

Radio Frequency Assembly (RFA) Description:

The Antenna port (J3) uses a circulator to direct the receive and transmit signals.

In transmit mode, the RFA performs direct-sequence spreading using 21 chips per message symbol. A 250 MHz local oscillator (LO) and 248.75 MHz Surface-Acoustic Wave (SAW) filter are used to perform the continuous-phase-shift-modulation (CPSM) which converts the digital signal to a spread spectrum signal at the RFA's 248.75 MHz intermediate frequency (IF). After the CPSM modulation, the spread signal is upconverted to one of 40 center frequencies at 1 MHz intervals from 2423.75 MHz to 2462.75 MHz using an appropriate LO frequency between 2175 MHz and 2214 MHz. This later LO is designated the 2.2 GHz LO to differentiate it from the 250 MHz LO.

The 2423.75 MHz to 2462.75 MHz ISM band signal is then filtered to suppress undesired components of the frequency conversion, and amplified to 28.5 dBm at the Antenna port (J3). The amplifier incorporates Automatic Gain Control (AGC) to maintain the desired level of 28.5 dBm +/-1.0 dB across the frequency band and environmental conditions.

In receive mode, the incoming 2423.75 MHz to 2462.75 MHz ISM band signal from the antenna port (J3) is filtered to reject out-of-band signals and amplified to establish a low noise factor. Improved dynamic range on receive, as well as protection of the receiver during transmit, is provided by an RF AGC loop using a high dynamic range semiconductor attenuator. The signal is then down converted to the 248.75 MHz IF using the same 2.2 GHz LO developed for the transmitter. In addition, switches reconfigure the 248.75 MHz AGC'd IF amplifier containing the SAW filter between the receiver and transmitter functions.

The 248.75 MHz IF amplifier output is demodulated to 1.25 MHz I and Q signals using the 250 MHz LO. I and Q signal is digitized using a 2-bit adaptive A/D converter, and are then output to the Signal and Message Processor (SMP) module – the I-channel being the PN encoded data and the Q-channel used for 250 MHz LO phase adjustment decision-making.

All LO's as well as the spread spectrum modulation are developed from a precision 32.514 MHz reference frequency oscillator. The 32.514 MHz reference source is converted into three 5 MHz sources, each with the capability to phase and frequency track the appropriate system timing, using individual Numerically Controlled Oscillators (NCO). One of these 5 MHz sources is the Time Track which is synchronized with the spread spectrum chip rate. Another is the synthesized 250 MHz LO reference and the third is the reference for the 2.2 GHz LO. This later LO reference is created by first synthesizing a 40 MHz reference from the 5 MHz reference using a 40 MHz voltage controlled crystal oscillator (VCXO). The 40 MHz VCXO is then divided to the 2.2 GHz LO synthesizer reference frequency and phase lock to the 2.2 GHz LO variable divider, achieving 1 MHz channel spacing.