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Paper Title: Power Factor Correction

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Abstract:In this paper, a new parallel-connected single phase power factor correction (PFC) topology using flyback converter in parallel with forward converter is proposed to improve the input power factor with simultaneously output voltage regulation taking consideration of current harmonic norms. Paralleling of converter modules is a well-known technique that is often used in medium-power applications to achieve the desired output power by using smaller size of high frequency transformers and inductors. The proposed approach offers cost effective, compact and efficient AC-DC converter by the use of parallel power processing.Forward converter primarily regulates output voltage with fast dynamic response and it acts as master which processes 60% of the power. Flyback converter with AC/DC PFC stage regulates input current shaping and PFC, and processes the remaining 40% of the power as a slave. A parallel-connected interleaved structure offers smaller passive components, less loss even in continuous conduction inductor current mode, and reduced volt-ampere rating of DC/DC stage converter. MATLAB/SIMULINK is used for implementation and simulation results show the performance improvement.

Keywords: ac-dc converter,pwm,pfc, simulink, matlab.

I. INTRODUCTION

Most electronic equipment is supplied by 50-60 Hz utility power, and more than 50% of this power is processed through some kind of power converter. Usually power converters use a diode rectifier followed by a bulk capacitor to convert AC voltage to DC voltage. Since these power converters absorb energy from the AC line only when the line voltage is higher than the DC bus voltage, the input line current contains rich harmonics, which pollute the power system and interfere with other electric equipment. These converters usually have a low power factor of 0.65. More stringent international requirements to limit the line input current harmonics, such as IEC 1000, have been effected recently. Because the conventional simple diode rectifier followed by a bulk capacitor cannot meet the requirements, which have stimulated the research of power factor correction techniques. In recent years, single-phase switch-mode AC/DC power converters have been increasingly used in the industrial, commercial, residential, aerospace, and military environment due to advantages of high efficiency, smaller size and weight. However, the proliferation of the power converters draw pulsating input current from the utility line, this not only reduce the input power factor of the converters but also injects a significant amount of harmonic current into the utility line. To improve the power quality, various PFC schemes have been proposed. There are harmonic norms such as IEC 1000-3-2 introduced for improving power quality. By the introduction of harmonic norms now power supply manufacturers have to follow these norms strictly for the remedy of signal interference problem .

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II. LITERATURE REVIEW

1. Design and development of fully controllable power factor correction and regulation in AC-DC converters
2. Research in the area of efficiency, power factor correction and safety control oriented to appropriate power conversion modules
3. To develop and implement advanced power converters based on advanced power electronic techniques

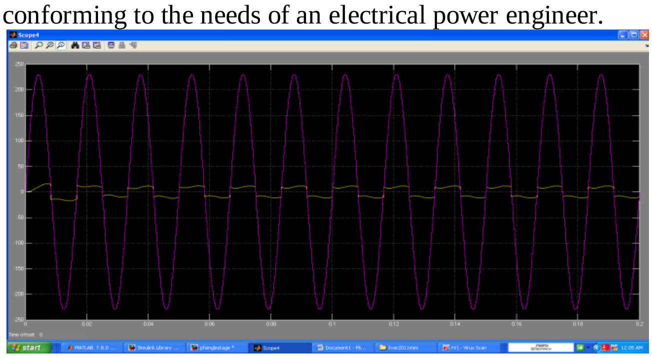
The objective of the project has been in the direction of better understanding of Parallel Power Flow scheme, closed loop simulation and analysis AC/DC converter. Various topologies have been discussed, in terms of advantages, disadvantages, technology and current implementation status. Emphasis of the project has been the design of 200W AC/DC converter with high input power factor and tight output voltage regulation.

Classification of PFC Techniques
The various methods of power factor correction can be classified as:
1. Passive power factor correction techniques
2. Active power factor correction technique

III. SIMULINK/MATLAB.

Simulation is a tool for the understanding of many complex problems. Several digital simulation packages are commercially available. This chapter presents a comparison of the salient features of various simulation tools available to model the electrical drive systems in a digital computer such as PSIM, CASPOC, PSPICE, SABER, SIMPLORER and SIMULINK/MATLAB.

PSPICE is mainly meant for the simulation of electronic circuits. Modeling of machines especially with a feedback control loop becomes very difficult in this package. PSIM and CASPOC take very little time to learn but the micro-modeling of devices is not possible in this package due to which the accuracy of results is quite limited. SABER and SIMPLORER are exclusively meant for power electronic and drive system simulations and they are user-friendly as well. But both these packages are extremely expensive. SIMULINK/MATLAB is a general-purpose simulation tool with several tool-boxes embedded in it to enable modeling of complicated control schemes as well. The power system block set has specifically a large number of components conforming to the needs of an electrical power engineer.



IV. NEW PROPOSED SCHEME

MATLAB is an interactive system. The basic data element is an array, which does not require dimensioning. Thus the technical computing problems, with matrix and vector formulations, are solved very quickly in MATLAB environment. MATLAB also provides an extensive library of predefined functions. The advantages of MATLAB for technical programming are:

- Ease of use.
- It is supported on many different computer systems. Hence it has platform independence.
- It has an extensive library of predefined functions which make the job easier.
- Device independent plotting. MATLAB has many integral plotting and imaging commands.

SIMULINK is a tool-box in MATLAB software that can be used for modeling, simulating and analyzing dynamical systems. It supports linear and nonlinear systems, modeled in Continuous time, sampled time or a hybrid of the two. Systems can also bemultirate, i.e., have different parts that are sampled or updated at differentiates. For modeling SIMULINK provides a graphical user interface (GUI) for building models as block diagrams, using click-and-drag mouse operations. With this interface, we can draw the models just as we would on paper. This is accomplished through the SIMULINK block library of sinks, sources, linear and nonlinear components and connectors.

MATLAB ODE solver functions implement numerical integration. In this package, the ode45 solvers used for a non stiff problem and the ode15s solver for a stiff problem. In a "stiff" problem, solutions can change on a time scale that is very short compared to the interval of integration.

V. CONCLUSIONS AND FUTURE WORK

The circuit of the conventional thyristors based line frequency controlled single-phase rectifier has been rearranged in order to make possible the improvement of its power factor. Once modified the circuit, the rectifier power factor is improved by extending to it an already introduced passive and economical correction technique.

The passive PFC technique is essentially based on the use of a passive R, C branch, to be added at the DC-side terminals of the rectifier, in order to make fully resistive the behavior of the DC equivalent load. The analysis of the results, obtained by loading different PSPICE simulations on a case study of about 2.5 kW of active power and under different working conditions, have shown the effectiveness of the introduced PF correction technique, particularly showing that the circuit can have a unity PF for any load condition and for any value of the delay angle, at the same time being also able to control the mean value of the rectifier DC-side voltage, like a conventional controlled rectifier.

Improving power conversion performances of the proposed fully controlled rectifier by introducing a resistance electronic emulator, able to minimize power losses on the resistor R of the currently proposed passive correcting branch.

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