ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Performance Improvement of Front End and Back End Converter in Decoupled Control of AC Drive

C.Prathyusha
M.Tech,
(PE&ED),
K.O.R.M College of Engineering,
Kadapa,A.P, India.

G.Siva Prasad
Assistant Professor,
Department of Electrical Engineering,
K.O.R.M College of Engineering,
Kadapa,A.P, India.

ABSTRACT:

This paper explains the technique as new wave shaping for cost effective reduction of harmonics in rectifier based converters for induction motor drives by vector control technique at the occurrence of point of common coupling. The introduced reduction of harmonics comprises of polygon auto connected transformer dependson twelve-pulse rectifier based converter at a rated passive shunt tuned filter for 11th harmonic frequency. This rectifier based converter mitigates the predominantes 5th, 7th, and 11th harmonics and imposes the reduction of other increase in harmonics from the current at ac mains, and increases the power indices parameters at the point of common coupling. The structure of auto-connected transformer is worked by the proposed rectifier based converter to provide suitable applications, where a 6-pulse rectifier based converter has been used. The occurrence of changing of load on VCIMD has to execute the introduced rectifier based converter has been effectively used in operating range of the drive. Experimental outputs has been used to obtained the model and design of the ac-dc converter

INDEX TERMS:

Autotransformer,VCIMD, Power quality, multipulse ac-dc converters

I.INTRODUCTION:

The increased use of induction motors for vector control technique has various usage in industrial areas, electrochemical, textile mills, air conditioning, etc., has highlighted the problem of harmonics [1-3]. This is mainly due to the occurrence of the induction drives such as three phase diode bridge rectifier, which exploites the injection of harmonics into ac mains, thereby extracting the power improvement at the point of common coupling (PCC).

This project has although publish this paper of several power indices at the standards such as IEEE Standard 519 [4], IEC 61000-3-2 [5], etc. Different techniques (wave shaping) have been submitted in the published literature [4-14]. Active shunt, series and even hybrid filters requires the stability performance [6], and they have expensive and they reliability ,apart from high switching losses occurs at the increase in frequency. The techniques (passive wave shaping) have retained their popularity since their inception. The use of passive filters should become popular in the industry these days, as they are very complex and reliable. But to provides the requirement of several power quality parameters standards such as IEEE 519 [4], the passive filters has been rated very high[7]. However , at light load conditions, their performance deteriorates. The use of multi pulse ac-dc converters is another equally important technique(wave shaping) [8]. A variety of auto connected transformer based solutions have been introduced throughout the literature [8-12].

It is seen that a twelve pulse rectifier based converter is simple for this the power quality parameters are not within IEEE standard limits. As the pulse number are very high, the application of the converter improves, but at the cost of increased complexity and also the cost. This project explains a technique(new wave shaping) using a polygon auto connected transformer depends on twelve-pulse ac -dc converter having a small rated passive shunt filter. This scheme is able to provide the power improvement indices within limits as per the standards [4-5]. It is obtained that the introduced harmonic mitigator performs well even during changing of load on the drive. A set of obtained results gives of various power quality parameters such as total harmonic distortion (THD) and crest factor (CF) of the ac mains current, power factor (PF), displacement factor (DPF), distortion factor (DF), THD of supply voltage at PCC, and ripple factor (RF) on the DC bus and presented for an induction motor fed at an 6-pulse rectifier based converter (as shown in Fig. 1,

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

referred to as Topology 'A'), 12-pulse rectifier based converter (as shown in Fig. 2, indicates to as Topology 'B') and introduced reduction of harmonics (as shown in Fig. 3, indicates to as Topology 'C').Induction motors are also used in industrial purposes and they have many benefits such as ruggedness, energy savings , low cost and they have improvement in efficiency. The dc motors are also used for flexible characteristics at the occurrence of variable speed drives. In this main technique was vector control technique and it has been used in industrial purposes and it used for induction motor only. The induction motor drives at vector control technique comprises of 6 pulse diode bridge rectifier, at dc link it has an energy storage element and a three phase voltage source inverter which feeds power in the ac-dc converter. They have variety of operating problems such as poor power factor, injection of harmonic currents, low rectifier efficiency and the electromagnetic interference for diodes. To mitigate the harmonic currents which was affecting by utility lines an IEEE standard 519 has been discovered at 1981 which was limited on voltage distortions. There are several methods which depends on higher number of pulse rectifications in rectifier based converter have been submitted.

For 12 pulse rectification scheme the main conventional scheme star-delta scheme was taken. The kilovolt ampere rated on the autotransformer which has been rated as 1.03p0 where postands as a active power drawn by the converter. For reducing transformer rating in this the autotransformer depends on multi pulse rectifier based converters have been reported in poly phase auto-connected transformer arrangement having an reduction in KVA capacities for reduction of harmonics in rectifier type utility interface. For applications when the demand for reduction of harmonics having increase in stringent, an 18- pulse rectifier based converter is generally preferred. This 18 pulse converter which is more than the 24-pulse rectifier based converter, while increase in the 12-pulse rectifier based converter. For reducing the total harmonic distortions of the current at ac mains the autotransformer based both for 12 pulse and 18 pulse have been submitted in multi pulse converter system. Although , when the dc-link voltage increases, and this scheme are non applicable for applications. A new topology has been developed by Hammond, but the transformer structure is very complex to the transformer design. For 18 pulse converters a new parameter has been submitted by paice. The total harmonic distortions for this topology which is around at 8% for full load. For 12 pulse and 18 pulse converters which is high at full load around at 6.9% and as load decreases and in this concept reduction of harmonic increases which is around at 13.1% and as load was 50% which have been submitted by kamath in a compact auto connected transformer depends on 12 pulse rectifier based circuit and a autoconnected transformer depends on 18 pulse rectifier circuit. In this project, a auto connected transformer depends on 18-pulse rectifier based converter (Topology "D"), which is suitable for applications, where an 6-pulse ac-dc converter has been used, indicated as Topology 'A', have been introduced to feed power on VCIMD. The proposed rectifier based converter results in elimination of 5th, 7th ,11th and 13th harmonics. A set of results gives the comparison of the power quality parameters which are presented for a VCIMD fed from an proposed 6-pulse rectifier based converter and different 18 pulse rectifier based converter. Moreover, the occurrence of load changing on serious power quality parameters were also studied. To demonstrate the introduced 18- pulse rectifier based converter feed power on VCIMD.

II.Performance of Harmonic Mitigation Alternatives:

Frequency drives at variable often have demands placed on them to reduction of harmonics effected by non-linear loads. There are Many applications which occurred to them includes line reactors, harmonic traps, 12-puls,18-pulse diode bridge rectifiers and low pass filters. There are many techniques require extensive system analysis to reduce resonant problems and capacitor failures. This theory explains the principles of various passive harmonic reduction techniques and explains their real life performance. It takes the harmonic filtering by explaining the performances of several harmonic reduction techniques and offers an analysis for real life VFD Operating drives. Since power distribution auto connected transformers frequently have impedance rated from 1.5% and 5.75%, one should expect that the impedances are relatively high, and for that the harmonics are quite low. Although ,the auto connected transformer impedance ratings depends on auto connected transformer rated KVA, for this the transformer are partially loaded, the impedance of the auto connected transformer, which is relative to the actual load, which are proportionately lower i.e.,1.5% impedance at Line Reactors. The usage of line reactors at AC andeffective means of increased source impedance which are arranged to an individual load Line reactors which are aligned in series along with the six pulse rectifier diode bridge rectifier at the input n at supply side.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

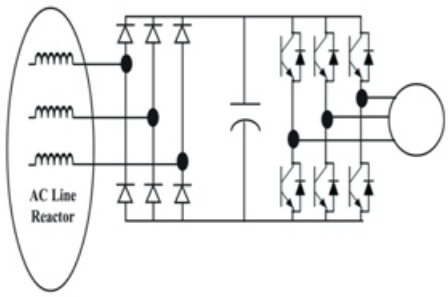

Fig 1:AC Line Reactor Connection at Supply Side

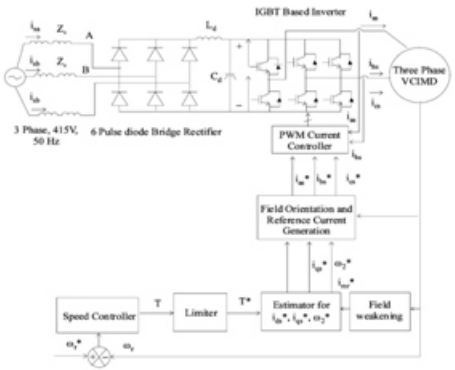

Fig 2: Six pulse diode bridge rectifiers fed at vector controlled induction motor drives

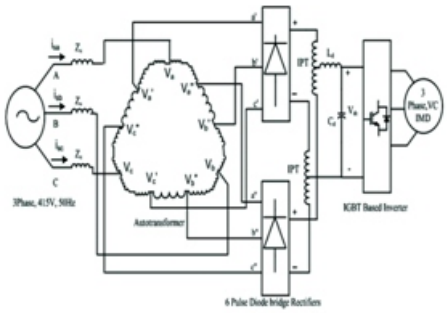

Fig 3: polygon auto transformer based 12 pulse fed VCIMD

III.Analysis and Design of Proposed HarmonicMitigation:

The introduced rectifier based converter feeds power on a VCIMD is presented in Fig. The total circuit comprises three parts namely auto connected transformer, passive filter and VCIMD. The modelled details of different parts of the introduced converter are given here. Design of Autotransformers for Proposed Twelve Pulse rectifier based Converter the fundamental concept of harmonic elimination through autotransformers makes use of multipulse converters, for this the harmonics can be obtained by one converter which are eliminated by the other converter through proper phase shift given by [8]; Phase shift = 600 / Number of six-pulse converters For producing 12-pulse rectifier based conversion, the phase rotation between the two sets of voltages may be have 00 , 300 and ±150 with respect to the supply voltages. In this project a 12-pulse rectification requires and depends on ±150 for the reduction of size of the magnetics. The detailed structure procedure for the introduced 12-pulse rectifier based converter, which has flexible by varying the transformer output voltages for making them suitable for applications by simply varying the tap positions.

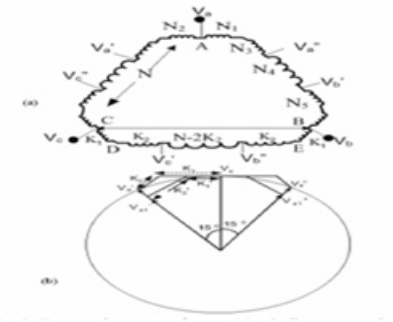

Fig 4: Proposed auto transformer (a)winding connection diagram (b)vector diagram of phasor voltages for based 12 pulse harmonic mitigator for retrofit applications

The capacitors with metallized film construction lose capacitance as they age. Similarly, the production of importance of the harmonic filters reactor may result in tuned frequency increases than that recommended. IEEE Standard 1531[13] exhibits that the passive filters which are tuned at 6% and which are lower than the rated frequency and it requires acceptable tuning filter at the end of its 20 year life. However, the passive filters has been tuned at the frequency of 517Hz for the 11th harmonic components corresponds to the 50 Hz fundamental frequency.

IV.Vector controlled induction motor drives:

The fig 2 explains the arrangement of indirect VCIMD. For this technique they have three motor phase currents and the motor speed. The controller of the speed compares both the reference speed with the motor speed and it has generates reference torque.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

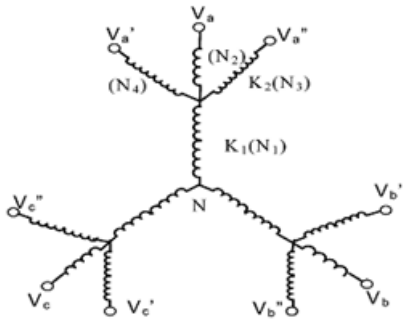

Fig 5: Proposed autotransformer winding connection diagram

The reference flux signal has been referenced by flux control signal. The reference flux signal and flux control signal has fed by vector controller and calculates the torque component of current, slip speed and the flux angle. These three phase motor currents which has been generated by vector controller and sensed currents which has been fed by the technique pulse width modulated current controller which always controls by the gating of different switches in voltage source inverter.

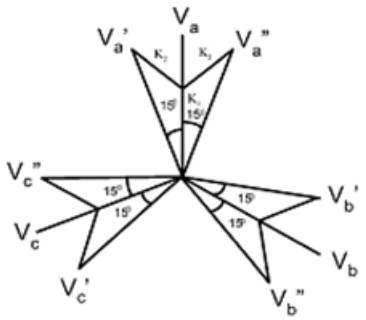

Fig 6: vector diagram of phasor voltages for 12 pulse based harmonic mitigation

The inverter named as voltage source inverter has been generated by the Pulse width modulated voltages which are being fed to the motor to produce the torque for running the motor at a desired speed under required loading conditions.Phase variation involves for dividing the electrical supply separated into two or more outputs, each output has been phase shifted with respect to each other with an approximate angle for the harmonic pairs are to eliminated. This concept has to be displaced by the harmonic reduction pairs in which it is placed and bring each to a 180degrees phase variation and they eliminate each other out.The current at the primary side in the auto connected transformer which is the sum of every six pulse diode bridge rectifier or a twelve-pulse diode bridge rectifier.

For every instance, at the occurrence of two 6-pulse diode bridge rectifiers at variable frequency drives of similar rating, providing a wye-delta transformer (30°with respect to the primary) on one drive, and delta, delta transformer (0° with respect to the primary)on the other drive, provides an angular displacement of 30° between the two outputs, providing the equivalent of a 12-pulse system. On the common supply of both auto connected transformers on the primary, phase variation between the systems will cancel out the 5th and 7th harmonic currents. An angular displacement with 15° between outputs requires the equivalent system of a 24-pulse system, but provides four 6-pulse loads. The above procedure that is phase variation of non linear loads can have been used to mitigate the occurrence ofselectedharmonics.

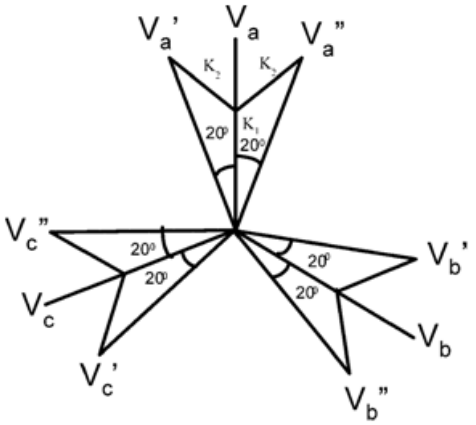

Fig 7: vector diagram of phase voltages for 18 pulse based harmonic mitigation

But, using the above winding constants, the average dc output voltage obtained which increases than that of the six-pulse diode bridge rectifier due to an 18-pulse operation. The aforementioned design procedure can still be used to redesign the transformer for suitable applications. Fig. shows the generalized diagram for changing the auto connected transformer output voltages for maintaining an 18-pulse operation.

Here, the outer circle represents voltage corresponds to the input supply-voltage system. To make the introduced rectifier based converter suitable for applications, the voltage for the three-phase diode bridge rectifiers are tapped at the inner circle (with 4% reduced voltage).

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

V.MATLAB Based Model:

The introduced rectifier based converter feeds power on VCIMD and it is simulated in a MATLAB environment both with Simulink and Power System Block set (PSB) toolboxes. Fig 8shows the MATLAB model of the proposed harmonic mitigation feeding VCIMD to improve several power improvement indices and Fig 9. Shows the MATLAB model of a 10 hp VCIMD, The explanations of these indices of an induction motor were given in Appendix A. The 10 hp induction motor is controlled using indirect vector controltechnique.

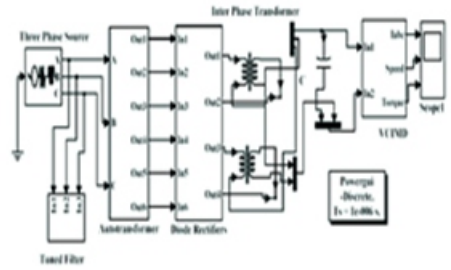

Fig 8: MATLAB block diagram of proposed 12-pulse AC-DC converter based harmonic mitigation (topology C) fed VCIMD

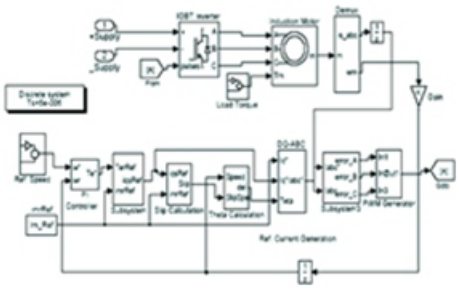

Fig 9: MATLAB block diagram of vector controlled induction motor drive

Experimentation to verify the simulation model experimentally a prototype of proposed auto connected transformer depends on 12-pulse rectifier based converter were explained in Fig. is developed in the laboratory. The passive filter consists of capacitors and a set of a newly proposed inductors were developed to realize an 11th harmonic passive shunt filter.

Three single-phase auto connected transformers have been designed and developed. Similarly the change of transformers of small ratings have been designed and fabricated. The design details of the autotransformers are shown below [15];

VI.Results and Discussion:

The introduced twelve-pulse rectifier based converters have been designed along with the VCIMD to suit for applications for a 10hp induction motor. The simulations have been arranged in a MATLAB environment. The obtained outputs are verified on the developed prototype of the proposed ac-dc converter

SIMULATION RESULTS:

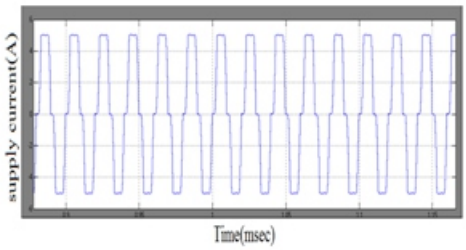

Fig 10: AC mains current waveform of VCIMD fed by 6 pulse diode bridge rectifier at full load

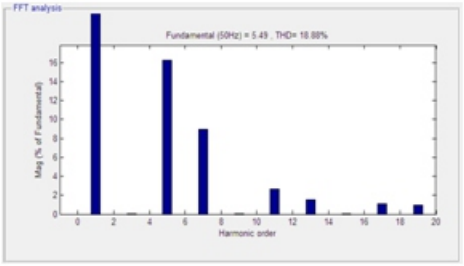

Fig 11: THD values of AC mains current waveform of VCIMD fed by 6 pulse diode bridge rectifier at full load

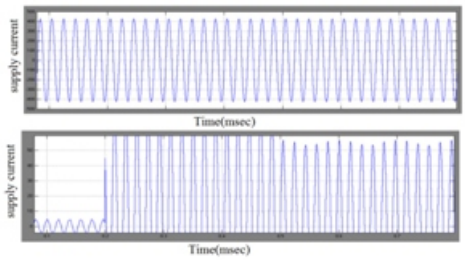

Fig 12: AC mains current waveform along with harmonic spectrum at full load with 12 pulse ac-dc converter on ac side

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

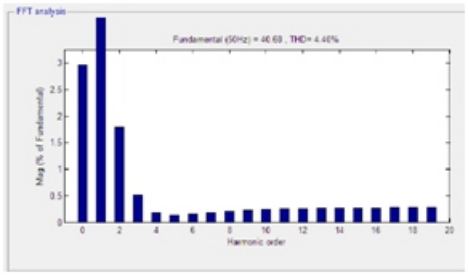

Fig 13: THD values of AC mains current waveform along with its harmonic spectrum at full load fed by 12 pulse

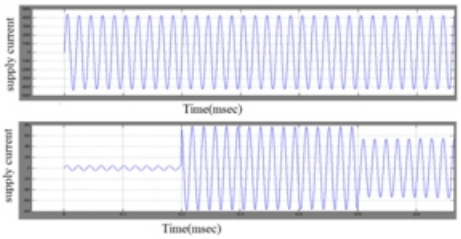

Fig 14: AC mains current waveform along with its harmonic spectrum at light load fed by 18 pulse diode bridge rectifier

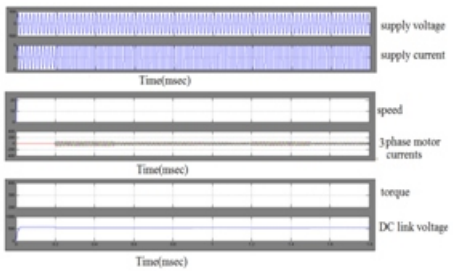

Fig 15: Dynamic response of 18 pulse ac-dc converters based proposed harmonic mitigation fed VCIMD with load perturbation

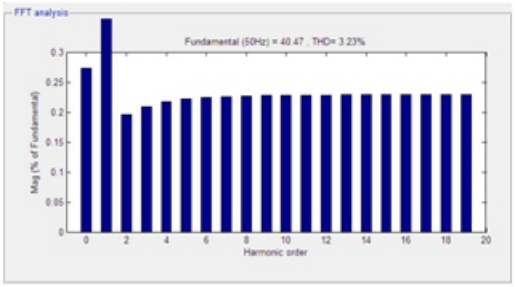

Fig 16: AC mains current waveform along with its harmonic spectrum at full load with 18 pulse ac-dc converter on ac side

VII.Conclusions and Future Scope of Work:

A auto connected transformer depends on eighteen-pulse rectifier based converter has been modeled with a VCI-MD load. The introduced reduction of harmonics has been observed suitable for applications having an induction motor drives at variable frequency condition operated at variation of load conditions. The observation of the introduced reduction of harmonics fed VCIMD by the variation of load conditions is found to be satisfactory. The introduced harmonic mitigator has resulted in reduction in the side of magnetic leads to the saving the total cost of the drive. The observation of the introduced reduction of harmonics has demonstrated the ability of this ac-dc converter to improve the power quality parameters at ac mains in terms of THD of supply current, THD of supply voltage, power factor and crest factor. On the dc link side too, there is a remarkable improvement in ripple factor of dc link voltage.

Future Scope:

In this paper simulated an 18-pulse rectifier based converter which depends on auto connected transformer based transformer. Extended this project in to 18-pulse to 36 pulse and also verify the power quality parameters maintains or not and with the using of this project control the HVDC System & also implement in the traction system.

REFERENCES:

[1] P. Vas, Sensorless Vector and Direct Torque Control. London, UK: Oxford University Press, 1998.

[2] IEEE Guide for Harmonic Control and Reactive Compensation of Static Power Converters, IEEE Standard, p. 519, 1992.

[3] Y. Jang and M. M. Jovanovic, "A comparative study of single switch three-phase high power factor rectifiers," IEEE Trans. Ind. Appl., vol. 34, no. 6, pp. 1327–1334, Nov./Dec. 1998.

[4] D. Rendusara, K. J. Slater, B. S. Lee, P. Enjeti, I. Pitel, and W. Gray, "Design considerations for 12/24-pulse autoconnected rectifiers for large VA, PWM drive systems," in Proc., IEEE APEC 1999 Conf., pp. 903–909.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

[5] D. A. Paice, Power Electronic Converter Harmonics: Multipulse Methods for Clean Power. New York: IEEE, 1996.

[6] S. Choi, P. N. Enjeti, and I. J. Pitel, "Polyphase transformer arrangements with reduced kVA capacities for harmonic current reduction in rectifier type utility interface," IEEE Trans. Power Electron., vol. 11,no. 5, pp. 680–689, Sep. 1996.

[7] D. A. Paice, "Multipulse converter system," U.S. Patent 4876634, vol. 24, Oct. 1989.

[8] P. W. Hammond, "Autotransformer," U.S. Patent 5619407, vol. 8, Apr. 1997.

[9] D. A. Paice, "Transformers for multipulse AC/DC converters," U.S. Patent 6101113, vol. 8, Aug. 2000.

[10] G. R. Klamath, B. Runyan, and R. Wood, "A compact autotransformer based 12-pulse rectifier circuit," in Proc. 2001 IEEE IECON, pp. 1344– 1349.

[11] G. R. Klamath, D. Benson, and R. Wood, "A novel autotransformer based 18- pulse rectifier circuit," in Proc. 2003 IEEE IECON, pp. 1122–1127.

[12] IEEE Guide for Application and Specification of Harmonic Filters, IEEE Standard, p. 1573, 2003.

[13] D. A. Gongalez and J. C. Mccall, "Design of filters to reduce harmonic distortion in industrial power systems," IEEE Trans. Ind. Appl., vol. IA-23, no. 3, pp. 504–511, May/Jun. 1987.

[14] S. M. Peeran and C. W. P. Cascadden, "Applications, design, and specifications of harmonic filters for variable frequency drives," IEEE Trans. Ind. Appl, vol. 31, no. 4, pp. 841–847, Jul./Aug. 1995.

Authors Details:

C.Prathyusha studying M.Tech in KandulaObul Reddy College of engineering, Department of power electronics and Electrical Drives

G.Siva Prasad, M.Tech He is presently working as assistant professor of Electrical Electronics Engineering of KORM College of engineering, KADAPA.

A.V. Padmaja, M.Tech She is presently working as assistant professor of Electrical Electronics Engineering of KLM College of engineering for women, KADAPA.