UPFC using multiconverter operated by phase-shifted triangle carrier SPWM strategy

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Abstract

The acronym UPFC covers Ggugyi's unified power flow controller and Akagi and Fujita's unified power flow conditioner. This paper describes one method of meeting high MVA specifications by using multiple modules of two-level three-phase power converter modules controlled by the phase-shifted trianglecarrier technique of the sinusoidal pulsewidth modulation (SPWM) strategy. Two conceptual designs are presented. The first is the gate-turn-off (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. The second is the insulated gate bipolar transistor (IGBT)-SPWM-UPFC, at $f_c/f_m=12$ or higher, in which SPWM theory assures that direct paralleling of the modules is free of current unbalance. A laboratory UPFC based on six modules of three-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; flexible AC transmission systems; harmonic distortion; insulated gate bipolar transistors; power bipolar transistors; power factor correction; power semiconductor switches; power system harmonics; switching circuits; thyristor convertors