Multimodular UPFC operated by phase-shifted triangle carrier SPWM strategy

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Abstract

The acronym UPFC covers L. Ggugyi's unified power flow controller and Akagi and Fujita's unified power flow conditioner. The paper describes one method of meeting high MVA specifications by using multiple modules of 2-level, 3-phase power converter modules controlled by the phase-shifted triangle carrier technique of the sinusoidal pulse width modulation (SPWM) strategy. Two conceptual designs are presented: (1) the GTO-SPWM-UPFC at the lowest switching rate, $f_c/f_m=3$, to minimize GTO switching loss. The design is based on applying the fundamentals of SPWM theory to overcome unbalances arising from sideband harmonic interferences; and (2) the IGBT-SPWM-UPFC, at $f_c/f_m=12$ or higher, which SPWM theory assures that direct paralleling of the modules is free of current unbalance. A laboratory UPFC based on 6 modules of 3-phase, 5 kVA size, IGBT power converters operating at the baseline condition of dual unity displacement factor at the sending-end and the receiving end, has been implemented.

Keywords: PWM power convertors; bipolar transistor switches; harmonic distortion; insulated gate bipolar transistors; load flow; load regulation; power bipolar transistors; power semiconductor switches; power system control; switching circuits