Silicon Labs' turnkey energy harvesting reference design features an extremely low power wireless sensor node that operates from a solar energy harvesting source, making it an ideal demonstration for wireless energy harvesting applications where batteries would be inconvenient to replace or expensive. At the heart of the system is the Si10xx single-chip wireless MCU, which performs both control and wireless interface functions at very low power levels. An auxiliary input allows the power management stage to accept an input from an alternative energy source (e.g., vibration, thermal or RF) when the solar cell input is bypassed. Integrated USB connectivity makes it easy to transfer data to a computer for processing.

- Turnkey wireless sensor node design
- Optimized for low power consumption
- Flexible design accommodates other harvested energy sources
- Integrated USB connectivity

**SILICON LABS SOLUTIONS FOR ENERGY HARVESTING SYSTEMS**

- C8051F9xx MCUs featuring the industry's lowest power consumption in all operating modes
- Si1xxx low power MCU with integrated sub-GHz transceiver, full operation to 0.9 V
- Low power, high sensitivity radio (-121 dB) transmitters, receivers and transceivers
- Radio has integrated power amp capable of +20 dBm output power or +13 dBm at 0.9 V operation
- Operating voltage down to 0.9 V (integrated dc-dc converter)
- Integrated microcontroller peripherals including 12-bit ADC, comparators, RTC, UART, SPI, I2C, PWM and timers
- In-system programmable flash memory
- Integrated mixed-signal peripherals to remove the need for external components
- The industry’s smallest package sizes
- Low MCU sleep mode current (10 nA) for longest battery life

**APPLICATIONS**

- Home and building automation networks
- Industrial sensor networks
- Wireless sensor nodes
- Medical monitoring systems
- Infrastructure sensing systems
- Security systems
- Agriculture monitoring systems
- Asset monitoring/tracking devices

**MORE INFORMATION AND DOCUMENTATION DOWNLOADS AT:** [www.silabs.com/energy-harvesting](http://www.silabs.com/energy-harvesting)
Energy Harvesting Reference Design
Part Number: ENERGY-HARVEST-RD

The wireless sensor node on the energy harvesting reference design measures temperature, light level and charge level. When a send button on the sensor node PCB is depressed, this data is transmitted to the USB wireless adapter. The USB wireless adapter then transfers the data to the Wireless Development Suite (WDS) software environment. An intuitive graphical user interface (GUI) displays the data (temperature, light level and charge level) for up to four wireless sensor notes. A solar cell on the wireless sensor node converts light to current that trickle-charges the thin film battery via a power management stage.

Charging Times for Thin Film Battery
The thin film battery included in the reference design is rated at 700 μA/hours. Average times for fully charging an empty battery with no system load are listed below.

- **Electric Light** (50-200 Lux): 24 Hours
- **Office Window** (~1000 Lux): 6 Hours
- **Direct Sunlight** (100 K Lux): 2 Hours
- **USB Charging** (Limited to 3 mA): 30 Minutes

### Silicon Labs’ Products Optimized for Energy Harvesting Solutions

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>DESCRIPTION</th>
<th>SILICON LABS SOLUTION</th>
<th>CUSTOMER BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Si1xxx</td>
<td>Wireless MCU</td>
<td>Integrated low power MCU and RF transceiver</td>
<td>Full operation down to 0.9 V, small package with no external PA required</td>
</tr>
<tr>
<td>CB051F9xx</td>
<td>Low Power MCU</td>
<td>Ultra low-power MCU product family</td>
<td>Stop mode as low as 10 nA, RTC on as low as 300 nA, active mode as low as 150 μA per MHz</td>
</tr>
<tr>
<td>Si4xxx</td>
<td>EZRadioPRO® ISM Band Radio</td>
<td>Sub-GHz ISM band transmitters, receivers and transceivers</td>
<td>Up to 141 dB link budget, 240-960 MHz continuous frequency range, +13/+20 dBm output power</td>
</tr>
<tr>
<td>ENERGY-HARVEST-RD</td>
<td>Energy Harvesting Reference Design</td>
<td>On-chip temperature sensor, reduce power by harvesting energy from solar, thermal, piezo and radio frequency waves</td>
<td>No need for batteries, reduces overall cost and size, improved reliability</td>
</tr>
</tbody>
</table>