

Base Camp 446

TECHNICAL DESCRIPTION

A). GENERAL DESCRIPTION

The BASE CAMP 446 is a self-contained transceiver unit with integral antenna intended for use as a general communication tool. It is designed to operate on all 75 channels allocated by the CE for the licensed PMR&LPD. This model also features a CTCSS system with 38 pre-defined, user selectable sub-audible tones for channel quieting. The useable range, while dependent upon terrain and other radio propagation principles, is typically ten miles. The BASE CAMP 446 uses the maximum transmit power allowed to help ensure the maximum communication range.

Features include : 57 Marine Channels, AM&FM Radio, Watch, and 75 PMR&LPD Channels with 38 CTCSS codes, Channel Monitor, Page and LCD Display. The unit is equipped with an external Headset option connector. Four AA alkaline batteries and Battery pack(NI-MH) that are readily available in retail outlets supply operating power. An automatic power savings feature allows the typical standby battery life to extend to more than 3 days.

B). FREQUENCY DETERMINING CIRCUITS

The fundamental frequency for both the transmitter and the receiver local oscillators are controlled by a phase lock loop (PLL) circuit IC102 (GP214D, or equivalent). The frequency of operation of the GMRS voltage controlled oscillator (VCO), composed of Q142, 143 operating in cascade is phase locked to a voltage controlled crystal reference (VCXO) operating at 20.95MHz (X102).

The VCO is locked to the fundamental of the transmit signal in the transmit mode and is locked to the receive 1st LO (Fundamental channel frequency minus 21.4MHz) in the receive mode. The crystal reference frequency is shared with the 2nd LO of 20.95MHz.

C). TRANSMITTER CIRCUITS

The transmitter amplifies the 0dBm signal from the VCO to approximately 35dBm that is fed to the antenna. The transmitter is a three stage amplifier composed of Q20,203,204 and Q205. 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 -50dBc. The desired frequency modulation of the carrier is accomplished by modulating the current in the VCO directly with the microphone audio signal. The microphone audio is conditioned with a three-pole high pass filter at 300Hz (IC201 A,B), a hard clipper circuit (IC4 C,D) to

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limit maximum deviation to +/- 2.5KHz and a three-pole low pass or splatter filter at 2.8KHz (IC103 A,D). The low pass filter insures that the occupied bandwidth of the FM modulated signal meets FCC 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 – Q401) centered from 430MHz to 450MHz that provides approximately 10 dB of gain. The output of the LNA is filtered with a Band Pass filter (SF1) with pass-band of 433MHz to 447MHz and stop band attenuation of 50 dB. The filtered receive signal is one input to the 1st mixer (Q402), the other mixer input (1st LO) is the output of the VCO at the desired channel frequency minus 21.4MHz. The output of the mixer is tuned to the 1st IF of 21.4MHz.

The 1st IF is transformer coupled for impedance matching to a X-tal filter centered at 21.4MHz with a bandwidth of +/-3.75Hz. The filtered 1st IF is fed to the 2nd mixer input of the multi-function receiver IC5. The 2nd LO (20.95 MHz) is generated by VCXO that is the reference frequency for the PLL. The 2nd mixer output of 450KHz is filtered through a 4 section ceramic filter that in combination with the 21.4MHz X-tal filter provides approximately 50 dB of adjacent channel attenuation. The 450KHz 2nd IF is then amplified, limited and fed to a quadrature detector for FM demodulation. The resulting audio output signal is band pass filtered from 300Hz to 3KHz (IC103 C,D,A) and amplified to provide 300mW of audio power (IC402, 404). A squelch circuit is provided 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 9dB SINAD receive signal strength, the audio output is muted.

E). TRANSMIT/RECEIVE SWITCH

When the radio is in the transmit mode, pin diode switches D3, 202 and D201 are both turned on (representing less than 0.7ohms). D3 and D202 allows the transmit signal to pass to the antenna and D201 shorts one leg of a T matching network (L03, L204 and C207) 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 D3,202 and D201 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 the transmit final amplifier is reduced to less than 1pF by D201.

F). RADIO CONTROL CIRCUIT

A microprocessor (CPU1,2) is used to control the transceiver. User stimuli is provided through a tack switch for PTT (push to talk), along with the keypad

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for channel selection, channel monitor, receive volume, and page. Pressing the PTT switch instructs CPU1,2 to switch to the transmit mode. This is accomplished by loading the proper channel counter information through a 3-wire serial link to the PLL IC (IC102), 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 GMRS radio that you wish to communicate. Pressing the channel Up/Down buttons (active in receive mode only) instructs U5 to increment or decrement respectively the channel frequency by one channel from the channel previously selected.

In receive mode the microcontroller periodically switches on the VCO 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 the VCO and 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.