SECURITAC Report Summary

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Final Report Summary - SECURITAC (High reliability, low cost, stackable power supply for security systems)

Executive summary:

Security systems (including fire, intrusion, access control, and voice alarm) typically contain an alternating current - direct current (AC-DC) power supply to deliver power to the system and to charge and maintain 12 V batteries, which provide the 'secondary source' during a mains failure. The combined power supply-charger-battery system represents a key component of such systems in terms of cost and contribution to system reliability.

For the small and medium-sized enterprise (SME) manufacturer and installer, the manufacturing, inventory, document control, and service costs associated with the provision of a wide range of power supplies to address the market is significant. Furthermore, as amendments are made to the applicable European standards (ENs) (EN 54-4, EN 50131-6, etc.), manufacturers are often required to re-design, re-test and re-certify each power supply design, which represents significant actual and opportunity costs.

In light of the above, the objective of the SECURITAC project has been to develop a unique stackable power supply module for security systems (including fire, intrusion and access control), in which 1 to 4 modules may be stacked (parallel connected) to deliver the required total output power (up to 260 W).

The project consortium comprised 5 SMEs (from Germany, Czech Republic (2), Spain and Turkey) and 3 research and technological development (RTD) performers (from Denmark, Spain and Hungary). Following market research, and study of EN standards, the SECURITAC specifications include: each stackable module, manufacturer configurable to deliver 26 V / 2.5 A for fire or 13 V / 5 A for intrusion, and contain power factor correction (PFC) for compliance with EN 61000-3-2. The module is to be cost effective, and comply with EN 50131-6 and enable 1 or 2 modules to be stacked. The fire version is to comply with EN54-4 and enable 1, 2, 3 or 4 modules to be stacked.

The modules were designed and built during the project by the RTDs with support from the SMEs, and were demonstrated and evaluated by the SMEs in their facilities and with their security system equipment and in installations. The SMEs have confirmed that the modules perform as required. The project has also conceived and simulated a novel hybrid PFC converter topology which promises good performance with relatively low cost. The project has also developed, built, and tested a digital signal processing (DSP)-based controller for the offline converter with PFC (digital power control is an emerging technology, with a forecast of high growth). The results of the digital controller development were presented at the PEMD2010 conference by IET and published in the conference proceedings. The consortium SMEs will undertake further development of the project results, which they expect to reach the market in Q4, 2012. A range of dissemination activities were performed during the project to bring the project results to a wider audience.

The SECURITAC project ran from 1 November 2008 to 30 April 2011, and received funding from the European Community's
The objective of the SECURITAC project has been to develop a unique stackable power supply module for security systems (including fire, intrusion and access control), in which 1 to 4 modules may be stacked (parallel connected) to deliver the required total output power (up to 260 W). The main features / objectives of the SECURITAC power supply module are:

(a) to enable manufacturers / distributors / installers to build a power supply of the required output power by stacking the required number of common modules;
(b) to implement load sharing, i.e. each module is to supply an equal fraction of the total load current;
(c) to have 20 % lower cost than existing security system power supplies of equivalent power, primarily via reduced inventory, certification, and production test costs;
(d) to include a microcontroller which offers self-test, remote diagnostics, and a high level of control of the power electronics to facilitate to provide a level of future proofing (via firmware upgrades) against future changes to applicable EN standards, and user requirements;
(e) for a multi-module system to offer an enhanced level of redundancy and reliability for security system applications, i.e. if one module in a stack were to fail, the fault will be flagged, and the load will be shared amongst the remaining module(s). A multi-module system could also be configured to offer N+1 redundant operation;
(f) to support a very wide range of battery capacities to support standby times of 12 to 72 hours, as required by the customer;
(g) to offer improved manufacturability, reliability and feature set;
(h) for use in SME security panels and for sale as an original equipment manufacturer (OEM) module;
(i) compliant with the relevant EN norms, including EN 54-4/A2 and EN 50131-6.

Project results:

Via input from SME and RTD partners, market research, and study of applicable EN standards, the detailed specifications for SECURITAC stackable power supply module were defined. Notably, the module was to be manufacturer configurable to deliver 26 V / 2.5 A for fire applications, or 13 V / 5 A for intrusion, and contain PFC circuitry to comply with EN 61000-3-2 for all stacking arrangements. The intrusion configuration is designed for compliance with EN 50131-6 and enables stacking of 1 or 2 modules. The fire configuration is designed for compliance with EN54-4 and enables stacking of 1, 2, 3 or 4 modules. Each module should accommodate a battery capacity in the range 2.1 Ah to 20 Ah.

The RTD performer Institute of Energy Technology (IET), University of Aalborg, Denmark) developed the part of the module which converts the 230 VAC mains input into the 26 VDC (or 13 VDC) output to power fire / intrusion / access control systems. Promising topologies for a 70 W approx. offline converter with PFC were evaluated, and a boost PFC + forward converter topology was selected to deliver an output voltage with low ripple, as required for security systems. The pros and cons of implementing a digital controller (an emerging technology) vs. conventional analog control were considered by the consortium. To manage risk, it was agreed to incorporate conventional analog control in the SME demonstration modules, but to also develop and bench-test a digital control solution (using a Microchip dsPIC30F) for possible post-project use by the SMEs. Both approaches were developed in a series of PCB revisions, with incremental improvements made each time. Measured performance (incl. power factor, conducted emissions, and efficiency) of both approaches were shown to be similar and within spec, with the digital approach having greater flexibility. The results of the digital controller development were presented at the PEMD2010 conference by IET, and published in the scientific paper: Török, L; Munk-Nielsen, S; ‘Simple Digital Control of a two-stage PFC converter using DSPIC30F microprocessor’, Proceedings of the 5th IET International Conference of Power Electronics, Machines and Drives (PEMD).

The RTD performer Centre de Recerca i Investigació de Catalunya, Spain, developed the part of the module which includes
battery charger, fault detection, control functions, serial communication, firmware, and provides load sharing amongst multiple modules. A battery test rig was developed to perform battery testing under a controlled ambient temperature of 8 to 40 degrees of Celsius to determine the minimum necessary battery charger current to meet EN54-4 requirements. After considering various battery charger approaches, it was agreed to implement a buck-boost charger, enabling the system voltage: 26 VDC (or 13 VDC) to be lower than the maximum battery float voltage: 28.5 VDC (or 14.25 VDC), which minimises standby power and reduces voltage stress on the system electronics.

The RTD performer Feltalálói és Kutató Központ Fkt (MFKK), Hungary developed an electro-mechanical solution which enables the Securitac modules to be stacked in an easy, low-cost, and reliable way, using industry standard connectors. They designed and manufactured four iterations of the module's plastic housing using rapid prototyping technology. The final version contained sheet metal inserts to meet electromagnetic compatibility (EMC) requirements. MFKK merged the separate designs from IET and CRIC onto a single PCB of 100 x 193.9 mm. They built and tested 13 modules, and shipped a total of 12 to the five SMEs for use in their demonstration activities.

Each SME tested the modules according to their particular requirements and produced a detailed report describing their tests, results, and recommendations for the commercialisation.

The main scientific and technical foreground generated by the project includes enhanced knowledge about:

(a) parallel connection of power supplies;
(b) active and passive load sharing methods for parallel connected power supplies;
(c) how reduced battery charging rates (and powers) can be used to meet EN54-4 requirements;
(d) simple methods to implement battery series resistance testing according to EN54-4/A2;
(e) switched-mode offline power conversion techniques;
(f) PFC methods, and boost PFC in particular;
(g) compact buck-boost battery charger circuits using surface-mount technology (SMT) components and using PCB copper heat sinks;
(h) rapid prototyping techniques to manufacture plastic components;
(i) development of an efficient communications protocol (expandable) using the industry standard I2C bus for communication between modules, and between modules and external equipment;
(j) development of a novel hybrid PFC converter topology which provides good performance with only one main magnetic component and relatively of low cost concept and simulation results;
(k) development of a DSP-based power controller (an emerging technology) hardware and firmware, with measured results.

Potential impact:

Over the last decade there has been a gradual trend for suppliers of electronic equipment to move production off-shore to low-cost countries such as China, resulting in a shift of power supply sales and production to such regions. For this reason, SECURITAC addresses a ‘niche’ power supply application: security system power supplies, which are subject to strict security system standards, to which general purpose / low-cost power supplies do not comply.

The physical security market (access control, video surveillance, intrusion and fire detection) was estimated at EUR 14.5 billion (Frost and Sullivan, 2008). The United Kingdom (UK), Germany, Iberia and France represented the four largest markets, with a combined 65 % of the total market. Growth rate was estimated around 6.9 % for the period 2007 - 2013. The market in Europe is dominated by big international players, like Bosch, Siemens, Honeywell, Hekatron, and Notifier. However, a variety of SMEs, like those in the SECURITAC consortium, are active in several market gaps of the security technology.

The SECURITAC power supply provides the consortium SMEs with a unique and flexible product, as part of their product
portfolio. Other technologies progressed during the SECURITAC project (digital power control, and hybrid PFC converter topology) may also form part of partner’s future products and intellectual property portfolios. The market for power supplies that use digital loop control will grow by 45% each year for the next five years, according to analysts at the Darnell Group in Corona, California.

Consortium SMEs will undertake further development of the pre-competitive results of the project, and expect the SECURITAC product to reach the market in Q4, 2012.

The project has raised SME knowledge and fomented cooperation between the partners from 5 different European Union (EU) countries and associated member state, Turkey. SECURITAC aims to increase SME competitiveness and to contribute to securing and fomenting employment. In line with community policy for energy efficiency and greenhouse gas emission, the project has placed due emphasis on maximising energy efficiency of the power supply under the 'standby' conditions found in security systems.

The key dissemination activities performed during the project are as follows:

- A brochure was produced to describe the project and the product under development and was used in dissemination activities.
- A project website was set up for dissemination and for communication between partners.
- Partners referred to their participation in the project on their own websites.
- Promotion of the project at the EU Research Connection Congress ’09 in Prague.
- Promotion of the project at Electrotech ’10 (energy, electric and electronic technologies) trade fair in Istanbul.
- Writing of a scientific paper which describes the development and performance of the digital controller - Lajos Török, Stig Munk-Nielsen, ‘Simple Digital Control of a two-stage PFC converter using DSPIC30F microprocessor’.
- The paper was presented in the 5th IET International Conference of Power Electronics, Machines and Drives (PEMD 2010) in Brighton, UK, and published in the proceedings of the conference.

Further dissemination activities are planned, post-project.

SMEs have defined the key project results, plans for intellectual property right (IPR) protections, and plans for further post-project development and commercialisation of the project results.

List of websites: http://securitac.cric-projects.com

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