A Multilevel Transformerless Inverter employing Ground Connection between PV Negative Terminal and Grid Neutral point

Introduction:

A tremendous increase of interest in photovoltaic (PV) energy systems. There has been significant drop in the price of PV modules in the last decade, hence the reduction of manufacturing costs of PV inverters becomes a necessity. PV inverters that employ an isolation transformer, are bulky and hard to install. Although by employing a high frequency transformer alongside a DC-DC converter can reduce the size of the inverter, it reduces the overall efficiency due to the leakage in the high frequency transformer.

As the name suggests, the transformerless inverters are devoid of the bulky Isolation transformer which not only makes them compact but also makes them cheaper and highly efficient. Therefore, the popularity of transformerless PV inverters is increasing day by day. However, as there is no galvanic isolation between the PV panel and the grid, it can result in the flow of common mode leakage currents through the PV panel parasitic capacitance.

Existing system:

The half-bridge family of inverters with two, three or more output voltage levels are devoid of fluctuating CM voltage. Their main drawback is the need of high input voltages, which requires either a previous boost dc-dc stage or a large PV string. On the other hand, the full-bridge topology requires half of the input voltage demanded by the half-bridge topology. However, the full bridge has to be...
modulated with bipolar SPWM to avoid a varying common-mode voltage.

One of the topology that employ ground connection based on the concept of virtual DC bus is proposed. Here the PV negative terminal and the grid neutral are directly connected thus eliminating the leakage current issue. However, to charge the virtual DC bus, two capacitors with unequal voltages are connected in parallel. Large deviation in the capacitor voltages can lead to very high switch currents. Therefore, this inverter topology is incompatible for high power systems. Also, this inverter topology cannot provide multilevel output voltage.

Dis-advantages:
- They need two DC link capacitors and some extra switches for clamping purpose.
- Increasing the total cost of the inverter.

Proposed system:
A novel multilevel transformerless inverter topology is proposed which completely eliminates CM leakage current by connecting grid neutral point directly to the PV negative terminal, thereby bypassing the PV stray capacitance. It provides a low-cost solution consisting of only four power switches, two capacitors and a single filter inductor.
The proposed inverter topology is a H4 topology consisting of two half bridges with switches S1, S2 and capacitor C1 forming one half bridge and switches S3, S4 and capacitor C2 forming the other half bridge. The parasitic capacitance of the PV panel is directly bypassed by employing ground connection between PV negative terminal and grid neutral point.

**Advantages:**

- Eliminates the CM leakage current with less than five power switches.
- Multilevel voltage output improves current THD, thereby reducing filter size requirement.
- Can be easily extended to get n-level output by adding appropriate number of half bridge modules
Applications:
- Grid Applications.
- High power conversion applications.

Block Diagram:

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Solar PV → H4 Inverter → Filter → Load

12VDC → Gate driver circuit

5VDC → Buffer circuit

Microcontroller circuit
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