VX-6000L Circuit Description

Reception and transmission are switched by “RX” and ”TX” lines from the microprocessor unit (MPU). The receiver uses double-conversion superheterodyne circuitry, with a 17.7 MHz 1st IF and 450 KHz 2nd IF. The 1st LO, produced by a PLL synthesizer, yields the 17.7 MHz 1st IF.

The 2nd LO uses a 17.25 MHz (17.7 MHz - 450 KHz) signal generated by a crystal oscillator.

The 2nd mixer and other circuits use a custom IC to convert and amplify the 2nd IF, and detect FM to obtain demodulated signals. During transmit, the PLL synthesizer oscillates at the desired frequency directly, for amplification to obtain RF power output. During transmit, voice modulation and CTCSS (or DCS) modulation are applied to this synthesizer. Transceiver functions, such as TX/RX control, PLL synthesizer settings, and channel programming, are controlled using the MPU.

Receiver

Incoming RF signals from the antenna connector are delivered to the PA Unit, and pass through a low-pass filter (LPF) consisting of coils L6011, L6010, and L6009, capacitors C6047, C6045, C6044, C6075, C6043, C6042, and C6074 and antenna switching Relay for delivery to the receiver front end in the Main Unit.

Signals within the frequency range of the transceiver are then passed through a varactor-tuned bandpass filter consisting of L1008, L1009 / L1018, L1019 before RF amplification by Q1012 (3SK240).

The amplified RF is then band-pass filtered again by varactor-tuned resonators L1024, L1025 / L1038, L1039 and then to ensure pure in-band input to 1st mixer by Q1025 (3SK240)
Buffered output from the VCO Unit is amplified by Q1021 (2SC5415) and low-pass filtered by L1042 / L1046 and C1132 / C1139 / C1142, to provide a pure 1st local signal between 54.7 and 67.7 MHz to the 1st mixer.

The 17.7 MHz 1st mixer product then passes through dual monolithic crystal filters XF1001 and XF1002 (12 KHz BW) is amplified by Q1029 (2SC4215) and delivered to the input of the FM IF subsystem IC Q1026 (TA31136FN).

This IC contains the 2nd mixer, 2nd local oscillator, limiter amplifier, FM detector, noise amplifier, and squelch gates.

The 2nd LO in the IF-IC is produced from crystal X1001 (17.25 MHz), and the 1st IF is converted to 450 KHz by the 2nd mixer and stripped of unwanted components by ceramic

filter CF1002. After passing through a limiter amplifier, the signal is demodulated by the FM detector.

Demodulated receive audio from the IF-IC is amplified by Q2014 (CXA1846N). After volume adjustment by the AF power amplifier Q2029 (TDA7240AV), the audio signal is passed to the optional speaker jack or 4 Ω loudspeaker.

PLL synthesizer

The 1st LO maintains stability from the PLL synthesizer by using a 17.25 MHz reference signal from crystal X1001. PLL synthesizer IC Q1024 (SA7025DK) consists of a prescaler, reference counter, swallow counter, programmable counter, a serial data input port to set these counters based on the external data, a phase comparator, and charge pump. The PLL-IC divides the 17.25 MHz reference signal by 1725 using the reference counter (10.0 KHz comparison frequency). The phase detector comparison frequency to be two times the channel spacing (5 KHz). The VCO output is divided by the prescaler, swallow counter and programmable counter. These two signals are compared by the phase comparator and input to the charge pump. A voltage proportional to their phase difference is delivered to the low-pass filter circuit, then fed back to the VCO as a voltage with phase error, controlling and stabilizing the oscillating frequency. This synthesizer also operates as a modulator during transmit.

The RX-VCO is comprised of Q1015 (2SK508) and D1017, D1018 (HVU306A x 2), and oscillates between 54.7 MHz and 67.7 MHz according to the programmed receiving frequency. And the TX-VCO is comprised of Q1014 (2SC4226) and D1015, D1016, D1034, D1035 (HVU300A x 4), and oscillates between 37.0 MHz and 50.0 MHz according to the programmed transmit frequency. The VCO output passes through buffer amplifier Q1018 (2SC5107), and a portion is fed to the buffer amplifier Q1019 (2SC4215) of the PLL IC, and at the same time amplified by Q1021 (2SC5415) to obtain stable output. The VCO DC supply is regulated by Q1008 (2SC4154E). Synthesizer output is fed to the 1st mixer by diode switch D1024 (1SS321) during receive, and for transmit. The reference oscillator feeds the PLL synthesizer, and is composed of crystal X1001 (14.500 MHz), the temperature compensation circuit which includes D1033 (MC2850) and thermostats TH1002 and TH1003, and transmit (DCS) modulation circuit D1029 (HVU306A).

Transmitter

Voice audio from the microphone is delivered via the MIC (Jack) Unit to the MAIN Unit, after passing through amplifier Q3039/Q2108 (NJM2902V), pre-emphasis, limiter (IDC instantaneous deviation control), and LPF Q2001 (NJM2902V), is adjusted for optimum deviation level and delivered to the next stage.

Voice input from the microphone and CTCSS are FM-modulated to the VCO of the synthesizer, while DCS audio is modulated by the reference frequency oscillator of the synthesizer.

Synthesizer output, after passing through diode switch D1024 (1SS321), to obtain RF output. The RF energy then delivered to the PA Unit. Then its RF energy amplified by push-pull junction transistor Q6006 / Q6007 (SD1405 x 2) and passes through antenna switching relay RL6001 and a low-pass filter circuit. And finally to the antenna connector.

RF output power from the final amplifier is sampled by CM coupler and is rectified by D6006, D6007 (MA729 x 2). The resulting DC is fed through Automatic Power Controller Q1007 (NJM2902V), Q2131 (DTC124EK), Q2132 (DTB124EK) to transmitter RF amplifier and thus the power output.

Generation of spurious products by the transmitter is minimized by the fundamental carrier frequency being equal to the final transmitting frequency, modulated directly in the transmit VCO. Additional harmonic suppression is provided by a low-pass filter consisting of L6009, L6010, L6011, and C6042, C6043, C6044, C6047, C6074, C6075, and C6045, resulting in more than 65 dB of harmonic suppression prior to delivery to the RF energy to the antenna.

DCS Demodulator

DCS signals are demodulated on the MAIN-UNIT, and are applied to low-pass filter Q2110 (NJM2902V), as well as the limiter comparator Q2110.

CTCSS encoder/decoder

The CTCSS code is generation and encoding by MPU IC Q2019 (MB90F583B).
Demodulation and detection of the CTCSS tones are carried out by IC Q2013 (MX165C).

MPU

Operation is controlled by 16-bit MPU IC Q2019 (MB90F583B). The system clock uses a 16.000 MHz crystal for a time base. IC Q2027 (S-80735SN) resets the MPU when the power is on, and monitors the voltage of the regulated 5 V power supply line.

EEPROM

The EEPROM retains TX and RX data for all memory channels and CTCSS data, DCS data, prescaler dividing, and REF oscillator data (internal/external).