VVVF POWER SOURCE USING SPWM

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ABSTRACT

VVVF power source means variable voltage variable frequency power source. Now days the development of variable VVVF power source, is the demand for various applications. Thus the low cost variable voltage variable frequency power source is designing using PIC micro-controller. The configuration of ac to dc converter and dc to ac inverter is called a dc-link converter. VVVF power source is developed using MOSFET H-bridge means full bridge inverter. Here design methodology proposed to utilize a different concept of generating pulse width modulation signals for the driver circuit of the inverter. The PWM which is used in this system is sinusoidal pulse width modulation (SPWM). The system proposes to incorporate the look-up table (LUT) which will be store in the system for the sinusoidal signal generation with more stability. The proposed system uses two micro-controllers; first micro-controller used for variable voltage & other micro-controller is used to generate the proposed variable frequency sine wave PWM & displaying purposes. The proposed system provides wide range of voltage and frequency commands and their performances at low cost.

Keywords*- *Variable Voltage, Variable Frequency, Sinusoidal Pulse Width Modulation, PIC Microcontroller, MOSFET H Bridge Inverter, Display.

I.INTRODUCTION

Now days dedicated types of power sources are required according to specific demands. Such requirements are specified in form of generation of ac sources having different types of waveform shapes or variable voltages, variable frequency of single phase or three phase power sources. So different type of power sources are designed using different control strategy with the help of different controllers. The configuration of ac to dc converter and dc to ac inverter is called a dc-link converter. The PWM is required for the inverter. The PWM patterns have been achieved for different switching and fundamental frequencies. The SPWM developed in a single FPGA. The simulations are carried out using ModelSim 5.7. [1]. Again the new method is introduced to obtain various possible output voltages depending on the switching topology and the voltage inputs available. This method is used to obtain a sinusoidal voltage waveform with a frequency which is a multiple of the frequency of the sinusoidal input voltage.[2].The high precision three-phase SPWM designed which is based on DSP chip, by using comparison units on event manager. This system provides high quality and reliability of SPWM waveform, and output waveform of the variable frequency [3]. Using Direct Modulation Strategy the SPWM switching are done with the help of VHDL code. In direct modulation scheme PWM pulses are generated directly and thus require less memory space as compared to conventional sine-triangular scheme. The periodic PWM signals are generated, separated by positive and negative group of polarity control switching pulse and evoked at the output as a control signal for FPGA interfaced H bridge inverter circuit. But the direct PWM technique scheme doesn't using high frequency signal [4][5].

The generation of high quality variable frequency sinusoidal waveforms is designed with unique technique. Arithmetic operations on the bit streams are performed through digital blocks. The proposed technique is simple and can be implemented on the field programmable gate array (FPGA)[6]. Instead of this if PIC controllers are used then cost will be reduce. So I am trying to design the low cost, stable & reliable power source at desired voltage & desired frequency.

II.SYSTEM DESCRIPTION

The block diagram describes the development of a microcontroller-based single phase Variable Voltage Variable Frequency (VVVF) sinusoidal power source. The proposed scheme uses the new different concept of generating PWM signals, called sinusoidal pulse width modulation (SPWM) signals. In SPWM technique, sine wave is compare with triangular wave, the frequency of triangular wave describes number of pulses in output for each half cycle. The width of PWM is varied with respect to amplitude of sine wave means the pulse width is made sinusoidal function of angular position of pulse in the cycle. In this system SPWM is generated with the help of look-up table (LUT). The system uses two microcontrollers where one micro-controller is used to generate the proposed variable voltage and the other micro-controller is used for controlling the frequency & LCD display. The variable voltage & variable frequency are display on the LCD.

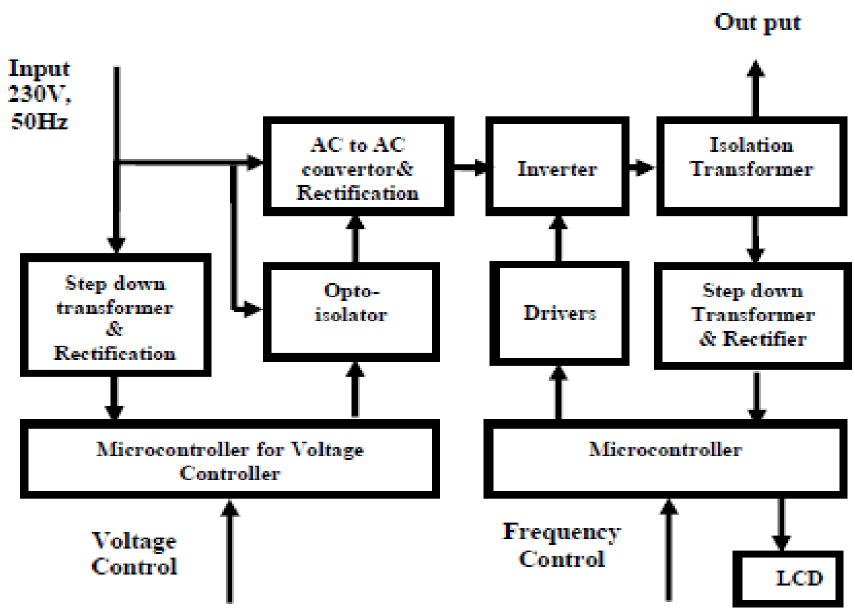


Fig.1 Block Diagram of Proposed System

AC voltage having 230V, 50Hz from the mains is applied to the step down transformer then it rectified. The resistive pot is connected to the PIC controller. With the help of pot the voltage is varied. The controlled signal is used for convergence of AC to controlled AC through opto-isolator. The controlled AC is applied to the full bridge rectifier; rectifier converts this AC into DC. This DC voltage is as an input voltage for an inverter. The full bridge inverter is constructed with the four N channel enhancement MOSFETs. The second PIC controller is used for the generation of SPWM & the pot is connected to this controller. The frequency can be varied with respect to this pot. The SPWM pulses are required for firing the MOSFETs. The inverter is used to convert this DC voltage in to AC again. After that bulb is used as the load to the circuit. The output ac voltage is again step down and rectified. And it gives to PIC controller for displaying purpose. The output voltage and frequency will be display on LCD display.

III.DESIGN OF THE HARDWARE

The hardware is design with the help of PIC controller, TRIAC, BridgeKBPC3510, MOSFETs, MOSFET Drivers, and MOSFETs.

3.1 PIC controller

In this system I am using 16F877A. It is 40 pins high performance RISC CPU. It operate on 2.0V to 5.5V rang. It provides inbuilt 10 bit ADC with 8 channels. It has 256 B Data ROM. It has up to 18 sources interrupt capability & three timers.

3.2 TRIAC

These are three terminal devices. BTA41 is a TRIAC having 800V peak off-state voltage& 41A on-state rms current. With the help of TRIAC we can control the AC.

3.3 MOSFETs

MOSFETs are required for single phase full bridge inverter. IRFP460 is the MOSFET which is used in this system. For the fast switching purpose IRFP460 is used. Its Drain-Source voltage is 500V and continuous drain current is 20A. MOSFET drivers are required for the IRFP460.

3.4 MOSFET Drivers

IR2110 is used in the present system. MOSFET Drivers are required to drive an N-channel power MOSFET in the high-side configuration which operates up to 500 V. Its Gate drive supply range is 10 to 20V.This can drive independently high and low-side referenced output channels.

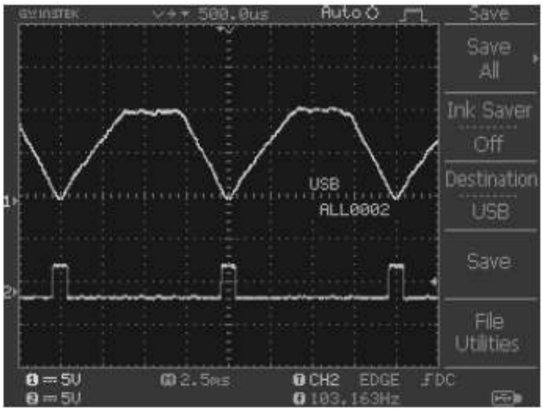
IV.DEVELOPMENT OF THE SOFTWARE

In this system author using two microcontrollers. First for variable voltage and second for generation of SPWM. The first controller controls the firing angle of triac. The pot is provided for varying the firing angle. When pot varies that time ADC convert the analog data and according to that firing angle is provided to triac. And using this technique we are converted the AC in to controlled AC signal.

The second controller controls the operation of an inverter. The PWM is the heart of an inverter. In this system SPWM signal is generated which will provide to the MOSFETs. For this purpose look-up table will generate and store in the system. Total 80 steps are generated for each half cycle. For variable frequency purpose pot is connected. According to pot position frequency will change and values will be call from look up table. The output voltage and frequency will display on the LCD.

V.EXPERIMENTAL RESULTS

The center tap rectifier is used in this system. The signal after rectification is shown in fig. 2(a). And fig. 2(b) shoes zero crossing signal. Whenever the signal of rectifier crosses the zero that time we get the pulses as shown in fig 2(b).



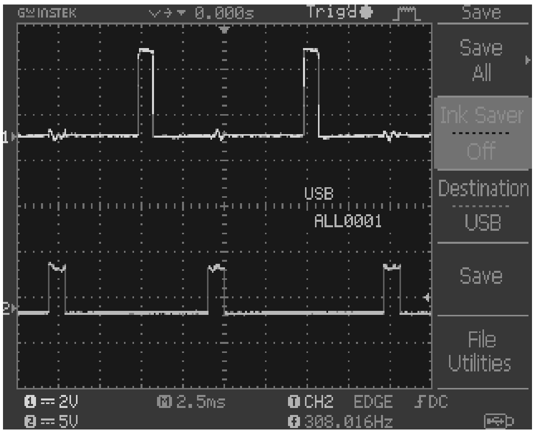
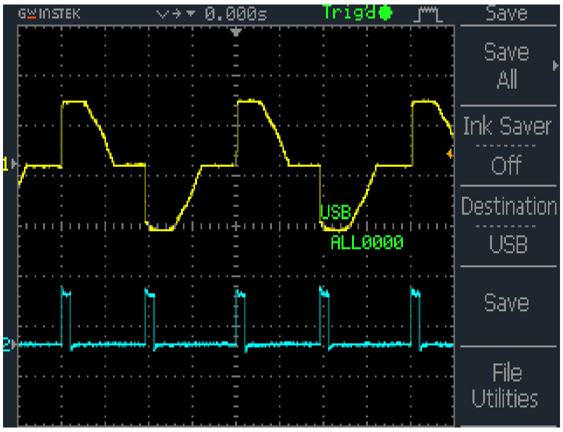


Fig.2(a) Rectified signal and 2(b)Zero crossing signal **Fig.3(a) Zero crossing signal and 3(b) Triac firing signal**

The zero crossing signals are shown in figure 3(a). The difference between two zero crossing pulses is 10ms. The triac firing pulses are generated with the help of PIC controller. When the pot will vary that time firing angle of triac will change. The firing pulses for triac with respect to zero crossing are shown in Fig.3 (b). Here triac is fire at 4ms. Fig. 4 shows the controlled AC signal with respect to controlled pulses from controller.



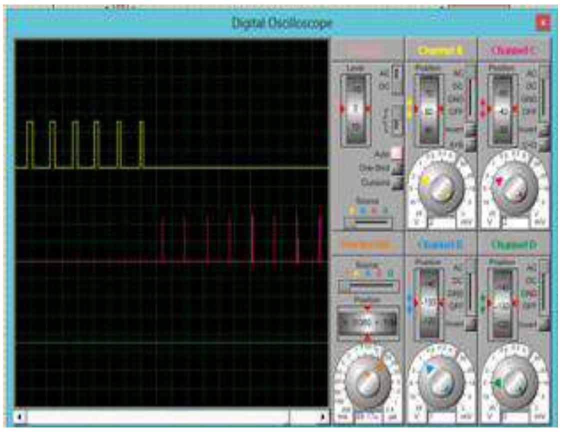


Fig.4(a)controlled AC output and 4(b) zero crossing pulse **Fig. 5 SPWM pulses**

The second controller is used to generate the SPWM. The 80 step size per half cycle is selected for more accuracy. Fig.5 shows the SPWM pulses which are generated by CCP modules. Fig. 6 and 7 shoes the output of the system. The firing angle of triac is changes according to that the intensity of bulb which is connected to the output side is change. Fig. 6 shows the high intensity of bulb and that time the output voltage is 61V. Fig. 7 shows the low intensity of bulb at 41V. The final output is step down and sense by the controller.

Fig. 8 show output waveform having 40Hz frequency and fig.9 show the 51 Hz's waveform. Fig.10 shows the output voltage and frequency of the system on display.

Fig .6 the output voltage at intensity of bulb is high

Fig 7 the output voltage at intensity of bulb is low

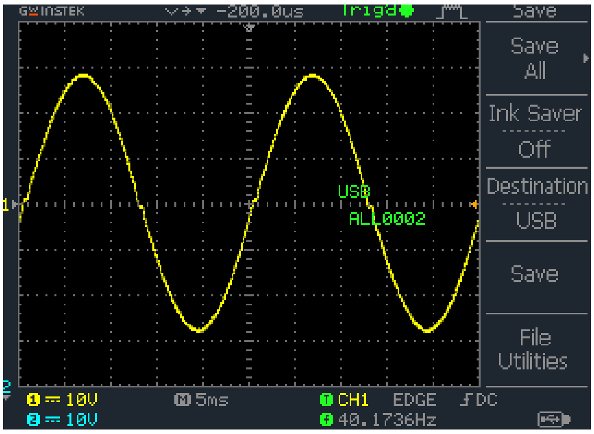


Fig 8 output sine wave at 40 Hz

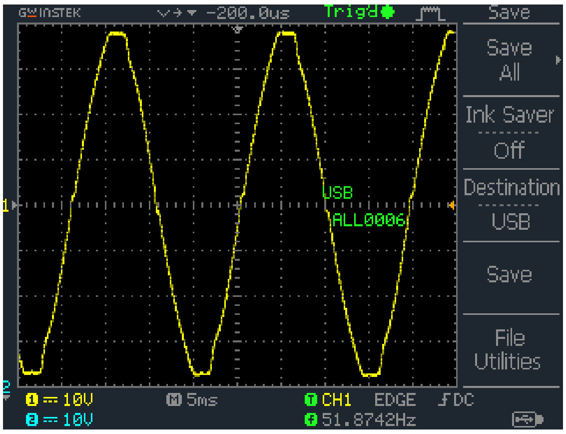


Fig 9 output sine wave at 51Hz

Fig 10LCD display

VI. CONCLUSION

In this work the VVVF power source is design using microcontroller at low cost. The configuration of ac to dc converter and dc to ac inverter is called a dc-link converter. This system is also the DC-link. As compare to DSP controller the cost of PIC controller is less. This system will provide more stable, reliable output because of the SPWM technique. This system provides wide range of voltage and frequency as per the requirement.

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