

GX5000S/GX5500S Circuit Description

Reception and transmission are switched by 16-bit MPU IC Q2001 on the CNTL Unit. The receiver uses double-conversion superheterodyne circuitry, with a 30.4 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 Main Unit, and pass through a low-pass filter (LPF) consisting of coils L1001 & L1002 and capacitors C1007, C1014, & C1035, and antenna switching diode D1005 for delivery to the receiver front end. Signals within the frequency range of the transceiver are passed through a bandpass filter consisting of coils L1003 & L1004 and capacitors C1017, C1019, C1029, C1038, & C1042, before RF amplifier Q1013.

The amplified RF is passed through a bandpass filter consisting of coils L1014, L1015, & L1016 and capacitors C1102, C1104, C1108, C1111, C1112, C1114, & C1117. The pure in-band input signal is delivered to the main 1st mixer which consists of balun transformers (T1001, T1002, and T1003) and FETs Q1029, Q1030, Q1033, and Q1035.

Buffered output from the MAIN VCO is amplified by Q1031 and Q1024 and low-pass filtered by coils L1020 and L1021 and capacitors C1148, C1155, C1165, C1173 and C1175, to provide a pure 1st local signal between 125.65 and 131.625 MHz for delivery to the main 1st mixer.

The 30.4 MHz 1st mixer product is amplified by Q1041, then passes through monolithic crystal filters XF1001 and XF1002 (± 6.5 kHz BW), and is amplified by Q1046.

After that, it delivered to the input of the FM IF subsystem IC Q1047. This IC contains the 2nd mixer, the 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.

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Demodulated audio from the FM IF subsystem IC is amplified by Q1048 and Q1050. The amplified signal is passed through the AF selector switch Q1057 to the amplifier Q1045. The amplified signal is passed through the AF mute switch Q1057 and the electronic volume control IC Q1044. The adjusted audio signal is passed through the AF mute switch Q1054 to the AF power amplifier Q1055.

The amplified audio signal is delivered to the 8 Ohms 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 Q1026 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 applied to the external charge pump which is comprised of Q1037, Q1038 and D1010.

The PLL synthesizer IC divides the 29.950 MHz reference signal by 2396 using the reference counter (12.5 kHz comparison frequency).

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 RX VCO consists of Q1039 and varactor diodes D1013/1014/1016/1017, which oscillates at 30.4 MHz below from the receiving frequency. The TX VCO consists of Q1040 and varactor diode D1015, which oscillates at the fundamental transmit frequency during a transmit with direct frequency-modulation using varactor diode D1012. The VCO output passes through buffer amplifier Q1031 and Q1024 to obtain stable output, then applied to the main 1st mixer of.

The DC supply for the VCO is regulated by Q1023.

The SUB VCO (on the SUB Unit) consists of Q4008 and varactor diodes D4002 and D4003, which oscillates at 134.225 MHz for the CH70 receiving. The SUB VCO output passes through buffer amplifier Q4006 to obtain stable output. The SUB VCO output is passed through another buffer amplifier Q4007 to the sub 1st mixer which consists of balun transformers (T4001, T4002, and T4003) and FETs Q4010, Q4011, Q4013, and Q4014 during receiving.

The DC supply for the SUB VCO is regulated by Q4001.

Transmitter

The voice from the microphone is delivered to the Main Unit via the selector switch Q2014 on the CNTL Unit. After passing through microphone amplifier Q1028, a pre-emphasis network, limiter (IDC: instantaneous deviation control), and low-pass filter network, the audio is adjusted for optimum deviation level.

The voice or DSC (Digital Selective Calling) encoded signal from the low-pass filter network Q1028 is applied to the TX VCO which oscillates at the fundamental transmit frequency with direct frequency-modulation using varactor diode D1012. The modulated signal is amplified by the buffer amplifier Q1031 and Q1024, then passed through the diode switch D1008 to drive amplifiers Q1017 and RF power amplifier module Q1010.

The RF energy then passes through antenna switch D1006 and low-pass filter (LPF) consisting of coils L1009 and L1010 and capacitors C1010, C1017, & C1038, and finally to the antenna connector.

RF output power from the RF power amplifier module Q1010 is sampled by C1018 and C1022 and is rectified by D1003. The resulting DC is fed through Automatic Power Controllers Q1034 to RF power amplifier module Q1010, 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 80 dB of harmonic suppression prior to delivery of the RF energy to the antenna.

DSC Encoder/ Decoder

Encoder

The DSC (Digital Selective Calling) encode signal which D/A converted in the 16-bit MPU Q2001 on the CNTL Unit is fed through the low-pass filter Q1028 on the Main Unit to the TX VCO Q1040.

Decoder

The RF modulated in DSC code on the CH70 from the antenna connector are passed through a SUB-RX RF amplifier Q4004 to the bandpass filter consisting of coils L4007, L4008 & L4012 and capacitors C4044, C4047, C4051, C4056, C4060, C4063, and C4069, then the filtered signal deliver to the sub 1st mixer which consists of balun transformers (T4001, T4002, and T4003) and FETs Q4010, Q4011, Q4013, and Q4014.

Buffered output from the SUB VCO Q4008 is amplified by Q4007 and Q4006 and

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bandpass filtered by coils L4015 & L4017 and capacitors C4081, C4085, C4087, C4089, C4090 & C4094, to provide a pure 1st local signal (134.225 MHz) for delivery to the sub 1st mixer.

The 22.3 MHz 1st mixer product then passes through monolithic crystal filters XF4001 and XF4002 (± 6.5 kHz BW) and buffer amplifier Q4016 and Q4020, then deliver to the SUB-RX FM IF subsystem IC Q4012. 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 X4001 (21.850 MHz) then deliver to the 2nd mixer in the SUB-RX FM IF subsystem IC Q4012. The 1st IF is converted to 450 kHz by the 2nd mixer and stripped of unwanted components by a ceramic filter CF4001.

Filtered signal from the ceramic filter CF4001 is applied to the limiter amplifier in the SUB-RX FM IF subsystem IC Q4012, and then demodulate by the FM detector in the SUB-RX FM IF subsystem IC Q4012. Demodulated signal from the SUB-RX FM IF subsystem IC Q4012 is passes through the low-pass filter Q4009 to the DSC Decoder IC Q4015. The decoded DCS signal delivered to the 16-bit MPU IC Q2001.

The SUB-RX 1st Local signal maintains stability from the PLL synthesizer by using a 21.850 MHz reference signal from crystal X4001. PLL synthesizer IC Q4005 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 21.850 MHz reference signal by 1748 using the reference counter (12.5 kHz comparison frequency). The reference oscillator feeds to the PLL synthesizer IC Q4005 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 SUB VCO consists of Q4008 and varactor diode D4002 and D4003, which oscillates at 134.225 MHz. The SUB VCO output passes through buffer amplifier Q4006 to obtain stable output.

1050 Hz Weather Alert Decoder

On the Main Unit, 1050 Hz Weather Alert signal from the FM IF subsystem IC Q1047 is filtered by Q1049, then is applied to 16-bit MPU IC Q2001 on the CNTL Unit.

PA (Public Address) Circuit

The voice from the microphone is delivered to the Main Unit. This audio is amplified by Q1028, then passes the MIC select switch Q1042 and the IC/MIC select switch Q1057 to the buffer amplifier Q1045. The amplified audio passes through the LB/HAIL select switch Q1051 to the buffer amplifier Q1056. The amplified audio is delivered to the electronic volume control IC Q1044 for volume control. The adjusted audio is delivered to the audio power amplifier Q4018 on the SUB Unit which is amplified the voice audio up to 30 watts, and then passes through the relay switch RL4001 to the external PA speaker.

LB (Listen Back) Circuit

The listen back audio from the PA speaker is delivered to the SUB Unit. The audio is passed through the relay switch RL4001 and buffer amplifier Q1056 to the LB/HAIL selector switch Q1051, then passes through the MUTE switch Q1057 to the buffer amplifier Q1045. The audio then passes through the AF MUTE switch Q1057 to the electronic volume control IC Q1044 for volume control. The adjusted audio is delivered to the audio power amplifier Q1055 which is amplified the voice audio up to 4.5 watts, and then deliver to the internal or external speaker.

A portion of the audio from the Q1057 is passed through the buffer amplifier Q1045 and MIC select switch Q1042 to the RAM microphones, if connected.

Fog Horn Circuit

A 400 Hz square wave for foghorn is generated by the microprocessor Q2001 on the CNTL Unit, then deliver to the Main Unit. A 400 Hz square wave passes through the buffer amplifier Q1056 to the electronic volume control IC Q1044 for volume control. The adjusted audio is delivered to the audio power amplifier Q4018 which is amplified the voice audio up to 30 watts, and then passes through the relay switch RL4001 to the external PA speaker.

MPU

Operation is controlled by 16-bit MPU IC Q2001 on the CNTL Unit. This MPU uses a 14.74560 MHz crystal X2001 for the system clock. IC Q2007 and a transistor Q2025 resets the MPU when the power is on, and monitors the voltage of the regulated 5V power supply line.

EEPROM

The EEPROM Q2009 on the CNTL Unit retains TX and RX data for all memory channels, prescaler dividing, IF frequency, local oscillator injection side, and reference oscillator data.