

## **New module integrated multilevel inverter for grid connection of photovoltaic plants**

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### **Background:**

The basic concept of a multilevel converter is to synthesize a staircase voltage waveform by the use of several lower voltage DC sources. Capacitors, batteries, fuel cells and photovoltaic modules can be used as DC sources. A multilevel converter has several advantages, like a high voltage quality and low electromagnetic compatibility problems.

### **Challenge/Objectives:**

Present multilevel converters add voltages of the same amplitude to pattern a reference voltage or to eliminate single harmonics. In contrast, it shall be shown in the paper that it is possible to generate directly space phasors with a high grade of symmetry, without synthesizing a reference voltage. For this, voltages of differing amplitudes must be added.

For example, an ideal sinusoidal tri-phase system corresponds with a circular space phasor, which is a geometrical figure with infinite axis of symmetry. Hence, it has the highest grade of symmetry. Each divergence of this ideal operation state is directly reflected in the space phasor. Considering a non circular space phasor, the divergence from the ideal space phasor depends on the grade of symmetry. That means, with a growing grade of symmetry, the three-phase system is getting more and more ideal and the distortions are decreasing. So, if it is possible to generate space phasors with a high grade of symmetry whole groups of harmonics could be eliminated, instead of conventional just single harmonics.

Especially in the field of photovoltaic this new method is practicable and provides good results.

### **Approach:**

Within this work, a circuit had to be developed, which enables on the one hand the generation of symmetrical space phasors and on the other hand an energetic optimized grid connection of solar modules. Therefore a modification of the established cascaded multilevel inverter was necessary. For this purpose, it was necessary to find energy redundancies between the voltage levels of the multilevel inverter. Also a special MPP-tracking method for this inverter had to be developed. With this new inverter different operation conditions were calculated and simulated.

### **Results:**

One important result is that this operation mode limits the distortions. Also, a so far unknown correlation between the energies, belonging to special chosen voltage levels of a space phasor, is presented. Because of this correlation, energy redundancies can be used to balance the voltages of a multilevel inverter and to improve the MPP tracking of solar multilevel inverters.

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