TK-690H Tuning Procedures

Preparation for tuning the transceiver.

Before attempting to tune the transceiver, connect the unit to a suitable power supply. Whenever the transmitter is tuned, the unit must be connected to a suitable dummy load, unless the instruction specify otherwise. The speaker output connector must be terminated with a 4ohm dummy load at any time during the tuning and connected to an AC voltmeter and an audio distortion meter or a SINAD measurement meter at all the time during the tuning.

Transceiver tuning

NOTE: To avoid damaging components in the transceiver while tuning, transmitter on time should be kept minimum and if the chassis or heatsink temperature becomes excessively hot, give the transceiver enough time to cool down in the steps 11 through 15 below.

1. Select the frequency to High-edge 36.9MHz,42.9MHz,49.9MHz.
2. Connect a digital voltmeter to CV.
3. Adjust TC302 in the TX-RX unit to obtain the 1.5V±0.1V.
4. Select the frequency to Low-edge 29.8MHz,35.1MHz,40.1MHz.
5. Apply a receive signal without a modulation to the transceiver.
6. Tune L101,L102,L104,L105 to obtain the maximumreceive quieting(Minimumoise).
   Reduce the RF signal level as tuning progress.
   Connect a sweep signal generator to CN102.
   Connect a display through an RF detector to CN103 in the TX-RX unit.
   Tune L128,L129,L131,L132,L133.
7. Modulate the receive signal with a 1000 Hz tone at ±3.0kHz deviation.
8. Set the RF signal level to 1mV.
9. Tune L127,L129,L131,L133 for the minimum audio distortion level.
   Reduce the volume control setting as tuning progress to avoid saturation in the audio amplifier stages.
   Apply a standard signal at the level of 3dB less than the 12dB SINAD.
   Tune the squelch threshold by the PC tuning.

10. Adjust VR1 in the transmitter final section for 110W±5% in the transmit mode.
11. Apply a 1000 Hz tone with a 50 mV (RMS) level to the MIC input.
12. Adjust the maximum deviation to ±5.0kHz or less in the frequency ranges of 29.7 to 50MHz by the UP/DOWN of PC tuning.
13. Reduce the 1000 Hz signal level to 5 mV (RMS).
14. Adjust VR501 in the Control section to obtain ±3.0kHz of deviation in the transmit mode.

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.

*** SEMICONDUCTOR PARTS LIST *** PAGE 1
FOR MODEL : TK-690HB
(: Y51-4460-10)

CURCUIT SYMBOL	PARTS NUMBER	DESCRIPTION	
Q1	2SC1971	TRANSISTOR	TX DRIVE AMP.
Q5	2SC1972	TRANSISTOR	TX DRIVE AMP.
Q9	2SC2694	TRANSISTOR	FINAL AMP.
Q10	2SC2694	TRANSISTOR	FINAL AMP.

FOR MODEL : TK-690HB

(FINAL UNIT : X45-3550-10)

CURCUIT SYMBOL	PARTS NUMBER	DESCRIPTION	
D1	1SS184	DIODE	TEMPERATURE COMPENSATION
D2	MA4PH633	DIODE	ANT SWITH
D3	MA4PH633	DIODE	ANT SWITH
D4	MI809	DIODE	ANT SWITH
D5	1SS184	DIODE	PROTECTOR
D6	HSM88AS	DIODE	REFLECTED WAVE RECTIFICATION
D7	22ZR-10D	SURGE ABSORBER	SURGE ABSORPTION
D8	SG-5L(R)	DIODE	PROTECTION OF REVERSE CONNECTION
D9	HSM88AS	DIODE	FORWARD WAVE RECTIFICATION
D10	MI809	DIODE	ANT SWITH
Q2	2SC2712(Y)	TRANSISTOR	DC AMPLIFIER
Q3	DTC114EK	TRANSISTOR	DC SWITCH
Q4	2SC2712(Y)	TRANSISTOR	DC SWITCH
;	2SD2531	TRANSISTOR	APC CONTROLLER
Q7	2SA1162(Y)	TRANSISTOR	DC AMPLIFIER
Q8	FMW1	TRANSISTOR	APC COMPARATOR
Q11	2SC2712(Y)	TRANSISTOR	DC SWITCH

FOR MODEL : TK-690HB

(TX-RX UNIT : X57-5600-10)

CURCUIT SYMBOL	PARTS NUMBER	DESCRIPTION
D102	1SV228	VARIABLE CAPACITANCE DIODE BPF TUNING
D103	1SV228	VARIABLE CAPACITANCE DIODE BPF TUNING
D104	1SV228	VARIABLE CAPACITANCE DIODE BPF TUNING
D105	1SV228	VARIABLE CAPACITANCE DIODE BPF TUNING
D106	MA716	DIODE NOISE DETECTOR
D107	1SS355	DIODE DC SWITCH
D301	1SV228	VARIABLE CAPACITANCE DIODE FREQUENCY CONTROLLER
D302	1SV228	VARIABLE CAPACITANCE DIODE FREQUENCY CONTROLLER
D303	1SV228	VARIABLE CAPACITANCE DIODE FREQUENCY CONTROLLER
D304	1SV228	VARIABLE CAPACITANCE DIODE FREQUENCY CONTROLLER
D305	1SV214	VARIABLE CAPACITANCE DIODE MODULATOR
D306	DAN235K	DIODE RF SWITCH
D501	02CZ18(X,Y)	ZENER DIODE VOLTAGE REFERENCE
,02	1SS355	DIODE REVERSE CURRENT
D503	1SS355	DIODE SURGE ABSORPTION
D504	02CZ5.6(X,Y)	ZENER DIODE VOLTAGE REFERENCE
D505	1SS355	DIODE DC SWITCH
D506	1SS301	DIODE DC SWITCH
D507	02CZ15(X,Y)	ZENER DIODE VOLTAGE REFERENCE
D508	1SS355	DIODE DC SWITCH
D511	1SS301	DIODE DC SWITCH
D512	1SS355	DIODE REVERSE CURRENT PREVENTION
D513	DA204U	DIODE SURGE ABSORPTION
D514	DA204U	DIODE SURGE ABSORPTION
D515	DA204U	DIODE SURGE ABSORPTION
D516	DA204U	DIODE SURGE ABSORPTION
D517	DA204U	DIODE SURGE ABSORPTION
D518	DA204U	DIODE SURGE ABSORPTION
D519	DA204U	DIODE SURGE ABSORPTION
D520	DA204U	DIODE SURGE ABSORPTION
D521	DA204U	DIODE SURGE ABSORPTION
;22	DA204U	DIODE SURGE ABSORPTION
D523	DA204U	DIODE SURGE ABSORPTION
D524	DA204U	DIODE SURGE ABSORPTION
D525	DA204U	DIODE SURGE ABSORPTION
D526	DA204U	DIODE SURGE ABSORPTION
D527	DA204U	DIODE REVERSE CURRENT PREVENTION
D528	1SS355	DIODE REVERSE CURRENT PREVENTION
D529	1SS355	DIODE REVERSE CURRENT PREVENTION
IC101	TA31136FN	IC FM IC
IC201	BU4094BCF	IC SHIFT REGISTER
IC202	NJM78L05UA	IC AVR
IC203	AN8009M	IC AVR
IC301	SA7025DK	IC PLL IC
IC501	TC4013BF(N)	IC D FF
IC502	NJM4558M	IC LPF
IC503	TA7808S	IC AVR
IC504	TC35453F	IC AUDIO PROCESSOR
IC505	NJM4558M	IC HPF/IDC
IC506	L78LR05B-FA	IC AVR

FOR MODEL : TK-690HB

(TX-RX UNIT : X57-5600-10)

CURCUIT SYMBOL	PARTS NUMBER	DESCRIPTION
IC508	NJM4558M	IC LIMITER/BUFFER AMPLIFIER
IC509	MC33172D	IC BUFFER AMPLIFIER
IC510	NJM4558M	IC SUMMING AMPLIFIER /LPF
IC511	PCD3312CT	IC DTMF ENCODER
IC512	M62364FP	IC D/A CONVERTER
IC513	NJM4558M	IC LPF/SUMMING AMPLIFIER
IC514	AT24C64N10SI27	IC EEPROM
IC515	BU4066BCF	IC ANALOG SWITCH
IC516	784214GC0238EU	IC CPU
IC517	BU4094BCF	IC SHIFT REGISTER
IC518	NJM4558M	IC BUFFER AMPLIFIER
IC519	AT29C020-90TI	IC FLASH ROM
IC520	TC7S02F	IC NOR GATE
IC521	NJM4558M	IC BUFFER AMPLIFIER/AMPLIFIER
IC522	TDA8561Q	IC AUDIO POWER AMPLIFIER
IC523	BU4094BCF	IC SHIFT REGISTER
IC524	NJM4558M	IC BUFFER AMPLIFIER/DE-EMPHASIS
IC525	LC73872M	IC DTMF DECODER
IC526	TA75S01F	IC AMPLIFIER
Q101	2SK520(K43)	FET 1ST AMPLIFIER
Q102	2SK520(K43)	FET 1ST AMPLIFIER
Q103	2SK508NV(K52)	FET IF AMPLIFIER
Q105	2SK508NV(K52)	FET NB GATE
Q106	2SK508NV(K52)	FET NB GATE
Q107	2SC4215(Y)	TRANSISTOR IF AMPLIFIER
Q108	2SC4617(S)	TRANSISTOR SQL AMPLIFIER
Q110	2SK508NV(K52)	FET RX 1ST MIXER
Q111	2SK508NV(K52)	FET RX 1ST MIXER
Q112	2SK508NV(K52)	FET RX 1ST MIXER
Q113	2SK508NV(K52)	FET RX 1ST MIXER
Q114	DTC144EUA	TRANSISTOR NB SWITCH
Q115	2SK1824	FET DC SWITCH
Q201	2SB1132(Q,R)	TRANSISTOR 8T SWITCH
Q202	DTC114EUA	TRANSISTOR 8T SWITCH
Q203	2SC2954	TRANSISTOR TX PRE-DRIVE AMPLIFIER
Q204	DTC114EUA	TRANSISTOR 8R SWITCH
Q205	2SB1132(Q,R)	TRANSISTOR 8R SWITCH
Q301	2SC4116(GR)	TRANSISTOR RIPPLE FILTER
Q302	2SC4116(GR)	TRANSISTOR RIPPLE FILTER
Q303	2SC3722K(S)	TRANSISTOR LOOP FILTER
Q304	2SC3722K(S)	TRANSISTOR LOOP FILTER
Q306	2SK508NV(K52)	FET OSC
Q307	2SK508NV(K52)	FET OSC
Q308	2SC4116(Y)	TRANSISTOR DC SWITCH
Q309	2SC4116(Y)	TRANSISTOR DC SWITCH
Q310	DTC144EUA	TRANSISTOR DC SWITCH
Q311	2SC4215(Y)	TRANSISTOR BUFFER AMPLIFIER
Q312	2SC4215(Y)	TRANSISTOR AMPLIFIER
Q313	2SC3357	TRANSISTOR AMPLIFIER
Q501	DTA114EUA	TRANSISTOR DC SWITCH

FOR MODEL : TK-690HB

(TX-RX UNIT : X57-5600-10)

CURCUIT SYMBOL	PARTS NUMBER	DESCRIPTION	
Q502	DTC114EUA	TRANSISTOR	DC SWITCH
Q503	DTC114EUA	TRANSISTOR	DC SWITCH
Q504	DTC363EK	TRANSISTOR	MUTING SWITCH
Q505	DTC144EUA	TRANSISTOR	DC SWITCH
Q506	DTA114YUA	TRANSISTOR	DC SWITCH
Q507	DTC114YUA	TRANSISTOR	DC SWITCH
Q509	DTC144EUA	TRANSISTOR	DC SWITCH
Q510	DTC144EUA	TRANSISTOR	DC SWITCH
Q511	DTC144EUA	TRANSISTOR	DC SWITCH
Q512	DTC144EUA	TRANSISTOR	DC SWITCH
Q513	DTC144EUA	TRANSISTOR	DC SWITCH
Q514	DTA144TKA	TRANSISTOR	MUTING SWITCH
Q516	DTA114TUA	TRANSISTOR	DC SWITCH
Q517	DTC144EUA	TRANSISTOR	DC SWITCH
Q518	DTA114EUA	TRANSISTOR	DC SWITCH
Q519	2SJ506(S)	FET	POWER SWITCH
Q520	DTD114EK	TRANSISTOR	DC SWITCH
Q522	2SC4215(Y)	TRANSISTOR	BEAT SHIFT SWITCH
Q523	DTC114TU	TRANSISTOR	DC SWITCH
Q524	DTC114TU	TRANSISTOR	DC SWITCH
Q525	DTC144EUA	TRANSISTOR	DC SWITCH

FOR MODEL : TK-690HB

(NB UNIT : X58-4610-10)

CURCUIT SYMBOL	PARTS NUMBER	DESCRIPTION	
D1	1SS184	DIODE	SWITCH
IC1	MC1350D	IC	AGC AMP.
Q1	3SK131(M)	FET	IF AMP.
Q2	2SA1162(Y)	TRANSISTOR	AM DET.
Q3	2SC2712(Y)	TRANSISTOR	RF AMP.
Q4	2SC2712(Y)	TRANSISTOR	AM DET.
Q5	2SC2712(Y)	TRANSISTOR	AF AMP.
Q6	2SC2712(Y)	TRANSISTOR	SWITCH
Q7	2SA1162(Y)	TRANSISTOR	SWITCH