

GX1500S Circuit Description

Reception and transmission are switched by 16-bit MPU IC **Q2003** on the CNTL Unit. The receiver uses double-conversion superheterodyne circuitry, with a 21.4 MHz 1st IF and 450 kHz 2nd IF. The 1st local is produced by a PLL synthesizer, yielding the 30.4 MHz 1st IF. The 2nd local uses a 29.950 MHz crystal oscillator, yielding the 450 kHz 2nd IF. 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 is 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 RF Unit, and pass through a low-pass filter (LPF) consisting of coils L1001 & L1002 and capacitors C1002, C1004, & C1007, and antenna switching diode **D1004** for delivery to the receiver front end. Signals within the frequency range of the transceiver are then passed through a bandpass filter consisting of coils L1010 & L1013 and capacitors C1059, C1060, C1062, C1094, & C1095, before RF amplification by **Q1022**.

The amplified RF is then passed through a bandpass filter again consisting of coils L1027, L1028, & L1031 and capacitors C1165, C1166, C1167, C1168, C1169, C1191, & C1192, the pure in-band input signal is delivered to 1st mixer **Q1031**.

Buffered output from the MAIN VCO is amplified by **Q1032** and low-pass filtered by coils L1038, L1040, & L1055 and capacitors C1216, C1217, C1245, and C1246, to provide a pure 1st local signal between 125.65 and 131.625 MHz for delivery to the 1st mixer **Q1031**. The 30.4 MHz 1st mixer product then passes through monolithic crystal filters XF1003 and XF1004 (± 6.5 kHz BW), and is amplified by **Q1037** and delivered to the input of the FM IF subsystem IC **Q1039**. This IC contains the 2nd mixer, 2nd local oscillator, limiter amplifier, FM detector, noise amplifier, and squelch gates.

The 2nd local in the FM IF subsystem IC is produced from crystal **X1001** (29.950 MHz), and the 1st IF is converted to 450 kHz by the 2nd mixer and stripped of unwanted components by ceramic filter **CF1001**.

After passing through a limiter amplifier, the signal is demodulated by the FM detector. Demodulated receive audio from the FM IF subsystem IC is amplified by **Q1046** and **Q1050**, then the signal is through the AF selector switch **Q1036**. The selected signal is passed through the AF Mute switch **Q1047** to the AF power amplifier **Q1048**, the audio signal is

delivered to the 16 Ohm internal loudspeaker and external Speaker terminal in the accessory cable.

PLL Synthesizer

The 1st Local signal maintains stability from the PLL synthesizer by using a 29.950 MHz reference signal from crystal **X1001**. PLL synthesizer IC **Q1035** 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 a charge pump.

The PLL synthesizer IC divides the 29.950 MHz reference signal by 2396 using the reference counter (12.5 kHz comparison frequency). The reference oscillator feeds to the PLL synthesizer IC **Q1035**. for the 2nd local signal.

The VCO output is divided by the prescaler, swallow counter and programmable counter. These two signals are compared by the phase comparator, and applied 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 MAIN VCO is consisted of **Q1035** and varactor diodes **D1015**, **D1016**, **D1017**, and **D1018**, which oscillates at 30.4 MHz below from the receiving frequency. The MAIN VCO output passes through buffer amplifier **Q1032** to obtain stable output, then applied to the 1st mixer **Q1031**. The DC supply for the MAIN VCO is regulated by **Q1030**.

The TX & SUB VCO is consisted of **Q1025** and varactor diode **D1010**, **D1011**, **D1012**, and **D1013**, which oscillates at 134.225 MHz for the CH70 receiving and the fundamental transmit frequency during a transmit, with direct frequency-modulation using varactor diode **D1009**. The TX & SUB VCO output passes through buffer amplifier **Q1024** to obtain stable output. The TX & SUB VCO output is passed through another buffer amplifier **Q1020** and diode switch **D1007** to the sub 1st mixer **Q1023** during receive, and to drive amplifiers **Q1014** for transmit. The DC supply for the TX & SUB VCO is regulated by **Q1021**.

Transmitter

Voice audio from the microphone is delivered via the **MIC** connector to the MAIN Unit. After passing through microphone amplifier **Q1002**, a pre-emphasis network, limiter (IDC: instantaneous deviation control), and low-pass filter network **Q1052**, the audio is adjusted for optimum deviation level and delivered to the next stage.

Voice or DSC (Digital Selective Calling) encode signal inputs from the low-pass filter network **Q1052** is by the TX & SUB VCO **Q1025** and varactor diode **D1010**, **D1011**, **D1012**, & **D1013**, which oscillates the fundamental transmit frequency with direct frequency-

Circuit Description

modulation using varactor diode **D1009**. The modulated signal passes through buffer amplifier **Q1024** and **Q1020**, diode switch **D1007** to drive amplifiers **Q1014** and RF power amplifier module **Q1005**.

The RF energy then passes through antenna switch **D1002** and low-pass filter (LPF) consisting of coils L1001 & L1002 and capacitors C1002, C1004, & C1007, and finally to the antenna connector.

RF output power from the RF power amplifier module **Q1012** is sampled by C1005 and C1006 and is rectified by **D1001**. The resulting DC is fed through Automatic Power Controllers **Q1002** to RF power amplifier module **Q1012**, thus providing positive control of 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 coils and capacitors, resulting in more than 70 dB of harmonic suppression prior to delivery of the RF energy to the antenna.

DSC Encoder/ Decoder

Encoder

The DCS (Digital Selective Calling) encode signal which D/A converted in the 16-bit MPU IC **Q2003** on the CNTL Unit is fed through the low-pass filter **Q1052** on the MAIN Unit to the TX & SUB VCO **Q1025**.

Decoder

Incoming the receiving DSC code on the CH70 from the antenna connector are passed through a SUB-RX RF amplifier **Q1013** to the bandpass filter consisting of coils L1014, L1015, & L1016 and capacitors C1066, C1068, C1099, C1100, C1101, C1102, C1103, & C1104, then the filtered signal deliver to SUB-RX 1st mixer **Q1023**.

Buffered output from the TX & SUB VCO **Q1025** is amplified by **Q1024** and **Q1020** and bandpass filtered by coils L1021 & L1022 and capacitors C1106, C1107, C1121, C1122, & C1123, to provide a pure 1st local signal (134.225 MHz) for delivery to the SUB-RX 1st mixer **Q1023**.

The 22.3 MHz 1st mixer product then passes through monolithic crystal filters XF1001 and XF1002 (± 6.5 kHz BW) and buffer amplifier **Q1028**, then delivered to the SUB-RX FM IF subsystem IC **Q1045**. This IC contains the 2nd mixer, 2nd local oscillator, limiter amplifier, FM detector, noise amplifier, and squelch gates.

The 2nd local is produced by crystal X1002 (21.850 MHz) then delivered to the 2nd mixer in the SUB-RX FM IF subsystem IC **Q1045**. The 1st IF is converted to 450 kHz by the 2nd

mixer and stripped of unwanted components by ceramic filter CF1002.

Filtered signal from the ceramic filter CF1002 is applied to the limiter amplifier in the SUB-RX FM IF subsystem IC **Q1045**, and then demodulate by the FM detector in the SUB-RX FM IF subsystem IC **Q1045**. Demodulated signal from the SUB-RX FM IF subsystem IC **Q1045** is passes through the low-pass filter **Q1044** to the DSC Decoder IC **Q1045** which the receiving DCS code is decoded. The decoded DCS signal delivered to the 16-bit MPU IC **Q2004**.

The SUB-RX 1st Local signal maintains stability from the PLL synthesizer by using a 29.950 MHz reference signal from crystal **X1001**. PLL synthesizer IC **Q1035** 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 a charge pump.

The PLL synthesizer IC divides the 29.950 MHz reference signal by 2396 using the reference counter (12.5 kHz comparison frequency). The reference oscillator feeds to the PLL synthesizer IC **Q1035**. for the 2nd local signal.

The VCO output is divided by the prescaler, swallow counter and programmable counter. These two signals are compared by the phase comparator, and applied 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.

The TX & SUB VCO is consisted of **Q1025** and varactor diode **D1010**, **D1011**, **D1012**, and **D1013**, which oscillates at 134.225 MHz. The TX & SUB VCO output passes through buffer amplifier **Q1024** to obtain stable output.

1050 Hz Weather Alert Decoder

1050 Hz Weather Alert signal from the FM IF subsystem IC **Q1039** is demodulated by **Q1049** then is applied to 16-bit MPU IC **Q2003** on the CNTL Unit.

MPU

Operation is controlled by 16-bit MPU IC **Q2003**. The system clock uses a 14.74560 MHz crystal for a time base. IC **Q2002** resets the MPU when the power is on, and monitors the voltage of the regulated 5V power supply line.

EEPROM

The EE-PROM **Q2004** retains TX and RX data for all memory channels, prescaler dividing, IF frequency, local oscillator injection side, and reference oscillator data.