

VX-230 Series Circuit Description

1. Circuit Configuration by Frequency

The receiver is a Double-conversion Super-heterodyne with a first intermediate frequency (IF) of 67.65MHz and a second IF of 450kHz. Incoming signal from the antenna is mixed with the local signal from the VCO/PLL to produce the first IF of 67.65MHz.

This is then mixed with the 67.2MHz second local oscillator output to produce the 450kHz second IF. This is detected to give the demodulated signal.

The transmit signal frequency is generated by the PLL VCO, and modulated by the signal from the microphone. It is then amplified and sent to the antenna.

2. Receiver System

2-1. Front-end RF amplifier

Incoming RF signal from the antenna is delivered to the RF Unit and passes through Low-pass filter, antenna switching diode, high pass filter and removed undesired frequencies by varactor diode (tuned band-pass filter).

The passed signal is amplified in Q1013(MSG33001) and moreover cuts an image frequency with the tuned band pass filter and comes into the 1st mixer.

2-2. First Mixer

The 1st mixer consists of the Q1024(3SK293). Buffered output from the VCO is amplified by Q1022(2SC5005) to provide a pure first local signal between 382.35 and 444.35MHz for injection to the first mixer.

The IF signal then passes through monolithic crystal filters XF1001(± 7.5 kHz BW) to strip away all but the desired signal.

2-3. IF Amplifier

The first IF signal is amplified by Q1033(2SC5226).

The amplified first IF signal is applied to FM IF subsystem IC Q1038(NJM2591V) which contains the second mixer, second local oscillator, limiter amplifier, noise amplifier, and RSSI amplifier.

The signal from reference oscillator X1002 becomes 4 times of frequencies in Q1038, it is mixed with the IF signal and becomes 450KHz.

The second IF then passes through the ceramic filter CF1001 (LTM450FW) to strip away unwanted mixer products, and is applied to the limiter amplifier in Q1038, which removes amplitude variations in the 450kHz IF, before detection of the speech by the ceramic discriminator CD1001 (ECDA450C24).

2-4. Audio amplifier

Detected signal from Q1038 is inputted to TX/RX switch Q1001-4(TC74VHC4066AFT).

The signal which appeared from Q1001 is in high pass filter Q1050(NJM12902V).

The signal which passed Q1050 goes to AF volume(VR1001). And then the signal goes to audio amplifier Q1005(NJM2070M).

The output signal from Q1005 is in audio speaker.

2-5. Squelch Circuit

There are 16 levels of squelch setting from 0 to 15. The level 0 means open the squelch. The level 1 means the threshold setting level and level 14 means tight squelch. From 2 to 13 is established in the middle of threshold and tight.

The bigger figure is nearer the tight setting. The level 15 becomes setting of carrier squelch.

2-5-1. Noise Squelch

Noise squelch circuit is composed of the band path filter of Q1038, and noise detector D1029(1SS400G).

When a carrier isn't received, the noise ingredient which goes out of the demodulator Q1038 is amplified in Q1038 through the band path filter Q1038, is detected to DC

voltage with D1029 and is inputted to 52pin (the A/D port) of the Q1026 (CPU).

When a carrier is received, the DC voltage becomes low because the noise is compressed.

When the detected voltage to CPU is high, the CPU stops AF output with Q1001-3 "OFF" by making the 41pin (CPU) "L" level.

When the detection voltage is low, the CPU makes Q1001 ON with making 41pin "H" and the AF signal is output.

2-5-2. Carrier Squelch

The CPU (53pin: A/D port) detect RSSI voltage output from Q1038 12 pin, and controls AF output.

The RSSI output voltage changes according to the signal strength of carrier. The stronger signal makes the RSSI voltage to be higher voltage.

The process of the AF signal control is same as Noise Squelch

The shipping data is adjusted -1dBu(EMF) higher than squelch tight sensitivity.

3. Transmitter System

3-1. Mic Amplifier

The AF signal from internal microphone MC1001 or external microphone J1002 is amplified with microphone amplifier Q1049-3 (NJM12902V).

This signal enters high pass filter Q1050 via the mute switch Q1001-1(TC74VHC4066AFT).

Afterwards, the switch circuit is controlled in the gain by way of microphone gain volume Q1017 (M62364FP-CH1).

AF signal is passes a pre-emphasis circuit and is input to the limiter amplifier Q1049-2(NJM12902V).

The signal passed splatter filter of Q1049 and adder amplifier Q1046 is adjusted by maximum deviation adjustment volume Q1012 (M62364FP-CH4).

The AF signal ingredient is amplified Q1046(NJM12902V). After that, it is made FM modulation to transmit carrier by the modulator D1014(HVC383B) of VCO.

3-2. Drive and Final amplifier

The modulated signal from the VCO Q1032(2SC4227) is buffered by Q1027(2SC5005) and amplified by Q1022(2SC5005). Then the signal is buffered by Q1018(2SC5227) for the final amplifier driver Q1015(RQA0004PXDQS). The low-level transmit signal is then applied to Q1010(RQA0011DNS) for final amplification up to 5watts output power.

The transmit signal then passes through the antenna switch D1002(HVU131) and is low pass filtered to suppress away harmonic spurious radiation before delivery to the antenna.

3-4. Automatic Transmit Power Control

The current detector Q1052-1(NJM12904V) detects the current of Q1010 and Q1015, and converts the current difference to the voltage difference.

The output from the current detector Q1052-1 is compared with the reference voltage and amplified by the power control amplifier Q1052-2.

The output from Q1052-2 controls the gate bias of the final amplifiers Q1010 and the final amplifier driver Q1015.

The reference voltage changes into four values (Transmit Power High and Low) controlled by Q1012 (M62364FP-CH8).

3-5. PLL Frequency Synthesizer

The frequency synthesizer consists of PLL IC, Q1042(MB15E03SL), VCO, TCXO(X1002) and buffer amplifier.

The output frequency from TCXO is 16.8MHz and the tolerance is +/- 2.5 ppm (in the temperature range -30 to +60 degrees).

3-5-1. VCO

While the radio is receiving, the RX oscillator Q1030(2SK508) in VCO generates a programmed frequency between 382.35 and 444.35MHz as 1st local signal.

While the radio is transmitting, the TX oscillator Q1032(2SC4227) in VCO generates a frequency between 450 and 512MHz.

The output from oscillator is amplified by buffer amplifier Q1027(2SC5005) and becomes output of VCO. The output from VCO is divided, one is amplified by Q1027 and feed back to the PLL IC 8pin. The other is amplified in Q1022 and in case of the reception, it is put into the mixer as the 1st local signal through D1012, in transmission, it is buffered Q1018, and more amplified in Q1015 through D1012 and it is put into the final amplifier Q1010.

3-5-2. VCO Tuning Voltage

Tuning voltage of VCO is expanding the lock range of VCO by controlling the cathode of varactor diode at the voltage and the control voltage from PLL IC.

3-5-3. PLL

The PLL IC consists of reference divider, main divider, phase detector, charge pumps and pulse swallow operation. The reference frequency from TCXO is inputted to 1pin of PLL IC and is divided by reference divider.

The other hand, inputted feed back signal to 8pin of PLL IC from VCO is divided with the dividing ratio which becomes same frequency as the output of reference divider. These two signals are compared by phase detector, the phase difference pulse is generated.

The phase difference pulse and the pulse from through the charge pumps and LPF. It becomes the DC voltage to control the VCO.

The oscillation frequency of VCO is locked by the control of this DC voltage.

The PLL serial data from CPU is sent with three lines of SDO (60pin), SCK (58pin) and PSTB (59pin).

The lock condition of PLL is output from the UL (14Pin) terminal and UL becomes "H" at the time of the lock condition and becomes "L" at the time of the unlocked condition. The CPU always watches over the UL condition, and when it becomes "L" unlocked condition, the CPU prohibits transmitting and receiving.