CIRCUIT DESCRIPTION : BR-100

GENERAL INFORMATION

Circuitry is described in the following order : Microprocessor/control section, VCO/Synthesizer Section, Transmitter Section, Receiver Section and Battery Section. Refer to the Block Diagram and the schematics.

MICROPROCESSOR / CONTROL SECTION

The microprocessor IC301 is constantly operating when the radio is turn ON. It is continuously monitoring the keyboard. The PTT line and other internal inputs such as the squelch detect, etc. When a change occurs, the microprocessor makes the appropriate response. The microprocessor is used for control. The Radio emits a beep on channel change and the synthesizer is loaded with the correct frequency information. The microprocessor runs off a 4.1943㎒ oscillator which is composed of X301, C312, C313, and R306.
When the radio is first turned on, the microprocessor reads the radio status from the EEPROM IC310.
The microprocessor determines the receive frequency codes, then loads the synthesizer via its pins 23, 24, and 25.

VCO / SYNTHESIZER SECTION

This section consists of the Temperature-Compensated Crystal Oscillator(TCXO), Voltage controlled Oscillator (VCO), Synthesizer and the Loop Filter.

Temperature-Compensated Crystal Oscillator(TCXO)

The reference oscillator(X103) is a temperature compensated crystal-oscillator by Thermisters and resistors network. The reference oscillator is held within the specified 2.5ppm from -20 to +50(℃).

VOLTAGE-Controlled Oscillators

When the radio is turn on, the receive VCO oscillates. And if the PTT is pressed, IC301 pin 38 goes low (approx.0V) converting the receive VCO to the transmitter VCO by the Q307, Q99.

The receive VCO consists of TC101, D107, C209-C215, L111, L114, and Q107-Q108. This VCO oscillates at 21.4 ㎒ below the programmed receive frequency. The VCO's oscillating frequency is tuned by the varactor D107. The tuning voltage is supplied from the output of the Loop Filter. The output of the VCO is AC coupled (C161 and C207) to the synthesizer IC101 pin1.

The transmitter VCO consists of TC101, D107, C209-C215(except C213), L111, L114, and Q107-Q108. The VCO oscillates on the programmed transmit frequency. The VCO's oscillating frequency is tuned by the varactor D107. The tuning voltage is supplied from the output of the Loop Filter. The output of the VCO is AC coupled (C161 and C207) to the synthesizer IC101 pin1.

The transmit voltage controlled oscillator is directly frequency-modulated and operates on the carrier frequency. In the receive mode, the receive VCO is enabled, producing the receive local oscillator signal at a frequency 21.4 ㎒ below the incoming receive frequency. The synthesizer is tuned in 6.25㎑ step.
The frequency synthesizer is a large scale monolithic synthesizer integrated circuit IC101.
The synthesizer IC contains a dual modular prescaler, divide-by-N counter, prescale control(swallow) counter, reference oscillator, reference divider, phase detecter, charge pump and lock detecter. Also, included in IC101 are control circuits for frequency controls and general device control.

RF output from the active VCO is AC coupled to the synthesizer IC101 prescaler input at pin 1. The divide-by-N counter chain in IC101, consisting of the dual-modulus prescaler, swallow counter and programmable counter, divides the VCO signal down to a frequency very close to 6.25㎑ which is applied to the phase detecter. The phase comparator compares the edges of this signal with that of the 6.25㎑ reference signal from the reference divider and drives the internal charge pump.

When the PLL become unlocked, the lock detector at IC101 pin5 will be pulsing low. A RC circuit converts pulsing low to a low level for the microprocessor. The microprocessor then change the RX/TX line to a high. Therefore the transmitter remains disabled while the loop remains out of lock.

Loop Filter

The Loop Filter, a passive lead-lag filter consisting of R137, R139-R141 and C193-C195, integrates the charge pump output to produce the DC turning voltage for the VCO. One parasitic pole, consisting of R141/C195 and RF choke L115, prevent modulation of the VCO's by the 6.25㎑ reference energy remaining at the output of the loop filter. Direct FM is obtained for modulating frequencies outside the PLL bandwidth by applying the CTCSS signals and pre-emphasized, limited microphone audio to the VCO modulation circuit. The modulation circuit consists of R132, D108, C190.

TRANSMITTER SECTION

RF POWER Amplifier

After the PTT is pressed, the TX_POW line switches to approximately 4V. Q307 is turned on enabling transmit VCO. RF output from the transmit VCO is applied to the pre-drive amplifier Q103. The output signal from Q103 feeds the drive amplifier Q104, whose output from the driver stage feeds the final amplifier Q105 to produce the rated output power of 0.5 watts. The output power of the final is applied to the transmit/receive switch D102 and then fed to the antenna via the output low-pass filter C183, C179-C181, L119-L121.

Antenna Switching

Switching of the antenna between the transmitter and the receiver is accomplished by the transmit/receive switch consisting of diodes D101 and D102. In the transmit mode, switched TX B+ is applied through R129 and RF choke L123, hard forward biasing the two diodes on. D102 thus permits the flow of RF power from the Q105 ((final amplifier) to the output low-pass filter. D101 shorts the receiver input to ground.

Transmitter Audio Circuits

The transmitter audio circuits consist of the audio processing circuit, the CTCSS circuits.

Audio Processing

Transmit speed audio is providing by either the internal electric microphone MIC301 or the external microphone. The microphone audio is applied to MIC MUTE SW Q311., and high-pass filter IC306(A,B,C). The audio is pre-emphasized by 6dB per octave by C362 and R359, and then signal amplification. The gain is such that when a signal 20dB greater than limiting the peak-to-peak output. Under these conditions, the MOD. ADJ. Pot VR802 configured as a four-pole active low-pass filter. The resulting signal is then limited when respect to side band splatter, and has an 18dB per octave roll-off above 3㎑. The audio is then applied to transmit VCO. By varing the voltage on the varactor diode D108 at an audio rate. The resonant frequency of VCO is varied. The result is an oscillator output that is frequency-modulated at the audio frequency.

CTCSS Tone Encoder

CTCSS signals are synthesized by microprocessor IC301 and appear as pulse waveform on I/O lines pin 45-48. These I/O lines are applied to a resistive digital-to-analog converter network(consisting of R376-R379, and R381) which produce a pseudo-sine wave for CTCSS at its output. The waveform is smoothed by low-pass filter IC305 to produce an acceptable sine wave output. The CTCSS tone signal is adjusted to the proper level by VR102. The signal is then applied to the TCXO circuit.

RECEIVER SECTION

Receiver Front End

In the receive mode, the RF signal enters through the antenna, then through the low-pass filter C183, C179-C181, L119-L121. The diodes D101 and D102 are biased off so that the output of the low-pass filter is coupled(C100) to the first band-pass filter C101-C109, L100-L102, L104 and to the Front End RF overload protection diode pair D100. The signal from the band-pass filter is applied to the input of the RF amplifier Q100. The output of the RF amplifier feeds the input to four more stages of band-pass filter consisting of TC101, C114-C125, L104-L107. The output from the band-pass filter is applied to the mixer Q101.

Local Oscillator(LO)

The receive VCO (TC101, D107, C209-C215, L111, L114, and Q107-Q108) provides the LO signal. The VCO is running at 21.4㎒ below the desired receive frequency and is applied to the mixer Q101's emitter.

Mixer

The mixer is a transistor type(Q100). The mixer LO frequency is 21.4㎒ below the desired receiver frequency. When the receiver frequency is present, the mixer output will be a 21.4㎒ signal. The mixer output is peaked for 21.4㎒ at L109, C132, R104, and the signal filtered by crystal filter X100 and amplified by Q102 before being applied to the input of the IF IC100. Inside IC100, the 21.4㎒ IF signal becomes the input to a second mixer with a LO frequency of 20.945㎒ set by X101. The 455㎑ ceramic filter X102 filters the second mixer's output which is the second IF signal. The mixer's output is then fed to the internal limiting amplifier and then on to the FM decoder.

FM Detector and Squelch

The FM detector output is used for squelch, decoding tones and audio output. The setting of the squelch adjustment potentiometer VR100 sets the input to the squelch amplifier. The squelch amplifier is internal to IC100 and its output is fed to an rectifier and squelch detector. The output on IC100 pin14 signals the microprocessor IC301 with a low(0V) to unmute the radio. The audio is unmuted by the microprocessor IC301 pin21 switching to a low(0V) thus biasing on Q306. The audio is then routed to the audio amplifier IC309 via the volume control VR901.

Receiver Audio Circuit

The detecter's audio output also is fed to the tone(CTCSS) low-pass filter IC305. Then the output of the low-pass filter is applied to the squaring circuit IC306D and finally to the microprocessor IC301 pin17/34 for decoding.

Another branching of the detector output feeds the audio high-pass filter IC306(A,B,C) via IC304. The output

the audio high-pass filter feeds the volume control VR901. From the wiper arm on the volume control, the audio routed to pin3, the input to the audio power amplifier IC309. The output of the audio power amplifier is routed through the earphone jack J302 to the internal speaker SP301.

BATTERY SECTION

The battery connects to the contact pins on both sides end of the radio. The positive terminal of the battery connects to the ON/OFF Volume Control switch (VR901) and the negative terminal connects to the chassis ground.

Battery voltage status is monitored by the microprocessor IC301 pin2 through R387-R389. The upper right of LCD301 is blinking the low-battery-sign, when the battery voltage is below the preset value.