Networking Applications

Network-Enabled High-Performance UPS

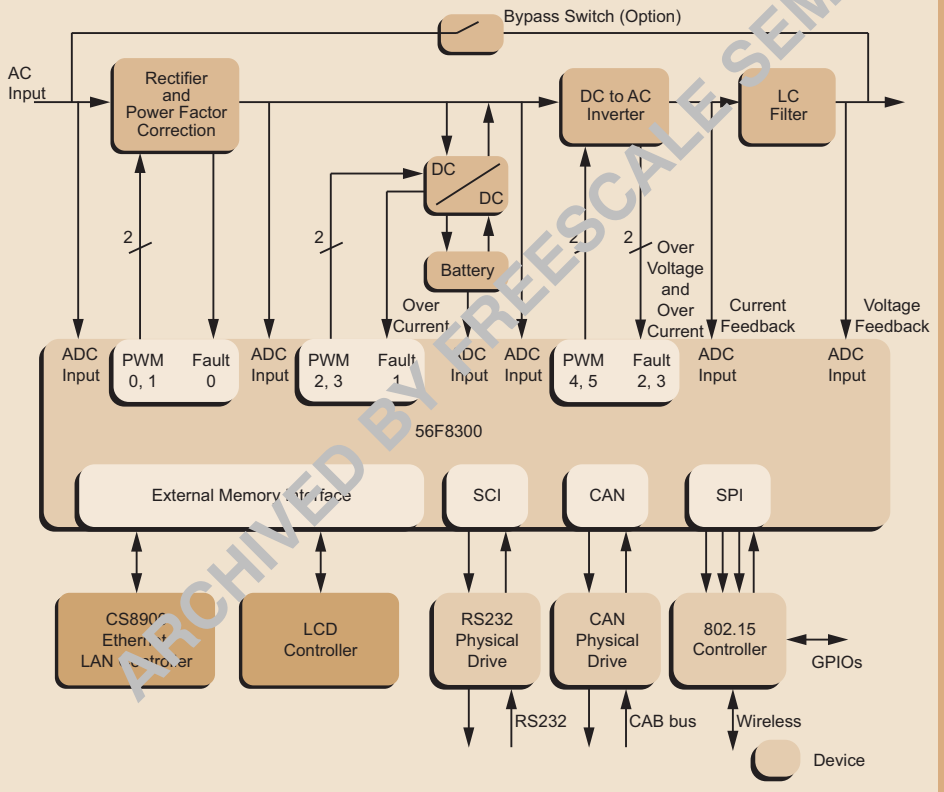
Overview

The main purpose of an Uninterruptable Power Supply (UPS) is to provide clean and stable power to a load, regardless of power grid conditions such as black-outs.

Uninterruptable Power Supplies have been widely used for office equipment, computers, communication systems, medical/life support and many other critical systems.

Recent market requirements include a target expectation for UPS reliability of 99.999% power availability, performance demands of zero switch over time, and complex network connectivity and control methods, such as Simple Network Management Protocol (SNMP).

NETWORK-ENABLED HIGH-PERFORMANCE UPS BLOCK DIAGRAM



Key Benefits

> Offers single device solution which combines MCU functionality and DSP processing power

> Expedites time-to-market using out-of-the-box software components

> Extends battery life and lowers maintenance costs

> Uses a high-input power factor (Direct PFC) and lower power pollution to the power grid

> Offers network monitored and controlled power source and load conditioning

freescale semiconductor

Freescale Ordering Information

Part Number	Product Highlights	Additional Information
DSP56F803	80 MHz, 40 MIPS, CAN, SCI, SPI, ADC, PWM, Quadrature Decoder, Quad Timer and > 31.5K Program Flash > 512K Program RAM > 4K Data Flash > 2K Data RAM	MCU-friendly instruction set, OnCE for debug, on-chip relaxation oscillator, 2K BootFLASH, external memory expansion, and up to 16 GPIO available in a 100-pin LQFP
DSP56F805	80 MHz, 40 MIPS, CAN, SCIs, SPI, ADC, PWMs, Quadrature Decoder, Quad Timers and Off-Chip Memory Expansion, and > 31.5K Program Flash > 512K Program RAM > 4K Data Flash > 2K Data RAM	MCU-friendly instruction set, OnCE for debug, on-chip relaxation oscillator, 2K BootFLASH, external memory expansion, and up to 32 GPIO in a 144-pin LQFP
DSP56F807	80 MHz, 40 MIPS, SCIs, SPI, ADCs, PWMs, Quadrature Decoder, Quad Timer Off-Chip Memory Expansion, and > 60K Program Flash > 2K Program RAM > 8K Data Flash > 4K Data RAM	MCU-friendly instruction set, OnCE for debug, on-chip relaxation oscillator, 2K BootFLASH, external memory expansion, and up to 32 GPIO in both a 160-pin LQFP and 160 MAPBGA
MC56F834x	Quad Timers, FlexCAN, Off-Chip Memory Expansion, an MCU-friendly instruction set, Enhanced OnCE for debug, and temperature sensor with > 144KB Flash > 12KB RAM	Industrial (-40°C to 105°C) and Extended (-40°C to 125°C) Temperature Ranges with up to 76 GPIOs in a 128, 144 or 160-pin LQFP
MC56F835x	Quad Timers, FlexCAN, Off-Chip Memory Expansion, an MCU-friendly instruction set, Enhanced OnCE for debug, and temperature sensor with > 280KB Flash > 20KB RAM	Industrial (-40°C to 105°C) and Extended (-40°C to 125°C) Temperature Ranges with up to 76 GPIOs in a 128, 144 or 160-pin LQFP
MC56F836x	Quad Timers, FlexCAN, Off-Chip Memory Expansion, an MCU-friendly instruction set, Enhanced OnCE for debug, and temperature sensor with > 576KB Flash > 64KB RAM	Industrial (-40°C to 105°C) and Extended (-40°C to 125°C) Temperature Ranges with up to 76 GPIOs in a 128, 144 or 160-pin LQFP

Design Challenges

Presently, a UPS is often implemented with an MCU. But MCUs have significant price/performance limitations that can be rectified by implementing the UPS using a hybrid MCU with efficient Digital Signal Processing capability. This has not been possible until recently, due to performance and the cost of the processors required to do the job. The 56F800 or 56F8300 series of hybrid controllers both have the required performance, peripherals, and price targets to enable UPS designs to implement advanced features.

Freescale Semiconductor Solution

The digital 56800/E network-enabled high-performance UPS reduces system component count, increases system reliability, and enables advanced functions while reducing cost. Key advantages of this digitally-controlled UPS include:

> Bidirectional AC/DC conversion
> High-input power factor with Direct PFC and lower power pollution to the power grid
> Extended battery life and lower maintenance costs
> Power source and load conditioning can be monitored in real time
> Network communication for remote control and monitoring

The functional blocks of the on-line triple conversion UPS are shown in the figure on page 1. During normal operation, the AC input voltage is rectified by an AC/DC converter that rectifies the input voltage and regulates the input power factor. The output of the AC/DC converter is a DCBus voltage that is used as the source for both the battery charger and DC/AC inverter. The battery charger is a boost/buck DC/DC converter. When the system is charging the batteries, the DC/DC converter works in buck mode, which steps the high DCBus voltage down to the batteries' acceptable voltage level and charges the batteries. When the battery pack is fully charged, the converter switches to stand-by mode. If an input power failure occurs, the DC/DC converter works in boost mode, which supplies power to the DCBus from the batteries. The DC/AC inverter is used to convert the DC voltage to an approximated sinusoidal output voltage pulses. The pulse string is input to an LC filter, which generates a true sinusoidal output voltage that is supplied to the load. The user can select the frequency of the sinusoidal output voltage and the frequency can either be synchronized to the input voltage frequency or any other desired independent stable frequency. When any failures or faults are generated or maintenance is needed in the UPS system, the bypass switch will be engaged, which turns the UPS system off and connects the load directly to the input power source.

All necessary control functions are implemented within the hybrid controller, such as:

> Power on/off control
> DCBus voltage regulation
> Input power factor correction
> Battery management
> AC output voltage regulation
> Frequency synchronization of input and output
> Power source monitoring
> System self diagnostics and self protection
> Emergency event processing
> Real-time multi-tasking system operation
> Communication protocols

Development Tools

Tool Type	Product Name	Vendor	Description
Software	CW56x8x	Freescale Semiconductor	CodeWarrior™ Development Studio for 56800/E Controllers With Processor Expert (Metrowerks)
Hardware	MC56F8300DSK	Freescale Semiconductor	56F8300 Developers Starter Kit
Hardware	56F800DEMO	Freescale Semiconductor	56F800 Demonstration Kit
Hardware	DSP56F803EVM	Freescale Semiconductor	Evaluation Module for 56F803
Hardware	DSP56F805EVM	Freescale Semiconductor	Evaluation Module for 56F805
Hardware	DSP56F807EVM	Freescale Semiconductor	Evaluation Module for 56F807
Hardware	MC56F8367EVM	Freescale Semiconductor	Evaluation Module for 56F834x, 56F835x, 56F836x

Disclaimer

This document may not include all the details necessary to completely develop this design. It is provided as a reference only and is intended to demonstrate the variety of applications for the device.

Notes

Learn More: Contact the Technical Information Center at +1-800-521-6274 or +1-480-768-2130.
For more information about Freescale products, please visit **www.freescale.com**.

SG2095
REV 2
6/2005

June2005