(FCC ID:22923110)

(FCC ID:22923120)

(FCC ID:22923130)

TK-690H Circuit Descriptions

The Kenwood Model TK-690H is an all solid-state VHF FM transceiver designed to operate in the frequency range of from 29.7 to 50.0MHz.

The TK-690H consists of a display unit, a control section, a transmitter-receiver (TX-RX) section, and a transmitter power amplifier section.

1. Display Unit (Front Panel Section)

There are two types of displays, A and B, available as a dealer installable option. The display unit consists of a microprocessor (iC4), a liquid crystal display (LCD) assembly, a power supply control circuit, and associated circuits.

(1) A rotary encoder is used for selecting the operating channel. An up or down pulse, generated at the rotary encoder is converted to a serial data signal and it is sent to the control section by the microprocessor.

(2) On or Off signals from various function switches are converted to a corresponding serial data signal and sent to the control section by the microprocessor.

(3) Serial data, sent from the control section, is received by the microprocessor, and the corresponding LCD segments are turned on.
The A type display comprises an 8-digits 13-segments alphanumeric display, 3-digits 7-segments alphanumeric display and icon display for confirming operation.
TX and BUSY indicators are also provided.
The B type display comprises 14-digits(large) and 3-digits(small) dot-matrix, 14-digits alphanumeric display, 3-digits channel status display and icon display for confirming operation.
TX and BUSY indicators are also provided.

2. Control Section

The control section consists of a receive audio circuit, a transmitter microphone amplifier circuit, a microprocessor, and associated peripheral circuits.

The control section transfers data to or from the display unit in serial format.

- The control section microprocessor (IC516) is connected to an external EPROM (IC514) and an external FLASHROM (IC519), and controls the following functions:

(1) Programs or retrieves the channel frequency data to or from the EEPROM.
(2) Sends the channel frequency data to the frequency synthesizer section.
(3) Sends sub-audible signal encoder data to the microphone amplifier section.
(4) Processes (decodes) an incoming sub-audible signal, received at its analog-to-digital converter input port, and controls the audio mute circuit.
(5) Processes a squelch signal from the IF IC (IC101) and controls the noise squelch circuit.
(6) Controls the audio circuit and switches between transmit and receive

according to the data sent from the display unit.

- Receive audio circuit and transmitter microphone amplifier (Mic amp.) circuit

A recovered audio signal from the received signal, obtained at the TX-RX unit, passes through band-pass filter circuit(IC518,524) and then it is applied to the D/A converter(IC512) for electronic volume control and the receive audio power amplifier(IC522) section. An audio signal, originating at the microphone, is applied to microphone amplifier section(IC505,510,513) after going through a mic gain adjustment (VR501).The signal is then pre-amplified, pre-emphasized. The processed audio signal is again amplified by a voltage saturation type limiting amplifier and it is routed to the TX-RX unit after going through a 24dB/oct low-pass filter and D/A converter (IC512) for maximum deviation control.

3. TX-RX Section

The TX-RX section contains a frequency synthesizer section, a receiver RF section, IF sections, and a transmitter exciter section.

3.1 Frequency Synthesizer Section

The frequency synthesizer section consists of a TCXO (X301), a PLL circuit, and associated circuits.

The TCXO operates at 16.8 MHz, its frequency being maintained within ±5.0ppm from -30°C to +60°C. The 16.8MHz signal from the TCXO is applied to the PLL IC (IC301), where the signal is divided by 25KHz reference signal.

Two independent VCOs are provided for the transmitter and receiver to cover a wide frequency spread between the transmit and receive frequencies. The transmit signal is produced by Q306, and the receive LO signal is produced by Q307. The RF signals, generated at the VCOs, are amplified by a common buffer amplifier (Q311). The output signal from the buffer amplifier is split into two and each signal is applied to buffer amplifiers Q312 and Q313. The Q312 output is routed to the PLL IC (IC301), and the Q313 output is used as the receiver LO signal or the transmit signal.

The PLL IC (IC301) consists of prescaler, fractional divider, reference divider, phase comparator, charge pump. The PLL IC is fractional-N type synthesizer and performs is the 40 or 25KHz reference signal which is fifth of the channel step (5.0KHz).

The input signal from the pin 5 of the PLL IC is divided down to the 25KHz and compared at phase comparator. The pulsed output signal of the phase comparator is applied to the charge pump and transformed into DC signal in the loop filter(Q303,304). The DC signal is applied to the VCO and locked to keep the VCO frequency constant.

The IC301 lock detector output signal causes the DC level to change and this is detected by the microprocessor in the control section. The microprocessor inhibits the transmitter to eliminate unlawful transmission if this condition occurs.

The output signal from the Mic amplifier in the control section is applied to the transmit VCO for frequency modulation (FM) of the transmit carrier signal.

3.2 Receiver RF and IF Stages

The receiver is a double conversion superheterodyne, designed to operate in the frequency range of from 29.7 to 50.0MHz. The RF and IF stages of the receiver section consists of an

RF amplifier (Q101,Q102), a first mixer DBM(Q110,Q111,Q112,Q113), a first IF amplifier (Q103,107) and a second IF system IC (IC101).

An incoming signal from the antenna is applied to a band-pass filter after going through a low-pass filter and an antenna switch. The signal is then amplified by the RF amplifier and again filtered by another band-pass filter (L102, L104 and L105). The amplified and filtered signal is heterodyned at the first mixer with a first LO signal originated at the frequency synthesizer. The resulting 10.7MHz first IF signal is amplified by a first IF amplifier(Q101,Q102)and filtered filtered by a 4-pole crystal filter (XF101) and is further amplified by a first IF amplifier (Q107). The processed first IF signal is then applied to the second IF system IC, where the signal is heterodyned again down to 455kHz, amplified, filtered,CF101,CF102 and FM detected. The FM system IC also includes an oscillator circuit to generate a second LO signal of 11.155MHz. FM detection is performed by a quadrature type detector and the detected signal is routed to the control section.

3.3 Transmitter Exciter Section

The transmitter exciter section consists of an amplifier(Q203) to amplify the modulated signal from the frequency synthesizer to between 200 and 300mW. The amplified signal is routed to the transmitter power amplifier section through a coaxial cable.

4. Transmitter Power Amplifier Section

The transmitter power amplifier section consists of two driver amplifier stages, transmitter final power amplifier stage an antenna switch, a low-pass filter and an automatic power control circuit (APC).

The exciter output signal from the TX-RX section is first amplified by two driver amplifiers (Q1,Q5). Then it is further up to 110W by the final power amplifier which is comprised of two class B amplifiers connected in push-pull (Q9 and Q10). The signal is routed to the antenna connector after going through the antenna switch and the low-pass(harmonics) filter. The low-pass filter of a chebychev type, which has an insertion loss of 0.5dB or less and a minimum attenuation of 50dB at the second harmonic frequency. The second harmonic attenuation at the output of the final power amplifier is 30dB or more. Therefore, the total attenuation of any frequency above the second harmonic signal is guaranteed to be greater than 80dB.

The antenna switching is done by a relay

The APC circuit consists of an RF level detector, and a temperature sensing circuit.

The RF level detector senses the forward and reflected power. The transmitter output power is kept constant by the exciter control circuit which monitors the forward power and regulates the supply voltage applied to the exciter section. If the antenna load becomes abnormal, the reflected power increases, causing the exciter control circuit to reduce the supply voltage to the exciter. In case of an abnormal temperature rise in the power amplifier section, the temperature sensing circuit detects this condition and send the information to the APC circuit, these actions reduce the transmitter output to a safe operating level.