CALCULATION OF RIPPLE AND TOTAL HARMONIC DISTORTION IN THREE PHASE SIX PULSE UNCONTROLLED AND CONTROLLED CONVERTER TO ENHANCE THE POWER QUALITY

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ABSTRACT:

In industrial environment, a great part of the consumed electric power is now a day processed by front-end three phase 6-pulse converters. Thyristor line commutated converters have come into common use over recent decades. Six pulse converters have low power factor and introduce excessive harmonic content and hence these requires expensive line filters. This problem rapidly intensifies with the increasing amount of electronic equipment. This paper approaches the calculation of ripple in output voltage, THD in input current and thus power factor by using the simulation results in MATLAB simulink power system block set environment. This paper deals with study and analysis of six pulse uncontrolled and controlled converters in terms of ripple, THD and power factor

KEYWORDS : *Total Harmonic Distortion (THD), three phase ac-dc converter, ripple factor, power factor, thyristor bridge.*

1. INTRODUCTION

This paper analyzes the performance of 6-pulse diode converters and thyristor converters. In six-pulse uncontrolled converters, diode rectifiers are connected either in parallel or in series. Each rectifier is fed by phase shifted secondary windings voltages of a transformer. Increasing the number of rectifiers raises the number of steps in the primary current waveform and produces a sinusoidal shaped supply current flowing into the transformer primary winding. For harmonic mitigation, multi pulse uncontrolled converters are very popular due to the absence of control system for the power diodes, however, control of output voltage is not possible. On the other hand, multi pulse controlled converters require a control circuit for switching of the thyristors.

3. SIX PULSE UNCONTROLLED CONVERTER

For harmonic mitigation multipulse uncontrolled converters are very popular due to the absence of any control system in the power diode, however control of output voltage is not possible. Circuit diagram of 6- pulse diode converter is given in Fig4.4

A CIRCUIT DIAGRAM

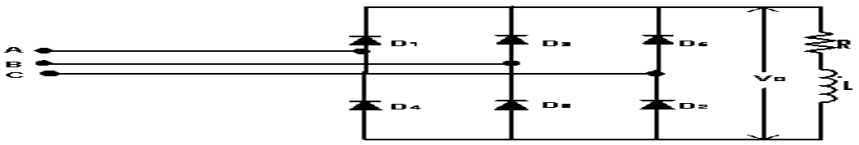


Fig. 1 Three phase six pulse diode converter

B. SIMULATION BLOCK DIAGRAM

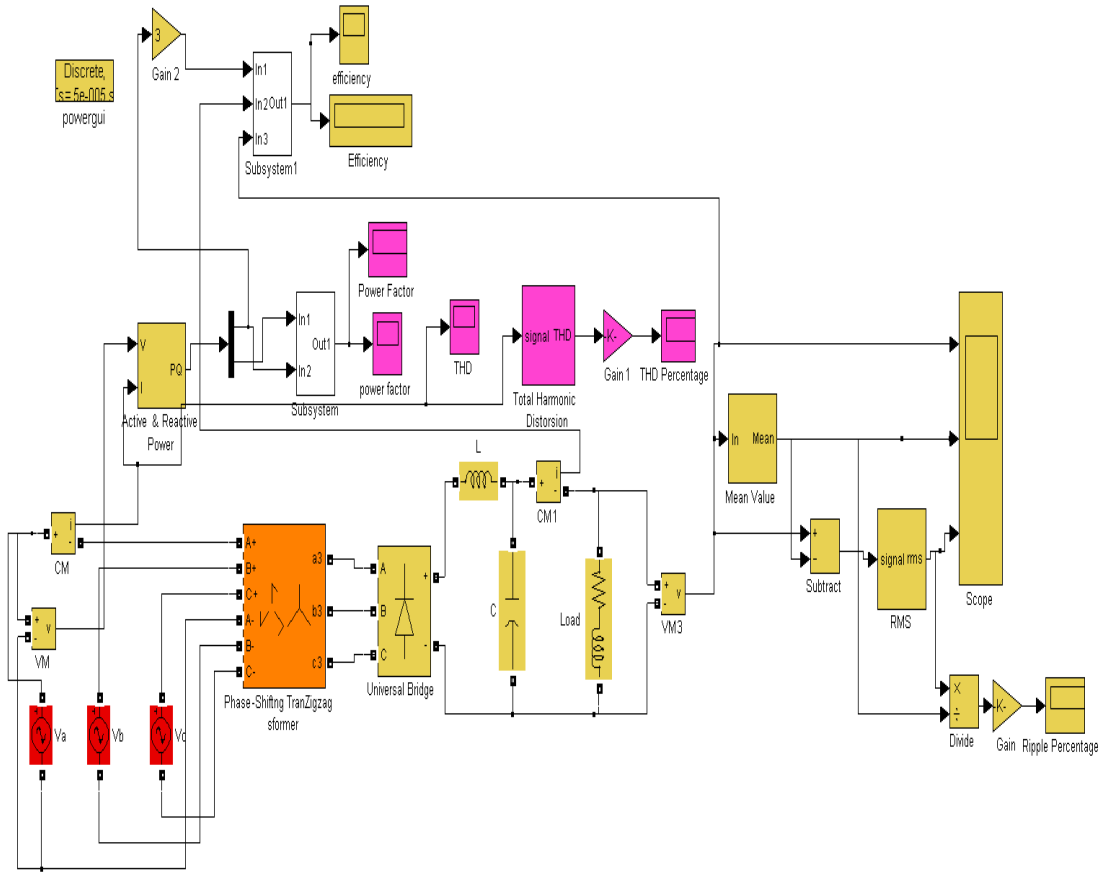
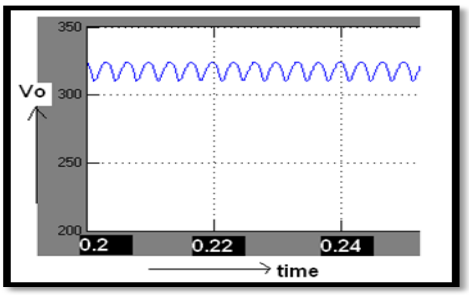


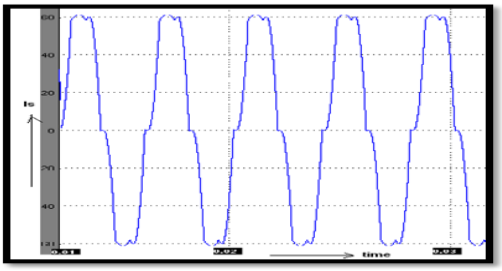
Fig. 2 Six pulse diode converter with LC filter

C. Six pulse diode converter waveform with filter

6 pulse diode converter with R-L load



With LC filter ripple 1.54%
(a) Output voltage



With LC filter THD 13.2%

(b) Input Current

Fig. 3 Six pulse diode converter waveform with filter by R-L load (a) output voltage (b) input current

By seeing the waveform of output voltage and input current, results for 6-pulse uncontrolled converters given in Table 4.1.

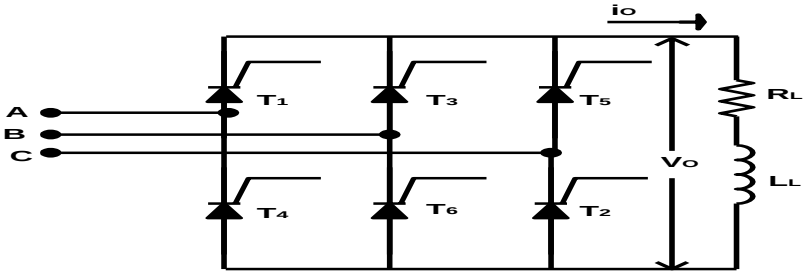
Table 1. Results of 6 pulse converter

S. no.	Converter	Vo (% ripple)	Io (% THD)	P.F.
1	6 pulse	1.58	13.6	0.88

3. SIX PULSE CONTROLLED CONVERTER

By adjusting firing angle, the converter can send power from the ac side to the dc side in its rectifier operation or from dc side operation dc voltage. V_{dc} is positive for rectifier operation. Because thyristors are unidirectional, dc current flows only in one direction. For generating 6 pulses per fundamental ac cycle synchronized 6 pulse generator is used.

A Circuit diagram



+ Three phase six pulse thyristor converters

B Simulation Block Diagram.

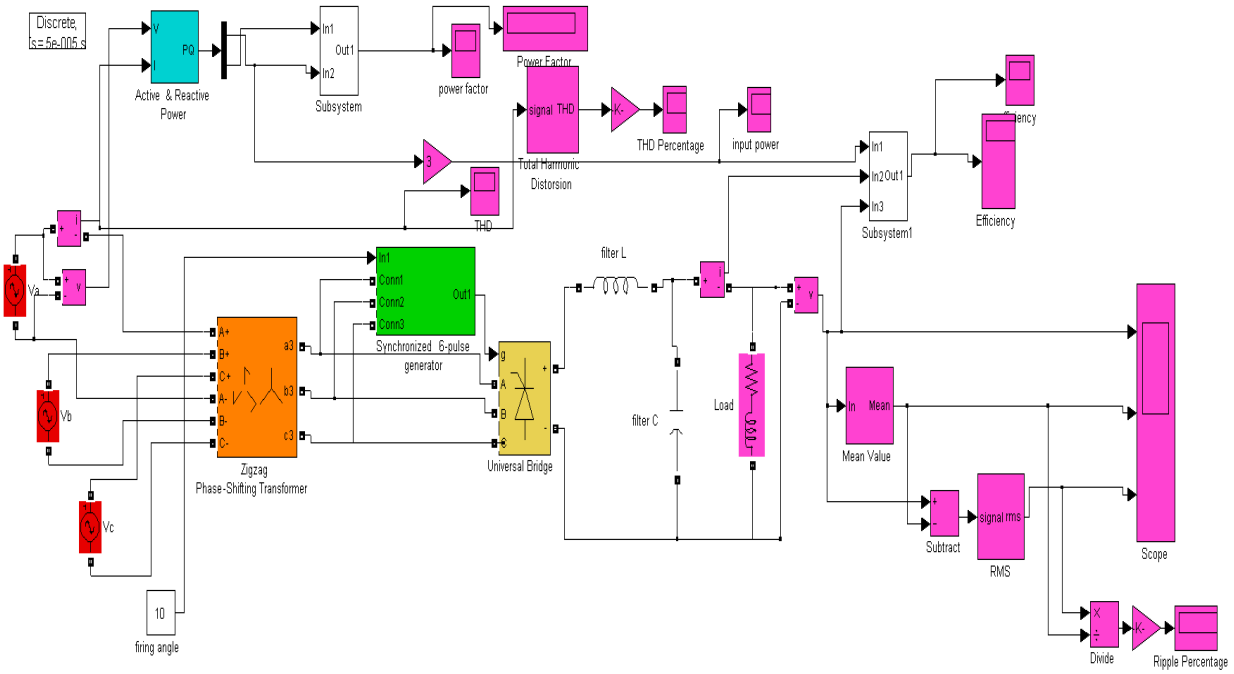
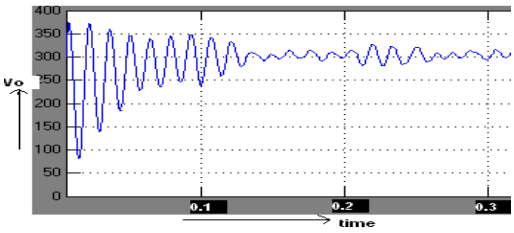


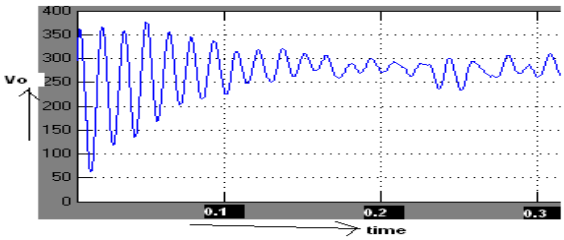
Fig.5 Six pulse thyristor converter with LC filter

C. *Six pulse controlled converter waveform with filter*

6 pulse thyristor converter with Resistive load

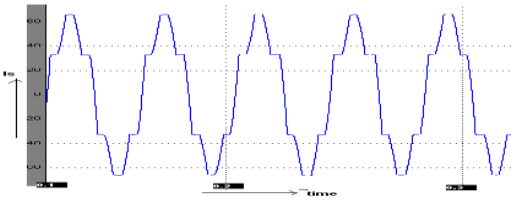


At α=10 degree ripple 5.86%

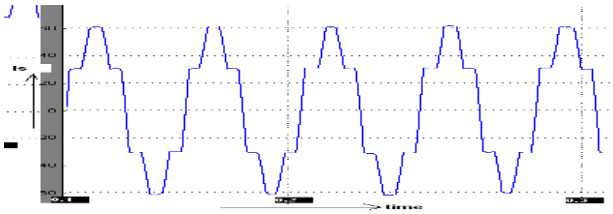


At α=20 degree ripple 5.02%

(a) Output voltage



At α=10 degree THD 15.70%



At α=20 degree THD 21.01%

(b) Input current

Fig. 6 Six pulse thyristor converter wave form at α=10, 20 degree (a) output voltage (b) input current

Table 2. Results of 6 pulse controlled converter with different firing angles

S no.	Converter / Firing Angle	10 degree			20 degree		
		Is THD%	Vo Ripple%	P.F.	Is THD %	Vo Ripple%	P.F.
1.	6 Pulse	15.70	5.86	0.88	21.01	5.02	0.76

4. CONCLUSION

In six-pulse diode/thyristor controlled converter, rectifier are connected either in series or in parallel .Each rectifier is fed by phase shifted secondary winding voltage of a transformer to shape the primary current close to sinusoidal. When the block diagram of 6- pulse uncontrolled converter is simulate, it gives the value of ripple, THD and power factor. The power factor can be improved efficiently by replacing the diodes with thyristor and will be more increased when the firing angle is increased from 10 degree to 20 degree.

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