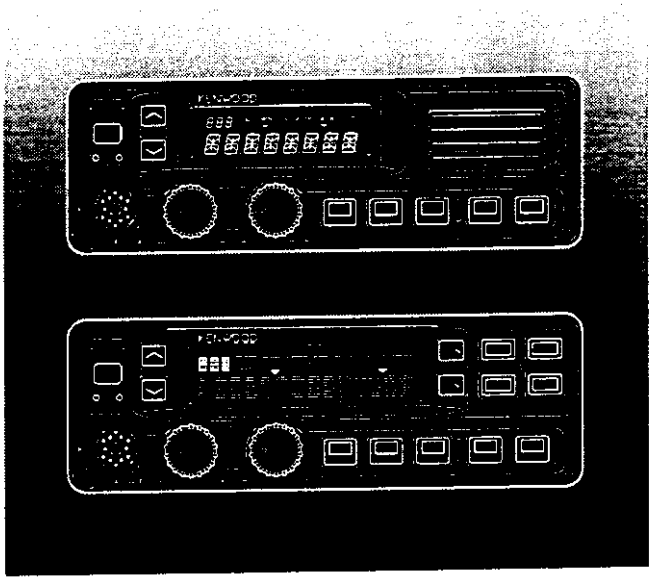
FCC ID: ALH22933210
2.983 (d)(8) MANUAL



KENWOOD

# INSTRUCTION MANUAL



LOW BAND VHF FM TRANSCEIVER

# TK-690 series

VHF FM TRANSCEIVER

# TK-790 series

UHF FM TRANSCEIVER

# TK-890 series

KENWOOD CORPORATION


09 08 07 06 05 04 03 02 01 00

## THANK YOU!

We are grateful you chose **KENWOOD** for your land mobile applications. We believe this easy-to-use transceiver will provide dependable communications to keep personnel operating at peak efficiency.

**KENWOOD** transceivers incorporate the latest in advanced technology. As a result, we feel strongly that you will be pleased with the quality and features of this product.

## MODELS COVERED BY THIS MANUAL

- **TK-690H:** Low Band VHF FM Transceiver
- **TK-790:** VHF FM Transceiver
- **TK-790H:** VHF FM Transceiver
- **TK-890:** UHF FM Transceiver
- **TK-890H:** UHF FM Transceiver

## NOTICES TO THE USER

***WARNING!***

- *GOVERNMENT LAW PROHIBITS THE OPERATION OF UNLICENSED RADIO TRANSMITTERS WITHIN THE TERRITORIES UNDER GOVERNMENT CONTROL.*
- *ILLEGAL OPERATION IS PUNISHABLE BY FINE OR IMPRISONMENT OR BOTH.*
- *REFER SERVICE TO QUALIFIED TECHNICIANS ONLY.*

**SAFETY:** It is important that the operator is aware of, and understands, hazards common to the operation of any transceiver.

***WARNING!***

- ***EXPLOSIVE ATMOSPHERES (GASES, DUST, FUMES, etc.)***
  *Turn OFF your transceiver while taking on fuel or while parked in a gasoline service station. Do not carry spare fuel containers in the trunk of your vehicle if your transceiver is mounted in the trunk area.*
- ***INJURY FROM RADIO FREQUENCY TRANSMISSIONS***
  *Do not operate your transceiver when somebody is within two to three feet of the antenna, to avoid the possibility of radio frequency burns or related physical injury.*
- ***DYNAMITE BLASTING CAPS***
  *Turn OFF your transceiver when in an area where blasting is in progress, or where "TURN OFF TWO-WAY RADIO" signs have been posted. Operating the transceiver within 150 meters (500 feet) of dynamite blasting caps may cause them to explode. If you are carrying blasting caps in your vehicle, make sure they are enclosed in a metal box with a padded interior. Do not transmit while the caps are being placed into or are being removed from the container.*

***Note:*** *This instruction manual covers only the basic functions of the transceiver. Consult your dealer for more detailed information.*

## One or more of the following statements may be applicable:

*FCC WARNING*

*This equipment generates or uses radio frequency energy. Changes or modifications to this equipment may cause harmful interference unless the modifications are expressly approved in the instruction manual. The user could lose the authority to operate this equipment if an unauthorized change or modification is made.*

*INFORMATION TO THE DIGITAL DEVICE USER REQUIRED BY THE FCC*

*This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can generate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that the interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:*

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer for technical assistance.*

# CONTENTS

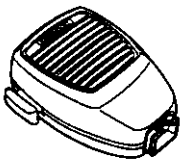
# UNPACKING AND CHECKING EQUIPMENT

***Note:*** *The following unpacking instructions are for use by your* ***KENWOOD*** *dealer, an authorized* ***KENWOOD*** *service facility, or the factory.*

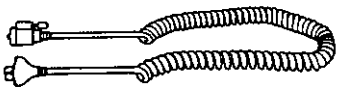
Carefully unpack the transceiver. We recommend that you identify the items listed in the following table before discarding the packing material. If any items have been damaged during shipment, file a claim with the carrier immediately.

## ■ Supplied Accessories

| Item | Part Number | Quantity | | | | |
|---|---|---|---|---|---|---|
| | | TK-890H | TK-790 | TK-790H | TK-890 | TK-890H |
| Microphone | T91-0587-X5 | – | 1 | – | 1 | – |
| Microphone cable | E30-2089-X8 | – | 1 | – | 1 | – |
| Microphone hanger | J19-1584-X5 | – | 1 | – | 1 | – |
| Mounting bracket | J29-0422-X3 | – | 1 | – | 1 | – |
| Power cable assembly | E30-3318-X5 | – | 1 | – | 1 | – |
| Fuse (15 A) | F05-1537-X5 | – | 3 | – | 3 | – |
| Speaker short plug | E37-0733-X5 | 1 | 1 | 1 | 1 | 1 |
| Cover | F07-1336-X5 | 1 | 1 | 1 | 1 | 1 |
| Retaining band | J61-0307-X5 | 1 | 1 | 1 | 1 | 1 |
| Knob | K29-4705-X4 | – | 5 | – | 5 | – |
| | K29-5276-X3 | – | 1 | – | 1 | – |
| | K29-5277-X3 | – | 1 | – | 1 | – |
| | K29-5305-X3 | – | 1 | – | 1 | – |
| Hex-headed screw | N09-2177-X5 | 1 | 7 | 1 | 7 | 1 |
| Self-tapping screw (5 x 16 mm) | N09-0335-X5 | – | 4 | – | 4 | – |
| Self-tapping screw (4 x 16 mm) | N46-4016-X6 | – | 3 | – | 3 | – |
| Spring washer | N16-0050-X6 | – | 4 | – | 4 | – |
| Flat washer | N15-1050-X6 | – | 4 | – | 4 | – |
| Warranty card (USA/ Canada only) | B46-0470-XX | 1 | 1 | 1 | 1 | 1 |
| Instruction manual | B62-0970-XX | 1 | 1 | 1 | 1 | 1 |

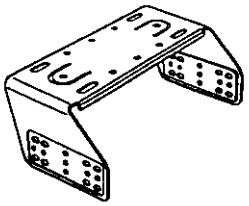


Microphone

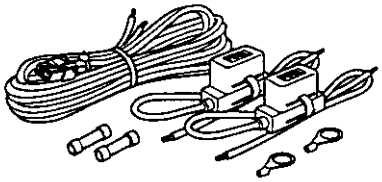


Microphone cable

Microphone hanger

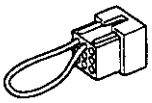


Mounting bracket



Power cable assembly

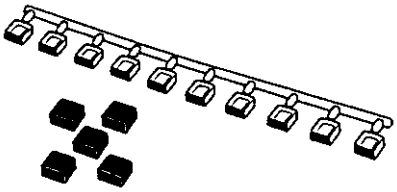
Fuse (15 A)



Speaker short plug

Cover

Retaining band



Knob

Hex-headed screw

Self-tapping screw (5 x 16 mm)

Self-tapping screw (4 x 16 mm)

Spring washer

Flat washer

# PREPARATION

***WARNING!***

- *VARIOUS ELECTRONIC EQUIPMENT IN YOUR VEHICLE MAY MALFUNCTION IF THEY ARE NOT PROPERLY PROTECTED FROM THE RADIO FREQUENCY ENERGY WHICH IS PRESENT WHILE TRANSMITTING. ELECTRONIC FUEL INJECTION, ANTI-SKID BRAKING, AND CRUISE CONTROL SYSTEMS ARE TYPICAL EXAMPLES OF EQUIPMENT THAT MAY MALFUNCTION. IF YOUR VEHICLE CONTAINS SUCH EQUIPMENT, CONSULT THE DEALER FOR THE MAKE OF VEHICLE AND ENLIST HIS AID IN DETERMINING IF THEY WILL PERFORM NORMALLY WHILE TRANSMITTING.*
- *ALTHOUGH THE REMOTE PANELS ARE WATER RESISTANT, THE MAIN TRANSCEIVER BODY IS NOT. MOUNT IT IN A PLACE WHERE IT WILL NOT GET WET.*

***Note:** The following preparation instructions are for use by your **KENWOOD** dealer, an authorized **KENWOOD** service facility, or the factory.*

## ■ Tools Required

***Note:** Before installing the transceiver, always check how far the mounting screws will extend below the mounting surface. When drilling mounting holes, be careful not to damage vehicle wiring or parts.*

The following tools are required for installing the transceiver:

- 6 mm (1/4 inch) or larger electric drill
- Drill bits (sizes listed below) and circle cutters

| Drill Bit Size | Purpose |
|---|---|
| 4.2 mm (5/32 inch) | 5 x 16 mm self-tapping screws |
| 3.2 mm (1/8 inch) | 4 x 16 mm self-tapping screws |

## ■ Power Cable Connection

***CAUTION:** THE TRANSCEIVER OPERATES IN 12 V NEGATIVE GROUND SYSTEMS ONLY! CHECK THE BATTERY POLARITY AND VOLTAGE OF THE VEHICLE BEFORE INSTALLING THE TRANSCEIVER.*

1 Check for an existing hole, conveniently located in the firewall, where the power cable can be passed through.
   - If no hole exists, drill the firewall and install a rubber grommet.

2 Run the two power cable leads through the fire wall and into the engine compartment, from the passenger compartment.
   - Keep the plug end of the cable at the transceiver.

3 Connect the red lead to the positive (+) battery terminal, or switched power source, and the black lead to the negative (–) battery terminal.
   - Locate the fuse as close to the battery as possible.

4 Recoil and secure the surplus cable with the provided retaining band.
   - Be sure to leave enough slack in the cables so the transceiver can be removed for servicing while keeping the power applied.

## ■ Installing the Transceiver

***WARNING!*** *FOR PASSENGER SAFETY, INSTALL THE TRANSCEIVER SECURELY, USING THE SUPPLIED MOUNTING BRACKET, SO THE TRANSCEIVER WILL NOT BREAK LOOSE IN THE EVENT OF A COLLISION.*

1 Mark the position of the holes in the dash by using the mounting bracket as a template. Drill the holes, then attach the mounting bracket using the supplied 5 x 16 mm screws.

- Be sure to mount the transceiver in a location where the controls will be within easy reach of the user, and where there is sufficient space at the rear of the transceiver for cable connections.

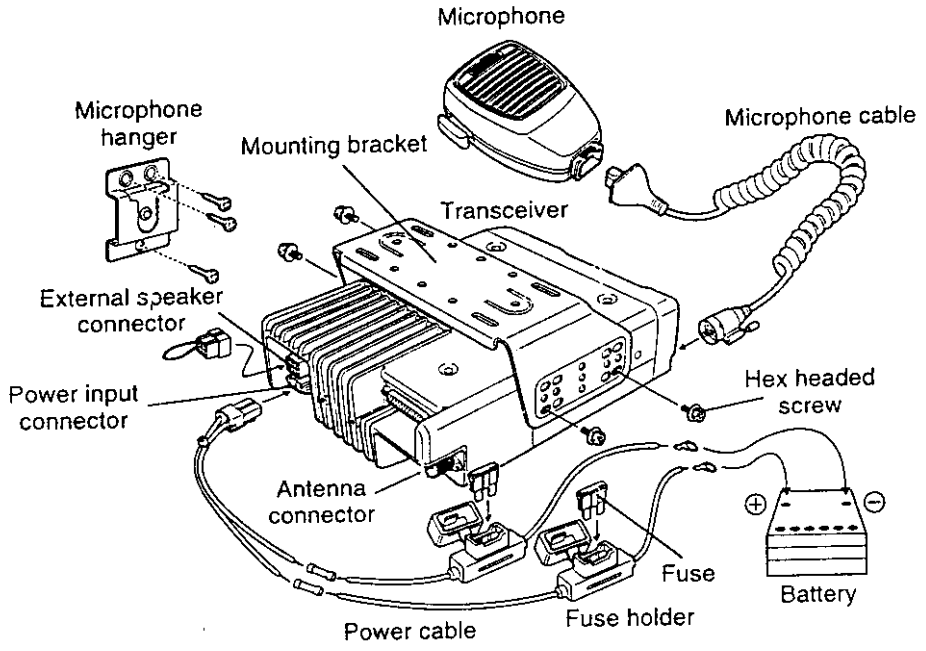
2 Connect the antenna and the supplied power cable to the transceiver.

3 Slide the transceiver into the mounting bracket and secure it using the supplied hex-headed screws.

4 Mount the microphone hanger, using the supplied 4 x 16 mm screws, in a location where it will be within easy reach of the user.

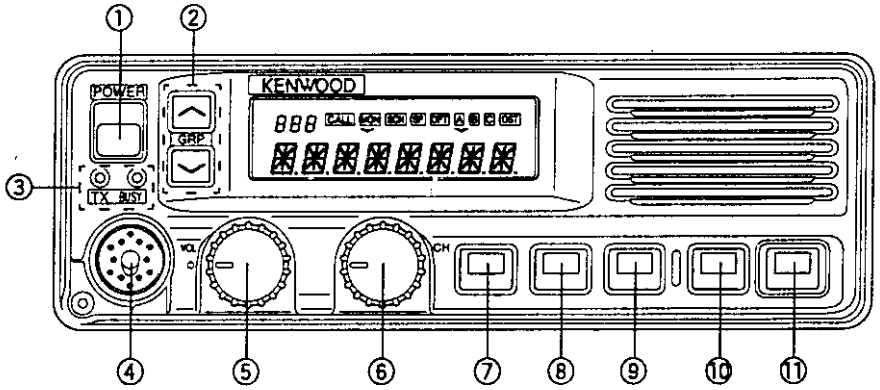
- The microphone and microphone cable should be mounted in a place where they will not interfere with the safe operation of the vehicle.

5 Connect one plug of the microphone cable to the jack on the base of the microphone, and the other plug to the microphone jack on the front of the transceiver. Place the microphone on the hanger.



# GETTING ACQUAINTED

## ■ Basic Front Panel Kit




① **POWER** switch
Press to switch the power ON (or OFF).

② **GRP** (Group) keys
Press **GRP Up** to increase the group selection by one step. Press **GRP Down** to decrease the group selection by one step. (See page 11 for other programmable functions for this key.)

③ **TX/BUSY** indicators
The red LED lights while transmitting. The green LED lights while the selected channel is in use.

④ Microphone connector
Insert the microphone plug into this connector and secure it using the attached screw. To remove the microphone, release the screw, then turn the connector clockwise until it becomes free.

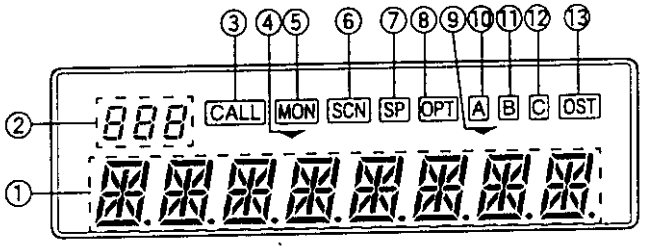
⑤ **VOL** (Volume) control
Turn clockwise to increase the volume, and counterclockwise to decrease it.

⑥ **CH** (Channel) control (default setting)
Turn clockwise to increase the channel selection, and counterclockwise to decrease it. (Alternatively, this control can be programmed with group up/down.)

⑦ **PF1** key
⑧ **PF2** key
⑨ **PF3** key
⑩ **PF4** key
⑪ **PF5** key

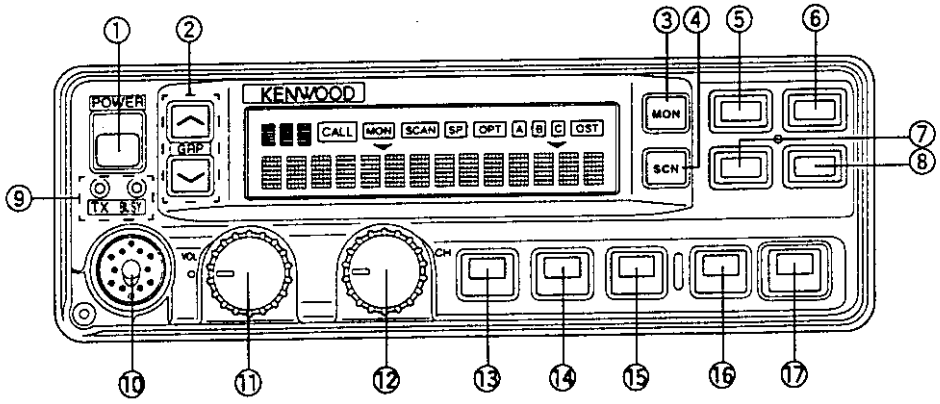
Press these PF (programmable function) keys to activate their programmable functions {page 11}. The default is set as No Function.

## ■ Basic Panel Display




| | | |
|---|---|---|
| ① | ▩▩▩▩▩▩▩▩ | Displays the operating Group/ Channel number, the Group/ Channel name, and the transceiver status. |
| ② | 888 | Displays the channel status: **P1** indicates a Priority 1 channel; **P2** indicates a Priority 2 channel; **PP** indicates a Priority 1 and 2 channel; **HC** indicates a Home Channel; **TA** indicates Talk Around mode; **RCL** indicates a Recall Channel; **R1 ~ R15** indicates remote channels. |
| ③ | CALL | Flashes when a call is received by DTMF or 2Tone signaling. Appears during and after transmitting if set by the dealer. |
| ④ | ▼ | Appears when the selected group is in the scanning sequence. |
| ⑤ | MON | Appears when signaling squelch is turned OFF. |
| ⑥ | SCN | Appears while scanning is in progress. |
| ⑦ | SP | Appears when the audio output is set to "External" speaker. |
| ⑧ | OPT | Appears when the optional scrambler board is enabled. |
| ⑨ | ▼ | Appears when the selected channel is in the scanning sequence. |
| ⑩ | A | Appears when Aux A is ON. |
| ⑪ | B | Appears when Aux B is ON. |
| ⑫ | C | Appears when Aux C is ON. |
| ⑬ | OST | Appears when Operator Selectable Tone is enabled. |

## ■ Full-featured Front Panel Kit




① **POWER** switch
Press to switch the power ON (or OFF).

② **GRP** (Group) keys
Press **GRP Up** to increase the group selection by one step. Press **GRP Down** to decrease the group selection by one step. (See page 11 for other programmable functions for this key.)

③ **MON** (Monitor) key (default setting)
Press to cancel QT, DQT, 2Tone, and DTMF signaling squelch. Press and hold for 2 seconds to hear background noise (unmute the audio). (See page 11 for other programmable functions for this key.)

④ **SCN** (Scan) key (default setting)
Press to start (or stop) the scanning sequence. (See page 11 for other programmable functions for this key.)

⑤ **PF6** key
⑥ **PF7** key
⑦ **PF8** key
⑧ **PF9** key

Press these PF (programmable function) keys to activate their programmable functions {page 11}. The default is set as No Function.

⑨ **TX/BUSY** indicators
The red LED lights while transmitting. The green LED lights while the selected channel is in use.

⑩ Microphone connector
Insert the microphone plug into this connector and secure it using the attached screw. To remove the microphone, release the screw, then turn the connector clockwise until it becomes free.

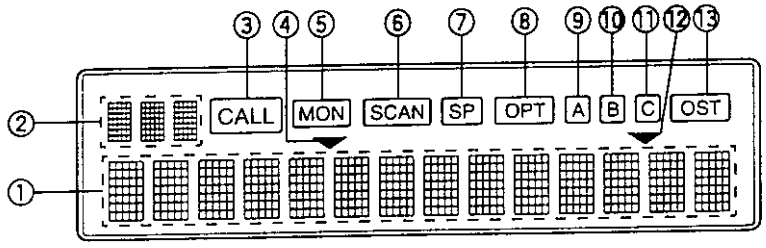
⑪ **VOL** (Volume) control
Turn clockwise to increase the volume, and counterclockwise to decrease it.

⑫ **CH** (Channel) control (default setting)
Turn clockwise to increase the channel selection, and counterclockwise to decrease it. (Alternatively, this control can be programmed with group up/down.)

⑬ **PF1** key
⑭ **PF2** key
⑮ **PF3** key
⑯ **PF4** key
⑰ **PF5** key

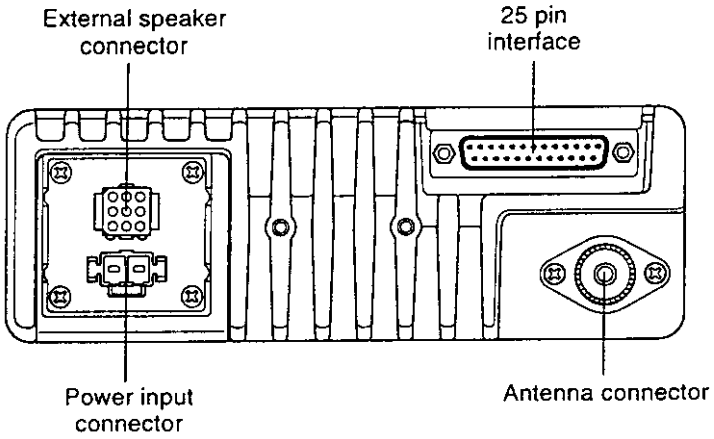
Press these PF (programmable function) keys to activate their programmable functions {page 11}. The default is set as No Function.

## ■ Full-featured Panel Display

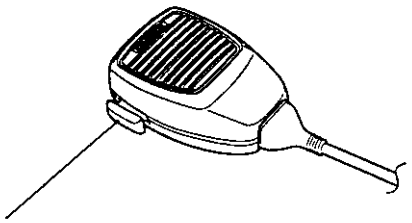



| | | |
|---|---|---|
| ① | | Displays the operating Group/ Channel number, the Group/ Channel name, and the transceiver status. |
| ② | | Displays the channel status: **P1** indicates a Priority 1 channel; **P2** indicates a Priority 2 channel; **PP** indicates a Priority 1 and 2 channel; **HC** indicates a Home Channel; **TA** indicates Talk Around mode; **RCL** indicates a Recall Channel; **R1 ~ R15** indicates remote channels. |
| ③ | CALL | Flashes when a call is received by DTMF or 2Tone signaling. Appears during and after transmitting if set by the dealer. |
| ④ | ▼ | Appears when the selected group is in the scanning sequence. |
| ⑤ | MON | Appears when signaling squelch is turned OFF. |
| ⑥ | SCAN | Appears while scanning is in progress. |
| ⑦ | SP | Appears when the audio output is set to "External" speaker. |
| ⑧ | OPT | Appears when the optional scrambler board is enabled. |
| ⑨ | A | Appears when Aux A is ON. |
| ⑩ | B | Appears when Aux B is ON. |
| ⑪ | C | Appears when Aux C is ON. |
| ⑫ | ▼ | Appears when the selected channel is in the scanning sequence. |
| ⑬ | OST | Appears when Operator Selectable Tone is enabled. |

## ■ Rear Panel




## ■ Microphone



PTT (Push To Talk) switch
Press and hold to transmit, then speak into the microphone. Release to receive.

# PROGRAMMABLE FUNCTIONS

The following functions can be programmed onto the **GRP Up**, **GRP Down**, **MON**, **SCN**, and **PF1** ~ **PF9** keys. Please contact your dealer for more information on these functions.

| Function | Description |
|---|---|
| Aux A | Turns the Aux A port ON (or OFF). |
| Aux B | Turns the Aux B port ON (or OFF). |
| Aux C | Turns the Aux C port ON (or OFF). |
| CH1 Direct | Jumps to the Group 1/ Channel 1 directory. |
| CH2 Direct | Jumps to the Group 1/ Channel 2 directory. |
| CH3 Direct | Jumps to the Group 1/ Channel 3 directory. |
| CH4 Direct | Jumps to the Group 1/ Channel 4 directory. |
| CH5 Direct | Jumps to the Group 1/ Channel 5 directory. |
| Channel Down | Decreases the channel number. |
| Channel Name | Switches the display between Group/ Channel number and Group/ Channel name. |
| Channel Recall | Jumps to the last called channel when pressed during Scan. Jumps to the previous channel when pressed again. |
| Channel Up | Increases the channel number. |
| Delete/ Add | Deletes a channel from, or adds a channel to, the scanning sequence. |
| Dimmer | Adjusts the brightness of the display backlight, key backlight, TX/BUSY LED, and DTMF Mic key backlight. |
| Emergency Call | Initiates an emergency call (requires ANI board). |
| Group Down | Decreases the group number. |
| Group Up | Increases the group number. |
| Home Channel (fixed) | Jumps to the pre-programmed Home Channel. |
| Home Channel (toggle) | Jumps to the Home Channel when pressed. Returns to the previous channel when pressed again. |
| Horn Alert | Turns the Horn Alert relay ON when receiving a channel ID code. |
| Intercom | Allows communication between two control head operators without transmitting over the air (dual head configuration only). |
| Mobile Relay Station | Allows the transceiver to function as a repeater (dual band configuration only). |
| Monitor | See **MON** (Monitor) key {page 7}. |
| No Function | No function. |
| Operator Selectable Tone | Selects signaling from the pre-programmed QT/DQT list. |
| Public Address | Allows the transceiver to function as a PA amplifier. |
| Scan | See **SCN** (Scan) key {page 7}. |
| Scrambler | Turns the optional scrambler board ON (or OFF). |
| Speaker 1-2 Mute | Disables the speaker audio from the other control head (dual head configuration only). |
| Speaker Internal/ External | Switches the audio output between "Internal" and "External" speaker. |
| Squelch Level | Enters squelch level adjustment mode. |
| Talk Around | Allows the transceiver to make a call without using a repeater. |

# BASIC OPERATIONS

## ■ Switching Power ON/ OFF

Press the **POWER** switch to switch the transceiver ON (or OFF)

- The display backlight illuminates when the power is switched ON.

## ■ Adjusting the Volume

Turn the **VOL** control clockwise to increase the volume, and counterclockwise to decrease it.

## ■ Selecting a Group

Press the **Group Up** or **Group Down** keys, or use the **CH** control (depending on which one is programmed with the group functions).

- Pressing **Group Up** or **Group Down** will increase or decrease the group selection by one step.
- Turning the **CH** control clockwise will increase the group selection, and turning it counterclockwise will decrease the selection.

## ■ Selecting a Channel

Press the **Channel Up** or **Channel Down** keys, or use the **CH** control (depending on which one is programmed with the channel functions).

- Pressing **Channel Up** or **Channel Down** will increase or decrease the channel selection by one step.
- Turning the **CH** control clockwise will increase the channel selection, and turning it counterclockwise will decrease the selection.

## ■ Making a Call

1 Select the desired group and channel (above).
   - Make sure the channel is not in use. If the channel is in use, the **BUSY** LED will light green; wait until the channel is no longer in use.

2 Press the **PTT** switch, then speak into the microphone in your normal speaking voice.
   - For best results, hold the transceiver approximately 3 to 4 cm (1 1/2 inches) from your lips.

3 Release the **PTT** switch to receive.

4 Replace the microphone on the hanger when the call is finished.

# DTMF CALLS

## ■ Manual Dialing

To dial a number manually:

1 Press and hold the **PTT** switch.

2 Press the desired DTMF keys.

## ■ Redialing

A maximum of 16 digits can be redialed. The last number dialed, either manually or automatically, will be redialed.

To redial a number:

1 Press the * key.
- An "A" will appear on the display.

2 Press the **0** key.
- The transceiver will redial the last number, and the digits will appear on the display.

***Note:*** *If the transceiver power is switched OFF, the redial memory will be erased.*

## ■ Auto Dialing

**Store:**

To store a number in memory:

1 Press the # key.
- A "D" will appear on the display.

2 Press the desired DTMF keys to enter a maximum of 16 digits.

3 Press the # key.

4 Select the desired memory channel by pressing a DTMF key (1 ~ 9).
- The entered number will be stored in the memory channel selected.

**Confirm:**

To confirm a stored number:

1 Press the # key.
- A "D" will appear on the display.

2 Press the * key.
- "D–" will appear on the display.

3 Press the memory channel key (1 ~ 9) with the stored number you want to confirm.
- The stored digits will appear on the display and the DTMF tones will sound.

**Send:**

To send a stored number:

1 Press the * key.
- An "A" will appear on the display.

2 Press the memory channel key (1 ~ 9) with the stored number you want to send.
- The transceiver will begin the transmission and the digits will appear on the display.

**Clear:**

To erase a stored number from memory:

1 Press the # key.
- A "D" will appear on the display.

2 Press the # key again.
- "D–CLR" will appear on the display.

3 Press the memory channel key (1 ~ 9) with the stored number you want to erase.

# PROGRAMMED KEYS REFERENCE TABLE

| Key | Programmed Function |
|---|---|
| GRP Up | |
| GRP Down | |
| MON | |
| SCN | |
| PF1 | |
| PF2 | |
| PF3 | |
| PF4 | |
| PF5 | |
| PF6 | |
| PF7 | |
| PF8 | |
| PF9 | |

# TK-790H 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 179.3MHz.
2. Connect a digital voltmeter to CV.
3. Adjust TC301 in the TX-RX unit to obtain the 1.5V±0.1V.
4. Select the frequency to 148.100MHz.
5. Apply a receive signal without a modulation to the transceiver.
6. Tune L110,L111,L112 to obtain the maximum receiver quieting(Minimum noise).
   Reduce the RF signal level as tuning progress.
   Connect a sweep signal generator to CN104.
   Connect a display through an RF detector to CN103 in the TX-RX unit.
   Tune L118,L119,L122(Wide).L117,L120,L123(Narrow).
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 for the minimum audio distortion level.
   Reduce the volume control setting as tuning progress to avoid saturation in the audio amplifier stages.
   Select the channel to narrow-band.
   Select the channel to wide-band.

# TK-790H Circuit Descriptions

The Kenwood Model TK-790H(G) is an all solid-state VHF FM transceiver designed to operate in the frequency range of from 148 to 174MHz.

The TK-790H(G) 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.

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 148 to 174MHz 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.

- 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 (Z301), a PLL circuit, and associated circuits.

The TCXO operates at 16.8 MHz, its frequency being maintained within ±2.0ppm 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 40KHz or 50KHz 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 Q305. The RF signals, generated at the VCOs, are amplified by a common buffer amplifier (Q310). The output signal from the buffer amplifier is split into two and each signal is applied to buffer amplifiers Q212 and Q311. The Q311 output is routed to the PLL IC (IC301), and the Q312 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 50KHz reference signal which is eighth of the channel step (5, 6.25 or 7.5KHz).
The input signal from the pin 5 of the PLL IC is divided down to the 40 or 50KHz 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 148 to 174MHz. The RF and IF stages of the receiver section consists of an RF amplifier (Q101), a first mixer DBM(A101), a first IF amplifier (Q102,107) 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 (L110, L111 and L112). The amplified and filtered signal is heterodyned at the first mixer with a first LO signal originated at the frequency synthesizer. The resulting 44.85MHz first IF signal is amplified by a first IF amplifier(Q102)and filtered filtered by a 4-pole crystal filter (XF101;wide.XF102;narrow) 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,CF301(WIDE),CF302(NARROW) and FM detected. The FM system IC also includes an oscillator circuit to generate a second LO signal of 45.305MHz. 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 two amplifiers(IC01,Q204) 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 an RF amplifier module a transmitter final power amplifier stage and 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 the RF amplifier module(IC1). Then it is further up to 110W by the final power amplifier which is comprised of two class C amplifiers connected in parallel (Q6 and Q7). 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 40dB 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 70dB.

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.