An Improved Zero-Current-Switching Single-Phase Transformer less PV H6 Inverter with Switching Loss-Free

Introduction:

The distributed PV generation system has received an increasing popularity in the residential, commercial, and industrial areas. Compared with isolated PV generation configurations, transformerless configurations have become a widespread acceptance due to the attractive efficiency, small volume and low cost. Based on these merits, some researchers intend to pursue high power density transformerless PV grid-connected inverters by raising the switching frequency.

Looking back, this developing trend will resemble the developed route of DC switching supplies in 3C (Computer, Communication and Consumer Electronic) industry, for their switching frequencies have already reached MHz level currently. However, in conventional transformerless PV grid-connected inverters, their switches are still on hard-switching state. Because of this, High frequency transformerless PV grid-connected inverters will suffer from high losses, cooling stresses, and EMI noises.

Existing system:

Soft-switching technique is one of the most promising techniques to reduce or even remove the switching losses, and to
degrade the switching stresses, such as $\frac{di}{dt}$ and $\frac{dv}{dt}$. Generally speaking, existed soft switching techniques can be roughly categorized into two sorts: the snubber-type with resonant tanks and the control-type using switching modulation strategies.

In active-snubber-types, the resonant tanks can only be activated during switching transitions of high-frequency switches. Therefore, once the switching transition is finished, this kind of converters can revert back to the familiar PWM operation mode so that the circulation loss of resonant tanks can be minimized.

**Dis-advantages:**
- The reverse recovery problem of freewheeling diodes are still retained.
- Turn-off loss of the auxiliary switches.

**Proposed system:**

A switching loss-free (SLF) concept based on the H6-I topology is proposed, which is attractive in high power density transformerless PV grid-connected inverters. A resonance trajectory with the self-compensation mode is designed, and a couple of the resonant tanks with the self-compensation mode are obtained based on the H6-I. They are able to compensate for the loss of the resonant tanks precisely.

The ZCS conditions are achieved for all power switches in both of turn on and turn off processes under unity power factor condition. Besides, the ZCS turn off of the freewheeling diodes is achieved naturally so that the reverse recovery problem is alleviated. By integrating the resonant tank and clamping diodes with saving one
diode, the freewheeling clamping function is obtained synchronously so that a constant common-mode voltage is realized at switching frequency scale.

**Advantages:**

- The ZCS turn off of the freewheeling diodes is achieved naturally.
- The reverse recovery current of freewheeling clamping diodes is alleviated, which reduces the reverse recovery loss and the EMI noise

**Applications:**
- Unity power factor application
- high frequency transformerless PV inverters

**Block Diagram:**