

# Common-mode voltage reduction modulation techniques for three-phase grid connected converters

侯中權, 施智中, 鄭博泰, Ahmet M. Hava

Electrical Engineering

Engineering

bird@chu.edu.tw

## Abstract

Grid connected photovoltaic (PV) systems grow dramatically in recent years thanks all kinds of incentive programs offered by the government and the awareness of global warming issues. The conversion efficiency, weight and size are critical factors when PV systems are evaluated for installations. Therefore, converter circuits which do not have galvanic isolation (i.e. transformerless) are often favored. Figure 1 shows a typical transformerless grid connected PV system. The stray capacitance between the PV panel and the ground is estimated at 200nF/kWp[1], and this results in significant common-mode current as the grid connected converter switches at high frequency pulse width modulation. The lack of the galvanic isolation presents a potential safety risk if the common mode current not well managed. This paper presents a study of various common-mode noise reduction modulation schemes for three-phase grid connected converters. These PWM schemes can synthesize the desired output voltage without using zero vectors in its switchings, thus the common-mode voltage (CMV) of the converter output can be greatly reduced. The triangular carriers of the PWM are modified to accomplish this feature of no zero vectors. Furthermore, this paper presents an integration of the dead-time compensation and these PWM schemes to improve output voltage accuracy of the grid connected converter. These can be easily programmed on a a complex

programmable logic device (CPLD) for implementation. Computer simulation and test results are utilized to verify the performance of the proposed common-mode voltage reduction PWM schemes for three-phase grid connected converter.

Keyword : common-mode voltage , converter