Open Loop and Closed Loop Comparision For Single Phase Cyclo Converter (PID Controller)

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ABSTRACT: ***This paper compares the open loop and closed loop system for a single phase Cyclo converter. This paper compares the characteristics like mechanical, speed and torque characteristics of the open loop and closed loop system. In this paper PWM technique is employed along with cyclo converter using IGBT which increases the performance and control of the system. Special advantage of using IGBT in this topology to increases the dynamic characteristics and reduces the total harmonic distortion. The filters are used to reduce the primary harmonics of the system and the secondary or the higher level harmonics.The output for open loop and closed loop was carried out by using MATLAB Simulink .This appear proves the dramatic changes in cycloconverter when comparing with open loop and closed loop using PID controller.***

Keywords: Cyclo converter, Pulse Width Modulation, IGBT, PID controller.

I. INTRODUCTION

A. CYCLOCONVERTER

Now a day's power requirement in industries is high and depending upon the applications required. In some types of system works both AC and DC is necessary. In this place the work of a converter is necessary. At olden days it was difficult to convert AC to AC because it is necessary to convert AC to DC and then converting the DC to AC[1]-[2]. This is a long process and the circuit is bulkier and costly. Cyclo converters are a special type of converters which directly converts from AC to AC by varying frequency from low to high and vice versa. Cyclo converter are employed in circuit mainly to control the speed for various frequency ranges [6]. In this topology Without the DC link the conversion of AC to AC is carried out thereby the size of the modern cyclo converter are reduced drastically.

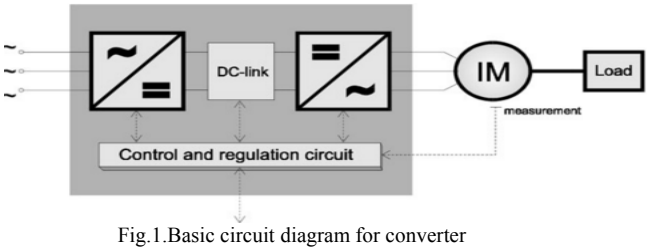

Fig.1.Basic circuit diagram for converter

In the above block diagram, the AC supply is first converted to DC using a rectifier and then converting the DC to AC using an inverter. The rectifier and inverter are controlled using a controller. This circuit is bulkier in construction and more components are used in this circuit which makes the circuit costlier. This paper overcomes by eliminating the DC link.

There are two types of cycloconverters

1. Step-up cycloconverter
2. Step-down cycloconverter

Step- up cyclo converter – The work of step up cyclo converter is to increase the frequency of the input signal and send it in the output terminal. The output frequency will be high compared to the input frequency. The frequency to time relation formulas are i) F=1/T (Hz) ii) F=W/2*pi (Hz)

This step up process is done by decreasing the time period of the input wave form which increases the frequency [3].

Step -down cyclo converter - The work of step down cyclo converter is to decrease the frequency of the input signal and send it to the output terminal. The output frequency will be low compared to the frequency at the input terminal

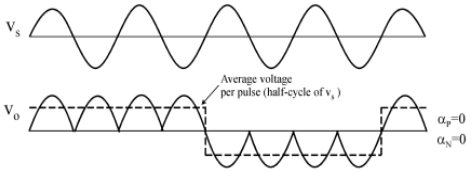

Fig.2.Basic Wave form for step down cycloconverter.

B. CONTROL STRATEGY

Control strategy refers to the set of protocols or instructions used in the system. There are two types of control strategy.

1. Open loop system.
2. Closed loop system.

OPEN LOOP SYSTEM:

Open loop control is the basic control of any system. Open loop systems are very simple in construction but they should be controlled manually. Errors can be corrected easily. The problems faced in an open loop control system is

1. Stability analysis.
2. Unit-step response.
3. Impulse response.

They can overcome in a closed loop system.

CLOSED LOOP SYSTEM:

Closed loop controls systems need a controlled to control the process. They are used in industries now a day to do a sequential process without wasting any time.

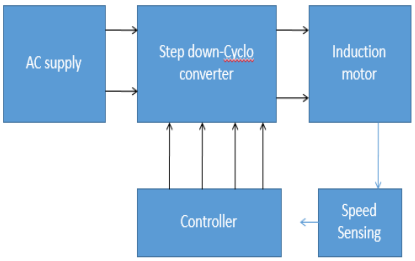

Fig.3. Basic Block Diagram of a Closed loop Cyclo-Converter.

The closed loop system helps getting more accurate calculation in the converter thus the output of the cycloconverter is more accurate and reliable. In the closed loop system for cycloconverter proportional-integral-derivative controller is used because it rejects the external disturbances. It is highly stable in the given set point and command track including rise time and settling time. In a speed control system PID controller is used to control the speed constantly, and if there is any change in the mechanical load of the system, [5] PID controller varies itself to maintain the constant speed.

$U(t)=K_p e(t)+K_i\int_0^t e(\tau)d\tau+K_d(de(t)/dt)$

II. SWITCHING TECHNIQUES

The PWM technique uses a rectangular reference wave to modulate the normal waves. For encoding a message for transmitting PWM techniques are employed. Power control system using low frequency PWM techniques are reliable with semiconductor switches. No power dissipation takes place when the switch is on or off. The power dissipation is comparably low because the on time and off time of the switches is between 100 nano seconds. This technique has an excellent voltage regulation. Using PWM technique the primary harmonics are reduced and then the higher harmonics can be reduced by the filters used in the circuits. SPWM (sine triangle pulse width modulation) technique has an advantage over the PWM technique[4]. They reduced more harmonics than the PWM technique.

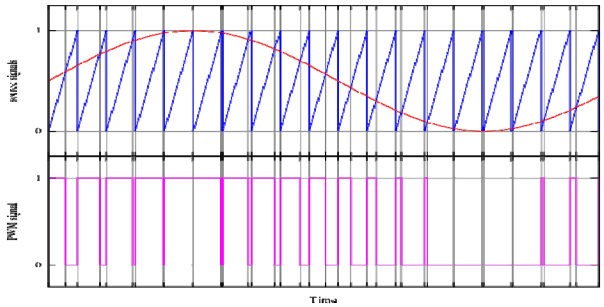

Fig. 4. Basic Wave form of a sinusoidal wave modulated by triangular carrier wave using PWM technique.

III. COMPARISON OF OPEN LOOP AND CLOSED LOOP SYSTEM FOR CYCLOCONVERTER USING MATLAB/simulink:

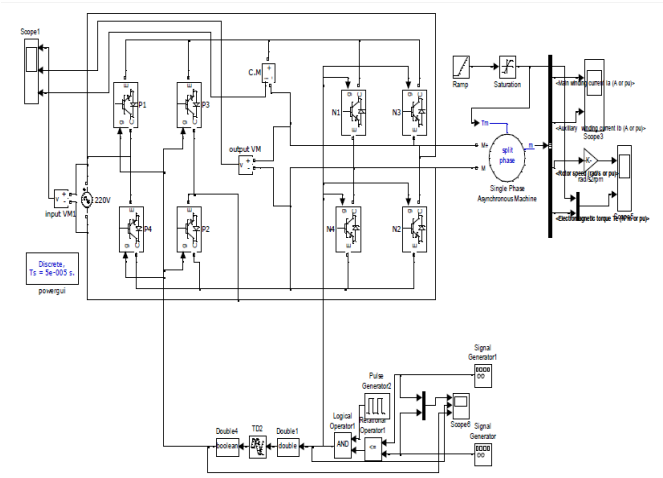

Fig.5. Design of MATLAB/Simulink for closed open loop cyclo-converter.

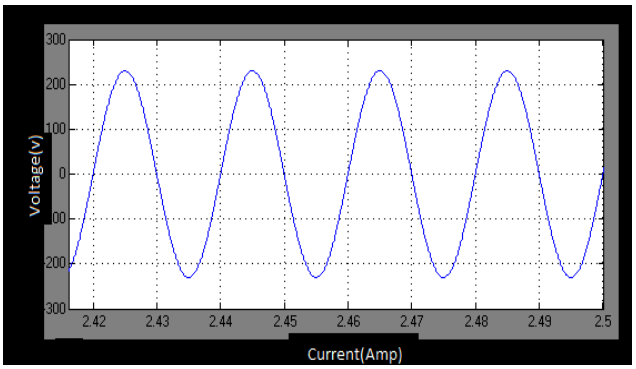

Fig.6. Input wave form for a cyclo-econverter

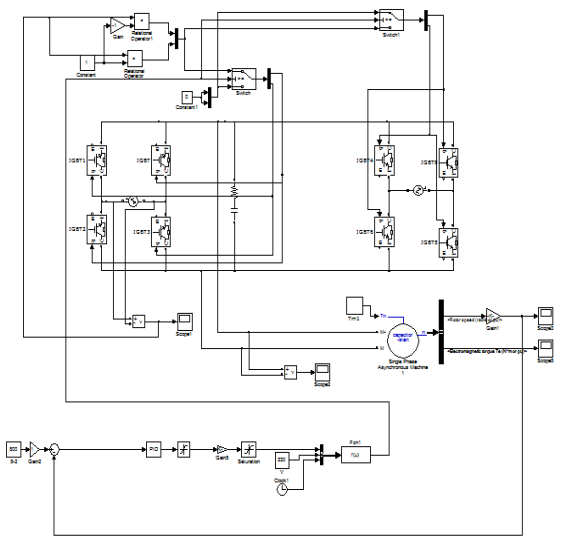

Fig.7. Design of a MATLAB/Simulink for a closed loop cyclo-converter

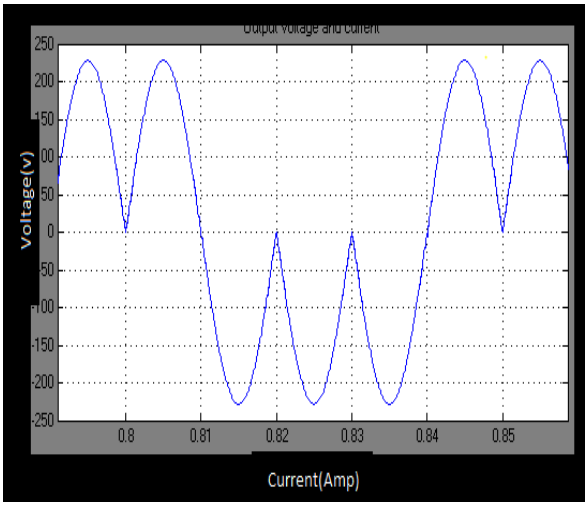

Fig .8. Output wave form for a closed loop cyclo-converter

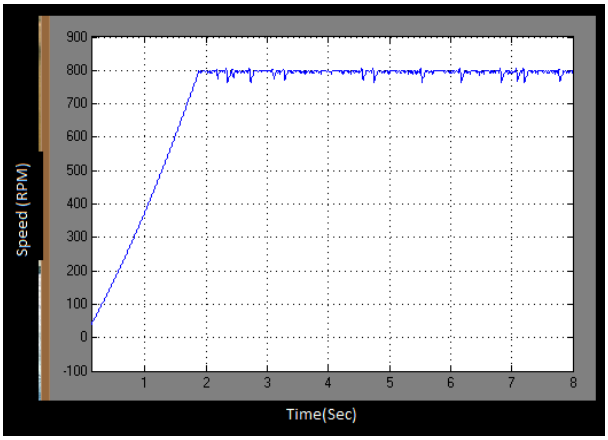

Fig.9. Speed to time relation for a closed loop cyclo-converter.

Table.1.Torque to Speed relation for open loop and closed loop cyclo-converter.

Torque (N-m)	Open Loop System rotor Speed(Rpm)	Closed loop system rotor speed (rpm)
0.1	1400	800
0.5	1370	800
1	1310	800

IV. CONCLUSION

The paper shows the scope for an open loop and closed loop characteristics of a single-phase cyclo-converter. The output wave form of open loop and closed loop systems are compared and studied. This gives a clear idea to design a high efficiency system. The controller used in the closed loop is PID. This paper shows for each variation in source the torque is also varied but even though the rotor speed for open loop and closed loop system (rpm) was controlled and it was shown in the tabulation. For future scope the controller can be varied and for a better efficiency this topology can be used with Neuro –fuzzy controller.

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