A STUDY OF SINGLE PHASE TO SINGLE PHASE CYCLOCONVERTER, CONTROL USING PIC 16F84A

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Abstract—**This project presents the study of single phase to single phase cycloconverter. The converter is used to produce an AC output voltage at reduced frequency from a 50Hz single phase main supply. Simulation of cycloconverter will be done on PSIM and the results were then verified experimentally.**

Keywords—single phase to single phase cycloconvert , control, PIC16F84A

I. INTRODUCTION

The cycloconverter is a direct frequency changer that converts ac power at one frequency to ac power at another frequency by ac-to-ac conversion without an intermediate dc link converter [2]. This cycloconverter has two converters which are positive and negative converters that mean there are four thyristors for each converter [3]. A major control problem of the cycloconverter is how to swap between converters in the shortest possible time to avoid distortion while ensuring the two converters do not conduct at the same time. It is important to keep the non conducting thyristors off at all times, otherwise the mains could be shorted through the two thyristors, resulting in waveform distortion and possible device failure from the shorting current [3]. If the problem can be avoided, the smooth waveforms will be obtained at the output load. The operation of single phase cycloconverter circuit practically should be done to produce low frequency as in the simulation program result. The simulation and experimental are both expected as comparison.

II. METHODOLOGY

This study is involved the operation principles of the single phase to single phase cycloconverter. The principle of the cycloconverter can be demonstrated by using simplest possible single phase input to single phase output with a pure resistance as load [3].

A. Basic Operation

The figure 1 below shows the connection of single phase to single phase cycloconverter. The cycloconverter has four thyristors divided into positive and negative converters. When positive converter is operated, the negative converter keep off until half of T, 0.05 seconds, as a result the average output for positive voltage is obtained and while negative converter is operated, the positive converter keep off until next half of T, 0.05 seconds, as a result the average output for positive voltage is obtained and completed 0.1 seconds for 10Hz [2]. During the positive half cycle of the output, firing pulses are given to the positive converter. During the negative half cycle of the output, firing pulses are given to the negative converter. [4] There is also connection single phase cycloconverter in the PSIM simulation as shown below in figure 2

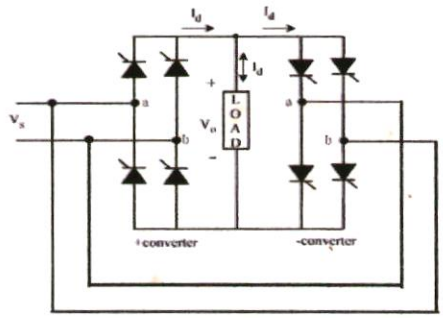

Figure 1: Single phase to single phase cycloconverter connection

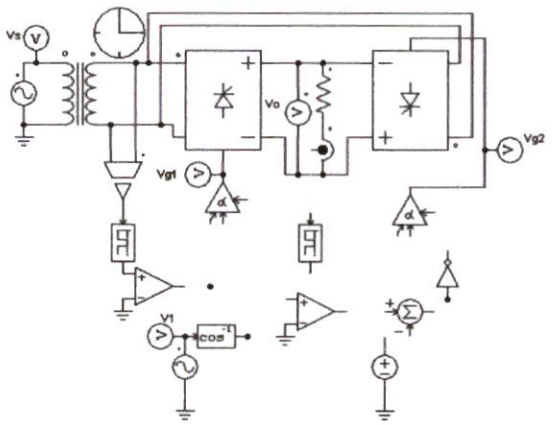

Figure 2 : Single phase to single phase cycloconverter connection in PSIM

B. Programming Flowchart

Figure 3 below shows the flowchart of the PIC programming. The delay program is used to give the pulses to the gate current of the thyristors. Supplying current to the gate will turn on each of the thyristor.

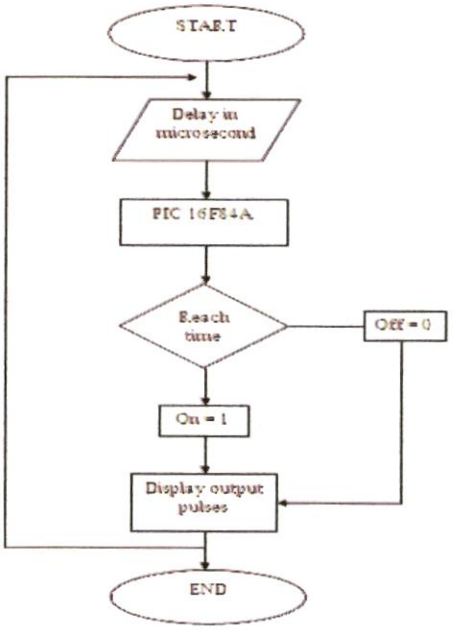

Figure 3; Flowchart of programming

C. Circuit Connection

Figure 4 show the connection of driver and gate current. The gate current is connected to the optocoupler as the driver for the thyristor. Then the input of optocoupler is connected to the output ports of PIC. There are eight optocouplers are used to connect to the gate current.

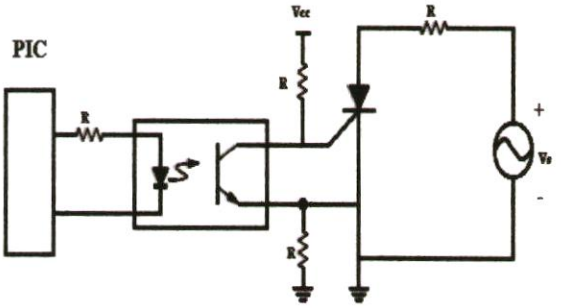

Figure 4; Driver circuit for gate current

III. RESULT AND DISCUSSION

The result can be obtained by simulation program and experimental. Figure 5 shows the simulation result and the output waveform is 10Hz frequency with phase angle 90 degree. It takes 0.1 seconds to complete one cycle that means, the frequency is equal to 10Hz by applying equation F = 1/T. Figure 6 shows the experimental result for the output voltage waveform. Figure 7 and 8 show the positive and converters. The oscilloscope is set to 10ms/Div means that to trace X axis it spends 0.1 seconds which 10ms multiplied by 10 divisions is equal 100ms.

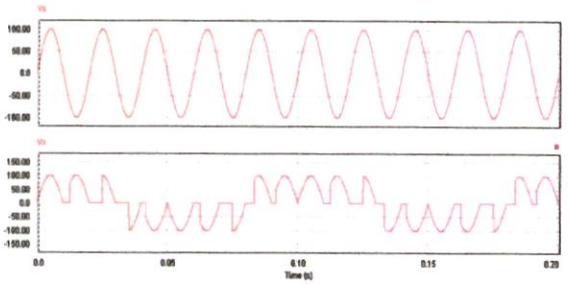

Figure 5: Output voltage waveform in simulation

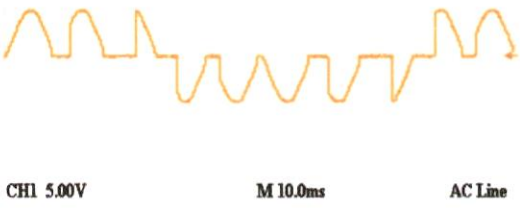

Figure 6: Output waveform in experimental

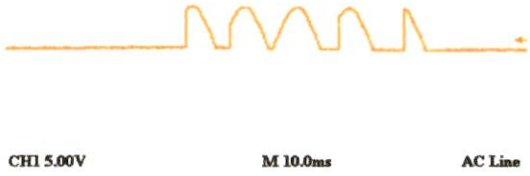

Figure 7: Output waveform for positive converter

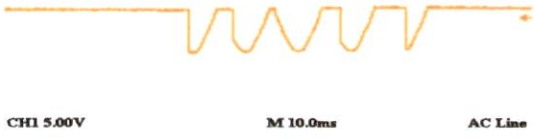

Figure 8: Output waveform for negative converter

Figure 9 shows the simulation result and the output waveform is 25Hz frequency with phase angle 90 degree. It takes 0.04 seconds to complete one cycle that means, the frequency is equal to 25Hz by applying equation F = 1/T. Figure 10 shows the experimental result for the output voltage waveform. Figure 11 and 12 show the positive and negative output voltage waveforms for both converters. The oscilloscope is set to 10ms/Div means that to trace X axis it spends 0.04 seconds which 10ms multiplied by 4 divisions is equal 40ms.

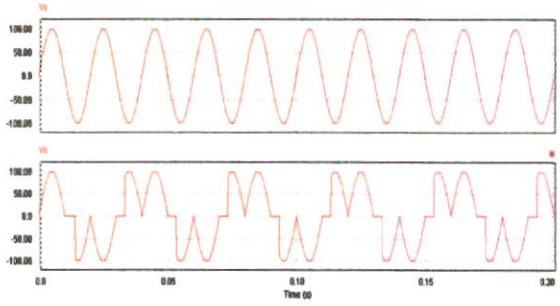

Figure 9: Output voltage waveform in simulation

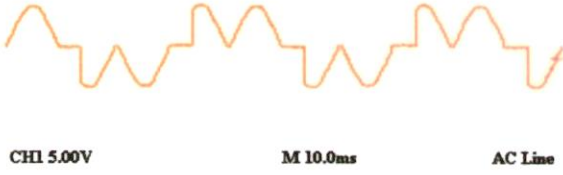

Figure 10: Output waveform in experimental

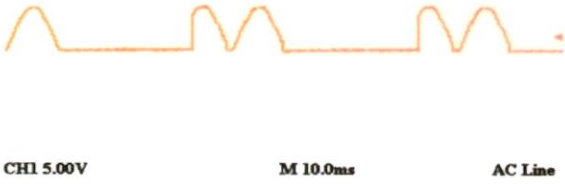

Figure 11: Output waveform for positive converter

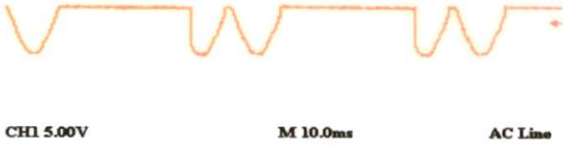

Figure 12: Output waveform for negative converter

IV. CONCLUSION

As conclusion, the single phase to single phase study has been achieved in order to get the similarity output waveforms between theory and practical of cycloconverter. The principle and operation of cycloconverter was explained which that a low frequency supply can be directly obtained from a higher frequency source by suitable switching of the cycloconverter elements. If the input is 50Hz and the output frequency is around 10Hz or 25Hz, the result being that the cycloconverter application is limited to low frequency of the load.

V. RECOMMENDATION

The objectives of this project have been achieved but in the future development and research should be done. This project can be continued by using three phase to three phase cycloconverter to obtain smooth output waveform waveform of the load in the future with understanding single phase cycloconverter first. Besides, the application of the cycloconverter can be implemented to control speed of the induction motor

VI. REFERENCE

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