TK-3130/3131 Circuit Description

The KENWOOD model TK-3130/3131 is UHF/FM hand-held transceiver designed to operate in the frequency range of 460 to 470MHz. The unit consists of a receiver, a transmitter, a phase-locked loop (PLL) frequency synthesizer, a digital control circuit, power supply circuit and a signaling circuit.

1. RECEIVER CIRCUIT

The receiver is double conversion super heterodyne, designed to operate in the frequency range of 460 to 470MHz.

1.1 FRONT-END RF AMPLIFIER

An incoming signal from the antenna is applied to on RF amplifier (Q18) after passing through a transmit/receive switch circuit (D13 is off) and SAW filter. After the signal is amplified (Q18), goes to the first mixer.

1.2 FIRST MIXER

The signal from the RF amplifier is heterodyned with the first local oscillator signal from the PLL frequency synthesizer circuit at the first mixer (Q19) to become a 38.85MHz first intermediate frequency (1st IF) signal. The first IF signal is fed through two monolithic crystal filters (MCFs:XF1) to further remove spurious signals.

1.3 IF AMPLIFIER

The first IF signal is amplified by Q20, and then enters IC2 (FM processing IC). The signal is heterodyned again with a second local oscillator signal within IC2 to become a 450kHz second IF signal. The second IF signal is fed through a 450kHz ceramic filter to further eliminate unwanted signals before it is amplified and FM detected in IC2.

1.4 AUDIO AMPLIFIER

The demodulated signal from IC2 goes through high-pass filtered, and is amplified in the base band IC (IC205), low-pass filtered, high-pass filtered, and de-emphasized. The processed audio signal passes through an audio volume control and is amplified to a sufficient level to drive a loud speaker by an audio power amplifier (IC208).

1.5 SQUELCH AND MUTE CIRCUIT

It amplifies the demodulated noise signal from FM IC (IC2) after filtering through BPF circuit. Then, the amplified signal is converted signal is fed through the microprocessor (IC204). The microprocessor controls the mute control line (MUTE) according to the input signal and the microprocessor task condition.

2. TRANSMITTER

2.1 MICROPHONE CIRCUIT

The signal from the microphone is amplified by IC207, passed through microphone mute circuit (Q210), limited and pre-emphasized by IC207. The signal component above the audio pass-band circuit is attenuated by splatter filter comprised of base band IC (IC205).

2.2 MODULATOR CIRCUIT

The output from the microphone amplifier passes through a variable resistor (VR201) for maximum deviation adjustment and is applied to a varactor diode (D8) in the voltage controlled oscillator (VCO) located in the frequency synthesizer section.

2.3 DRIVER AND FINAL POWER AMPLIFIER CIRCUITS

The transmit signal obtained from the VCO buffer amplifier Q6, is amplified to approximately 12dBm by Q7 and Q8. This amplified signal is passed to the power amplifier Q9 and Q10, which consists of a 2-stage FET amplifier and is capable of producing up to 1W of RF power.

2.4 TRANSMIT/RECEIVE SWITCHING CIRCUIT

The power module output signal is passed through a low-pass filter network and a transmit/receive switching circuit before it is passed to the antenna terminal. The transmit/receive switching circuit is comprised of D12 and D13. D10 is turned on (conductive) in transmit mode and turned off (isolated) in receive mode.

3. PLL FREQUENCY SYNTHESIZER

3.1 PLL

The frequency step of the PLL circuit is 5 or 6.25kHz. A 12.8MHz reference oscillator signal is divided at IC1 by a fixed counter to produce the 5 or 6.25kHz reference frequency. The VCO output signal is buffer amplified by Q1, then divided in IC1, by a dual-modules programmable counter in this case. The divided signal is compared in phase with the 5 or 6.25kHz reference signal in the phase comparator also in IC1. The output signal from the phase comparator is low-pass filtered and passed to the VCO to control the oscillator frequency.

3.2 VOLTAGE CONTROLLED OSCILLATOR (VCO)

The operating frequency is generated by Q4. The oscillator frequency is controlled by applying the VCO control voltage, obtained from the phase comparator, to the varactor diodes (D4). Q2 performs a change of the oscillation frequency of transmit/receive (turn on: transmit mode, turn off: receive mode). The outputs from Q4 is amplified by Q5 and outputted to the buffer amplifiers.

3.3 UNLOCK DETECTOR CIRCUIT

If a pulse signal appears at the LD pin of IC1, an unlock condition occurs, the DC voltage, obtained from D1, R4 and C13, causes the voltage applied to the UL pin of the microprocessor to go low. When the microprocessor detects this condition, the transmitter is disabled by ignoring the push-to-talk switch input signal.

4. DIGITAL CONTROL CIRCUIT

4.1 KEY SWITCHES INPUT CIRCUIT

The key switches in information are entered directly into the microprocessor (IC204).

4.2 RESET CIRCUIT

When the power is initially turned on, IC201 detects a 2.7V reference voltage rise, then output a high level signal to reset the microprocessor (IC204).

5. POWER SUPPLY CIRCUIT

5.1 POWER SWITCHING CIRCUIT

A 5V reference voltage [3M] supply for the control circuit is derived from an internal battery by IC213. Voltage for transmission [3T], voltage for receive [3R], and common voltage [3C] are supplied by IC209.

5.2 BATTERY SAVER CIRCUIT

If no activity is detected (squelch closed) on the channel, the unit's enters into the battery save mode controlled by the microprocessor.

6.ADDITIONAL CIRCUIT

6.1 QT, DQT ENCODE

The QT, DQT encoder tone is set by the data from the microprocessor. QT, DQT tone is generated by the microprocessor (IC204). The output is applied to the VCO and TCXO (X1).

6.2 QT, DQT DECODE

A part of the recovered audio signal obtained at the amplifier IC205 are the QT and DQT tones and are low pass filtered by IC206 and passed to the microprocessor for decoding.