Embedded Development:
tmote-sky platform

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Tmote Sky

- 8MHz Texas Instruments MSP430 microcontroller (10k RAM, 48k Flash)
- 250kbps 2.4GHz IEEE 802.15.4 Chipcon Wireless Transceiver
- Integrated onboard antenna with 50m range indoors / 125m range outdoors
- Integrated Humidity, Temperature, and Light sensors
- Hardware link-layer encryption and authentication
Tmote Sky Structure (Back)

- Texas Instruments MSP430 F1611 microcontroller
- 48-bit silicon serial ID
- 2-pin SVS connector
- USB Flash (2kB)
- 32kHz oscillator
- ST Code Flash (1MB)
Tmote Sky Structure (Front)

- User Button
- Reset Button
- USB Transmit LED
- USB Connector
- USB Receive LED
- LEDs
- JTAG connector
- USB Microcontroller
- Digital switch isolating USB from microcontroller
- CC2420 Radio
- SMA Antenna Connector (optional)
- 6-pin expansion connector
- 10-pin expansion connector
- Photosynthetically Active Radiation Sensor (optional)
- Humidity Temperature Sensor (optional)
- Total Solar Radiation Sensor (optional)
- Internal Antenna
Chipcon CC2420

- True single-chip 2.4 GHz IEEE 802.15.4/ ZigBee RF transceiver with MAC support
- DSSS modem with 2 Mchips/s and 250 kbps effective data rate
- Programmable output power in 8 steps from -25 to 0 dBm
- Low current consumption: RX=19.7 mA; TX=17.4 mA@0dBm
- Low supply voltage (2.1 V - 3.6 V)
- Few external components
- Hardware MAC encryption and authentication (AES-128)
## Chipcon CC2420

<table>
<thead>
<tr>
<th>Feature</th>
<th>CC2420</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>2.4GHz</td>
</tr>
<tr>
<td>Data rate</td>
<td>250kb/s</td>
</tr>
<tr>
<td>Tx Power</td>
<td>-25 to 0dBm, 8 steps</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>Tx 17.4mA@0dBm, Rx 19.7mA</td>
</tr>
<tr>
<td>Rx Sensitivity</td>
<td>-95dBm</td>
</tr>
<tr>
<td>MAC Support</td>
<td>802.15.4</td>
</tr>
<tr>
<td>Encryption</td>
<td>AES-128</td>
</tr>
</tbody>
</table>
MSP430F1611

- 16-Bit RISC Architecture, up to 8 MHz
- 48KB+256B Flash Memory
- 10KB RAM
- Low Supply-Voltage Range, 1.8 V-3.6 V
- Ultralow-Power Consumption
- 2 x 16-bit Timers
- 2 x Serial Communication Interfaces
- 8 x 12-Bit A/D Converter & 2 x D/A Converters
Basic Commands

- motelist
- msp430-gcc
- msp430-bsl.exe --telosb -c 16 -r -e -I -p ${NAME}.a43
Tmote-sky Block Diagram
MSP430F1611 Function Block Diagram
Clocks

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Table 4–1. Basic Clock Module Registers

<table>
<thead>
<tr>
<th>Register</th>
<th>Short Form</th>
<th>Register Type</th>
<th>Address</th>
<th>Initial State</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCO control register</td>
<td>DCOCTL</td>
<td>Read/write</td>
<td>056h</td>
<td>060h with PUC</td>
</tr>
<tr>
<td>Basic clock system control 1</td>
<td>BCSCTL1</td>
<td>Read/write</td>
<td>057h</td>
<td>084h with PUC</td>
</tr>
<tr>
<td>Basic clock system control 2</td>
<td>BCSCTL2</td>
<td>Read/write</td>
<td>058h</td>
<td>Reset with POR</td>
</tr>
<tr>
<td>SFR interrupt enable register 1</td>
<td>IE1</td>
<td>Read/write</td>
<td>000h</td>
<td>Reset with PUC</td>
</tr>
<tr>
<td>SFR interrupt flag register 1</td>
<td>IFG1</td>
<td>Read/write</td>
<td>002h</td>
<td>Reset with PUC</td>
</tr>
</tbody>
</table>
Timer B

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