

## A New Solar Powered Cascaded Multilevel Inverter Based on a Multi-Output DC-DC Converter

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**Abstract:** Cascaded MLI shows high power quality, it posses less harmonic content in generated output voltage. THD of cascaded MLI is lesser compared to two-level voltage source inverter. Switching strategy of cascaded H-bridge MLI is quite easy compared to other MLI topologies major drawback is the requirement of isolated DC source. N level cascaded MLI require  $(N-1)/2$  isolated Dc source to generate the desired level of output voltage. This study presents a new cascaded H-bridge multilevel inverter using single input multi output DC-DC converter suitable for photovoltaic applications. Single input DC source multi-output converter produces three isolated DC sources which can be utilized to generate seven level voltage by cascading three H-bridge circuits. Carrier phase shifted PWM technique is used to generate switching pulses for cascaded MLI. By varying modulation index of reference sine wave, THD of proposed multi-output DC-DC converter based cascaded MLI can be further reduced, THD of the proposed scheme is reduced to 8%. The proposed multi-output DC-DC converter based cascaded MLI is implemented in MATLAB/Simulink platform and results are presented.

**Key words:** Cascaded MLI, carrier phase shift PWM, Total Harmonic Distortion (THD), proposed, varying, modulation

### INTRODUCTION

MLI are employed to improve power quality; the main objective is to decrease THD in output voltage. Conventional seven-level inverter show 17% THD in output voltage, THD can be further reduced by using proper PWM techniques (Torres *et al.*, 2015). Literature presented non-linear control of a grid-connected multi-cell photovoltaic inverter with very fewer harmonics (Hemachandu *et al.*, 2015) (Fig. 1). Proposed a hybrid PV and fuel cell based seven-level inverter for grid interfacing. Research by (Garg *et al.*, 2016) implemented a multi-carrier phase shifted PWM technique for cascaded seven-level inverter. Literature by Boonmee *et al.* (2015)

shows a performance comparison of three level and multilevel inverter topologies. Research by Hasan *et al.* (2017) implemented a three phase cascaded seven-level inverter for drive applications. In this study, described that the studies on hall effect and DC conductivity measurements of semiconductor thin films prepared by Chemical Bath Deposition (CBD) method (Thirumavalavana *et al.*, 2015).

### MATERIALS AND METHODS

**Proposed topology:** Figure 1 shows the overall block diagram of proposed single input multiple outputs DC-DC converter based cascaded multilevel inverter. DC input is fed to integrated boost and sepic converter both the converters share the input source and they operate in interleaved mode of operation. A fly back unit is added at source inductance which acts as a voltage multiplier unit and AC output from the flyback unit is rectified to obtain DC voltage from the flyback converter. Output DC voltage from fly back can be controlled using transformer turns ratio. The multiple DC output from converter can be kept constant by changing duty cycle command by implementing the Pi controller. The high-efficiency

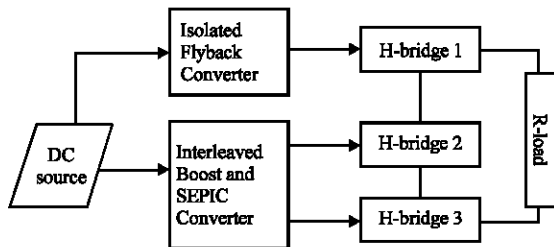


Fig. 1: Block diagram of proposed MLI

renewable PV inverter topology these concepts presented in this study (Bavitra *et al.*, 2015). Because constant DC voltage is essential for cascaded MLI, the level cannot be achieved with unbalance DC sources. In this study, described that the solar-driven air conditioning system integrated with latent heat thermal energy storage (Ponshammugakumar *et al.*, 2014). Three isolated DC sources from multi-output DC converter is fed to cascaded H-bridge multilevel inverter.

**RESULTS AND DISCUSSION**

Figure 2 Shows simulation implementation of proposed multi-output DC-DC converter based cascaded MLI. Table 1 shows simulation parameters applied for various elements used in proposed circuit. Figure 3 shows simulation result of proposed MLI seven level output voltage waveform. Figure 4-7 demonstrates the output of the multi-output DC-DC converter.

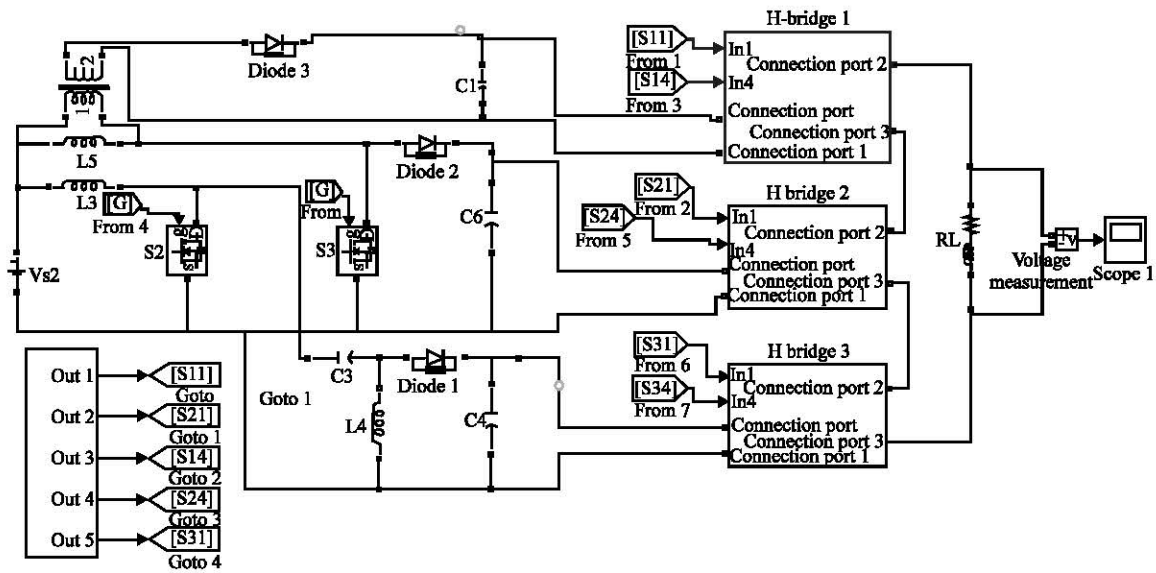


Fig. 2: Simulation implementation of proposed cascaded MLI

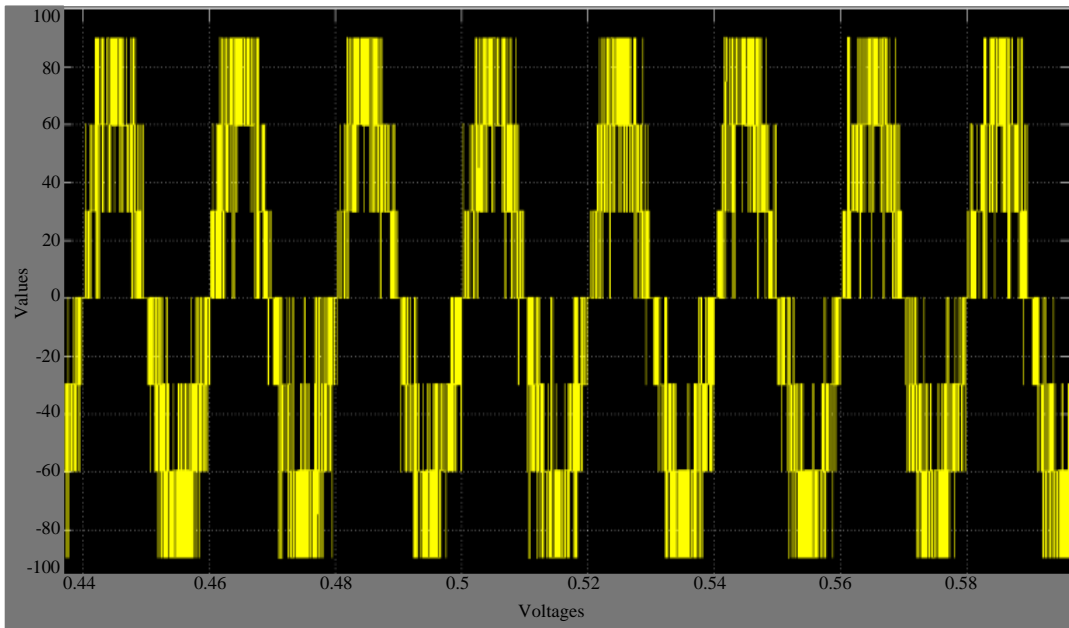


Fig. 3: Seven level output voltage from proposed cascaded MLI

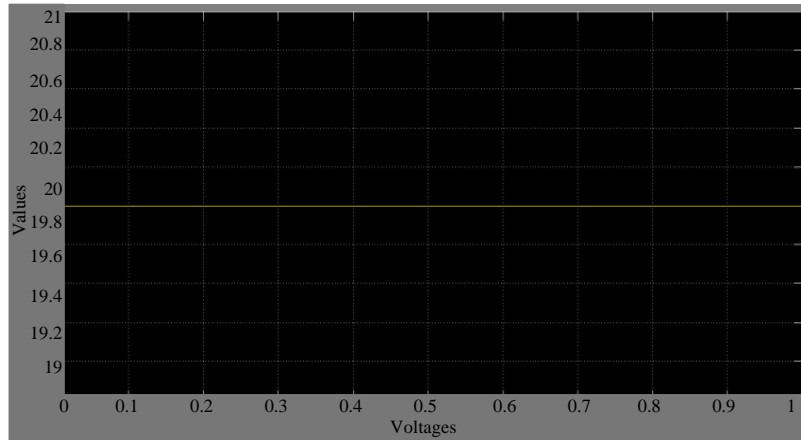


Fig. 4: Single input DC source voltage waveform

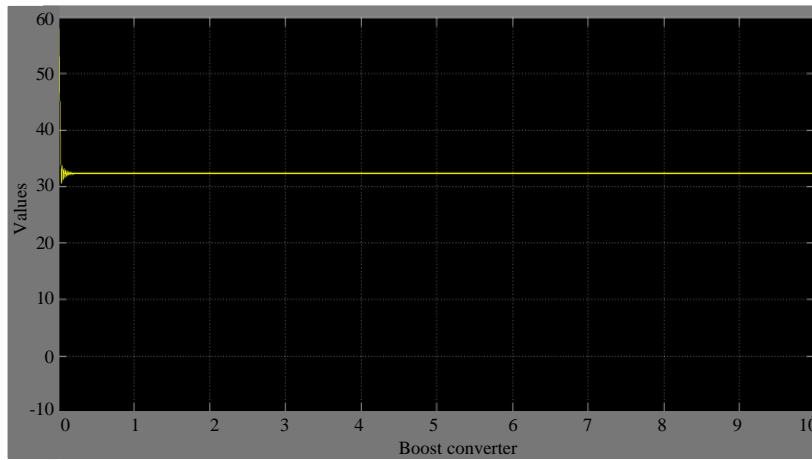


Fig. 5: Boost converter output voltage waveform

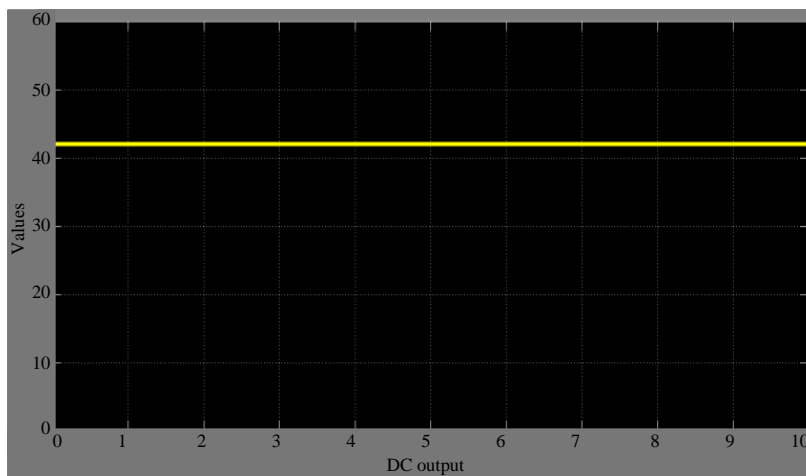


Fig. 6: DC output from fly back circuit

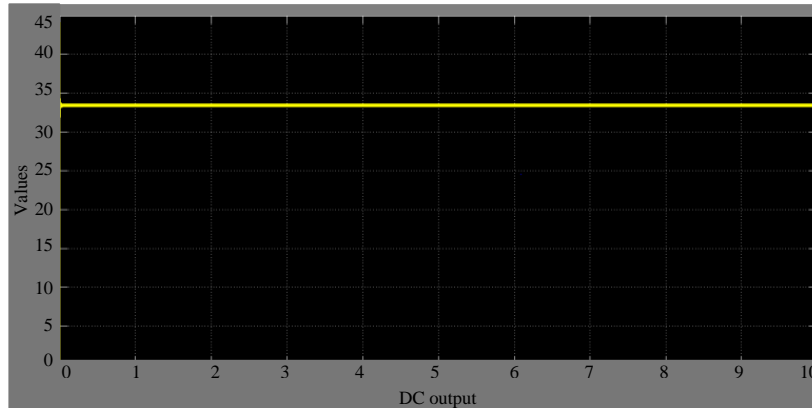


Fig. 7: DC output from SEPIC

Table 1: Simulation parameters

Variables	Values
DC input voltage	20 V
Output voltage	32 V×3
Inductor Ls, Ll	300 and 200 μH
Capacitor C1, C4, C6	100, 1000 and 1000 μF
Transformer ratio n	1:2
Load resistor	10 Ω
Load inductor	1 mH

### CONCLUSION

The proposed multi-output converter based cascaded MLI is simulated in simulink and results are presented in the previous study. THD of proposed MLI is 8% employing modulation index of 0.3 in carrier phase shifted PWM technique. The only single DC source is used to generate seven level output voltage in conventional cascaded MLI three dc sources are required.

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