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48 Pulse Converter with PI and PID Controller

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Abstract: ***This paper presents modelling and simulation of multi pulse AC to DC converter topologies. In this paper multi pulse converter are developed for improving power quality to reduce harmonics in ac main and ripple factor in DC output. The simulation of 48 pulse converter is performed on MATLAB simulink by using universal thyrister. The main focus of this study to minimise (THD) near to zero by use of PI and PID controller. The Thd of dc output are calculated by FFT analysis in matlab and comparative analysis of performance of each controller as PI and PID controller is done in this research paper.***

Keywords: Pulse Converter, PID Controller, PI Controller

1. Introduction

48 pulse AC to DC converter is the electronic device which is used to convert ac into dc voltage, in converter output there is more THD and ripple factor so in this research the THD and ripples can be minimise by use of pid controller and PI controller.

In this converter universal thyrister is used, each thyrister contains 6 pulses so 8 thyrister used and each thyrister connected in series to make 48 pulses converter.

2. Literature Review

The research has been done at 6 pulse 12 pulse 24 pulses 30 pulse and 36 pulse. Among them if the number of pulses is increased then THD becomes lower. THD is measured as almost 6.2% for 18 pulse 16% for 12 pulse rectifier. 37% for 6 pulse rectifier for low voltage level. The previous data is shown below without using any controller.

For 48 pulse –**THD is 2.98 and ripple factor- 1.635** as the number of pulses increased THD getting lower this is clear by previous study.

3. Methodology

Research is done by the scientific and systematic way. Type of Research is quantitative, and Analysis of data is primary data.

3.1 Scope of research

THD and harmonics would be reduced to very low. Reduction of ac input line current's harmonics. Reduction of DC output voltage ripple. Improvement of power quality in application of machine drive etc.

3.2 Proposed work

1) Analysis of harmonics in 48 pulse ac/dc converter
2) Implementation of PI and PID controller in 48 pulse converter.
3) Comparison of harmonics THD and form factor of 48 pulse converter with pi controller and PID controller.

Method used

1) Series connection of multi pulses is used to reduce harmonics and ripples.
2) Feedback system used by PI controller first and then PID controller.
3) Analysis of output value of PI controller.
4) Analysis of output value of PID controller.
5) Compare the each parameter of both converter.
6) Choose the lowest THD value, ripple factor, and form factor.
7) Verify the job which is best.

Tools implemented

1) Matlab 9.3 software is used.
2) Simulink library browser
3) Hardware as desktop/laptop

Relevance of research

1) Previous research has been done at 48 pulse converter without controller.
2) In this thesis we use robust control of ac/dc converter by use of pi and pid controller.
3) Thesis work is done by the comparative analysis of pi and pid controller on 48 pulse ac to dc converter.

Novelty of research

1) Automatic control of error signal to get unity power factor and THD reduction.
2) Comparative analysis of PI and PID controller at 48 pulse ac/dc converter**.**

Originality of research

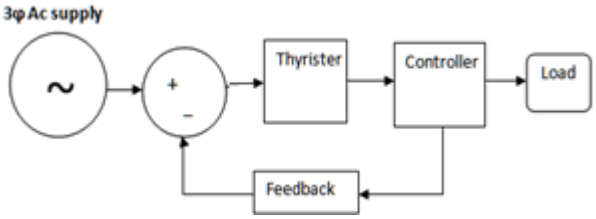
1) The research is on my scientific activity has not been done before.
2) Single unique technique is used in this research.
3) The use and comparison of PI and PID controller in 48 pulse converter make this work unique.

Research resource

1) Ieee explore
2) Researchgate.net
3) Sprinjal journal

4) Internet browser
5) books

Block Diagram



Block diagram of 48 pulse ac/dc converter with pi or pid controller

Explanation of block diagram

1) This block diagram shows the 48 pulse ac/dc converter with pi and pid controller.
2) In this block diagram an ac power given as input and dc signal found in output.

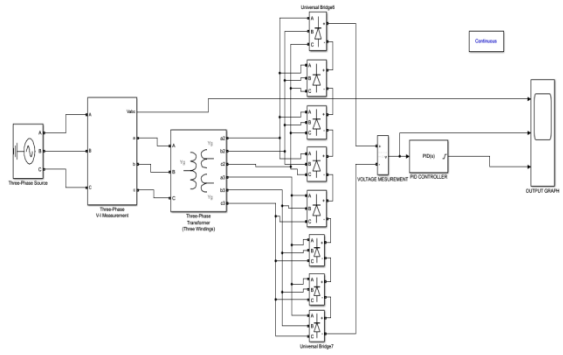
Explanation of basic blocks

1) Power supply is AC which have to convert into dc is connected as input of system.
2) Summing point produces the algebraic sum of the inputs. It also performs the summation or subtraction or combination of summation and subtraction of the inputs based on the polarity of the inputs.
3) **Feedback** is an event that occurs when the output of a system is used as input back.
4) **Converter** is a electronic device having controlled thyrister is used to convert AC power into DC power.
5) **DC load** is the load which has need only DC power supply to perform it's best.
6) **Controller** is the device which is used to control ac symptoms in output of device
7) **PID CONROLLER** compute the desired actuator output by calculating proportional, integral, and derivative responses and summing those three components to compute the output.
8) **PI CONTROLLER** PI Controller is a feedback control loop that calculates an error signal by taking the difference between the output of a system

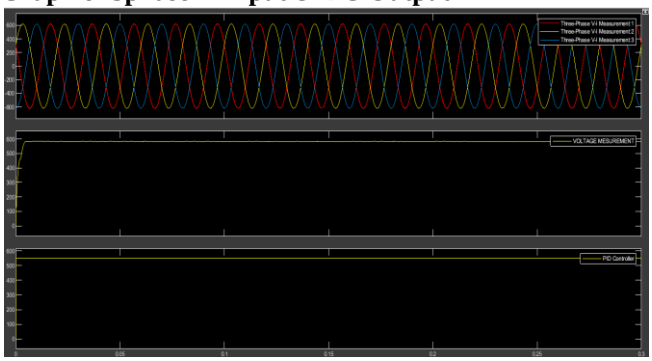
Tuning of PID and PI Controller

1) Ziegler-Nicolas method is used to tune pid controller.
2) **Ziegler-Nicolas method** This method starts by zeroing the integral and differential gains and then raising the proportional gain until the system is unstable. The value of K_P at the point of instability is called K_{MAX}; the frequency of oscillation is f_0.

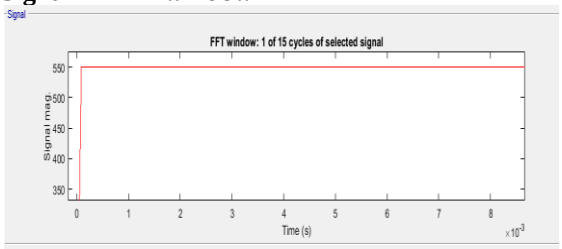
Simulation model of 48 pulse converter



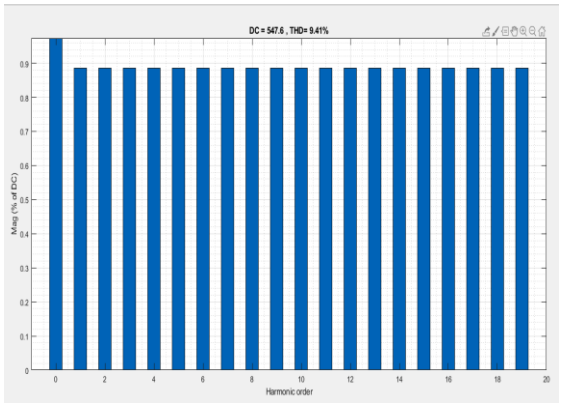
Graph of 3phase Input & DC Output



Signal in FFT window



%THD OF OUTPUT VOLTAGE



Explanation of Graph

1) Input signal is 3phase sin wave
2) Output signal of 48 pulse converter is dc signal with C filter of 55mfd.
3) Output signal of 48 pulse converter is dc signal with pid controller. (P=9, I=1.2, D=1.11) and saturation limit of (-550 to 550)

4. Result

The following table is given by the observation by the matlab 2019a software by the simulation of 48 pulse AC to DC converter model in simulink library.

No. Of pulses	Controller	THD
48	PID	9.17%
48	PI	9.13%

Comparison
In the 48 pulse ac/ dc model we found out that the performance of PID controller is better than PI controller.

5. Conclusion

In this research this clear that the THD of the converter will be reduced by the use of multi pulses and the use of controller by the use of PID controller we found THD 9.17% and by the use of PI controller we found THD 9.13% in the future we can apply controllers on less number of pulses of converter we can get a small size of converter with less THD.

References

[1] Nidhi Khurpia, R S Tare, Rahul Agrawal *Modeling, Design and Analysis of Multi Pulse Converter Using MATLAB Simulation*, IJournals: International Journal of Software & Hardware Research in Engineering, Volume 4, ISSN-2347-489, https://www.researchgate.net/, 2 February, 2016
[2] J. Gnanavadivel, Senthil Kumar N, *Comparative Study of PI, Fuzzy and Fuzzy tuned PI Controllers for Single-Phase AC-DC Three-Level Converter*, Journal of Electrical Engineering and Technology 12(1):78-90, January 2016, DOI: 10.5370/JEET.2017.12.1.078
[3] V.S. Vakula R. Sandhya Rani; Mrs V.V. VijethaInti; *AC–DC converters; DC motor; Multi pulse converter; Harmonic reduction; power quality; rectifiers.;* International Journal of Engineering Sciences & Research Technology (IJESRT) (Vol.7, No. 8) Date: 2018-08-30
[4] Md. Habibur Rahaman, Md. Rafiqul Islam Sheikh, *Design a Multi-Pulse Phase Shifted AC-DC Power Converter* INSPEC Accession Number: 18249283,IEEE,12November2018
DOI: 10.1109/I2CT.2018.8529679