

FLEXIBLE FPGA INTERFACE FOR THREE-PHASE POWER MODULES

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Abstract— This article proposes the development of a flexible interface for the control of Power Inverters. A FPGA-designed system enables an implementation adaptable to any Power Module, with no need to modify the existing hardware. The interface identifies and indicates the type of faults encountered in these modules, generates switching signals on the basis of dead-time and sends a protection signal that inhibits its operation.

Keywords— FPGA, Intelligent Power Modules, Power Semiconductors, VSI.

I. INTRODUCTION

Three-phase inverters synthesize any random waveform from a direct current (DC) source (Kazmierkowski and Malesani, 1998). Their field of application comprises active filters, uninterruptible power sources, power factor correction and motor drivers, among others. (Duan *et al.*, 1999; Ko *et al.*, 2006). Fig. 1 shows schematically the basic inverter and the control system.

The bridge configuration of Fig. 1 has two power switches per leg. Each leg corresponds to a different phase whose output is the common connection point.

The DC source (DC bus) consists of a three-phase rectifier and a capacitor that stores power.

The controller defines the switching actions (R_{out} , \overline{R}_{out} , S_{out} , \overline{S}_{out} , T_{out} , \overline{T}_{out}) by sensing the inverter output current (I_{filR} , I_{filS} , I_{filT}), and the reference current (I_{refR} , I_{refS} , I_{refT}). These actions are conditioned to achieve a safe switching. In order to safeguard a optimum operation of the inverter, some protections should be taken into account:

- A time delay or dead-time (DT) addition between same-leg switches turning-off and -on, to avoid short circuits in the DC bus (Leggate and Kerkman, 1997; Trivedi and Shenai, 1998; Lai and Shyu, 2004; Summer and Betz, 2004).

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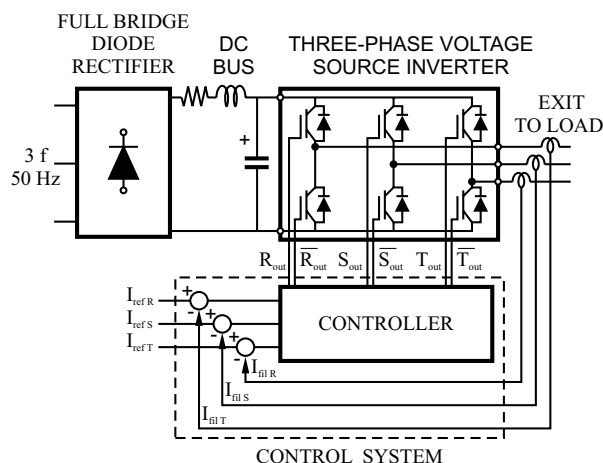


Figure 1: Basic Scheme of a Three-phase Control System

- A current control in the switches to avoid that maximum ratings specified by the manufacturer are not exceeded.
- Temperature of the switches monitoring to avoid reaching maximum devices junction temperature.
- Under voltage lockout for all power supply levels. This prevents the switches activation in the lineal area by voltage supply drops in the control signal.

The power semiconductor technology has allowed manufacturers to integrate semiconductor devices, control electronics and some protection systems in a single chip (Tanaka *et al.*, 2003). These devices, known as Power Modules (PM), provide similar specifications. PM characteristics are available in (Powerex, 1994; International Rectifier, 2005). However, the lack of standardized manufacturing renders them noninterchangeable (Allaith and Grant, 2000). Due to this, all the external electronics mandatory to condition trigger signals, fault type determination and controller operation inhibition are