THEORY OF OPERATION

Theory of Operation on GX Series

The GX Series Handheld Radio Transceivers are comprised of one main PCB.
The main PCB contains the transmitter, receiver, and control circuits.

Receiver

The receiver circuit adopts dual conversion super heterodyne with 1st IF 45.1MHz and 2nd IF 455kHz

Front-end

Front-end consists of pre-selector filter, RF Amplifier, Post-selector filter. The receive signal is routed through C3 and selected by C4, C6, L2, L3 to amplified around 13dB at RF amp. Q19. Front-end adjusts bandwidth by varicap diode tuning.

This circuit removes unnecessarily spurious 1st Image.

First Mixer

The signal from Front-end is input to Q18 base of 1st mixer. 1st local signal generated from VCO is input to Q18, emitter. These two signals are mixed at Mixer into 1st IF signal 45.1MHz, which is resonated in parallel at C22, L8 and inputted to XF1, Pair crystal filter.

IF Amplifier

1st IF signal from XF1 is amplified about 15dB at IF amp Q17 and inputted to IC3, IF IC.

2nd Local Oscillator is 44.645MHz. The signal from 2nd Mixer is refined removing unnecessary spurious signal and detected through high gain linear amp. This detected signal is inputted to IC3 pin9.

AF Amplifier

300Hz High Pass Filter IC507 removes the signal under 300Hz of the demodulated signal from IC3 so that noise under sub tone use is removed.

De-emphasis functions to get 6dB/oct by R601, C533 and this signal controls volume of sound by RV502.

IC508 can operate a speaker as audio current amplifier amplifying the signal. The operating current can be reduced by mute signal.

Squelch

The demodulated signal from IC3 is coupled of noise to C35. The noise is filtered and amplified by C45,109, R30 and used internal amplifier of IC3. This noise signal is used as the signal to mute RV2 audio.

Audio AMP

After CTCSS,DCS signal is removed at 300Hz High Pass Filter and de-emphasized to – 6 dB/Oct at R601, C533 the volume of sound is controlled by RV502.

IC508 is doing low frequency current amplify as audio amplifier to operate a speaker.

IC508 has mute function and if Pin 2, mute port is high, it's on mute. If it is low, it's unmuted.

Transmitter

The transmitter consists of Buffer, Power Amplifier, Low-Pass Filter, Antenna Switch, Auto-Power Control.

2-1) Buffer

-6dBm TX RF signal from VCO is amplified to around +29dBm by buffer

Q22,26 to have desired output power at final Amp.

Pie style resister attenuator is used between VCO and Buffer Amp. To minimize the effect of load caused by transmit amplifier in TX.

2-2) Power Amplifier

TX RF Signal form buffer Amp. Gains 6Watt output by final Amp Q27.

Collect impedance of Q27 states in low so that it is matching to 50ohm by

C97, 98, 99, 100, strip line and inputted to 5^{th} Low Pass Filter.

2-3) Low Pass Filter

5^{th} Low Pass Filter reduces the unwanted spurious for TX output power

from final Amp.

L19, 20, C103, 104, 105, 106, 107 are Chebisheve Filter.

2-4) Antenna Switch

Ant. Switch is to share the antenna in TX and RX. It prevents TX

sensitivity from degradation by LPF. Also, it protects receive circuit by

blocking TX signal to receive end, turning on D1, 2.

Flow of the signal in RX is designed to minimize the loss of the signal using the character of series resonance of L1, C3.

2-5) Auto-Power Control

This circuit controls TX Power by detection on the current through R95.

The voltage difference from these resistors is amplified by IC4-B and gets the voltage comparing the this signal with the reference voltage from R84, 85 at IC4-A.

This voltage difference is kept to stable value by RV4 changing Gate voltage of Final Amp.

PLL Synthesizer

Reference frequency is 12.8MHz and this oscillated frequency is compensated in temperature.

The frequency from VCO is inputted to PLL IC and this inputted signal is divided by the ratio set by data and compared with reference step frequency.

Then, the difference comes to IC1 pin15,16 Port. GX series consists of external charge pump.

Charge pump output turns into DC by PLL LPF R56, 57, 58, C59, 60, 61, 62 so that it can vary VCO control voltage to have set frequency.

For TX and RX switch, Q305 and Q3304 base switch to control voltage.(TX_EN)

Audio and Control circuit

IC501 controls all factions of the radio as Microprocessor.

It detects outer condition such as function data on frequency, Power supply switching and make it operate correctly.

IC509 consists of 250Hz LPF to function CTCSS,DCS decoding correctly and he output of this filter is amplified at IC509-A. Then, it goes to Q503 to be changed to logic signal so that CTCSS,DCS decoding is enabled.

IC509-A is CTCSS,DCS Encode Filter. It mixes the signals from 4 ports and this mixed signal goes through this filter to get clear CTCSS,DCS signal.

IC509-B, C, and D is TX Audio Amp and limiter. It amplifies the voice signal from C-Mic and have the character of 6dB/Oct Pre-Emphasis.

This voice signal is controlled by RV501 for the volume.

IC509-B is 3KHz LPF and has the character that reduces to 18dB/Oct.

This character minimizes the interference of adjacent channel by voice signal.

Alignment Procedure

This radio is adjusted to meet all condition in production except special case.

Readjustment is not requirement.

5-1) The preparation before adjustment.

1) Set the Power Supply voltage to 7.4V and then connect to the radio.
2) Connect the connector to Radio Antenna terminal.
3) Connect the radio to test equipment.

5-2) PLL Synthesizer

1) Measure the voltage of TP1 with High impedance voltage meter.
2) Adjust TC301 at RX channel 1.0 to be 1.5V.

Confirm if it is below 13V at RX high channel.

Adjust TC302 at TX channel 1.0 to be 1.5V.

Confirm if it is below 13V at TX high channel.

3) Confirm if Channel 1 is in 1.0 +/-0.3 in TX.

5-3) Adjustment of Transmitter

1) Adjust to tune the set frequency.
2) Adjust RV4 to tune the set power.
3) Set Audio Generator to be 1kHz 120mVrms and connect to Radio External Jack.
4) Adjust RV501 to tune desired modulation.
5) If a channel is set with CTCSS,DCS the modulation of CTCSS,DCS varies based on the size of the modulation.

5-4) Adjustment of Receiver

1) Set SSG RF level to –47dBm @1kHz 60% Dev.
2) Adjust SSG RF Level and confirm if 12dB Sinad is below –119dBm.
3) Adjust RV2 to open Audio at 12dB Sinad.
4) Set tone frequency to SSG when there is channel set with CTCSS, DCS and then set deviation to 10% Peak Dev. Then check if ORANGE LED is on.
5) Repeat the above in other channels.

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