TECHNICAL DESCRIPTION
G9Plus

A). GENERAL DESCRIPTION

The G9Plus PMR/LPD radio is a self-contained transceiver unit with integral antenna intended for use as a general communication tool. It is designed to operate on PMR 8 channels and LPD 69 channels allocated by the CE for the licensed PMR & LPD. This model also features a CTCSS system with 38 pre-defined and a DCS system with 104 pre-defined, user selectable sub-audible tones for channel quieting. The useable range, while dependent upon terrain and other radio propagation principles, is typically five miles. The G9Plus uses the maximum transmit power allowed to help ensure the maximum communication range.

Features include: 8 PMR and 69 LPD Channels with 38 CTCSS codes, with 104 DCS code, Channel Monitor, Page and LCD Display. The unit is equipped with an external Headset option connector and Nickel Metal Hydride battery pack. An automatic power savings feature allows the typical standby battery life to extend to more than 5 days.

B). FREQUENCY DETERMINING CIRCUITS

The fundamental frequency for both the transmitter and the receive are controlled by Analog Two Way Radio IC2(BK4811B). The frequency of operation of the PMR+LPD make inside IC2 by firmware with VCTCXO reference at 21.85MHz (TCXO1).

The VCTCXO reference frequency is shared with both the transmitter and the receive operation.

C). TRANSMITTER CIRCUITS

The transmitter amplifies the 0dBm signal from the IC4(BK4811B) to approximately 35dBm that is fed to the antenna. The transmitter is a three stage amplifier composed of Q1, 3, and Q11. The first two stages are operated class A and the final is operated class B in full saturation to help prevent unwanted amplitude modulation. The fundamental transmit signal is fed through an elliptical low pass filter (5-pole, 2 zero) in order to suppress the harmonics to below –36dBm. The desired frequency modulation of the carrier is accomplished by modulating the current in the IC2 directly with the microphone audio signal. The microphone audio is conditioned with a three-pole high pass filter at 3000 Hz (IC2), a hard clipper circuit (IC2) to limit maximum deviation to +/- 2.5 kHz and a three-pole low pass or splatter filter at 2.8 kHz (IC2). The low pass filter insures that the occupied bandwidth of the FM modulated signal meets CE requirements under all input conditions.

D). RECEIVER CIRCUITS

The received signal from the antenna is band limited to 600MHz by the transmitter harmonic filter. The desired signal is fed to a low noise amplifier (LNA – Q6) centered from 430 to 450 MHz that provides approximately 10 dB of gain. The output of the LNA is input to the IC2. Band Pass filter inside IC2 determine with pass-band of 430 to 450 MHz and stop band attenuation of 50 dB. The receive signal of input to the IC2 feed step by step of Mixer, ADC, Filter demodulator, de-emphasis and DAC.
Filter of IC2 provides approximately 50 dB of adjacent channel attenuation. The resulting audio output signal is band pass filtered from 300 to 3 kHz (IC2)
A squelch circuit is provided of inside IC2 to mute the receiver noise under low signal conditions. The squelch circuit amplifies and detects noise in a narrow bandwidth at approximately 5 kHz. When the detected noise exceeds a threshold set to trigger at approximately 12dB SINAD receive signal strength, the audio output is muted.

E). TRANSMIT/RECEIVE SWITCH

When the radio is in the transmit mode, pin diode switches D13, D13A and D1 are turned on (representing less than 0.7 ohms). D13 and D13A allows the transmit signal to pass to the antenna and D1 shorts one leg of a T matching network (L3, L15 and C4) to ground in the receive path. This results in a parallel tuned circuit high impedance being presented to the transmit signal so that the receive path does not load the transmit signal. In the receive mode, both D13, D13A and D1 are off, resulting in the antenna signal being coupled into the receive LNA through the 50 ohm T matching network and the unwanted load of transmitted final amplifier is reduced to less than 1 pF by D1.

F). RADIO CONTROL CIRCUIT

A microprocessor (CPU1) is used to control the transceiver. User stimulus is provided through a tack switch for PTT (push to talk), along with the keypad for channel selection, channel monitor, receive volume, and page. Pressing the PTT switch instructs CPU1 to switch to the transmit mode. This is accomplished by loading the proper channel counter information through a 3-wire serial link to the Analog Two Way Radio IC (IC2), turning on power to the PLL and VCO, microphone and transmit audio circuits and the transmit RF amplifiers. Pressing the call switch causes the microcontroller to transmit a warbling tone for approximately 3 seconds on the current channel selected that is used to notify another person with PMR+LPD radio that you wish to communicate. Pressing the channel Up/Down buttons (active in receive mode only) instructs CPU1 to increment or decrement respectively the channel frequency by one channel from the channel previously selected.

In receive mode the microcontroller periodically switches and receiver power and checks for a valid received signal by monitoring the squelch circuit output. If a valid signal is present, the audio output is turned on and receive power is maintained for the duration of the valid signal. If the valid signal is removed or no valid signal was present, the microcontroller removes power from receiver, waits for approximately 100 ms and then checks again. This periodic cycling of the power to the receiver circuits results in a much longer battery life vs. leaving power on continuously. The total period of the cycling is selected such that the worst case delay in 'seeing' a valid receive signal is not disruptive to normal two-way voice communications.