TK-780H
Tuning procedure

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

1.1 Enter into tuning mode

Press "SCN" key while turn on the transceiver. After about 1 second, the tuning mode starts.

1.2 Frequency version selection

The following operation frequency band can be chosen for the set under tuning.

Panel Display	Frequency
VHF F2	136 to 162MHz

Following keys on the panel can be used for frequency selection:

▲ key Next (Up) frequency selection
▼ key Next (Down) frequency selection
Channel down key Enter (or confirm)

Once, the channel down key is pressed the set tuning items will be started.

1.3 Transmitter tuning

Use "MON", "A" key to choose tuning item and "SCN", "B", "C" key to adjust tuning requirement.

1.3.1 Connect a voltmeter to TP1
1.3.2 Be sure the voltage should be below 8.3V at the test channel 3 and more than 2.0V at the test channel 2 in the Transmission and Reception mode.
1.3.3 Select the test channel 1 and adjust the transmission frequency to 149.100MHz ±100Hz.
1.3.4 Select Tuning Item 2, RF power adjustment.
Adjust RF output power to 45W ±1W.
1.3.5 Select Tuning Item 4, DQT balance adjustment.
Adjust the DQT pulse shape to obtain neat demodulation wave-form.
1.3.6 Select Tuning Item 5, Max. deviation adjustment.
Apply a 1000Hz tone with a 50mV RMS level to the Microphone input.
Adjust the maximum deviation to 3.8kHz ±0.1kHz (for the Wide band), or 1.8kHz ±0.05kHz (for the Narrow band).
1.3.7 Reduce a 1000Hz tone voltage to 5mV.
Be sure the deviation should be in ±2.5kHz to ±3.5kHz.
1.3.8 Select Tuning Item 6, QT deviation adjustment.
Adjust the QT deviation to 0.75kHz ±50Hz (for the Wide band), or 0.35kHz ±25kHz (for the Narrow band).
1.3.9 Select Tuning Item 7, DQT deviation adjustment.
Adjust the DQT deviation to 0.75kHz ±50Hz (for the Wide band), or 0.35kHz ±25kHz (for the Narrow band).
1.3.10 Be sure the DTMF deviation should be in ±2.8kHz to ±3.2kHz (for the Wide band), or ±1.4kHz to ±1.6kHz (for the Narrow band).

1.3.11 Be sure the LTR deviation should be in ±0.8kHz to ±1.1kHz (for the Wide band), or ±0.65kHz to ±0.80kHz (for the Narrow band).

1.4 Receiver tuning

1.4.1 Select Tuning Item 8, sensitivity adjustment.
Apply a 136.050MHz to the transceiver antenna terminal.
1.4.2 Tune L201, L202, L203 and L204 to obtain the maximum receiver SINAD.
1.4.3 Tune on the frequencies of 149.050MHz and 161.950MHz in the same way.
1.4.4 Select Tuning Item 9, squelch adjustment.
Apply a 149.050MHz with 3dB subtracted from the sensitivity value of 12dB SINAD to the transceiver.
1.4.5 Be sure to make the squelch closed once then opened.
1.4.6 Set the RF signal level to 8dB SINAD. Confirm the squelch should be opened.
1.4.7 Turn off the RF signal. Then confirm the squelch should be closed.

PARTS LIST

TK-780HK2 CONTROL (X57-5720-13)

SYMBOL	PARTS NO.	PARTS NAME	DESCRIPTION
D501	HSB123	DIODE	SURGE ABSORPTION
D502	MINISMDC075-02	POLY SW	CURRENT PROTECTION
D503	HSB123	DIODE	SURGE ABSORPTION
D504	HSB123	DIODE	SURGE ABSORPTION
D505	HSB123	DIODE	SURGE ABSORPTION
D507	DAN202U	DIODE	OR GATE(MIC MUTE)
D508	MA742	DIODE	LIMITER
D509	MA742	DIODE	LIMITER
D510	HCS119	DIODE	REVERSE CURRENT PREVENTION
D511	B30-2151-05	LED	LIGHT EMISSION
D512	B30-2171-05	LED	LIGHT EMISSION
D513	B30-2171-05	LED	LIGHT EMISSION
D514	B30-2171-05	LED	LIGHT EMISSION
D515	B30-2171-05	LED	LIGHT EMISSION
D516	B30-2171-05	LED	LIGHT EMISSION
D517	B30-2171-05	LED	LIGHT EMISSION
D518	02DZ9.1(X,Y)	ZENER DIODE	CURRENT STABILITY
Q501	DTC314TU	TRANSISTOR	MIC MUTE
Q502	DTC144EE	TRANSISTOR	AF MUTE
Q503	2SC4617(S)	TRANSISTOR	AMPLIFIER (NOISE)
Q507	DTC144EE	TRANSISTOR	DC SWITCH(PA)
Q508	2SC4617(S)	TRANSISTOR	DC SWITCH(LED)
Q509	2SC4617(S)	TRANSISTOR	DC SWITCH(LED)
Q510	2SC4619	TRANSISTOR	CLOCK SHIFT
Q511	DTA144WE	TRANSISTOR	DC SWITCH(FSW)
Q512	DTC114EE	TRANSISTOR	DC SWITCH(BLC)
Q513	2SC2873(Y)	TRANSISTOR	DC SWITCH(LED)
Q515	DTC114EE	TRANSISTOR	DC SWITCH(LED)
IC501	TA75W558FU	IC	AMPLIFIER
IC502	TC75W51FU	IC	AMPLIFIER
IC503	TA75W558FU	IC	AMPLIFIER
IC504	TC35453F	IC	AUDIO PROCESSOR
IC506	BU4066BCFV	IC	ANALOG SWITCH
IC507	LC73872M	IC	DTMF DECODER
IC508	BU4094BCFV	IC	SHIFT/STORE RESISTER
IC509	RH5VL42C	IC	RESET IC
IC510	AT29C020-90TI	IC	FLASH ROM
IC511	30612M4A-407GP	IC	CPU
IC512	AT2408N10SI2.5	IC	EEPROM
IC513	TA78L05F	IC	5V AVR
IC710	TA75S01F	IC	AMPLIFIER
IC711	TA75S01F	IC	AMPLIFIER

PARTS LIST

TK-780HK2 TX-RX (X57-5720-13)

SYMBOL	PARTS NO.	PARTS NAME	DESCRIPTION
D1	HSB123	DIODE	SURGE ABSORPTION
D2	HSB123	DIODE	SURGE ABSORPTION
D3	HSB123	DIODE	SURGE ABSORPTION
D4	HSB123	DIODE	SURGE ABSORPTION
D5	HSB123	DIODE	SURGE ABSORPTION
D6	HSB123	DIODE	SURGE ABSORPTION
D7	02DZ20(Y,Z)	ZENER DIODE	VOLTAGE REFERENCE
D8	HSB123	DIODE	SURGE ABSORPTION
D9	HSB123	DIODE	SURGE ABSORPTION
D11	DAN202U	DIODE	DC SWITCH
D12	HSB123	DIODE	SURGE ABSORPTION
D13	HSB123	DIODE	SURGE ABSORPTION
D14	HSB123	DIODE	SURGE ABSORPTION
D15	DAN235E	DIODE	RF SWITCH(TX/RX)
D16	1SS355	DIODE	REVERSE CURRENT PREVENTION
D17	HSB123	DIODE	SURGE ABSORPTION
D20	1SS355	DIODE	REVERSE CURRENT PREVENTION
D21	02DZ5.6(X,Y)	ZENER DIODE	VOLTAGE REFERENCE
D22	DAN235E	DIODE	IF SWITCH(WIDE/NARROW)
D23	DAN235E	DIODE	IF SWITCH(WIDE/NARROW)
D24	MINISMDC075-02	POLY SW	CURRENT PROTECTION
D25	1SS355	DIODE	REVERSE CURRENT PREVENTION
D26	1SS355	DIODE	REVERSE CURRENT PREVENTION
D27	HSM88AS	DIODE	APC VOLTAGE DETECT
D28	02DZ15(X,Y)	ZENER DIODE	VOLTAGE REFERENCE
D30	HSM88AS	DIODE	APC VOLTAGE DETECT
D31	1SS355	DIODE	REVERSE CURRENT PREVENTION
D32	22ZR-10D	SURGE ABSORBER	SURGE ABSORPTION
D34	02DZ18(X,Y)	ZENER DIODE	VOLTAGE REFERENCE
D35	MA742	DIODE	LIMITER
D36	DA221	DIODE	PROTECTION
D37	DSA3A1	DIODE	REVERSE CURRENT PREVENTION
D204	1SV286	DIODE	RF BPF TUNING
D205	1SV286	DIODE	RF BPF TUNING
D206	1SV282	DIODE	RF BPF TUNING
D207	1SV282	DIODE	RF BPF TUNING
D208	1SV282	DIODE	RF BPF TUNING
D209	HSB123	DIODE	TEMPERATURE COMPENSATION
D210	HSB123	DIODE	TEMPERATURE COMPENSATION
D211	MA4PH633	DIODE	ANT SW
D212	MI809	DIODE	ANT SW

PARTS LIST

TK-780HK2 TX-RX (X57-5720-13)

SYMBOL	PARTS NO.	PARTS NAME	DESCRIPTION
Q1	2SK1824	TRANSISTOR	AF SWITCH
Q2	2SC2412K(S)	TRANSISTOR	RIPPLE FILTER
Q3	2SC2412K(S)	TRANSISTOR	RIPPLE FILTER
Q4	DTD114EK	TRANSISTOR	DC SWITCH(HOR)
Q5	DTC114EE	TRANSISTOR	DC SWITCH(IGN)
Q6	DTC114EE	TRANSISTOR	DC SWITCH(HOR CONT.)
Q7	2SC4215(Y)	TRANSISTOR	BUFFER AMP
Q8	DTC363EU	TRANSISTOR	AF MUTE SWITCH
Q9	DAT114YUA	TRANSISTOR	AF MUTE SWITCH
Q10	DTC114EE	TRANSISTOR	DC SWITCH(8R)
Q11	2SA1362	TRANSISTOR	DC SWITCH(8R)
Q12	2SB1132(Q,R)	TRANSISTOR	DC SWITCH(8T)
Q13	DTC114EE	TRANSISTOR	DC SWITCH(8T)
Q15	2SC2059K(P)	TRANSISTOR	IF AMP
Q16	DTC144EE	TRANSISTOR	DC SWITCH(W/N)
Q17	2SC2412K(S)	TRANSISTOR	APC SWITCH(APC)
Q18	2SK1824	TRANSISTOR	RX MUTE
Q19	2SD2394	TRANSISTOR	APC CONTROLLER
Q20	2SB1188(Q)	TRANSISTOR	APC CONTROLLER
Q21	FMW1	TRANSISTOR	APC CONTROLLER
Q22	DTC114EE	TRANSISTOR	DC SWITCH(TOF)
Q23	DTA114EE	TRANSISTOR	DC SWITCH(W/N)
Q24	DTC144EE	TRANSISTOR	DC SWITCH(W/N)
Q25	DTA114EE	TRANSISTOR	DC SWITCH(TOF)
Q26	DTA114EE	TRANSISTOR	DC SWITCH(PSW)
Q27	2SA1641(S,T)	TRANSISTOR	SB SWITCH
Q28	DTC114EE	TRANSISTOR	DC SWITCH(SB)
Q29	DTC114EE	TRANSISTOR	DC SWITCH(H/L)
Q30	DTA114EE	TRANSISTOR	DC SWITCH(SB)
Q31	DTC114EE	TRANSISTOR	DC SWITCH(SB)
Q32	2SK1824	TRANSISTOR	AF SWITCH
Q33	2SC2712(Y)	TRANSISTOR	PROTECTION
Q202	2SC3357	TRANSISTOR	RF AMP
Q203	2SC3357	TRANSISTOR	IF AMP
Q204	2SC2954	TRANSISTOR	RF AMP
Q300	2SC4215(Y)	TRANSISTOR	BUFFER AMP
Q301	2SC3722K(S)	TRANSISTOR	CHARGE POMP
Q302	2SC3722K(S)	TRANSISTOR	CHARGE POMP
Q401	DTC114EE	TRANSISTOR	PROTECTION
Q402	DTC114EE	TRANSISTOR	DC SWITCH
Q403	DTC114EE	TRANSISTOR	DC SWITCH

PARTS LIST

TK-780HK2 TX-RX (X57-5720-13)

SYMBOL	PARTS NO.	PARTS NAME	DESCRIPTION
IC1	TA75W01FU	IC	AMPLIFIER
IC2	TA75W558FU	IC	AMPLIFIER
IC3	TA75W558FU	IC	AMPLIFIER
IC4	TC4S66F	IC	SWITCH
IC5	M62363FP	IC	D/A CONVERT
IC6	TA75W01FU	IC	AMPLIFIER
IC7	BU4094BCFV	IC	SHIFT/STORE REGISTER
IC8	BU4094BCFV	IC	SHIFT/STORE REGISTER
IC9	TA78L05F	IC	5V AVR
IC10	LA4422	IC	AF AMP
IC11	TA31136FN	IC	FM DEMODULATION
IC12	TA78L05F	IC	5V AVR
IC13	AN8009M	IC	9V AVR
IC14	TA7808S	IC	8V AVR
IC15	TC4013BF(N)	IC	POWER SUPPLY LOGIC CIRCUIT CONTROL
IC201	LMC7101BIM5	IC	PC/TV CONTROL
IC202	GN2011(Q)	IC	D.B.M.
IC300	SA7025DK	IC	PLL SYNTHESIZER
IC400	M68702L	IC	POWER MODULE
IC401	NJM2904V	IC	PROTECTION

TK-780H
Circuit Descriptions

The Kenwood model TK-780H is an all solid-state frequency synthesized VHF/FM transceiver designed for operation in the frequency range of 136 MHz to 162MHz (ALH24583220)
The unit consists of a TX-RX unit and LCD assembly and its transmitter is rated for 45W output power (TK-780H).

1. TX-RX Unit

The TX-RX unit consists of a Voltage Control Oscillator (VCO) sub-unit, a receiver section, a transmitter section, a control section and a power supply section.

1.1 PLL Frequency Synthesizer

The transmit signal and the receiver first L. O. signal are generated by the PLL digital frequency synthesizer. The frequency synthesizer consists of a transmitter voltage controlled oscillator (TX VCO, Q103), a receiver voltage controlled oscillator (RX VCO, Q102), a buffer amplifier (Q106), an RF amplifier (Q300), a low-pass filter, a PLL IC (IC300) and TX VCO/RX VCO switches (Q104 and Q105).

The signal from Q300 passes through the low-pass filter and is applied to IC300 which is PLL frequency synthesizer with VCXO ; X1. The VCXO of which the frequency stability is within 2.5ppm (temperature range of –30 to +60℃) generates 16.8MHz.

The PLL-IC consists of three modulus prescaler, fractional divider, reference divider, digital phase comparator with pump output.

This PLL-IC is Fractional-N type synthesize and performs is 40 or 50kHz reference signal which is eighth of the channel step (5 or 6.25kHz). The input signal from the pins 5 and 8 of the PLL-IC is divided down to the 40 or 50 kHz and compared at digital phase comparator. The pulsed output signal of the digital phase comparator is applied to the charge pump and transformed into DC signal. The DC signal from the pin 14 of the PLL-IC passes through the active low-pass filter (loop filter), is applied to the VCO and controls to keep the frequency of the VCO.

The serial data (DT,CP,EP) from the CPU (IC511) is input to the PLL-IC. And PLL lock condition is always monitored the pin 31 (LD) of IC511.

The transmitter modulation signals (processed Mic. audio and sub-audible signaling) are applied to the TX VCO for frequency modulation.

In the receive mode, the VCO is substituted with Q102 (RX VCO) and it generates the receiver first local oscillator signal according to the data sent from the control unit. The basic operation of the synthesizer remains the same.

1.2 Receiver Circuit

The receiver is a double conversion super-heterodyne, designed to operate in the frequency range of 136 MHz to 162MHz (ALH24583220)

The receiver RF and IF sections consist of an RF amplifier (Q202), a first mixer (IC202), a first IF amplifier (Q15) and an FM IF IC (IC11).

An incoming RF signal from the antenna is fed into a band-pass filter which consists of L201 and variable capacitors (D204 and D205) after going through an antenna switch in the transmitter power amplifier section. The D204 and D205 will be electrically tuned by TV voltage for the best BPF response. This RF signal is then amplified by an RF amplifier (Q202) and filtered again by band-pass filters (L202, L203, L204 and D206, D207, D208). After amplification and filtering, the signal is applied to the first mixer (IC202) for mixing with the first local oscillator signal generated by the frequency synthesizer.

The heterodyning action of the first mixer produces a 44.850MHz intermediate frequency (first IF), which is applied into two monolithic crystal filters. The signal out of the crystal filters is amplified by a first IF amplifier (Q15) and is sent to the FM IF IC (IC11).

The FM IF IC (IC11) contains a second mixer, a second local oscillator, second IF amplifiers, a second IF filter, an FM detector and a RSSI output. The signal applied to IC11 is mixed with 44.395MHz, which produces a 455kHz second IF signal. The signal obtained at the second mixer is filtered by a 455kHz ceramic filter (CF1 for wide or CF2 for narrow) and it is amplified by limiting amplifiers. The recovered audio signal from the incoming signal is obtained from quadrature type FM demodulator. This recovered audio signal is then sent to the audio amplifier circuit and to the noise actuated squelch circuit.

The recovered audio signal obtained at IC11 is de-emphasized and further amplified for driving a loud speaker.

1.3 Transmitter Circuit

The transmitter circuit consists of a microphone amplifier, an RF power amplifier driver (Q203 and Q204), an RF power amplifier module (IC400), an antenna switching network, a spurious and harmonics low-pass filter, and an automatic power control (APC).

The audio signal, originating at the microphone, is applied to the microphone amplifier (IC711, IC504). The audio signal is amplified, pre-emphasized (IC504), voltage limited and low-pass filtered. The signal is then switched by transistors to the TX VCO for modulating the transmit carrier signal or to public address operation.

The transmit signal, generated at the frequency synthesizer, is applied to the RF power amplifier driver to gain a sufficient signal level to drive the RF power amplifier.

The output signal from the RF power amplifier driver is further amplified, in the RF power amplifier module, up to the level of the transmitter rated output power. This signal is routed to the antenna connector after going through the antenna switching network and the low-pass filter. This filter has a minimum attenuation of 65dB at the second harmonic frequency.

This output power level once it was set it will be maintained at a constant output level by automatic power control unit (D27, D30, Q19, Q20and Q21).

1.4 Control Section

The control section consists of a CPU (IC511), LCD assembly and associated interface circuits.

The CPU (IC511) is connected to an external EEPROM (IC512), which stores the operating frequency information.

The CPU (IC511) performs the following functions:

(1) Switches transmit and receive mode based on the push-to-talk line information at the Mic. connector (J501).

(2) Detects control signals from key pad and converts the information to a serial format.

(3) Retrieves the transmit and receive frequency programming data from the EEPROM (IC512), and sends it to the frequency synthesizer.

(4) Detects control signals from each function switch, and sends the information to the associated peripheral circuits in a serial format.

(5) Controls squelch and audio-mute.

(6) Generate the sub-audible signaling encode data (QT, DQT LTR DATA) and DTMF signals.

(7) Decodes the sub-audible signaling data (QT, DQT 2TONE) and LTR DATA signals.

(8) Detects the noise level from Q503, and controls the noise squelch operation.

2. LCD (Liquid Crystal Display) Assembly

The display receives the data from the CPU (IC511) in a control circuit and the data is displayed as a visual indication to the operator.