ISSN No: - 2456 – 2165

Variable Voltage – Variable Frequency Controller (VVVF) - An FPGA Approach

Dr. N.Ashokkumar
AP/III/SCSVMV UNIVERSITY,
EEE DEPARTMENT, Kanchipuram.
nr.ashokk@gmail.com

***Abstract*— Variable- voltage and variable- frequency controllers are gaining more significance in the present industrial applications. These controllers are widely appreciated for its flexibility. This paper attempts to present the design for the above controller using pulse width modulation technique and FPGA (Field programmable gate arrays). To maintain maximum torque for a given working condition, the flux in the machine must be maintained constant. In other words, the ratio of Voltage to frequency must be held constant. The fundamental component of the inverter output has to be checked. To vary the fundamental component of the inverter, the Modulation Index of the carrier signal has to be changed. The application part of it is wide.**

***Keywords*— *FPGA; Modulation Index; VVVF*.**

I. INTRODUCTION

Pulse width modulation is a potential technique to control many devices in electrical engineering. The main drawback of this technique is that the wave forms are not perfect. For this reason the controllers are affected. Also, there is power loss and harmonic disturbance. FPGA based controllers are widely used in many control applications particularly closed loop type. [1, 2, 3] Here for a three phase induction motor a control algorithm is evolved. This is mainly based on space vector pulse width modulation techniques.

II. METHODOLOGY ADAPTED

1) Configure the timers and compare units to generate PWM outputs.
2) Input the desired speed, and it is used as the set speed.
3) The motor speed is measured and is used as feedback.
4) Command frequency is obtained with a speed controller.
5) The magnitude of reference voltage vector Vout is obtained based on V/Hz profile.
6) The phase of Vout based on command frequency is determined.
7) The sector of Vout is determined.
8) Vout is decomposed to obtain T1, T2 and T0.
9) The switching pattern or sequence to be used is determined and the calculated compare values are loaded into the corresponding compare registers.

The above procedure requires a digital signal processor having all the needed timers and compare units with associated PWM outputs. The controller dsPIC30F4011 is fulfilling all the above requirements hence it is used in this implementation.

III. FPGA AND ITS FLEXIBILITY

A Field-Programmable Gate Array (FPGA) is an integrated circuit that can be configured by the user to emulate any digital circuit as long as there are enough resources. An FPGA can be seen as an array of Configurable Logic Blocks (CLBs) connected through programmable interconnect (Switch Boxes).

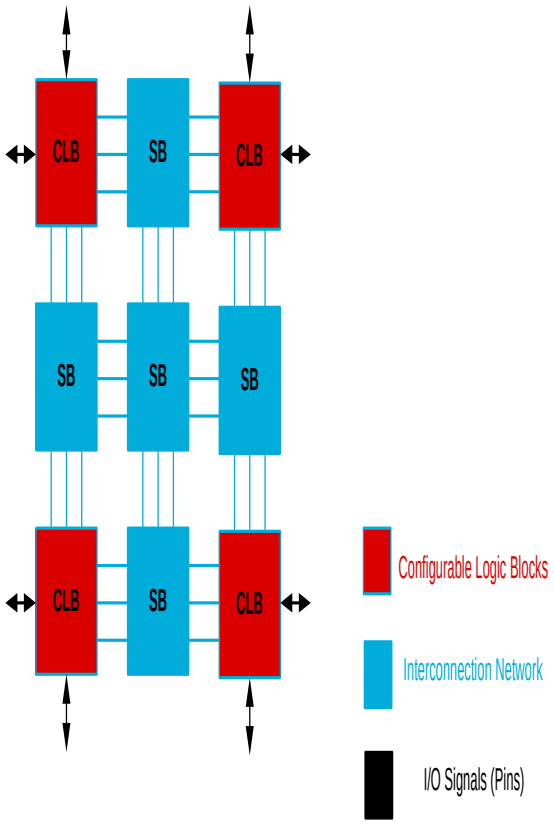

Fig: 1 Basic FPGA structure.

IV. INTER CONNECTION NETWORK

The following diagram represents the interconnection between networks this is refined to improve the control process.

ISSN No: - 2456 – 2165

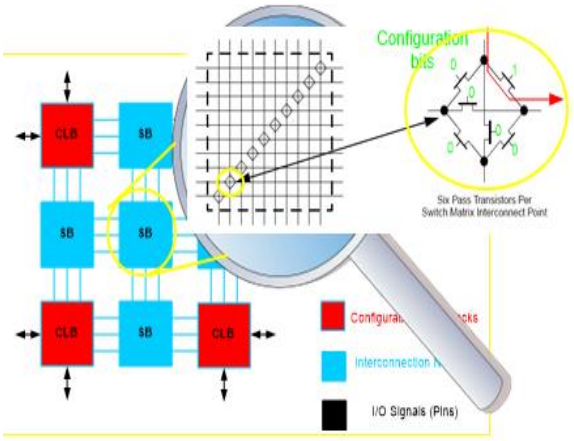

Fig: 2. FPGA Network structure.

The Unique features of FPGA are certain FPGA has combined analog and digital functions. Comparators play a very useful role in FPGA functionality.

Certain FPGA have ADC AND DAC arrangements. (FPAA), which, transfers, analog values on its inner programmable interconnect fabric.

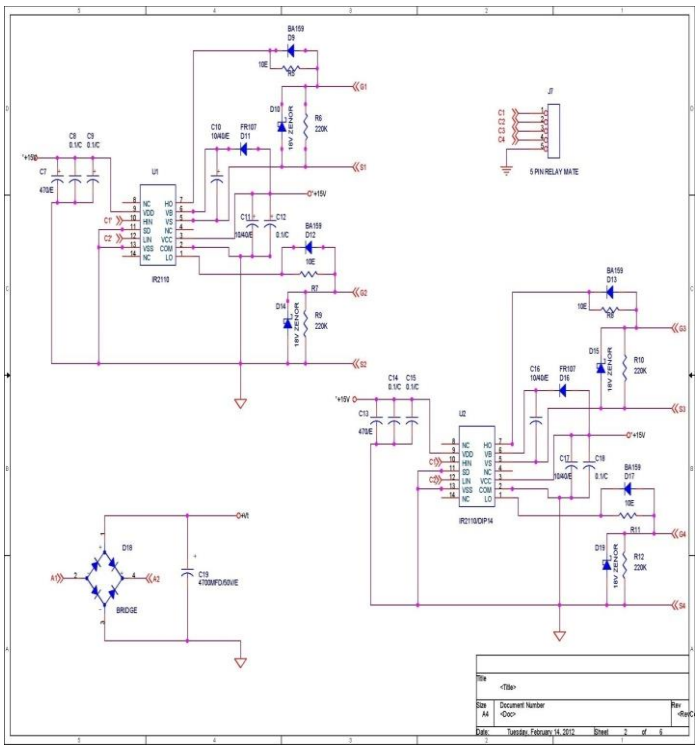

Fig: 3. Driver circuit: The following is the driver circuit

The above driver circuit is fine tuned and is used in motor control. This paper explores some basics of it.

V. CONCLUSION

Motor and its control play a dominant part in today's industrial world. Also, Xilinx motor control also plays a vital part. [4, 5] Software's like Micro blaze, Cortex A9 also dominates the FPGA programming world. This paper explores fundamental part of FPGA and its control application as induction motor. Much controllability has to be improved in Driver circuits to enhance the control applications.

REFERENCES

[1] Hogan, N.: Impedance control: an approach to manipulation: theory (part 1); implementation (part 2); applications (part 3). J. Dyn. Syst. Meas. Control **107**, 1–24 (1985)

[2] Alternative topology for three-phase four-wire PWM converters applied to a shunt active power filter P. Rodriguez; R. Pindado; J. Bergas.

[3] O. A. Mohammed, Fellow IEEE, S. Liu, Member IEEE, and Z. Liu,"A Phase Variable PM Machine Model for Integrated Motor Drive Systems", 35th Annual IEEE Power Electronics Specialists Conference, Aachen, Germany, 2004, pp. 4825-4831.

[4] C. Dufour, S. Abourida, J. Bélanger, V. Lapointe, "InfiniBand-Based Real-Time Simulation of HVDC, STATCOM, and SVC Devices with Commercial-Off-The-Shelf PCs and FPGAs", 32nd Annual Conference of the IEEE Industrial Electronics Society (IECON-06), Paris, France, November 7-10, 2006 .

[5] Analog Devices AD2S90 rev.D specs sheet "AD2S90: Low Cost, Complete 12-Bit Resolver-to-Digital converter".