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Implementation of a Single-phase Unipolar Inverter Using DSP TMS320F241

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Abstract

This paper presents the design and implementation of a single-phase inverter that produces a symmetric ac output voltage of desired magnitude and frequency. A diode bridge rectifier is used to rectify the ac line voltage. Unipolar PWM technique is employed to control the output voltage magnitude and frequency. The digital signal processor (DSP) of Texas Instruments TMS320F241 is used for the implementation of the inverter

Keywords: *Single-phase inverters, digital signal processor (DSP), unipolar-switching scheme, output voltage control of single-phase inverters, Matlab simulation.*

1. Introduction

Single-phase inverters are widely used in industrial applications such as induction heating, standby power supplies and uninterruptible supplies. A block diagram representation of a single-phase inverter is given in Fig.1-1. The inverter consists of four switching devices (represented as ideal switches) connected in the form of a bridge. The control scheme is implemented using TMS320F241 DSP controller (Techakittiroj *et al.* 2003)

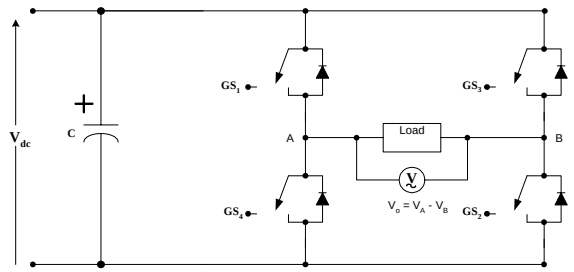

Fig. 1-1. Single-phase inverter

In the unipolar switching scheme (Ned *et al.* 1995), the output voltage changes between positive and zero, or between zero and negative voltage levels. To produce a sinusoidal output voltage waveform of variable frequency and amplitude, a sinusoidal reference signal (V_{ref}) is compared with the triangular waveform (V_{tri}). The amplitude modulation index (m_a), which controls the rms value of the output voltage, is defined as

$$m_a = \frac{\hat{V}_{ref}}{\hat{V}_{tri}} \tag{1.1}$$

The $\hat{V}_{ref}$ and $\hat{V}_{tri}$ in equation (1.1) refer to the peak amplitudes of the signals.

Leg A and B of the full-bridge inverter are controlled separately by comparing V_{tri} with V_{ref} and V_{tri} with $-V_{ref}$. The resulting waveforms are used to control the switches as follows:

In leg A: (1.2a)

$V_{ref} > V_{tri}$ *: GS1 on* and

$V_{ref} < V_{tri}$ *: GS4on*

and

In leg B: (1.2b)

$-V_{ref} > V_{tri}$ *: GS3 on* and

$-V_{ref} < V_{tri}$ *: GS2 on*

The PWM signals obtained are shown in Figs. 1-2a and 1-2b. Note that GS4 and GS2 will be automatically created as the inversion of GS1 and GS3, respectively.