A Single-Phase Transformer less Inverter with Charge Pump Circuit Concept for Grid-Tied PV Applications

Introduction:

The photovoltaic (PV) power systems have become very popular among the renewable energy sources, because they generate electricity with no moving parts, operate quietly with no emissions, and require little maintenance. Distributed grid-connected pvs are playing an increasingly role as an integral part of the electrical grid. However, due to the large stray capacitors between the PV panels and the ground, PV systems suffer from a high common mode (CM) current, which reduces the system efficiency and may cause safety issues like electric shock.

In order to eliminate the leakage currents, transformers are commonly used in the PV system to provide galvanic isolation. However, it possesses undesirable properties including large size, high cost, and weight with additional losses. Thus, eliminating the transformer is a great benefit to further improve the overall system efficiency, reduce the size, and weight.

Existing system:

Topologies based on H6 are proposed to eliminate the leakage current of the grid-tied PV application. These inverters consist of six power switches and some diodes for disconnecting the dc side from
the grid. These topologies are more costly than the FB inverter, because they use extra switches and diodes. Another disadvantage of these topologies is lower efficiency due to the current that circulates through three power switches at the same time.

Several high efficient new H6 transformer less inverters are proposed to achieve lightweight and also lower cost. They have the capability of reactive power injection to the grid. The leakage current is not totally eliminated in these topologies, which is the main disadvantage of them.

**Dis-advantages:**
- Leakage losses.
- Less efficiency

**Proposed system:**

A new transformerless inverter based on charge pump circuit concept, which eliminates the leakage current of the grid-connected PV systems using a unipolar sinusoidal pulse width modulation (SPWM) technique. In this Solution, the neutral of the grid is directly connected to the negative terminal of the charge pump circuit, so the voltage across the parasitic capacitor is connected to zero and the leakage current is eliminated. The charge pump circuit is implemented to generate negative output voltage.
There is not any limitation on the modulation strategy of the proposed inverter because the leakage current is eliminated by the circuit topology. The proposed topology consists of only four power switches, so the cost of the semiconductors is reduced and the power quality is improved by three-level output voltage in order to reduce the output current ripple. During operation of the proposed inverter, the current flows through two switches; thus, the conduction loss is also lower. The used dc voltage of the proposed inverter is the same as the FB inverter (unlike NPC, ANPC, and half-bridge (HB) inverters). The proposed inverter is capable of delivering reactive power into grid too.

**Advantages:**

- The charge pump circuit has no active device and it has a lower cost for grid-tied applications.

- The capacitor of the proposed inverter charges every switching cycle, which reduces the size of the required capacitor with the switching frequency.

**Applications:**

- Grid applications.
**Block Diagram:**

- Solar PV
- 12VDC
- 5VDC
- Transformerless single phase inverter with Charge pump
- Gate driver circuit
- Buffer circuit
- Microcontroller circuit
- Load