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HARDWARE IMPLEMENTATION OF MODIFIED SEPIC CONVERTER FED DC MOTOR

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ABSTRACT –

Modern day-to-day devices also use an AC sourceas an input while working with DC voltage. An AC-DC converter is used to get an effective and versatile DC output. Without sacrificing conversion efficiency, however, traditional converters are not suitable for high voltage output. Within this paper a new topology called the Cascaded Boost-SEPIC (CBS) converter is suggested. The converter is validated on the basis of conversion efficiency, minimum THD and maximum power factor. The results obtained evinces the improvement achieved in the power quality.

Key Words: AC-DC Converter; ANN (Artificial Neural Network controller); Separately excited DC motor

1.INTRODUCTION :

1. Block diagram

The following block diagram that consist of AC supply that is rectified by the full wave rectifier and converted into DC supply and then the switch is controlled by theANN controller and given to the motor load.

Electronic devices are used in grid-connected systems, communication systems, and power supply systems etc. which play an indispensable role in our daily lives. Devices operate in variable voltage levels. A converter that facilitates the capability of different level of operating voltage is essential for versatile use. But not all converters are able to make conversion properly without compromising performance. It is almost always the case that a tradeoff has to be made between necessity and performance. High voltage gain will cause for a deterioration of signal shape (high THD).

The overall efficiency goes down slightly as the duty cycle rises in conventional converter. [1][8] Again increasing duty cycle causes conduction losses and serious reverse-recovery problem in diodes. [9][10] Also Boost converter can operate with lower voltage level of MOSFET. Boost converter also gives output with lower distortion which makes the circuit manage the THD level as low as possible.

In this paper a new topology is introduced – Cascaded Boost SEPIC (CBS), which is used to avail different voltage level in accordance the duty cycle. Higher voltage conversion can be achieved using cascaded Boost-SEPIC converter.

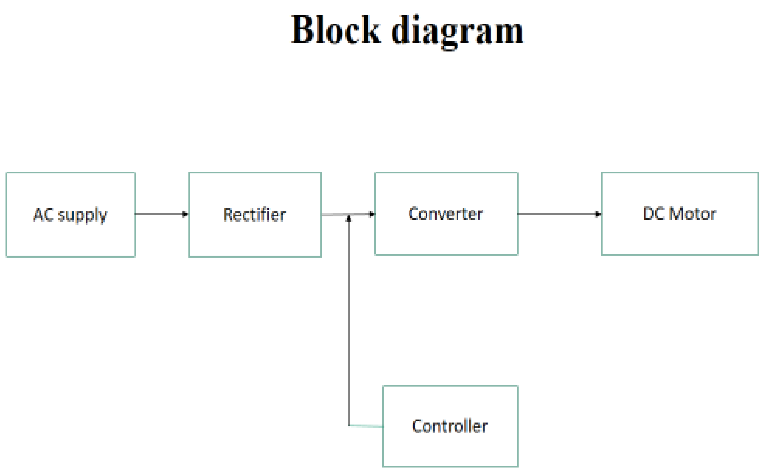

Fig 1.1 Block diagram

Circuit diagram

In this Fig 1.2 it shows that the circuit diagram of the SEPIC converter with given input AC supply to the circuit and the diode it converts into DC supply by using the full bridge rectifier and then the switch is being controlled by using ANN (Artificial Neural Network) and then output will given to the load.

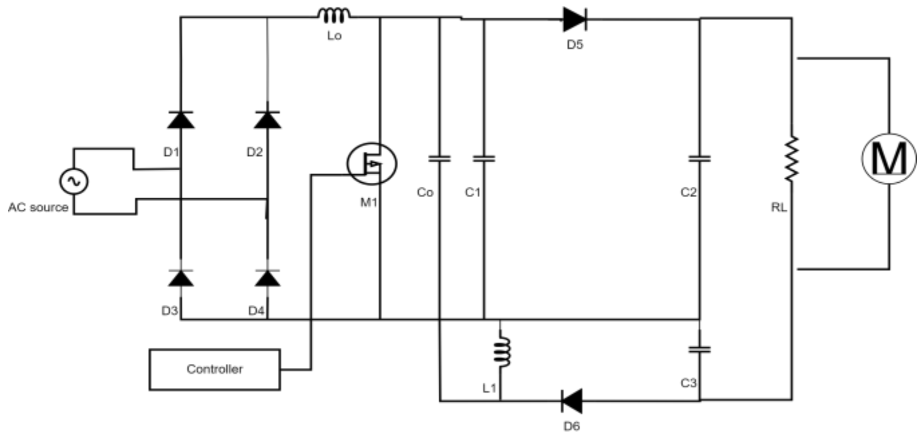

Fig 1.2 Circuit diagram

Modes of operation :

Mode 1:

In mode 1 operation Fig 1.3 shows that the current flows from the higher potential to the lower potential. At mode 1 when the switch is ON , the diode D_5 will not conduct and the current flows from the supply through diode D_6 and C_2 supplies energy to load.

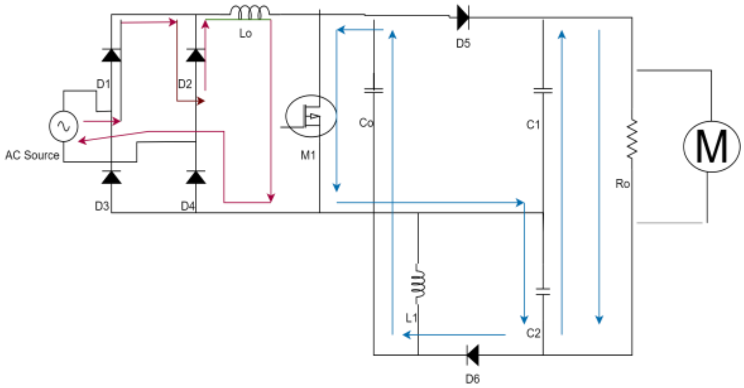

Fig 1.3 Mode 1 operation

Mode 2:

In mode 2 operation 1.4 shows that the current flows from the higher potential to the lower potential. At mode 2 when the switch is OFF, the diode D_6 will not conduct and the current flows from the supply through diode D_5 and C_3 supplies energy to load.

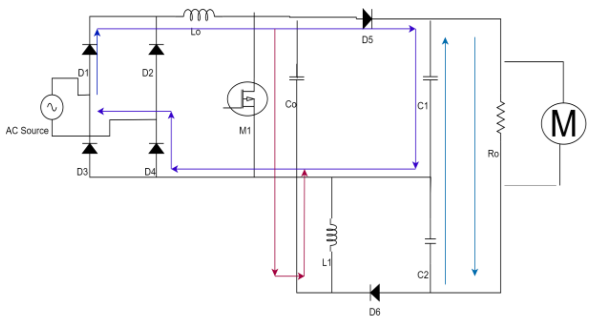

Fig 1.4 Mode 2 operation

Mode 3:

In mode 3 operation Fig 1.5 shows that the current flows from the lower potential to the higher potential. At mode 3 when the switch is ON , the diode D5 will not conduct and the current flows from the supply through diode D6 and C2 supplies energy to load.

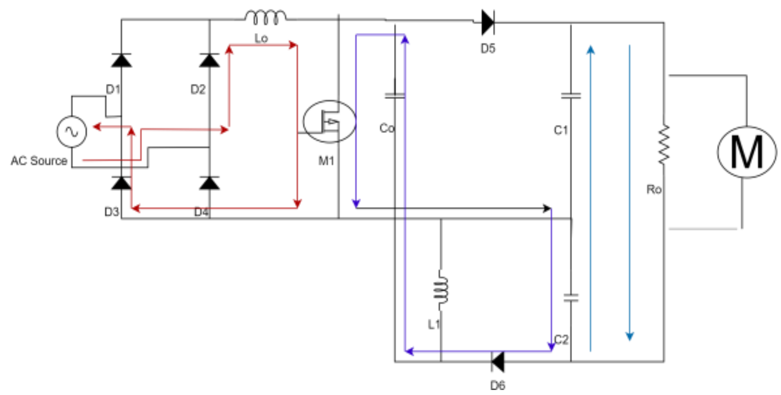

Fig 1.5 Mode 3 operatio

Mode 4

In mode 4 operation Fig 1.6 shows that the current flows from the lower potential to the higher potential. At mode 3 when the switch is OFF, the diode D6 will not conduct and the current flows from the supply through diode D5 and C3 supplies energy to load.

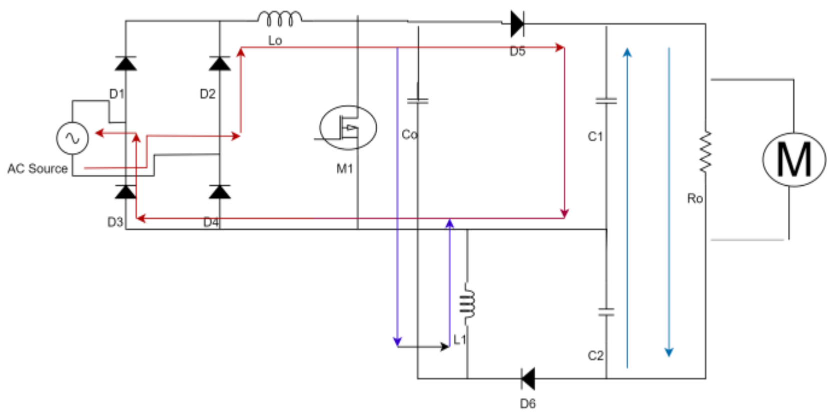

Fig 1.6 Mode 4 operation

Table of modes of operation:

Modes	Switch	Conduction of diode	Energy flow
Mode 1(Higher potentialto lower)	ON	D6	C2
Mode 2Low tohigh potential	OFF	D5	C3
Mode 3(Higher potential to lower potential)	ON	D6	C2
Mode 4(Low tohigh potential)	OFF	D5	C3

Modelling of the Converter :

The voltage gain of the converter is calculated by thegiven formula.

$$v_0 = v_{01} + v_{02} \quad \text{——— } 1$$

$$v_0 = \frac{1}{(1-D)} v_i + \frac{D}{(1-D)} v_i \quad \text{——— } 2$$

$$v_0 = G v_i$$

$$G = \frac{(1+D)}{(1-D)} \quad \text{——— } 3$$

Design of the converter

Selection of Inductor

$$\Delta I_L = I_N \times 40\% = I_{out} \times \frac{V_{out}}{vin} \times 40\%$$

Where ΔI_L = Ripple current of inductors

I_N =Input current

I_{out} = Output current

$$L_o = L_1 = L \quad \frac{v_{in(min)}}{\Delta I_L \times fsw} \quad \text{——— } 4$$

Selection of Capacitor

$$I_{out(RMS)} = I_{out} \times \sqrt{\frac{V_{out} + V_D}{Vin\ min}} \quad \text{——— } 5$$

I_{out} = Output current

$$C_{out} \geq I_{out} \times \frac{I_{out} \times D}{V_{ripple} \times 0.5} \quad \text{——— } 6$$

C_{out} is the output capacitance

Selection of Diode

$$VRD1 = VIN(\max) + VOUT(\max) \quad \text{——— } 7$$

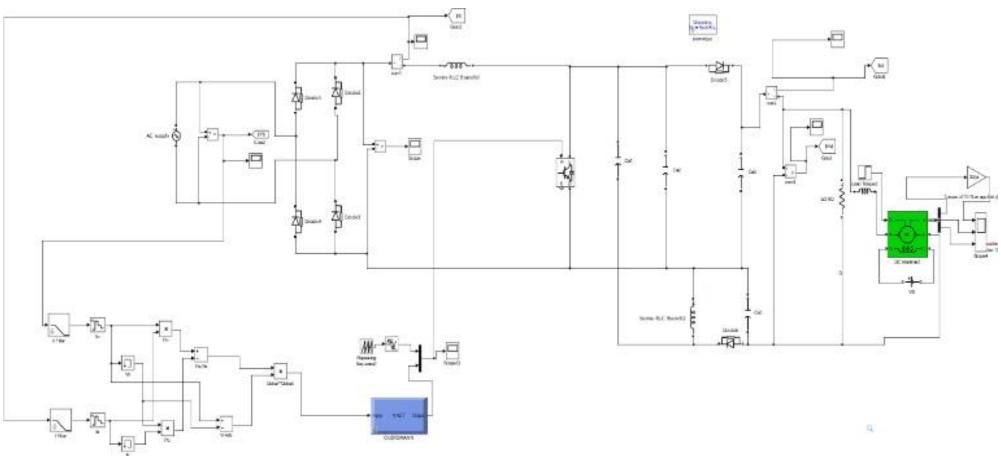

Fig 1.1 Simulation diagram

Simulation Results :

Input Voltage waveform

Fig 1,2 Shows the input voltage waveform that isobtained in the MATLAB/SIMULINK.

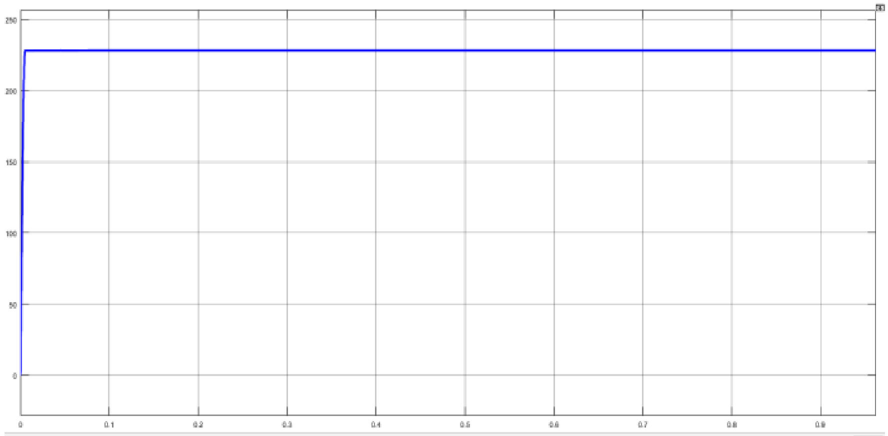

Fig 1.2 Input voltage waveform

Input Current Waveform

Fig 1.3 Shows the simulated waveform of input current in MATLAB/ SIMULINK.

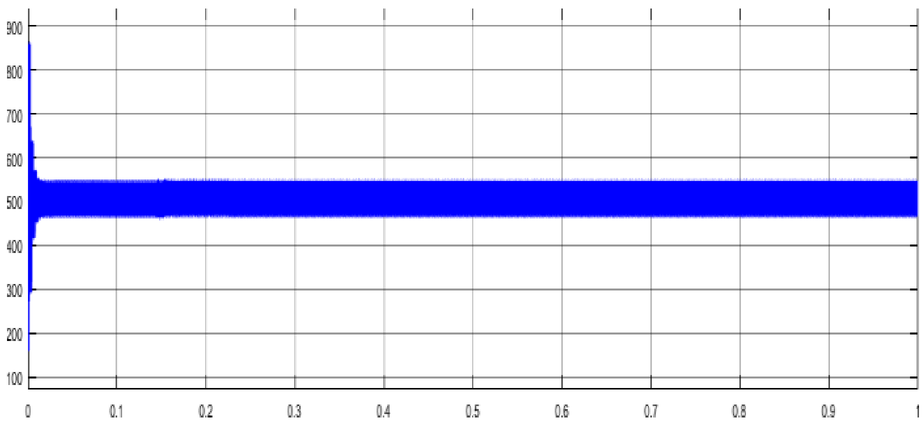

Fig 1.3 Input current waveform.

Input voltage after rectification

Fig 1.4 Shows the simulated waveform of the input voltage after rectification in MATLAB/SIMULINK.

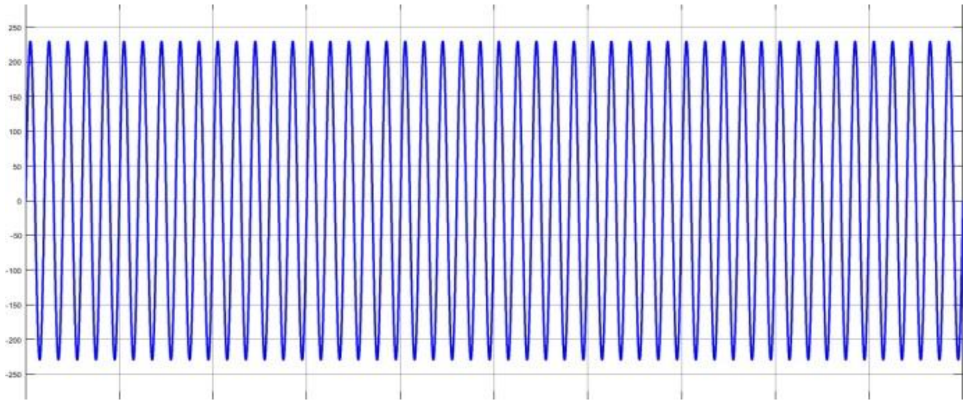

Fig 1.4 Input voltage rectification

Output current waveform

Fig 1.5 Shows the waveform of the output current that issimulated in MATLAB/ SIMULINK.

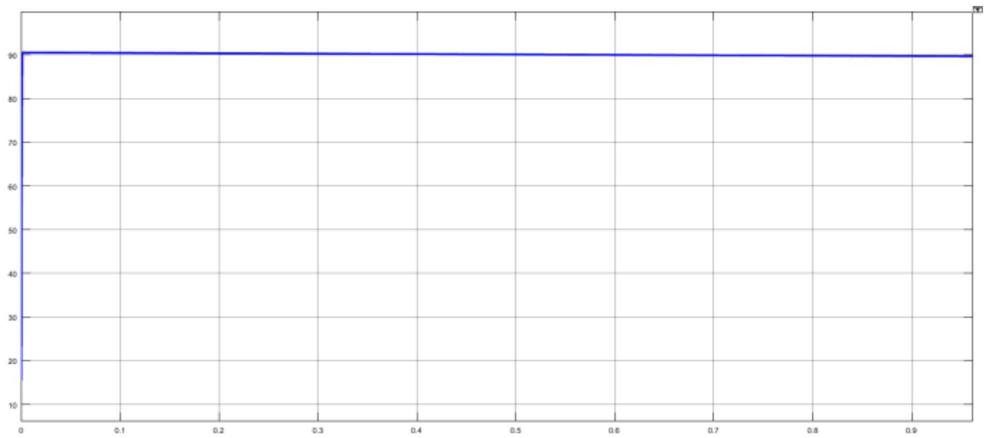

Fig 1.5 Output current waveform

Output voltage Waveform

Fig 1.5 Shows the waveform of the output current that issimulated in MATLAB/ SIMULINK.

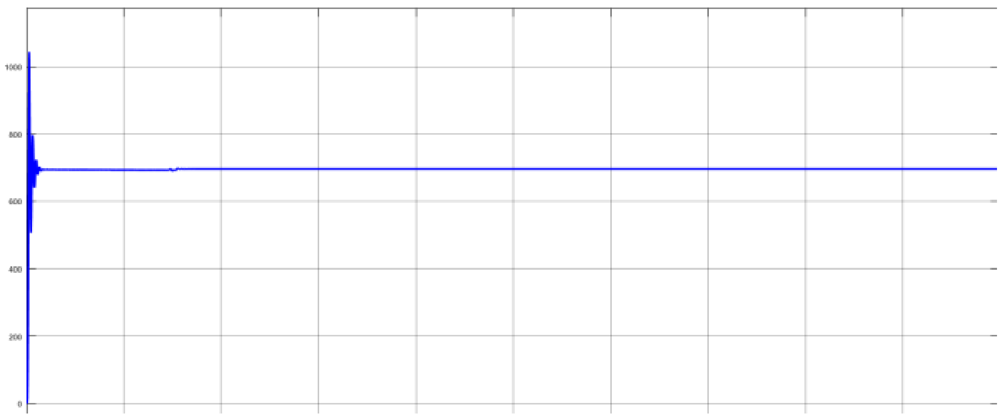

Fig 1.6 output voltage waveform

Simulated Parameters

Table 1.1 Shows the simulated parameters

Parameters	Values
Input voltage	12V
L_0 , L_1	3.36µH
C_0 , C_1	4.7µF
C_2 , C_3	100µF

HARDWARE SETUP

Input voltage

The input voltage given to the converter is 12V

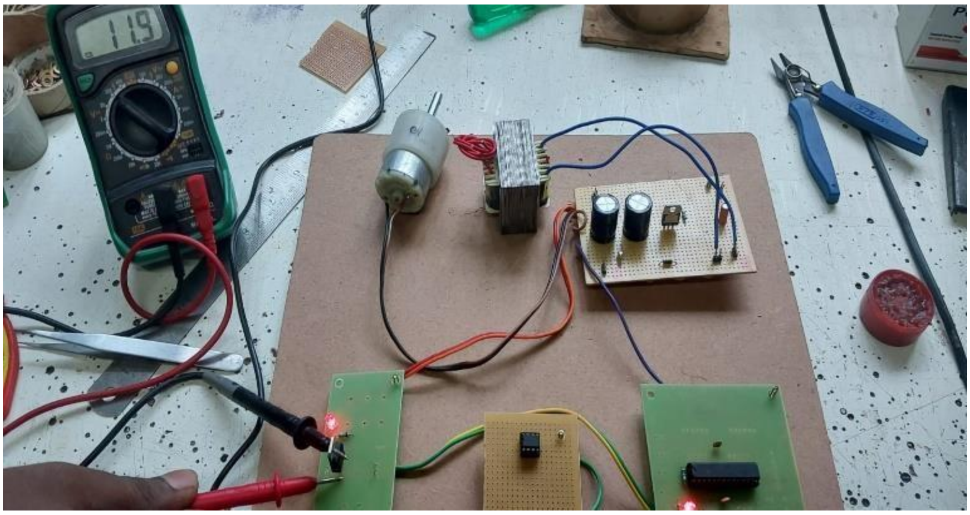

Fig 1.7 Input voltage

Output voltage

Fig 1.8 shows the output voltage given to the power supply board is measured using multimeter

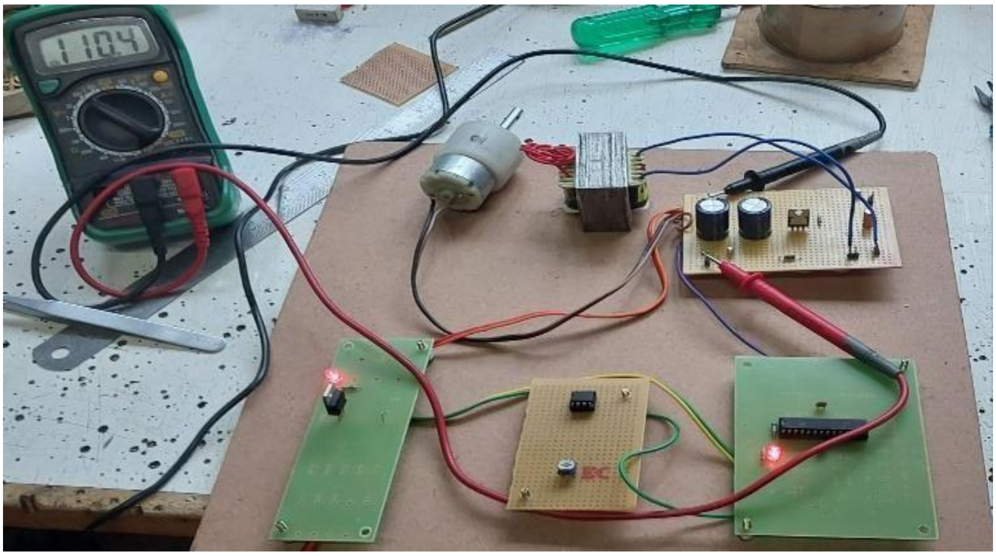

Fig 1.8 Output voltage

Output voltage through DSO

Fig 1.9 shows the output voltage waveformof the hardware are displayed by DSO

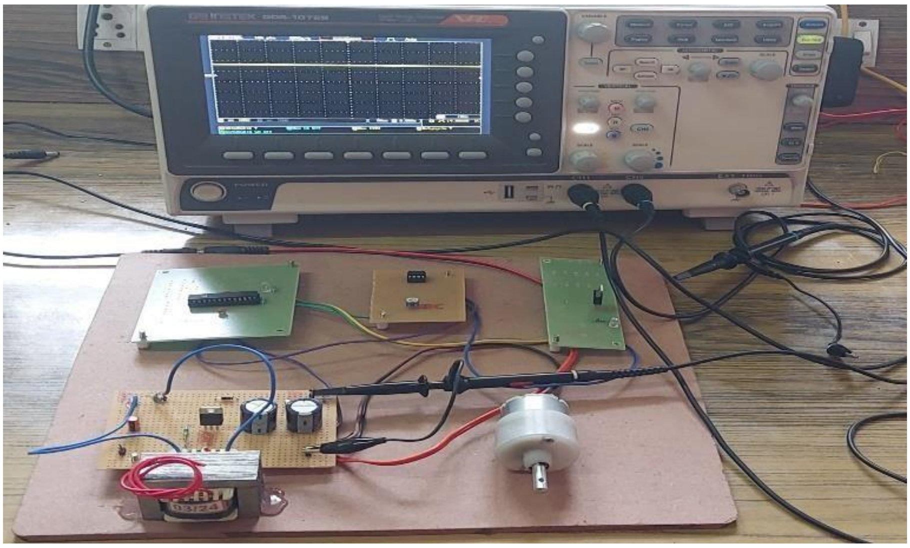

Fig 1.9 Output voltage waveformthrough DSO

CONCLUSIONS :

The proposed MBS converter designed by cascading Boost and SEPIC converter to obtain the advantages of both the converters. The maximum efficiency the circuit can produce without any controller is 97.8%. However the THD was quite high which is brought down to 9.94% by using the PI controller. The power factor is also improved with the addition of the PI controller. The proposed MBS converter can be effectively used for high voltage DC application like DC micro grid, heater etc.

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