A Novel Nine-Level Inverter Employing One Voltage Source and Reduced Components as High-Frequency AC Power Source

Introduction:

Dc power distribution system (DC PDS) is gradually unable to meet the requirements due to its insufficiencies such as more conversion stages, low efficiency, and poor transient response. High-frequency ac power distribution system (HFAC PDS) proposed has become an alternative because of its merits such as fewer conversion stages, higher efficiency, faster response, high power density, distributed heat profile, and potential for connector-less power transfer.

HFAC PDS is usually composed of two stages: A high frequency (HF) multilevel inverter (MLI) or a resonant inverter as the source side and several ac/ac or ac/dc voltage-regulation modules as the load side. In order to raise the power capacity, one of the most popular methods of the source side is to connect multiple resonant inverters in series or in parallel, while the control for the HF synchronizations of both amplitudes and phases will become extremely complicated.

Existing system:

Traditional MLIs include the neutral-point-clamped (NPC) inverter, flying capacitor (FC) inverter and cascade H-bridge (CHB) inverter. The NPC and FC inverters, respectively, use diodes and
capacitors to clamp the voltage levels and more levels can be obtained by increasing the number of power devices. However, both the circuit configurations and their controls will become extremely complicated along with the increasing number of voltage levels. Additionally, the capacitors’ imbalance is another problem needed to be solved. The CHB inverter increases the output voltage levels and simplifies the modulation by the combination of H-bridge cells. However, the number of power devices and input dc sources multiplies when outputting more voltage levels. Several simplified topologies have been proposed in recent years to overcome the shortcomings of the traditional ones. However, they have the common disadvantage that symmetric or asymmetric dc inputs are needed.

Dis-advantages:
- Symmetric or asymmetric dc inputs are needed.
- Number of power devices and input dc sources multiplies when outputting more voltage levels.

Proposed system:
A nine-level inverter employing one voltage source and two capacitors is proposed for HFAC PDS. Compared With the aforementioned topologies, the proposed inverter has more voltage levels with fewer components. Lower THD of output voltage is obtained and the voltage stress on the power switches in the backstage is relatively relieved. More importantly, the inherent self-voltage balancing ability of the two capacitors has simplified the modulation algorithm.
The proposed nine-level inverter, which consists of two stages. The circuit in the frontend is a developed sc Circuit (DSCC), which is different from the basic sc cells in that it can output more voltage levels with relatively fewer components. An h-bridge circuit (HBC) is used in the backend to change the polarity of the frontend output. When the two capacitors in proposed nine-level inverter discharge to supply the load separately or in series with the voltage source, voltage ripples will appear on them, which should be limited to no more of the capacitors’ own maximum voltages.

Advantages:
- The proposed HF inverter can output nine levels using only one voltage source and fewer components.
- Less harmonics,
- Thus the switching loss is decreased greatly.

Applications:
- High power conversion applications.
Block Diagram:

- Dc input
- Developed sc Circuit (DSCC)
- H-bridge circuit (HBC)
- Load

- Gate driver circuit
- Buffer circuit
- Microcontroller circuit

- 12VDC
- 5VDC

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