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DESIGN OF A THREE-PHASE INVERTER TO CONTROL THE SPEED OF AN ENGINE

Engineering

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ABSTRACT

The prototype refers to the design and construction of a speed regulator for use in high power applications such as industrial-based induction motors, the prototype's goal is to control engine speed for certain applications in the industry, for example, in the transport of material. This consists of a voltage rectifier source, which interconnects with the microcontroller card, to prevent poor power quality from damaging the system. The design is based on existing electronic technology, to build an electrical circuit that is capable of increasing or decreasing the speed of a 2-4 hp three-phase motor, depending on the required application. This project was designed and programmed with Proteus 8 and Pickit 2 programmer software's. This circuit is controlled by the PIC16F877A board and my controller, which has a digital programming according to the microcontroller, it also employs mountable microcontrollers PS2501-4, IR2112, MC33202 to synchronize in optimal conditions the power-stage components.

KEYWORDS

Speed, Prototype, Energy, Programming, Power.

INTRODUCTION

Electric motors have become an important part of human life. The simple fact of converting electrical energy into mechanical energy brings with it tons of applications and facilities. from things as everyday as opening the electric gate, to moving the bands in an industrial production plant. The handling and control of the various types of engines has allowed industries to improve and optimize their processes. For these reasons and more, this project aims to design and implement a control system that allows the handling of the speed of an AC motor. Such control shall be carried out using power electronics, by programming. For this purpose, the characteristics of the operation of a DC motor shall be investigated.

Motors are widely used in modern industry, especially electric motors, due to their good performance characteristics and low pollution (aspect that is taken into account today). In addition, these motors often work at variable speeds for maximum productivity at all times, as well as significant energy savings.

Regulators allow very fast responses to system changes, increasing system accuracy. Some systems do not need such speed as for example the engine that causes a conveyor belt to move, because depending on speed the conveyor will move faster or slower.

OPERATION: PROTOTYPE

The power control of the motor uses a single-phase supply which rectifies the voltage, to provide the AC power that powers the motor in full waves. The source can be single-phase, biphasic or three-phase depending on the necessary electrical network, the inverter will take this energy to transform it into three-phase by pulse width modulation (PWM) in this case powered the three-phase motor with a single-phase source which is built by: a 27 amp diode bridge, 30 amp fuse holder, capacitor from 250 volts to 820.0 uf.

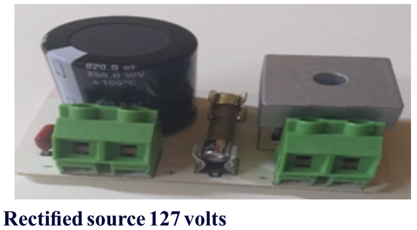

Figure 1: Rectified source 127 volts
Sources: Own/ Mauricio Gustavo Espejel Pascual

The following material was used for the manufacture of the prototype:

TABLE 1 COMPONENTS USED.

Material	
1/4W Resistors	Integrated Circuits
5W Resistors	PIC16F877A
Logarithmic potentiometers	PS2501-4
DIP-type bases	IR2112
Diodes	MC33202
Connectors	copper vaquela
Lentil capacitors	IGBTs Transistors
Electrolytic capacitors	xtal 20 MHz
micro suiches	Leds
Material used in different capacities of the two power stages	

Sources: Own/ Mauricio Gustavo Espejel Pascual

For the design and construction of the electronic components the softwares were used: Traxmaker was used to design the PCB, CircuitMaker is used to make the tracks for the electrical connections of the cards and Proteus 8 professional to perform simulations of integrated circuits and electronic components.

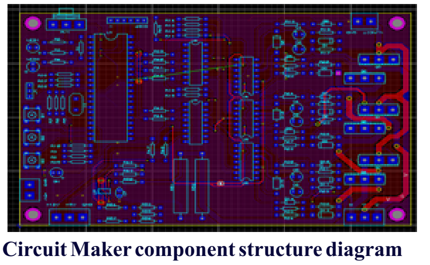

Figure 2: Circuit Maker component structure diagram
Sources: Own/ Mauricio Gustavo Espejel Pascual

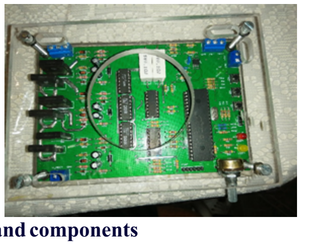

Figure 3: Card and components
Sources: Own/ Mauricio Gustavo Espejel Pascual

INITIAL DESCRIPTION:

1. The card contains two stages:

A digital one of +5Vdc and +12Vdc. Integrated circuits are sensitive to static discharge and can damage people or static laden surfaces, caution is recommended.

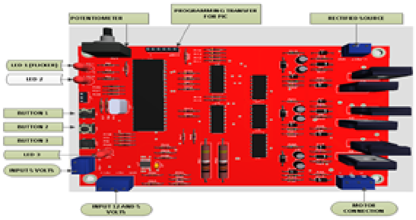

Figure 4: characteristics de la PCB
Sources: Own/ Mauricio Gustavo Espejel Pascual

2. One of power that energizes the engine. This stage handles hazardous currents and voltages, caution is recommended.

Each stage requires their respective power supplies. The drive is designed to handle 1hp or fraction three-phase motors.

OBSERVATIONS:

A. The card, components and/or paths should not be tampered while they are in operation (just press the buttons).
B. Because integrated circuits and insulated door bipolar transistors (IGBTs) are sensitive to electrostatic discharge, they should not be touched, the card should not be placed on surfaces that generate static load. It should also prevent static load from being generated on the card by friction of the card against other surfaces.
C. OPERATION: The motor must be set to star.
D. POT MODE: It is the one that allows you to control the engine speed from the potentiometer.
E. Energize the power stage (rectified source)
F. Power the digital part of the card, supplying +12Vdc and +5Vdc.El led indicating that you are waiting for your approval to begin.
G. Button 2 is pressed. The LED then turns off, the card reads the potentiometer and calculates the frequency at which it will energize the three-phase motor to rotate it.
H. Turning the potentiometer causes the programmable integrated circuit (PIC) to decide to increase or decrease the frequency that powers the motor.
I. To reverse rotation, press button 3. At that point the PIC stops powering the engine and waits for the engine to stop (by default about seven seconds), to re-energize the engine, but exchanging one of its phases, which causes the engine to return to the speed at which it was spinning, but this time in the other way.
J. To stop the engine turn off the rectified source first and then the digital source (+12Vdc and +5Vdc)

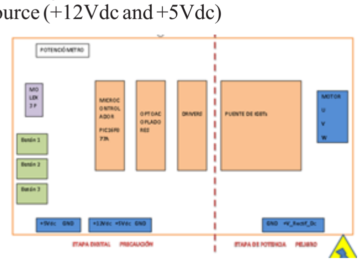

Figure 5: Diagram of each power stage
Sources: Own/ Mauricio Gustavo Espejel Pascual

The programming interface for the microcontroller works with binary code to synchronize the frequency of the engine with the drivers, the executable file to program the PIC16F877A uses the programmer: PicKit2 loads the file by pressing on the option of program the PIC.

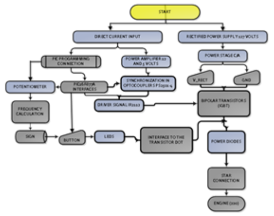

Figure 6: Prototype diagram.
Sources: Own/ Mauricio Gustavo Espejel Pascual

CONCLUSIONS

The realized project allowed to understand its composition, structure and operation, in its two power stages to carry out the variation of frequency and speed. It was determined to be the most effective method to control the speed of an electric motor. The operation of the unit was carried out through its use, operating the different types of control that its programming has, the different ways to start the unit is the way to program the PIC16F877A microcontroller to store the data and commands that are interconnected to the IR2112 controllers to synchronize IGBT and all necessary components for proper operation, using PICkit_2_v2.55.02 incorporating in the binary control code such as the PIC and a slave, in this case the potentiometer. To create this electronic prototype we have seen the different prototypes and brands that are similar but electronic components are difficult to find and replace in electronic circuits.

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