

RA-400 Operational Description

RA-400 is a two-way radio for transmitting and receiving digital data modulated on a radio frequency carrier with a frequency range of 400 to 432 MHz. The unit consists of an antenna, receiver and transmitter circuitry, a microcontroller to control the basic radio functionality and a modem board for baseband processing of the digital data.

Antenna

The antenna is tuned to the 400 – 432 MHz frequency band. Immediately next to the antenna is a directional coupler to sample the outgoing transmit signal for use in the linearisation of the transmitter amplifier chain (see below). A low-pass filter common to both transmitter and receiver is followed by a high linearity Tx-Rx switch to separate the signal paths between the transmitter and receiver.

Receiver

The receiver is a dual conversion superheterodyne type with a first intermediate frequency at 70 MHz. It consists of a second low-pass filter to further eliminate the out-of-band signals and prevent desensitisation in subsequent stages. The incoming signal is then boosted by a low-noise amplifier (LNA) and downconverted to the first IF frequency by means of a mixer and local oscillator (LO1). LO1 is a phase-locked loop controlled oscillator and its output frequency (within the range of 470 – 502 MHz) is determined by the on-board microcontroller (μ P). The choice of this frequency also determines the channel the receiver is operating at. After channel filtering and amplification, the IF signal is down-converted once again by means of a second mixer and local oscillator (LO3) tuned to 73.125 MHz. Analogue-to-digital conversion and I/Q demodulation is performed at baseband after a further mixing stage and the signal is then fed into the FPGA on the modem board for baseband processing and decoding.

Transmitter

The transmitter has a direct-conversion architecture whereby the digital baseband signal obtained from the FPGA undergoes digital-to-analogue conversion and I/Q modulation, and then up-converted to the final transmitter frequency (400 – 432 MHz, as in receiver) in single mixing stage by the help of the transmitter local oscillator (LO2) with the same frequency range. The frequency of LO2 is also controlled by the microcontroller and this selection determines the transmit channel being used. The modulated signal at the final frequency is amplified in two stages by the pre-amplifier (RF AMP) and the power amplifier (Power AMP) to achieve the desired output power level at the antenna. After low-pass filtering, the signal is fed to the Tx port of the Tx-Rx switch.

In order to maintain the linearity of the transmitter signal chain and cause minimal distortion on the complex modulation, the outgoing transmitter signal is sampled just prior to the antenna by means of a directional coupler and is fed back to the I/Q modulator. Transmitter linearisation is performed using the Cartesian Feedback architecture.

Antenna connections and grounding

Please refer to Section 6 (Installation) of the User Manual also provided with the certification application documents.