Electronic Tamper Detection
Smart Meter Reference Design

Overview
The smart grid needs to physically secure all elements that may include smart meters, data concentrators, intelligent electronic devices (IEDs) and secure gateways. Freescale provides a high performance electronic tamper detection smart meter reference design that integrates an ultra low-power Xtrinsic 3-axis tilt sensor used for electronic tamper detection. This reference design has the ability to connect to a ZigBee® network through an internal daughter card. Hence, it can easily become part of the smart grid network. Firmware for this reference design is based on the MQX™ real-time operating system. All standard metering values are displayed on the built-in LCD and selectable via the push button. A variety of communication interfaces are available for remote data collecting, making this an ideal solution for advanced residential metering.

Metrology Key Features
- 5(100)A current range, nominal current is 5A, peak current is 100 A
- 85V...264V voltage range
- 47Hz...63Hz frequency range
- 4-quadrant measurement
- Fast Fourier Transform (FFT) DSP processing implemented
- IEC50470-3 and ANSI C12.20 compatible
- Active and reactive energy accuracy: IEC50470-3 Class B, 1%
- Line frequency measurement (for precision zero-cross detection)
- Current transformer for current sensing circuit implementation
- Cost-effective bill of materials (BOM)
- Low-power modes effectively implemented, including the use of the built-in RTC (Libattery backed-up)
- LCD display, 4x44 segments including charge pump
**Electronic Tamper Detection Smart Meter Reference Design**

**Freescale Technology**

**Optional**

```
<table>
<thead>
<tr>
<th>ADC16</th>
<th>Internal OSC</th>
<th>Clock Gen.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-axis Transducer</td>
<td>Y-axis Transducer</td>
<td>Z-axis Transducer</td>
</tr>
<tr>
<td>Voltage Regulator</td>
<td>C to V Converter</td>
<td>Embedded Functions</td>
</tr>
</tbody>
</table>
```

**MC1322x Low Power Node**

- Full 802.15.4 compliant wireless node based on Freescale's third-generation ZigBee® platform
- 2.4 GHz radio frequency transceiver
- 32-bit ARM7 core-based MCU
- Hardware acceleration for both the IEEE 802.15.4 MAC and AES security
- Connectivity from simple point-to-point to a complete ZigBee® mesh
- On-board balun and antenna switch in package (valid for 1322x-LPN module)
- Over-the-air data rate of 250 kbps
- Typical range (outdoors, line of sight) is 300 meters
- 99-pin LGA Platform-in-Package (PiP)

**MMA8491Q Xtrinsic 3-Axis MEMS Tilt Sensor**

- Miniature 3 mm x 3 mm QFN 12-pin package
- 0.65 mm lead pitch
- Visual solder joint inspection capable
- Integrated tilt algorithms
- Low current consumption: 400 nA at 1 Hz sample rate
- Fast turn on time
- 14-bit accelerometer data
- MEMS technology
- 1.95V to 3.6V VDD supply range

---

**Document Number:** TAMPERMTRFS REV 0

For more information, visit freescale.com/metering

Freescale and the Freescale logo are trademarks of Freescale Semiconductor, Inc., Reg. U.S. Pat. & Tm. Off. ARM is a registered trademark of ARM Limited. Cortex-M4 is a trademark of ARM Limited. All other product or service names are the property of their respective owners. © 2012 Freescale Semiconductor, Inc.