New Compact Energy-Harvesting and Power-Management IC

The MAX17710 harvests energy from power sources of 1uW to 100mW for efficiently charging THINERGY(R) Micro-Energy Cells (MECs).

Maxim Integrated Products introduces the MAX17710, the industry's first IC to integrate all of the power-management functions for ambient energy harvesting, as well as for charging and protecting micro-energy cells (MECs), a form of solid-state battery. Operating at an ultra-low current level, the MAX17710 accepts energy from a variety of poorly regulated energy harvesting sources with output levels ranging from 1uW to 100mW. Examples include light (captured by photovoltaic cells), vibration (captured by a piezoelectric element), heat (captured by a thermoelectric generator), and RF (e.g., near-field communications (NFC)). The MAX17710 integrates a programmable input boost regulator and needs no expensive external components to charge a MEC with energy sources as low as 0.8V. It protects the MEC by using a linear shunt-series regulator. An ultra-low-quiescent current, adjustable low-dropout linear regulator (LDO) with selectable voltages of 3.3V, 2.3V, or 1.8V allows the MAX17710 to adapt to a variety of loads. Packaged in a low-profile 0.5mm TQFN, it enables a new class of thin, card-like applications. The IC will also be available in wafer form to enable even thinner form factors. The MAX17710 is targeted for powered smart cards, real-time clock (RTC)/memory backup applications, and wireless sensor networks. Examples of wireless sensor networks include remote applications like irrigation valve control, building energy management, machine monitoring systems, asset tracking, biometric security systems, medical applications, and a myriad of portable consumer electronics.

Industry Needs a Highly Integrated Energy-Harvesting System

Energy harvesting is poised for rapid and exponential growth. However attractive the energy sources and the uptake potential for business growth, efficient harvesting has been hampered until now by the many different power-management blocks and functions that needed to be combined for the task. As essential components were assembled, more space was consumed, which defeated the goal of reducing application size and cost. Meanwhile, a larger cell was needed for storage because quiescent current was added to the system, and the overall power budget rose to unmanageable levels for low-energy ambient sources.

The Importance of MECs

While creating the MAX17710 energy-harvesting and power-management solution, Maxim worked closely with Infinite Power Solutions, Inc. (IPS), the manufacturer of THINERGY(R) solid-state, rechargeable MEC battery products. THINERGY MECs are flexible and provide unrivaled rechargeability, cycle life, and power performance.

These ultra-thin, postage-stamp-sized energy storage products offer extremely low self-discharge rates, enabling many years of shelf life and still providing reliable backup power. The unprecedented cycle life capability and unique metal foil encapsulation enable decades of reliable, maintenance-free operation.

The MAX17710 provides the energy harvesting and power management to maximize, protect, and control the energy stored in MECs. “When combined with ambient energy harvesting, MECs uniquely enable autonomous, perpetually powered solutions for decades of use,” explained David Squires, Vice President of Business Development for Infinite Power Solutions. “In energy harvesting applications, a key enabler is the quiescent current drawn by the power-management IC,” Squires added. “The MAX17710 has an unprecedented 1nA battery current draw when a harvesting source is not present.”

The MAX17710 Brings Efficiency and Flexibility to Energy Harvesting

The ultra-low operating current MAX17710 simplifies the design of energy-harvesting systems by integrating a programmable regulator, buffer energy storage management, and the charger and protection for THINERGY MECs.

The MAX17710 has an ultra-low-quiescent linear charger block to safely charge THINERGY MECs. To protect the MEC from overvoltage conditions, the MAX17710 regulates the input voltage and can shunt excess power. An ultra-low-quiescent current, undervoltage protection circuit prevents potentially damaging overdischarge of the MEC. The undervoltage protection recovers only when an external energy source raises the voltage of the MEC back into a safe zone.

At very low temperatures, all batteries exhibit increased characteristic impedance, which limits high pulse currents to the application loads. The MAX17710 integrates a unique feature that manages an external storage capacitor to augment the battery output and provide high pulse currents, even at very cold temperatures like -40 degrees Celsius.

The Benefits of Energy Harvesting for Remote and Portable Applications

Designers are attracted to energy-harvesting-based solutions because they can eliminate the need to run expensive power cables to remote locations or to replace primary batteries frequently.

Many applications such as remote sensors need extensive wiring that is difficult and expensive to install, and often time-consuming and costly to maintain. Some alternative approaches use primary batteries. Ultimately, these batteries can be burdensome and costly to replace. Enhanced security systems for critical environments like airports and hospitals are also requiring significantly upgraded personnel identification systems. Many of these portable systems have traditionally used computationally intensive biometric techniques that require a power source like a battery on the ID device. These batteries add bulk to the form factor and can be unwieldy to use in high-volume deployments. Eventually each battery needs to be replaced, a process that will cost both time and money.

Maxim's MAX17710, in tandem with THINERGY MECs, overcomes the power- and battery-management limitations posed by the traditional sensor installations. Managing harvested ambient energy from available sources such as light, heat, RF, and vibration with the MAX17710, and efficiently storing that energy in a THINERGY MEC, provides an autonomous, maintenance-free energy source to power a remote sensor. This solution eliminates the need for expensive wiring or prohibitive labor costs to replace traditional primary batteries.

The MAX17710 also works in power-bridging applications where energy harvesting is not necessarily used. In such applications, infrastructure power (from the grid or a larger battery) is typically available to power the system and can trickle-charge an MEC for memory or RTC backup power. In the event of a loss of grid power, or a system "brownout" during replacement of the larger system battery, the stored energy in the MEC continues to power volatile memory and/or an RTC for hours, days, or even weeks. This solution displaces bulky coin cells and supercapacitors that have high self-discharge currents and limited life, especially at elevated temperatures.

Designed for the low-profile requirements of many energy harvesting applications, the MAX17710 is packaged in a lead-free, 12-pin, 3mm x 3mm x 0.5mm UTDFN. Pricing starts at $4.11 (2.5k-up, FOB USA). An evaluation (EV) kit featuring the MAX17710 PMIC, THINERGY MEC101, and solar energy harvesting is also available.

At the Energy Harvesting & Storage Europe 2011 event in Munich, Germany, Maxim will be showcasing the MAX17710 in a two-part demo that displays the various energy sources used for micropower energy harvesting. This demonstration will take place in booths 27 and 28 at the Holiday Inn Munich City Centre, June 21–22, 2011.

For more information please visit, www.InfinitePowerSolutions.com [1]

For more information, please visit, www.maxim-ic.com [2]

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