CIRCUIT DESCRIPTION

General

The TRC-238 is a 40-channel, crystal controlled handy transceiver which consists of a PLL-synthesizer circuit, a receiver circuit and a transmitter circuit. Power is supplied by 12 V DC (1.5 V "AA" alkaline battery × 8 pcs or 1.2 V "AA" Ni-cd battery x 10 pcs). Refer to the Block Diagram and the Schematic Diagram as you read the following descriptions.

PLL Synthesizer Section

The TRC-238 uses a Phase-Locked-Loop (PLL) circuit to synthesize the local-oscillator frequencies for receiving and transmitting.

It employs one IC and only one crystal. IC1 is a CMOS large scale integrated circuit containing a reference oscillator, phase detector, active low pass filter, reference divider (1/4096) and a programmable divider.

The programmable divider directly divides the output of the VCO (voltage controlled oscillator) down to a 2.5 kHz signal. Crystal X1 provides a reliable frequency standard which controls the local-oscillator frequencies. The reference-frequency divider inside IC1 counts down the oscillator signal to 1/4096, and passes it on to the phase detector, where it is compared with the 2.5 kHz signal from the programmable divider. An error voltage is generated by the phase detector, which is proportional to the phase difference between the two 2.5 kHz signals.

This error voltage appears at pin 27 of IC1 and passes through the active LPF (low pass filter), where the error voltage is integrated and harmonics and noise are filtered out. The resulting DC voltage is applied to the varicap diode (D8). Its capacity varies with the applied DC voltage. Because of this capacity change, the output frequency of the VCO is corrected. With proper circuit design and precise adjustments, the VCO frequency is accurate and precise when the system is "locked".

This means that the phase detector senses no phase differences between the two 2.5 kHz signals, and the VCO generates a frequency that is as accurate and stable as the reference crystal oscillator. The VCO circuit consists of D8, Q14 and T6.

The circuit is connected in the form of a Hartley oscillator with varicap diode D8 as part of the tank circuit. The VCO circuit generates a signal ranging from 13.4825 to 16.710 MHz. The IC1 also includes and unlock-signal-detector circuit. Should the condition occur, the output at pin 18 of IC1, which is normally open, will be shorted to ground. This means that VCO frequency (1/2 carrier for transmitting) is "sunk" to pin 18 of IC1 and the transmitter circuit are inhibited.

Transmitter Circuit

RF Implication

The output of doubler amp Q17 is fed through doubler tuning (27 MHz) T7 and T8 to the base of RF amp Q18. The output is then supplied through tuning circuit T9 to RF driver amp Q19. The Q19 output capacitance is divided by tuning circuit L8, C86 and C87 and passed through tuning circuit L9 to the base of final RF stage Q20.

Suppression of Spurious Radiation

The tuning circuit between frequency synthesizer and final amp Q20, and 3-stage "PI" network C89, L12, C91, L13, C3, L3 and C2 in the Q20 output circuit serve to suppress spurious radiation. This network serves to match Q20 impedance to the antenna and to reduce spurious content to acceptable levels. In-band spurious is reduced to acceptable levels by filtering.

Limiting Power

During factory alignment, the series base resistor of final Q20 (R95) is selected to limit the available power. The tuning is adjusted so the actual power is 2.5 watts, and there are no other controls for adjusting power.

Modulation

The mic input is fed to mic amp Q12 and then to audio power IC3, which feeds the signal to the modulator transformer T5. The audio output at the step up of T5 is fed in series with the B+voltage through diode D11 to the collectors of driver Q19 and final Q20 to collector-modulate both these stages.

Limiting Modulation

A portion of the modulating voltage is rectified by Q10 to turn on Q11, which attenuates the mic input to mic amp Q12. The resulting feedback loop keeps the modulation from exceeding 100 percent for inputs approximately 40 dB greater than required to produce 50 percent modulation. The attack time is about 18 ms and the release time is about 250 ms.

Receiver Circuit

Receiver

The receiver is a double conversion superheterodyne with the first IF at 10.695 MHz and the second IF at 455 kHz. The synthesizer supplies the first local oscillator 10.695 MHz below the received frequency and the second local oscillator at 10.240 MHz. The detector output provides reverse AGC to all previous stages except Q7. The AGC voltage is also amplified by Q8 and used to drive RF attenuator Q2. Squelch amp and audio amp are included in IC2.

Indicators

Channel Indication

The channel is indicated by the 2 digits/7 segments LED (LD201) and it is selected by the channel selector (SW4,SW5). The LED (LD201) lights dynamically by the outputs from IC1.

The output from pin 8 of IC1 controls the lighting of the 1st digit through Q202, and the output from pin 9 of IC1 controls the lighting of the 2nd digit through Q201.

The outputs from pin 1 to pin 7 of IC1 control the lighting of each segment of each digit.

Battery Test Indication

When the battery test switch (SW201) is pressed, the battery test LED (LD202) lights through D201 if the battery voltage is more than 9 volts, also the LED (LD201) lights.