INTRODUCTION

Grid-connected Photovoltaic (PV) systems, particularly single-phase systems, are becoming more important worldwide. Quite often, these grid-connected PV systems include a line transformer in the power-conversion stage, which guarantees galvanic isolation between the grid and the PV system, thus providing personal protection. Furthermore, it strongly reduces the leakage currents between the PV system and the ground, ensures that no continuous current is injected into the grid, and can be used to increase the inverter output voltage level [2]. The line transformer is large, heavy and expensive. Technological evolution has made possible the implementation, within the inverters, of both ground-fault detection systems and solutions to avoid injecting dc current into the grid. The transformer can then be eliminated without impacting system characteristics related to personal safety and grid integration. The advantages of eliminating transformer are reduction on manufacturing and maintenance cost, Size of the unit was much reduced and efficiency of the whole system improves[5].

II COMMON-MODE CURRENTS IN TRANSFORMERLESS PV SYSTEMS

When no transformer is used, a galvanic connection between the ground of the grid and the PV array exists. As a consequence, a common-mode resonant circuit appears, consisting of the stray capacity between the PV modules and the ground, the dc and ac filter elements, and the grid impedance. A varying common-mode voltage can excite this resonant circuit and generate a common-mode current. Due to the large surface of the PV generator, its stray capacity with respect to the ground reaches values that can be even higher than 200 nF/kWp in damp environments or on rainy days. These high values can generate ground currents with amplitudes well above the permissible levels, such as those concerning the standards. The currents can cause severe (conducted and radiated) electromagnetic interferences, distortion in the grid current and additional losses in the system [3].

These leakage currents can be avoided, or at least limited, by including damping passive components in the resonant circuit [3]. Obviously, additional losses will appear in the damping elements, thus decreasing the conversion stage efficiency. To avoid leakage currents, the common-mode voltage must be kept constant during all commutation states.
III PROPOSED TOPOLOGY

CIRCUIT DIAGRAM OF PROPOSED METHOD:

The proposed topology, which consists of Eight switches (S1-S8) and two diodes (D7–D8). In this topology, D7, D8 diodes and the capacitive divisor limit the blocking voltage of S5 and S6 to half of the input voltage VPV. S7 and S8 functions as a HERIC Grid-connected PV systems usually operate with unity power factor. The operational principle of the proposed converter is now analyzed for this case. The proposed topology with the modulation technique described below can operate with power factors other than unity. In these cases, the operation analysis would be similar. In the positive half cycle, S1 and S4 are on. In order to modulate the input voltage, S5 and S6 commutate at the switching frequency with the same commutation orders S2 and S3 commutate at the switching frequency together and complementarily to S5 and S6. In this situation, when S5 and S6 are on, \( V_{AB} = \frac{VPV}{2} \) and the inductor current, which flows through S5, S1, S4, and S6, increases. The common-mode voltage is:

\[
V_{cm} = \frac{(V_{AO} + V_{BO})}{2} = \frac{(V_{PV} + 0)}{2} = \frac{V_{PV}}{2}.
\]

When S5 and S6 are turned off and S2 and S3 are turned on, the current splits into two paths: S1 and S4 commutate at the switching frequency in order to modulate the input voltage, S1 and S4 commutate at the switching frequency together and complementarily to S5 and S6. In this situation, when S5 and S6 are on, \( V_{AB} = \frac{VPV}{2} \) and the freewheeling diode of S1, and the second of S2 and the freewheeling diode of S4. Consequently, S1 and S4 are turned on with no current, so no switching losses appear. In this situation, voltages VPV and VCD tend to zero and diodes D7 and D8 fix the voltages VA0 and VB0 to \( \frac{VPV}{2} \). The current decreases because VAB is clamped to zero. Now, the common-mode voltage is:

\[
V_{cm} = \frac{(V_{AO} + V_{BO})}{2} = \frac{(0 + \frac{VPV}{2})}{2} = \frac{VPV}{2}.
\]

In the negative half cycle, S2 and S3 are on. Again, S5 and S6 commutate at the switching frequency in order to modulate the input voltage. S1 and S4 commutate at the switching frequency together and complementarily to S5 and S6. In this situation, when S5 and S6 are on, \( V_{AB} = \frac{VPV}{2} \) and the inductor current, which flows through S5, S3, S2, and S6 decreases. The common-mode voltage is:

\[
V_{cm} = \frac{(V_{AO} + V_{BO})}{2} = \frac{(V_{PV} + 0)}{2} = \frac{VPV}{2}.
\]

When S5 and S6 are turned off S1 and S2 and are turned on, the current splits into two paths. The first path consists of S3


IV RESULTS AND DISCUSSION

The dc voltage generated in the photovoltaic array is simulated for 440 volt is applied to the inverter and the result is analyzed with the resistive load (normally the grid system consist of unity power factor so the resistive load is used for simulation analysis). This simulation model consist of the PV arrays and a parasitic capacitance two MOSFET switches with an freewheeling diodes is linked with an PWM inverter, the output is linked to an load along with the HERIC circuit and the filter across the terminal. The waveform is obtained from different part of the model and shown below. The output voltage is obtained across the load consist of low distortion.

The leakage current obtained from the midpoint of the load is minimized (Zero), as the ground leakage current is Zero the losses in the system will be minimum. The common mode voltage is obtained across the inverter output is constant and no varying common mode voltage is generated in the proposed topology and similarly no leakage current appears in
the topology. The constant common mode voltage waveform is shown below.

**CONCLUSION**

In the proposed topology by the use of switches and diodes between the PV arrays Parasitic capacitance and inverter. Along with the use of Heric and filter circuit in the AC side of circuit an ripple free output voltage along with the low ground leakage current and the common mode voltages are obtained. By this method an grid connected transformerless single phase PV inverter isolation get improved. Similarly, system overall efficiency get improved. Hence the proposed method is simulated and the output are verified.

**REFERENCES**


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**Fig 3. Simulation of Proposed Method**

**Fig 4. Output Voltage**

**Fig 5. Ground leakage current**

**Fig 5. Common Mode Voltage**