Over Current Protection
Reference Design & Study

Project Overview
As portable devices advance, the need for current sensing within the device is increasing. Current sensing allows for power monitoring, which may aid in extending battery life, as well as over current protection, which extends the overall lifetime of the product. Texas Instruments (TI) has provided Design Team 5 with two separate current sensing applications: emergency shutdown of a tablet PC and current & power monitoring of a cell phone using TI current sensing components. In addition to this, TI requested various studies be completed to explore how poor PCB traces adversely affect the overall accuracy of ICs used.

Design Specifications

- **Tablet-PC Emergency Shutdown**
  - Assume 3.6 V, 6.75 A-hr Li-Ion battery
  - Shutdown power to load at 1 A
  - Low cost
  - Small size
  - Low power consumption
  - Fast speed of shutoff > Accuracy

- **Cell Phone Power Monitoring***
  - Assume well-regulated 3 V supply
  - Variable load (2.7-3.3 V)
  - Accuracy within 7.0-192.5 mA
  - Minimal system impact
  - Low cost
  - Small size
  *Specifications based on Motorola Droid X

Results

**Tablet PC Shutdown**
- Speed: 125 µs
- Power: 288.72 µW
- Size: 0.97 in X 0.75 in

**Cell Phone Power Monitoring**
- Power consumption is monitored with an MSP430 microcontroller and displayed on an LCD screen.
- Accuracy: Within 100µV of actual signal

**PCB Design Studies**
- 4 cases completed:
  - Ideal case
  - Long traces
  - Unsymmetrical traces
  - Non-kelvin connections

<table>
<thead>
<tr>
<th>Case</th>
<th>Current</th>
<th>Expected output</th>
<th>Output</th>
<th>%Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ideal</td>
<td>118.92mA</td>
<td>297.3mV</td>
<td>323.5mV</td>
<td>8.81%</td>
</tr>
<tr>
<td>Long</td>
<td>111.42mA</td>
<td>278.55mV</td>
<td>493.89mV</td>
<td>77.11%</td>
</tr>
<tr>
<td>Non-symmetrical</td>
<td>100.24mA</td>
<td>250.56mV</td>
<td>273.77mV</td>
<td>9.57%</td>
</tr>
<tr>
<td>Non-Kelvin</td>
<td>99.513mA</td>
<td>248.78mV</td>
<td>325.24mV</td>
<td>30.77%</td>
</tr>
</tbody>
</table>

Design Concepts

- **Tablet PC emergency shutoff block diagram**
- **Cell phone current monitoring block diagram**