A Highly Efficient and Reliable Inverter Configuration Based Cascaded Multilevel Inverter for PV Systems

Introduction:

Transformer less multilevel inverter (MLI) topologies are gaining importance due to their advantages such as high efficiency, low switch count, low weight, and reduced size. However, removal of the transformer eliminates the galvanic isolation between the photovoltaic (PV) array and the output load. Removal of galvanic isolation increases the leakage current compromising the safety in PV systems. It has led to the development of various safety standards for the PV systems, which restrict the value or magnitude of leakage current flow in the PV system.

Apart from leakage current minimization, there is a continuously increasing demand for high-quality power output to be fed into the grid from the PV system. This requirement has led to the use of MLI in the transformer less PV systems.

Existing system:

The given MLI configuration consists of eight switches for the generation of three levels in the Output voltage. This topology reduces the switching losses but has the drawback of high conduction losses during both turn-ON and zero voltage states. The given MLI configuration has an asymmetric operation during each half-cycle of the fundamental component of the grid voltage. The inherent asymmetry in each half-cycle causes a dc offset in the MLI output.
voltage. Furthermore, the requirement of an additional number of switches for more than three-level operation limits its application.

Transformer less PV MLI topology to reduce the leakage current by maintaining CMV constant. This MLI topology uses six switches for the generation of three levels in the inverter output voltage.

Dis-advantages:
- High switching and conduction losses.
- Cannot be extended to more than three levels in the output voltage.

Proposed system:
An improved cascaded multilevel inverter (CMLI) with five level topology based on a highly efficient and reliable configuration for the minimization of the leakage current is proposed. Apart from a reduced switch count, the proposed scheme has additional features of low switching and conduction losses. The proposed topology with the given Pulse width modulation (PWM) technique reduces the high frequency voltage transitions in the terminal and common mode voltages.
Avoiding high-frequency voltage transitions achieves the minimization of the leakage current and reduction in the size of electromagnetic interference filters. The given configuration consists of two converters (Conv-1 and Conv-2). Conv-1 is a half-bridge inverter comprising two switches $Sx_1$ and $Sx_2$. The given PWM technique required only one carrier wave for the generation of $2m + 1$ levels.

**Advantages:**

- The topology uses eight switches for the generation of five levels in the output voltage.

- During the zero voltage state only one switch and one diode conduct.
- In the proposed topology, four switches are operated at a low switching frequency, which reduces the switching losses.

- The dead band in the PWM technique does not affect the CMV.

- The proposed inverter can be easily cascaded to achieve more than five levels in the output.

Applications:
- High power conversion applications.

Block Diagram: