Notion

Operational Description for Sensor (model 0001)

The sensor is comprised of individual sensing components including audio, light, moisture, and motion sensors, as well as LED indicators connected to a Ti cc2538 SOC, through analog and low frequency digital connections (DC to 100KHz) The cc2538 contains a 32 Khz RC oscillator used for timekeeping, a 16 MHz RC oscillator used to boot and for low power operatoin of an on-board Cortex M3 processor, and a 32 MHz crystal oscillator which may be used to drive the the processor, and is used as a source for the radio circuity of the cc2538. All memory for the CPU is contained on-chip.

The sensor is powered from a single 3.0 volt Lithium primary cell, type CR2477N. The cc2538 including all radio functions are directly powered form the battery.

The CPU within the Ti cc2538 SOC gathers data from sensor inputs and generates messages of significant events to be transmitted by 802.15.4 radio message.

Inside the Ti cc2538 SOC, the FSM submodule controls the RF transceiver state, the transmitter and receiver FIFOs, and the dynamically controlled analog signals. The modulator transforms raw data into I/Q signals to the transmitter digital-to-analog converters (DACs). This is done in compliance with the IEEE 802.15.4 standard. The demodulator retrieves the over-the-air data from the received signal. The amplitude information from the demodulator is used by the automatic gain control (AGC). The AGC adjusts the gain of the analog LNA so that the signal level within the receiver is approximately constant. The frame filtering and source matching supports the FSM in the RF Core by performing all operations needed to do frame filtering and source address matching, as defined by IEEE 802.15.4. The frequency synthesizer (FS) generates the carrier wave for the RF signal.

Modulation Process: (per IEEE 802.15.4) Each byte is divided into two symbols of 4 bits each. The least-significant symbol is transmitted first. For multibyte fields, the least-significant byte is transmitted first, except for security-related fields, where the most-significant byte is transmitted first.
Each symbol is mapped to 1 of 16 pseudo-random sequences, 32 chips each. The chip sequence is then transmitted at 2 Mchips/s, with the least-significant chip (C0) transmitted first for each symbol. The modulation format is offset – quadrature phase shift keying (O-QPSK) with half-sine chip shaping. This is equivalent to minimum shift keying (MSK) modulation. Each chip is shaped as a half-sine, transmitted alternately in the I and Q channels with one-half chip-period offset.

The carrier frequency is generated by a PLL from the 32MHz crystal oscillator. Carrier frequencies in the range from 2405 to 2480 MHz are supported. The carrier frequency will be one of the IEEE 802.15.4-2006 specifies 16 channels within the this range. These channels are numbered 11 through 26 and are 5 MHz apart.

The radio generates an RF signal to the antenna matching ntework. The Ti cc2538 SOC and surrounding components are on a PCB with reference ground plane covering all unused area except that surrounding the antenna, as required by the antenna design. The passive antenna matching network is connected to a PCB printed trace 'F' antenna, and no external antenna connection is provided. The maximum antenna gain is 3.3 dBi.