TK-360G/TK-370G CIRCUIT DESCRIPTION

The KENWOOD model TK-360G, TK-370G are UHF/FM hand-held transceiver designed to operate in the frequency range of 403 to 430MHz. 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 superheterodyne, designed to operate in the frequency range of 403 to 430MHz.

1.1 FRONT-END RF AMPLIFIER

An incoming signal from the antenna is applied to on RF amplifier (Q301) after passing through a transmit/receive switch circuit (D3 and D7 are off) and a band pass filter (L308,L309). After the signal is amplified (Q301), the signal is filtered by a band pass filter (L302,L304) to eliminate unwanted signals before it is passed 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 49.95MHz 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 Q22, and then enters IC4 (FM processing IC). The signal is heterodyned again with a second local oscillator signal within IC4 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 IC4.

1.4 AUDIO AMPLIFIER

The recovered audio signal obtained from IC4 is amplified by IC16 (1/2), high-pass filtered by IC14, and de-empfasized by IC14. The audio signal is then amplified by IC15. 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 (IC11).

1.5 SQUELCH AND MUTE CIRCUIT

The output signal from the squelch circuit, which consists of IC4, is applied to the microprocessor. 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 high-pass filtered by IC14, passed through microphone mute circuit (Q35), limited and pre-emphasized by IC14,D23.

2.2 MODULATOR CIRCUIT

The output of the Low-pass filter network (IC14) is passed to the D/A converter (IC17) for maximum deviation adjustment and is applied to a varactor diode (D6) 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 Q3 is amplified to approximately 17dBm by Q4,Q5 and Q6. This amplified signal is passed to the power module (IC1). The power module consists of a 2-stages amplifier and is capable of producing up to 4W of RF power.

2.4 TRANSMIT/RECEIVE SWITCHING CIRCUIT

The power module output signal is passed through a 3-stages 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 D3 and D7. D3 and D7 are turned on (conductive) in transmit mode and turned off (isolated) in receive mode.

2.5 AUTOMATIC POWER CONTROL CIRCUIT AND TRANSMITTER OUTPUT LEVEL SWITCH

The automatic power control (APC) circuit stabilizes the transmitter output power at a pre-determined level by sensing the collector current of the final amplifier Field Effect Transistor (FET) in the power module. The voltage comparator IC3 (2/2) compares the voltage obtained by the above drain current with a reference voltage, set using the microprocessor and Q15. An APC voltage proportional to the difference between the sensed voltage and the reference voltage appears at the output of IC3 (2/2). This output voltage controls pin 2 of the power module, which keeps the transmitter output power constant. The transmitter output power can be varied to 1W or 2W output power by the microprocessor, which in turn changes the reference voltage and hence the output power.

3. PLL FREQUENCY SYNTHESIZER

3.1 PLL

The frequency step of the PLL circuit is 5 or 6.25kHz. A 16.8MHz reference oscillator signal is divided at IC2 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 IC2, 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 IC2. 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 Q2 in transmit mode and Q10 in receive mode. The oscillator frequency is controlled by applying the VCO control voltage, obtained from the phase comparator, to the varactor diodes (D2 and D4 in transmit mode and D9 and D11 in receive mode). The T/R pin is set high in receive mode causing Q7 and Q8 to turn off Q2, and turn on Q10, and is set low for transmit mode. The outputs from Q2 and Q10 are amplified by Q3 and outputted to the buffer amplifiers.

3.3 UNLOCK DETECTOR CIRCUIT

If a pulse signal appears at the LD pin of IC2, an unlock condition occurs, the DC voltage, obtained from D1, R1 and C6, 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 AND ROTARY ENCODER INPUT CIRCUIT

The key switches and rotary encoder (channel selector) information are entered directly into the microprocessor (IC13).

4.2 RESET CIRCUIT

When the power is initially turned on, IC8 detects a 5V reference voltage rise, then output a high level signal to reset the microprocessor (IC13).

4.3 LAMP CIRCUIT

An LED is provided to illuminate the LCD and its operation is controlled by the microprocessor.

5. POWER SUPPLY CIRCUIT

5.1 POWER SWITCHING CIRCUIT

A 5V reference voltage[5M] supply for the control circuit is derived from an internal battery by IC7. This reference is used to provide a 5V supply in transmit mode [5T], and a 5V supply in receive mode [5R] and a 5V supply common in both modes [5C] based on the control signal sent from the microprocessor.

5.2 BATTERY SAVER CIRCUIT

If no activity is detected (squelch closed) on the channel, the units enters into the battery save mode controlled by the microprocessor. In this mode, SAVE line is set low, causing Q18 to disable [5C] and [5R].

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 (IC13). 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 IC16 (2/2) are the QT and DQT tones and are low pass filtered by IC19 and passed to the microprocessor for decoding.

6.3 DTMF ENCODE

Once a signal is passed from the DTMF keypad to the microprocessor. The encoded signal is obtained by the microprocessor. This signal provides a TX DTMF tone and a RX DTMF tone. The TX DTMF tone is passed to the pre-emphasis circuit (Mic. amplifier) and then to the VCO. The RX DTMF tone is passed to the de-emphasis circuit, audio power amplifier and then to the speaker.

6.4 DTMF DECODE

The DTMF input signal from the DET line is passed to IC18, DTMF decoder. The decoded information is then processed by the microprocessor.