LP3970

Powering Applications Processors with a Multifunction Integrated Power Solution

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Technology Edge

Powering Applications Processors with a Multifunction Integrated Power Solution

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Power consumption and battery life are major obstacles that system designers have to consider when designing for portable battery-operated systems. One system that requires sophisticated power management to achieve maximum battery life is one that incorporates a high-performance applications processor. An example is Intel's PXA27x XScale® applications processor. This device requires up to 12 different power domains for the processor, IOs and internal subsystems to function with peak performance and optimized efficiency. Intel's PXA27x processor has multiple power-supply inputs which can be turned on and off as demanded by the CPU's power management software. Its flexible power management architecture controls the selection of the internal and external peripherals that can be powered at any given time.

Flexible Integration

National has developed an integrated power solution, the LP3970 Flexible Power Management Unit, for Intel's XScale high-performance power architectures. The LP3970 provides an integrated power management solution that can supply power to support 10 independent low-noise, lowdropout LDOs, two DC-DC buck regulators, a backup battery charger for both Lithium-Ion (Li-Ion) and Lithium Manganese (Li-Mn) coin-cell batteries, and a dedicated regulator for the real-time clock (RTC) function - all integrated in a single 48-pin, thermally enhanced Leadless Lead-frame Package (LLP). The LP3970 automatically switches from main to backup battery when the preset battery empty voltage is reached. And, the LP3970 interfaces with the PXA27x processor via the simple two-wire I2C-compatible bus and four additional General Purpose Outputs (GPOs).

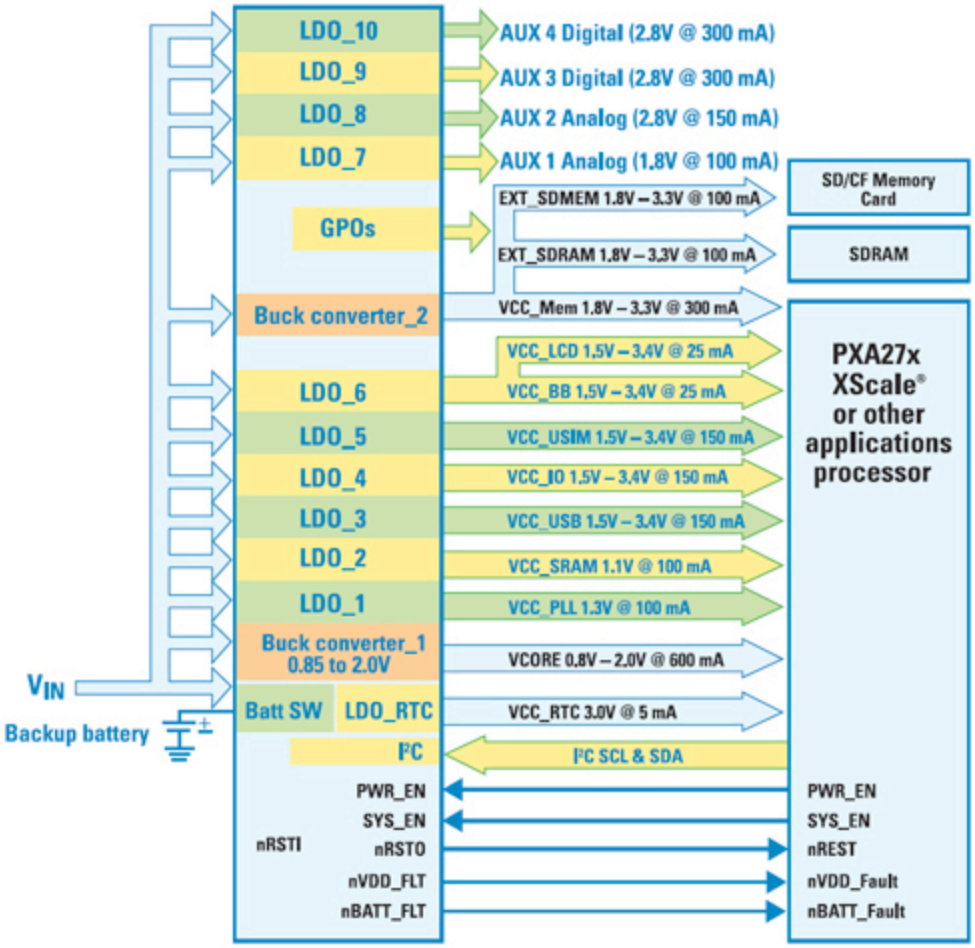

Figure 1. LP3970 Application diagram

Variable-Controlled Voltage Buck Regulators

One major feature integrated into Intel's PXA27x is their dynamic voltage management (DVM). Intel's DVM and dynamic frequency management allow continuous changes to system voltage and frequency, depending on the core load requirements, without interrupting the CPU. Thereby, additional tools are provided in the developer's library to achieve better balance between performance and battery life. For the LP3970 to achieve dynamic voltage management within the PXA27x processor, Buck converter_1 of the two programmable buck regulators will drive the dynamic input for the processor core, which needs an input varying from 0.85V to 1.7V. The internal power manager programs the required core voltage for the specified frequency. The step-size increment of 50 mV can then be programmed via the I2Ccompatible bus. Buck converter_2 meets the power requirements of internal peripheral logic blocks such as the memory controller, LCD controller, digital audio, and the serial ports for the PXA27x. The programmable voltage range for Buck converter_1 is 0.8V to 2V, which should provide power for a wide range of applications. Buck converter_2, with its programmable output voltage range of 1.8V to 3.3V, is designed for other high-current peripherals (i.e. internal processor memory, external SRAM, etc.). Programming can be initiated by the PXA27x host processor via the I2C-compatible bus with a series of commands to the LP3970, running at either at 40 kHz (standard mode) or at 400 kHz (fast mode) using the standard 7-bit addressing.

Additional Buck Features

The buck regulators can deliver up to 650 mA each, depending upon the external inductor, and the input and output voltages by using synchronous rectification with the internal FETs and voltage mode control. Each buck regulator can also operate up to a 100% duty cycle for low-dropout control of the output voltage. As a result, power efficiency of 90% or higher is achieved. Additional features for the buck regulators include softstart and both current and thermal overload protection. The buck regulators operate in PWM mode when the current loads are 70 mA or greater. With lighter current loads, the buck regulators automatically switch to PFM mode when the following two conditions occur. These two conditions are when the inductor becomes discontinuous and when the PMOS switch current drops below the current level of less than (66 mA +

VIN/160W).

The PXA27x processor outputs two hard-wired power control signals directly to the PMIC. The two control signals are system enable (SYS_EN), which controls the high-voltage supplies, and power enable (PWR_EN), which controls the low-voltage supplies from the LP3970 to the PXA27x. Installation of a backup battery for the first time begins the initial cold-start, power-up sequence, which enables its internal power management unit and one oscillator.

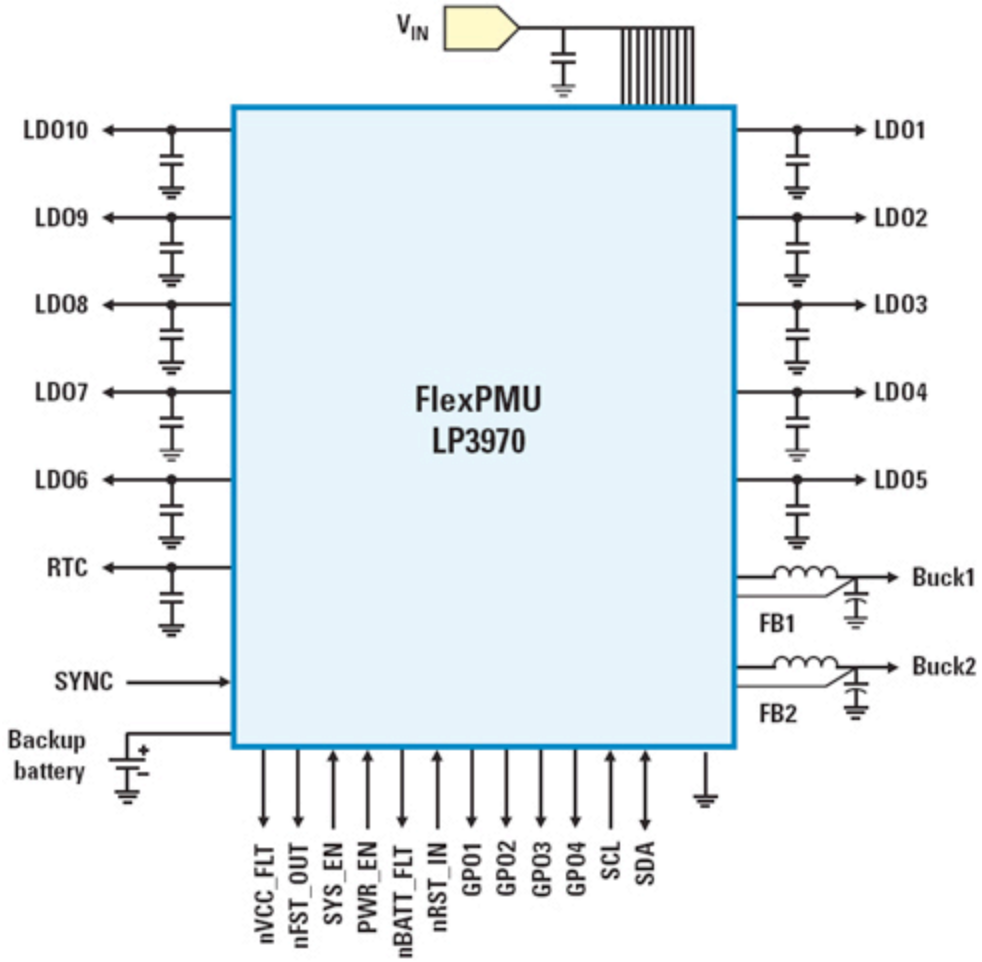

Figure 2. LP3970 functional schematic

Backup Battery Charger

With the integrated backup battery charger, the LP3970 automatically switches from the main battery to a backup coin-cell battery or super capacitor. Further, the switch happens when the main battery is removed or its voltage is too low. The backup battery continues to power the LDO_RTC until the main battery is recharged or replaced. When the main battery is available, the battery switch connects the main battery to the LDO_RTC and the backup battery charger starts charging the backup battery when the system voltage is above 3.4V. The battery charging current can be programmed via the I2C-compatible interface.

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