

Three-phase Inverter Using Microcontroller for Speed Control Application on Induction motor

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Abstract - This paper presents a PWM-controlled three-phase inverter designed for controlling the speed of a three phase induction motor. Inverter has very important role as a power conditioning on the electric power system and industrial field. The speed of the induction motor can be controlled by changing the voltage frequency input of the induction motor. The three phase inverter is implemented by using a Power MOSFET and the PWM signal is generated by a Microcontroller. The inverter performance is measured by simulation and experimental test. Inverter circuit is simulated using PSpice software to investigate the inverter behavior and performance. The testing is conducted using two induction motors with different rpm specification. The testing result shows that the Microcontroller can control well the motor speed in no-load mode with various speed references.

I. INTRODUCTION

Induction motor is the most widely electrical machine used in industry, due to its simple construction, sturdy, cheap, and easy maintenance. The induction motor have shifted the use of DC motor in the industry. However, induction motor has several parameters that are non-linear, especially the rotor resistance which varies for different operating conditions. It causes speed control on induction motor is more difficult in comparison with speed control on DC machine.

Common application of induction machine is for constant speed rotation by direct connection to the grid, rotor speed is determined by the grid system frequency. For variable speed application of induction motor, power conditioning device is required [1].

Speed control of an induction machine can be made by any change of pole number or input voltage frequency of induction motor. However, changing of its pole number is unfractical. Changing of input voltage frequency is realized by using a power conditioning or inverter. The use of inveter is a simple and easy way for controlling speed of induction motor and it has been broadly used on industry application [2],[3].

Inverter converts DC voltage into AC voltage where magnitude and frequency voltage can be varied as required. AC voltage generated is a square waveform or trapesoid. The application of filter device is required to produce pure sinusoidal waveform.

Voltage output regulation of inverter can be done in two ways. First, by adjusting the DC input voltage but the switching frequency is constant. Second, by adjusting the switching frequency while the DC input voltage is constant. In the second methode, the effective AC voltage generated is a function of the pulse width of the switching. How is called Pulse Width Modulation (PWM). [3]

II. THREE-PHASE INVERTER CIRCUIT

The basic circuit of three-phase inverter is presented in Figure 1. It has two capacitors to generate N points for each capacitor voltage $V_i / 2$ remains constant. There are three sides of the switch, namely: switch S1 and S1 + S2 + and S2- as well. Both sides of the switch, the switch S1 and S4, S3 and S4, and S5 and S2. Each switch, S1 and S4, or S3 and S4, or S5 and S2, can not operate simultaneously, because there will be short circuit. ON and OFF from both sides of the switch is determined by the PWM modulation technique [4],[5].

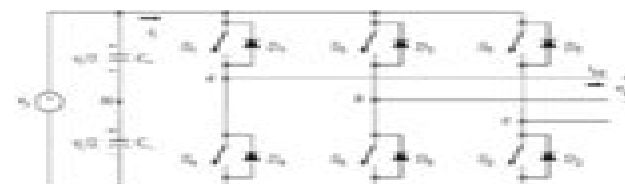


Figure 1. Three fasa Inverter Circuit

To produce the output voltage (V_a) in three phases, eight switching conditions configuration as shown in Table 1 should be applied.

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