GENERAL DESCRIPTION

RF MODULE.

This module enables RF communication to any device it is connected to using the EmberNet 802.15.4 compliant stack supplied by Ember Corporation. This is a 4-layer double-sided surface mount PCB.

This module exhibits a nominal transmit power of –0.5dBm and a receive sensitivity of –94dBm. It uses the 2.4GHz radio frequency range and is designed to comply with the IEEE 802.15.4 standard for short range wireless communication.

Microcontroller.

The MPU used for this design is the Atmel ATmega128L, this runs the EmberNet self-organising mesh networking firmware in addition to the application firmware.

Two external crystals are required for the application. First an 8MHz crystal is used with two loading capacitors to generate the microcontrollers system clock. This crystal is also used to generate the MAC time base to meet the requirements of 802.15.4 and hence is a high accuracy xtal with high stability loading capacitors.

The second xtal is a standard 32.768KHz watch xtal which is used to drive the microcontroller in power-save mode.

Capacitor C1, C2, C3 & C14 are used for power supply decoupling.

EM2420 RF Transceiver.

The EM2420 transceiver is configured for unbalanced operation, to accomplish that a balun circuit is used (components C20,C21,C22,C23,L1,L2 & L3) the values of which are critical.

The balun circuit used in this design performs several functions. First, it performs the typical function of a balun, which is to convert the balanced (or differential) RF input/output to an
unbalanced (or single-ended) port. Component pairs L2/C22 and L3/C20 accomplish this by
shifting the phase of the two balanced signals RF_P and RF_N by ±90° (ideally). By shifting the phase of the signals 180° relative to each other, the signals combine in-phase (or separate out-of phase, depending on the signal direction).

The second function performed by the balun is impedance matching. All component values were carefully chosen so that the impedance “looking into” the single-ended port of the balun is 50Ω. A well-matched balun circuit is essential to get full performance out of the EM2420.

Finally, the balun is used to provide the appropriate DC bias to the internal PA and LNA when the device is transmitting and receiving, respectively. A DC path must

exist from pin TXRX_SWITCH to pins RF_P and RF_N. In this design, this is accomplished with components L1 and L2. Component C22 is used for decoupling.

Crystal.

An external 16MHz xtal with two loading capacitors is required for the internal oscillator circuit. It is worth mentioning that, again, this is a high accuracy xtal used with specifically matched capacitors to ensure the transmit frequency's accuracy. Any build defects e.g. additional solder, flux, incorrect component values, etc can all be causes of transmit frequency errors and result in a degradation of the modules performance.

Bias resistor

The bias resistor, R2, is used to set an accurate bias current for the internal current reference
generator. A 43kΩ resistor with 1% tolerance must be used.

Voltage regulator

The on-chip voltage regulator is used to power all 1.8V power supply inputs. A 10µF tantalum capacitor (C15) is required to maintain stability of the regulator, and it must have an ESR between 0.5Ω and 5Ω. Since the ESR will vary with temperature, a series resistor may be used to prevent it from dropping below 0.5Ω.

Power Supply Decoupling

Proper power supply decoupling must be used for optimal performance. The placement and size of the decoupling capacitors are very important. To achieve the best performance, it is
recommended that the component values, sizes, and placements used in this reference design are followed closely.