ACTUAL TOPOLOGIES AND COMPONENTS FOR THREE-PHASE POWER FACTOR (PFC) FOR GRID TIED INVERTERS

Goal of the project

The Customer is a leading supplier for grid-tied motor control inverters for residential White Good applications like washing machines. It expects the market for inverters in residential ambient with power levels of up to 4kW to grow fast. For these inverters a new interface for residential grids must be designed which is EMC-conform. White Good applications with a power level of up to 1 kW uses passive chokes to fulfill the harmonic limits for the mains current drawn from the grid. The Subject of this contract is the compilation of a study dealing with the analysis and evaluation of current topologies and solutions for the three phase power factor correction (PFC) for 400V mains voltage.

Short description of the project

The evaluation of the current topologies was done in regards to electromagnetic compatibility (EMC) requirements including radio frequency interference (RFI) which is very important in the residential ambient. In a second step was decided if a standard PFC controller is used, or if the motor control DSC will also control the PFC power stage later on in the final design. For the 4 most promising topologies the efficiency versus output power (0-110%) calculation and filter requirement analysis (RFI and harmonics (EN 61000-3-2)) were done in an accurate approach to have a confident decision base. For these 4 topologies the losses in semiconductors (conduction and switching losses) and passive components (inductors, capacitors and EMI filter) were calculated. Two different topologies were selected by Diehl-Controls for prototype build for verification.

Project implemented by

Diehl AKO Stiftung & Co. KG Germany

Implementation period

6.01.2014 – 15.07.2014

Main activities

- Analysis of actual publications for three phase power factor correction (PFC) for 400V mains voltage for the power range of 1.5 kW up to 10 kW.
- Evaluation of current publications and state of the art in this field;
- Modeling and simulation

Research centre

Research Centre for Smart Energy Conversion and Storage

Fields of interest

It regards the market of grid-tied motor control inverters for residential White Good applications like washing machines. For these inverters a new interface for residential grids must be designed which is EMC-conform. White Good applications.

Financed through/by

Diehl AKO Stiftung & Co. KG Germany.

Results

- Analyzing all relevant three phase power factor correction (PFC) topologies currently existing for the power range of 1.5 kW up to 10 kW (passive PFC: single diode bridge rectifier system with smoothing inductor on the ac/dc side, passive 3-rd harmonic injection, multi-pulse rectifier system; low-frequency active PFC; high-frequency active PFC: phase modular system, direct three-phase system, buck type for 350 V dc bus, boost type; hybrid systems: 3-rd harmonic injection, combination of diode rectifier and dc/dc converter system (buck type – for 350 V dc bus, boost type), electronic reactance based rectifier system);
- Analyzing the currently existing methods for switching patterns and current sensing with high speed controllers;
- A decision matrix was prepared for different topologies;
- Two different topologies were be selected by Diehl-Controls for prototype build for verification.

Applicability and transferability of the results

Patentable inventions or parts in such inventions (hereinafter „inventions") made by one or several employees of the University within the course of carrying out the study considered here shall be notified and offered for transfer to the Customer by the University forthwith. Simultaneously, the University shall make available to the Customer any and all information potentially relevant for a realistic evaluation of the intrinsic value of such invention – as far as possible in writing.

Research team

a. Associate Prof. Sorin MUŞUROI, PhD(as project manager);
b. Associate Prof. Alexandru HEDEŞ, PhD
c. Assistant Mihaela Codruța ANCUȚI , PhD
d. Assistant Marcus SVOBODA
e. Prof. Dorin POPOVICI
f. Prof. Nicolae MUNTEAN

Contact information

Assoc.Prof. Sorin Muşuroi, PhD
Faculty of Electrical and Power Engineering
Address: Bd. Vasile Pârvan, No. 2, RO300223, Timisoara
Phone: +40 256 403462
E-mail: sorin.musuroi@upt.ro