VXA-220 Circuit Description

Receive Signal Path

Incoming RF from the antenna jack is passed through a low-pass filter and high-pass filter consisting of coils L1024, L1027, L1028, L1029, L1030 & L1031, capacitors C1213,C1218,C1219,C1222,C1223,C1224,C1226,C1227,C1228,C1229,C1230, &C1234 and antenna switching diodes D1038 and D1040 to the receiver front end section.

Signals within the frequency range of the transceiver is applied to the receiver front end which contains RF amplifier Q1049 and varactor-tuned band-pass filter consisting of coils L1014, L1015, L1018, L1020, L1021, L1025 & L1026, capacitors C1180, C1182, C1184, C1185, C1186, C1190, C1193, C1194, C1197, C1207, C1215 & C1216, and diodes D1035, D1036, D1037 & D1039, then applied to the 1st mixer Q1043.

Buffered output from the VCO is amplified by Q1032 to provide a pure 1st local signal between 155.25 and 184.25 MHz for injection to the 1st mixer. The 47.25 MHz 1st mixer product then passes through monolithic crystal filter XF1001 (7.5 kHz BW) which strips away all but the desired signal, which is then amplified by mixer post-amp Q1042.

The amplified 1st IF signal is applied to the AM/FM IF subsystem IC Q1039, which contains the 2nd mixer, 2nd local oscillator, limiter amplifier, noise amplifier and AM/FM detector.

A 2nd local signal is generated by PLL IC Q1025 from the 11.7 MHz crystal X1002 .The11.7MHz signal is quadruple by Q1037 to produce the 450 kHz 2nd IF when mixed with the 1st IF signal within Q1039. The 2nd IF then passes through the ceramic filter CF1001 to strip away unwanted mixer products.

In the FM mode, a 2nd IF signal from the ceramic filter CF1001 applied to the limiter amplifier section of Q1039, which removes amplitude variations in the 450 kHz IF before detection of the speech by the ceramic discriminator CD1001. Detected audio from Q1039 is passed through the de-emphasis, consisting of the resistors R1082, R1083, R1087 & R1090, capacitors C1069, C1070, C1069 & C1081, and Q1019-2.

In the AM mode, detected audio from Q1039 is passed through the audio amplifier Q1019-1 and ANL circuit, then applied to the AF amplifier Q1019-2. When impulse noise received, a portion of the AM detector output signal from the AM/FM IF subsystem Q1039, including pulse noise is rectified by D1019. The resulting DC is applied to the ANL MUTE gate Q1022, thus reducing the pulse noises.

The processed audio signal from Q1019-1 is passed through the amplifier Q1019-2 to the volume control IC Q1029. The audio signal is passed through the volume control IC to the audio power amplifier Q1003, providing up to 0.7 Watts to 16 Ω loudspeaker.

A portion of the AF signal from the AM/FM IF subsystem Q1039 converted into DC voltage within the IC, and provide to the inversion amplifiers Q1048 and Q1050. These amplifier reduce the amplifier gain of the RF amplifier Q1049 while receiving a strong signal.

Squelch Control

When signal is received, appear the DC squelch control voltage at pin 15 of AM/FM IF subsystem Q1039 according to the receiving signal strength. This DC is applied to pin 16 of microprocessor Q1015.

The DC squelch control voltage is compared with the SQL threshold level by the microprocessor Q1015. If the DC squelch control voltage is lower, microprocessor Q1015 control the volume control IC Q1029.and pin14 of Q1029 goes low. thus disabling the AF audio.

Also, the microprocessor stops scanning, if active, and allows audio to pass through the the volume control IC Q1029.

Transmit Signal Path

Speech input from the microphone is passed through the microphone amplifier Q1011-1,

then applied to the ALC amplifier Q1013. The amplified speech signal is passed through the high-pass filter Q1011-4 and low-pass filter Q1011-3, which adjust the modulation level, then fed to the AM modulator Q1045.

When using the optional headset, the SIDETONE signal from J1002 becomes “HIGH”, turning Pin10 of Q1015 on; pin 90 of Q1015 therefore a portion of the speech signal applied to the AF power amplifier Q1001 as a monitor signal.

The carrier signal from the VCO Q1028 passes through the buffer amplifier Q1049 and TX/RX switch D1026.

The signal from D1026 is amplified by Q1040 and Q1044, and ultimately applied to the final amplifier Q1045 which increases the signal level up to 5 watts output power. The transmit signal then passes through the antenna switch D1038, and is low-pass filtered to suppress away harmonic spurious radiation before delivery to the antenna.

Automatic Transmit Power Control

RF power output from the final amplifier is sampled by C1217/C1221 and is rectified by D1041. The resulting DC is fed through the Automatic Power Controller Q1047, thus allowing control of the power output.

Transmit Inhibit

When the transmit PLL is unlocked, pin 7 of PLL chip Q1025 goes to a logic low. The resulting DC “unlock” control voltage is switches off TX inhibit switches Q1035, to disable the supply voltage to transmitter RF amplifiers Q1040, disabling the transmitter.

Spurious Suppression

Generation of spurious products by the transmitter is minimized by the fundamental carrier frequency being equal to the final transmitting frequency. Additional harmonic suppression is provided by a low-pass filter consisting of L1027, L1029 & L1031 and C1213, C1222, C1224, C1227, C1229 & C1234, resulting in more than 60 dB of harmonic suppression prior to delivery of the RF signal to the antenna.

PLL Frequency Synthesizer

PLL circuitry consists of VCO Q1028, VCO buffer Q1032 & Q1034, and PLL subsystem IC Q1025, which contains a reference divider, serial-to-parallel data latch, programmable divider, phase comparator and charge pump.

Stability is maintained by a regulated 3.5 V supply via Q1033 and 5V supply via Q1031 which feeds the PLL reference oscillator Q1025, as well as capacitors associated with the 11.7 MHz frequency reference crystal X1002.

In the receive mode, VCO Q1028 oscillates between 155.25 and 184.25 MHz. The VCO output is buffered by Q1032 and Q1034, and applied to the prescaler section of Q1025. There the VCO signal is divided by 64 or 65, according to a control signal from the data latch section of Q1025, before being applied to the programmable divider section of Q1025. The data latch section of Q1025 also receives serial dividing data from the microprocessor Q1015, which causes the pre-divided VCO signal to be further divided in the programmable divider section, depending upon the desired receive frequency, so as to produce a 5 kHz derivative of the current VCO frequency.

Meanwhile, the reference divider section of Q1025 divides the 11.7 MHz crystal reference from the reference oscillator section by 2340 to produce the 5 kHz loop reference. The 5 kHz signal from the programmable divider (derived from the VCO) and that derived from the reference oscillator are applied to the phase detector section of Q1025, which produces a pulsed output with pulse duration depending on the phase difference between the input signals. This pulse train is filtered to DC and returned to the varactor D1013.

Changes in the level of the DC voltage applied to the varactors affect the reactance in the tank circuit of the VCO, changing the oscillating frequency of the VCO according to the phase difference between the signals derived from the VCO and the crystal reference

oscillator. The VCO is thus phase-locked to the crystal reference oscillator.

The output of the VCO Q1028 is buffered by Q1032 before application to the 1st mixer, as described previously.

For transmission, the VCO Q1028 oscillates between 118 and 137 MHz. The remainder of the PLL circuitry is shared with the receiver. However, the dividing data from the microprocessor is such that the VCO frequency is at the actual transmit frequency (rather than offset for IFs, as in the receiving case).

Receive and transmit buses select which VCO is made active by Q1023.

When the power saving feature is active, the microprocessor periodically signals to the PLL IC Q1025 to conserve power, and to shorten lock-up time.

Push-To-Talk Transmit Activation

The PTT switch on the microphone is control to pin 22 of microprocessor Q1015, so that when the PTT switch is closed, pin 31 of Q1015 goes high. This signals cut off the receiver by disabling the 5 V supply bus at Q1018 which feeds the front-end, FM IF subsystem IC Q1029, and receiver VCO circuitry. At the same time, Q1040 activates the transmit 5 V supply line to enable the transmitter.