

## TSLM UHF Circuit Description

### **RF Board**

#### *VCO/Synthesizer/DCXO*

The RF deck employs a Voltage Controlled Oscillator (VCO) that generates RF frequencies to be used for the on channel transmitter frequency and the first mixer of the receiver. The circuitry uses a Fractional N Phase Locked Loop (PLL) Synthesizer to lock the VCO to an on channel frequency using a 1.5 ppm 17.5 MHz Digitally Controlled Crystal Oscillator (DCXO) as a stable reference source. The DCXO is fed to the oscillator input (OSC\_IN) of the synthesizer and the VCO is fed to the RF input (RF\_IN). Through a combination of divides within the synthesizer the DCXO and VCO frequencies are divided down to provide for 6.25 kHz frequency resolution. The synthesizer generates a control voltage that is fed back to varactors in the VCO. The voltage changes on the varactors change the capacitance of the varactors, which controls the frequency of the VCO.

#### *Transmitter*

The transmitter consists of a series of 3 amplifiers and several inter-stage matching networks that amplify the RF frequency from the VCO. The amplified signal is then applied to an RF Low Pass Filter that filters off the harmonics generated by the amplifiers. The signal is then passed through an antenna switch to the antenna connector. The final output power of the transmitter is factory set to 5.0 Watts. The transmitter is power controlled by lightly coupling RF signal through an RF pin diode, which rectifies the RF signal. The rectified signal is then applied to an RC filter network that filters the signal to a proportionate DC level. The DC signal is applied to a feedback loop consisting of op amps, resistors, capacitor and a current source transistor back to the first stage of the transmitter. Power control is achieved using the feedback loop that controls the voltage on the first stage, which controls the RF drive to following stages. The power output is programmable using an electronically tunable digi-pot controlling the voltage on one of the feedback loop op amps.

#### *Receiver*

The receive signal enters through the antenna port and then passes through the antenna switch and a band pass filter. The signal is amplified by a low noise RF amp and then filtered again by a band pass filter. The RF signal is then applied to a passive mixer. The Local Oscillator (LO) signal for the first mix is generated by the VCO at 52.950 MHz above the received RF signal. The signal is mixed down to the 52.950 MHz First IF frequency. The output of the mixer is applied to an amplifier and matched to the 52.950 MHz four pole crystal filter set. The output of the crystal filter set is amplified and then sent to an FM IF IC. The FM IF IC performs the second mix down to 450 kHz. The LO for this mix is generated by using the amplified and filtered third harmonic of the DCXO

at 52.500 MHz. The FM IF IC then converts the 450 kHz Second IF frequency to baseband audio using a quadrature detector. The baseband audio is then filtered by a series of op amps.

### ***TSLM Modem***

The TSLM modem printed electronic circuit board is a combined modulator/demodulator and microcontroller circuit that performs baseband modulation/demodulation and global radio control functions.

The circuit operates on a DC source from 6 to 15V fed via the DE-15 connector. The main circuit consists of a CPU, it's memory and an analog CODEC through which transit the analog modulating signal to the radio and the radio received output. The CPU is a Digital Signal Processor from Analog Devices (the Blackfin ADSP-BF533) clocked at 12.288 MHz and it's memory, a 1M x 16 flash. No RAM memory is used. The analog interface (CODEC) is a Philips UDA1345TS stereo audio codec. The power supply section is made of a switcher converting the input raw voltage to +3.3Volt followed by a linear regulator converting the +3.3 Volt to +1.2V providing the CPU core voltage. Another linear regulator is used to convert the input raw supply to +5Volt used to feed the voltage converter buffers that converts +5 Volt signals from the radio deck to +3.3 Volt signals used on the TSLM modem. A four channels analog to digital converter is used to provide a reading of the raw supply voltage input as well as the reading of an on-board temperature sensor and calibration. The 2 remaining channels are used to calibrate the CODEC DC input and output voltages. Two dual LEDs are present on the TSLM, one is used as a Power indicator and the other one is used to show RX and TX.

The two main connectors on the board are a 15 pins (DE-15) and a 14 pins radio connector interface. The DE-15 connector is used for the RS-232 TX and RX data interface, the 3 channel select control lines (CS0, CS1, CS2) selecting 1 of 8 channels and the power supply input. The 14 pins radio interface connector carries the analog modulation/demodulation signals that are exchanged between baseband and radio as well as the digital signals needed to control hardware located on the radio deck. These digital signals include the keying for the transmitter (PTT), the signals required to program the radio synthesizer and the digipots used for Modulation, Transmit power and receive gain adjustments and finally the signals required to program the EEPROM where radio parameters are stored. The modem monitors the lock detect signal from the radio deck and inhibits the transmitter if an unlock condition is detected.