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A literature survey on AC-DC Converter using three phase single stage PFC & PWM Technique

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***Abstract*—**Today to achieve ac-dc power conversions with high input power factor and low harmonic distortions, Power factor correction (PFC) converters are widely used. This paper lays out the research and development done in the field of PFC's. Converter topologies, control strategies, power quality etc has been discussed here. Higher power ratings, faster switching speed and lower cost are the areas of concern for digital controllers and converters and thus PFC has gained attention.

Keywords-Power Factor Correction (PFC), Alternating Current (AC), Inductor (L) etc.

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I. INTRODUCTION

With the continuous research and development in the field of semiconductor and power electronics, design and circuit improvements have been made for superior performance, be it by the use of PWM, VSD etc. Inverters and converters have also gained researchers popular interests. A 3 phase voltage source inverter gives out variable voltage and frequency to AC drives. Series and parallel connections are important to get certain current and voltage ratings. Nowadays, multilevel inverters are used because of its better harmonic spectrum and voltage ratings. With increasing use of electrical equipments, power converter manufacturers have implemented a form of PFC- power factor correction according to the harmonic standards of IEC 1000-3-2. The power converters have high power factor and low input current harmonics as its performance criteria.

The power factor correction is broadly of 2 types- Active power factor correction technique and Passive power factor correction technique. In passive PFC, an LC filter is used. This technique is simple but results in heavy and bulky converters as low frequency L and C used are bulky in size and structure.

In active PFC the input current is made in phase with the input voltage by the use of SMPS switched mode power supply technique. In this active PFC, unity power factor is achieved along with reduced harmonics, light weight and smaller size but has the drawback of relative complexity and higher cost.

Active PFC has two stage scheme, that is it has independent 2 power stages cascaded with PFC stage and DC-DC converter, with a pre regulator for obtaining intermediate DC from sinusoidal input and DC-DC converter gives the desired output voltage but this 2 stage switch mode makes the converter more complex and costly. Hence single stage PFC converters are used as they are comparatively cheaper and simpler than the former. Three phase Single stage PFC converters are preferred for high power applications and systems.

II. TOPOLOGICAL ISSUES IN POWER FACTOR CORRECTION

In 1991, A.R.Prasad and P.D.Ziogas proposed and analyzed a novel active power factor correction method for power supplies with three phase front end diode rectifiers. This method required an additional single switch Boost chopper.

The converter drew ac current with unity power factor at fixed switching frequency. The study also found that on using active input pfc, the performance of the converter improves significantly.

Yimin Jiang et al. proposed a new scheme of the single-phase parallel power factor correction (PPFC) in 1994.The new PPFC circuits based on this new scheme are much simpler than the previous one. The new proposed PPFC circuits have shown better efficiency and good performance the experiments and analysis together with being more cost effective.

In 2000 Nagao. M. proposed a novel power-factor-correction (PFC) which is constructed with one stage by using a single forward converter. The PFC circuit suppress the output voltage ripple and provided high power factor. High power factor was achieved by operating PFC circuit in discontinuous conduction mode and ripple suppression was achieved by the exciting energy of the transformer in the forward converter.

In 2001 K. Jirasereeamornkul, et al. proposed a new converter having low voltage stress on its switch. The flyback converter is simplified into Buck-Boost form. Then the PFC flyback transformer is replaced by an inductor. The switch of both PFC and DC/DC stages are merged. and a diode is used to force the direction of power flow.

In 2002 Wenkai Wu et al. proposed a topology using a Flyback transformer and a small series connected inductor are implemented to replace traditional input PFC inductor, and a cost-efficient lossless snubber is also proposed to reduce the turn-off spike of the main switch

In 2004 Garcia-Gil, R., Espi, J.M., Sanchis-Kilders, E., Ejea, J.B. proposed a converter consisting of a hi-directional three-phase tn one phase cycloconverter or reduced matrix converter and a bi-directional active rectifier. Both schemes were implemented by four quadrant switches (4QSWs). Safe commutation of all the 4QSWs is implemented and incorporated in the soft-switching process .

In 2005 Vinicius Miranda Pacheco et al. introduced a dc dc converter that can be used in an online uninterruptible power supply (UPS). The proposed converter provides uninterrupted, reliable power and voltage regulation for critical loads, as well as power factor correction in supply systems. Operating principles, theoretical analysis, and control strategy are described. Digital simulation and experimental results are included for supporting the validity of the concept.

In 2006 Bento, A et al. proposed two Interleaved Boost Rectifiers, one in a Half Bridge Boost Rectifier (HBR) version and the other in a Full Bridge Boost Rectifier (FBR) version. These topologies alleviate the current stress and inductor size problems present in the both HBR and FBR .

A three-phase, single-switch, quasi-resonant, Buck converter that can operate with input power factor correction was proposed by Bassan. S. et al in 2007. The converter can operate with a narrower switching frequency range and can therefore perform power factor correction over a wider range of line and load conditions than other converters of the same type.

III. CONCLUSION

The paper gives a comprehensive review on Power Factor Correction. The topological issues and control strategies are surveyed. Power Factor correction and its implementation and subsequent advances made are discussed for the improvement of power factor of the converters and thus by providing high efficiency.

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