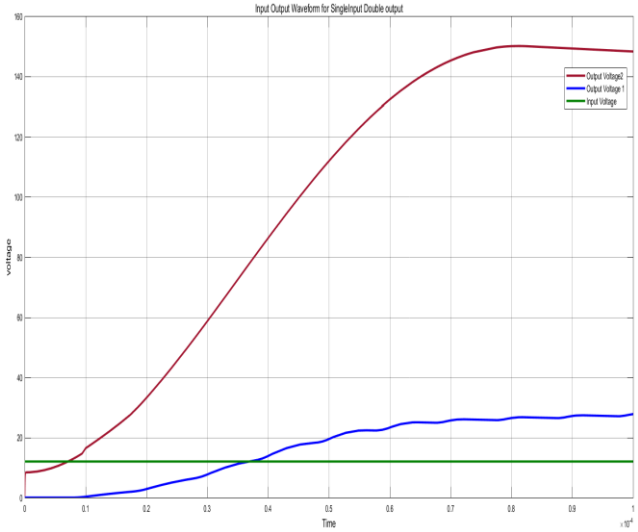

Fig6.Input output Waveform

The Input power of the circuit is 279.7VA.The calculated output power is 274.6 VA.So the efficiency of the circuit is 98.17%.

B. Single input and Triple Output DC DC Converter

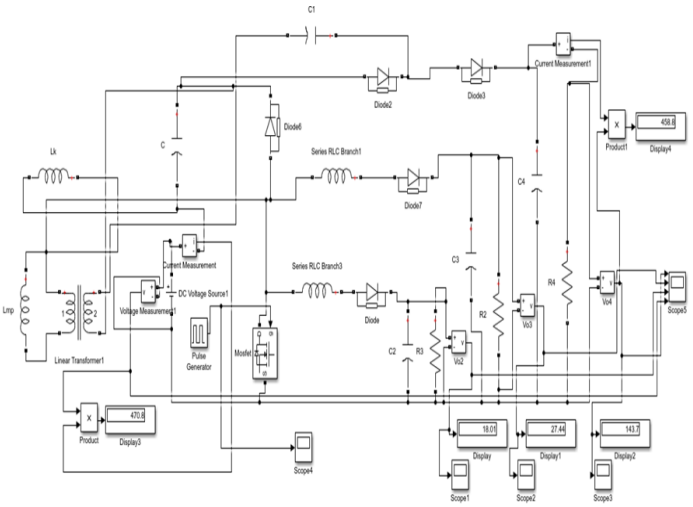

Fig7. Single Input Triple Output DC DC Converter Simulink Model

The given input voltage is 12V. The output voltage are 18.01V, 27.44V, and 143.7V.The corresponding waveforms are shown in fig [8-9].

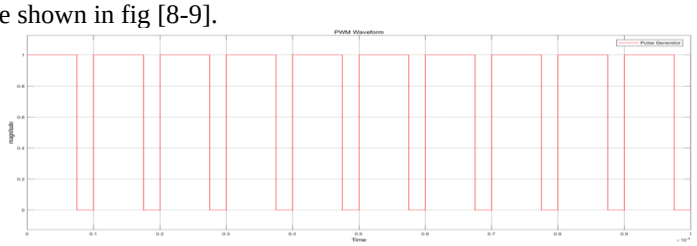

Fig8.PWM Waveform for Triple output

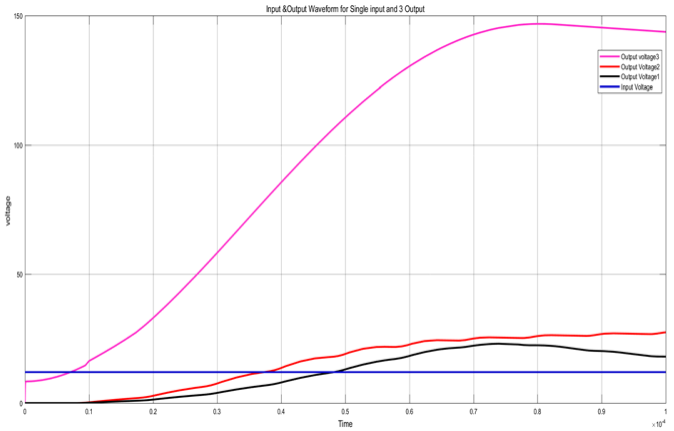

Fig9. Triple Output Graph

The efficiency of this circuit is
Output/input *100 =458.8/470.8*100
97.45%.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 01, January-2022

C . Single Input With Four Output DC DC Converter

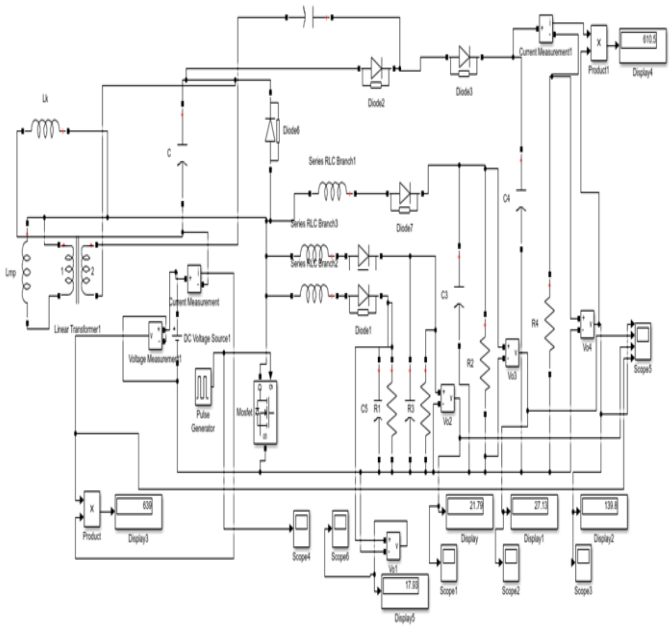

Fig10.Single Input with Four Output DC DC converter

The given input voltage is 12v. The output voltage are 17.93V, 21.79 V, 27.13V, 139.8V. The wave form of PWM and the output voltage are given in fig 11and 12.

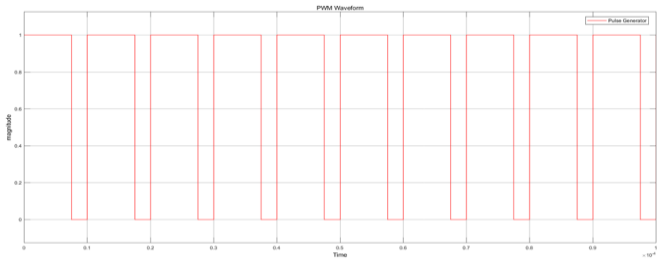

Fig11.PWM for Four Output

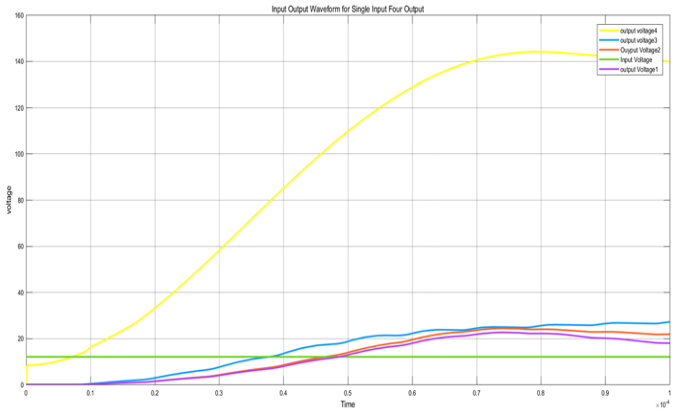

Fig12.Input Output waveform

B. Single Input With Five Output DC DC Converter

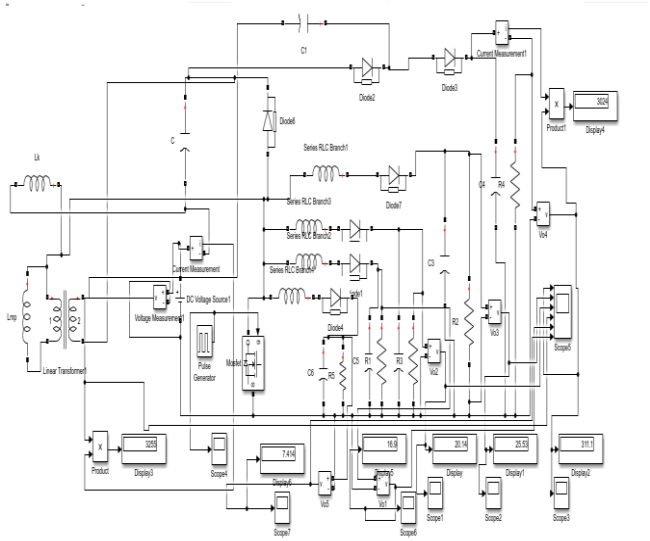

Fig13.DC DC Converter with Five Output

The given input voltage is 12v. The output voltages are 7.417V, 16.82 V, 20.01V, 25.53 V, and 311.1V.

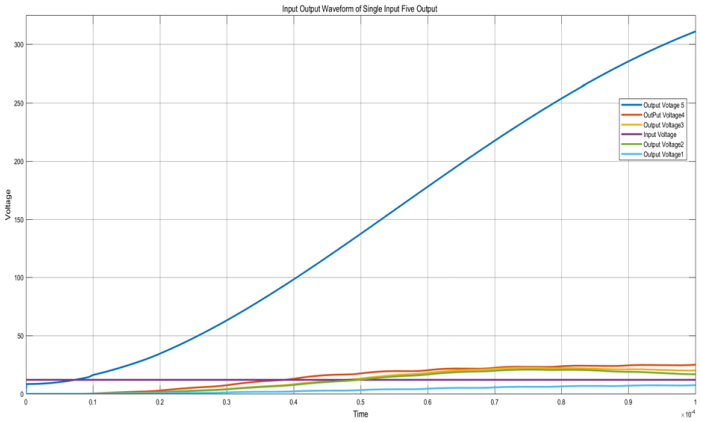

Fig 14.Output Voltage waveform

The efficiency of this circuit is
Output/input *100 =302.4/322.5*100 = 92.90%

The Results obtained in all types of Simulink model are summarized in Table2.

Table2.Output Voltage and Efficiency

S.No	Configuration	Input(V)	Output(V)	Efficiency (%)
1	Double Output	12	27.77	98.17
			148.2	
2	Triple Output	12	18.01	97.45
			27.44	
			143.7	
3	Four Output	12	17.93	95.15
			21.79	
			27.13	
			139.8	
4	Five Output	12	7.417	92.90
			16.82	
			20.01	
			25.53	
			311.1	

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 01, January-2022

I. CONCLUSION

This study has successfully developed a single input multiple output dc-dc converter with high efficiency. And this coupled inductor based converter was applied well to a single-input power source plus two output terminals, three output terminals, four output terminals and five output terminals composed of an auxiliary module, the middle voltages and a high voltage dc bus. The simulation result shows the single input power source is converted to multi output terminals. This topology adopts only one power switch to achieve the objective of multiple output with power conversion.

ACKNOWLEDGMENT

The authors would like to gratefully acknowledge the help of University of Technology and applied Sciences ,Nizwa Sultanate of Oman during the preparation of this manuscript.

REFERENCES

[1] Chen.Y and Kang.Y;"A full regulated dual-output dc-dc converter with special-connected two transformers (SCTTs) cell and complementary pulse width modulation-PFM(CPWM-PFM)," IEEE Trans. Power Elec-tron., vol. 25, no. 5, pp. 1296–1309, May 2010.

[2] Chen.Y, Kang.Y, Nie.S, and Pei.X; "The multiple-output DC–DC converter with shared ZCS lagging leg," IEEE Trans. Power Electron., vol. 26, no. 8, pp. 2278–2294, Aug. 2011.

[3] Ellis M.W,.VonSpakovsky M.R, and Nelson D.J;"Fuel cell systems: Efficient, flexible energy conversion for the 21 st century,"Proc. IEEE, vol. 89, no. 12, pp. 1808– 1818, Dec. 2001

[4] GaminiJayasinghe.S.D, MahindaVilathgamuwa.D, and MadawalaU.K.;"Diode-clamped three-level inverterbased bat-tery/supercapacitor direct integration scheme for renewable energy sys-tems," IEEE Trans. Power Electron., vol. 26, no. 6, pp. 3720–3729, Dec. 2011.

[5] Kim.J.K, Choi.S.W, and Moon.G.W; "Zero-voltage switching post regulation scheme for multi output forward converter with synchronous switches," IEEE Trans. Ind. Electron., vol. 58, no. 6, pp. 2378–2386,Jun. 2011 .