

FRONT PANEL CONTROL & SWITCH

1. **VOL** Knob

This control adjusts the volume of receiver audio and of the beep. Clockwise rotation increases the audio.

2. **SQL** Knob

This control sets the threshold level at which received signals (or noise) open the squelch. It should be advanced clockwise just to the point where the noise is silenced, so as to provide the best sensitivity to weak signals.

3. Display

The display consists of segmented digits for frequency readout and various icons representing enabled transceiver features, as well as for viewing menu programming and alphanumeric names.

4. [◀] Key

During split-frequency operation, such as through a repeater, this key reverses transmit and receive frequencies.

5. [SET] Key

This key selects the operating band between the VHF and UHF.
Press and hold this key for one second, to activate the Set Mode.

6. [▶] Key

This key toggles repeater shift: plus shift (+), minus shift (-), or simplex.

7. [DISP/SS] Button

This button selects display items for the low line of the display: Key Function, DC Voltage, or Operating Mode.

Press and hold this button for one second, to activate the Smart Search™ feature.

8. [PWR] Switch

This is the main "ON/OFF" switch for the transceiver.

9. **MAIN DIAL** Knob

This 20-position detented rotary switch is the main tuning dial for the transceiver. It is used for most tuning, memory selection, and function setting tasks on the transceiver.

RIGHT SIDE CONNECTOR

1. **MIC** Jack

This 6-pin modular jack accepts transmit audio, and provides 9600 bps data for a Packet Operation.

Pin 1: SW 2

Pin 2: 9600 bps Packet Data Output

- Pin 3: +9V
- Pin 4: GND
- Pin 5: Microphone Input
- Pin 6: SW 1

REAR PANEL CONNECTION

1. **EXT SP** Jack

This 2-conductor, 3.5-mm mini phone jacks provide receiver audio output for an optional external speaker. The audio impedance is 8Ω , and the level varies according to the setting of the front panel's **VOL** control. Inserting a plug into this jack disable audio from the transceiver's internal speaker. Also, this jack provide 1200 bps Packet Data output

2. **13.8 VDC** Cable Pigtail w/Fuse

This is the DC power supply connection for the transceiver.

3. Antenna Connector

Connect a dual-band antenna's 50Ω cable to this M-type (SO-239) coaxial connector. European versions are equipped with a Type-N connector. Be certain to use the proper type of plug for connection of the coaxial cable.

MICROPHONE SWITCHES

1. **[DWN]** Button

Press this button to tune downward in the current step increment, hold this button in to start scanning toward a lower frequency.

2. **[UP]** Button

Press this button to tune upward in the current step increment, hold this button in to start scanning toward a higher frequency.

3. **PTT** Switch

Press this switch to transmit, and release it to receive.

4. **[ACC]** Button

Press this button to activate the priority monitoring.

In the European version, press this button to transmit a 1750 Hz Burst Tone for repeater access.

5. **[VFO/MR]** Button

This button selects the operation between VFO mode and Memory mode.

6. **LOCK** Switch

Slide this switch upward to lock (disable) the microphone buttons.

7. Keypad

These 16 keys generate DTMF tones during transmit.

In the receiving mode, these 16 keys can be selects the VFO frequency and/or recalls the Memory channel.

8. [P1] Button

This button selects the Tone Squelch type: CTCSS, DCS, BELL or off.

9. [P2] Button

This key selects the transmitter power output level: HIGH, MID1 (Medium 1), MID2 (Medium 2), or LOW.

Note: ACC, P1, and P2 button functions can be changed via the MENU system. See page XX.

OPERATION

Turning the Power On/Off

Press the **PWR** switch momentarily to turn the radio on.

To turn the radio off, press and hold the **PWR** switch for 1/2 second.

Supply Voltage Display

When you turn on the radio, the current DC supply voltage is indicated on the display for one second.

After this interval, the display will resume its normal indication of the operating frequency.

To view the supply voltage at any time during operation, press the [DISP/SS] button several time, the current DC supply voltage is indicated on the display.

Adjusting the Volume and Squelch

Rotate the **VOL** control adjust receiver volume. To set the squelch, turn the **SQL** control fully counter-clockwise, then turn it clockwise a little past the point where band noise is muted.

A special RF Squelch feature is provided on this radio. This feature allows you to set the squelch so that only signals exceeding a S-meter level will open the squelch. To set up the RF squelch circuit for operation, use the following procedure:

- (1) Press and hold the [SET] key for one second, then rotate the **MAIN DIAL** knob to select "27RfSql".
- (2) Press the [▶] key to select the desired signal strength level for the squelch threshold (**S-3**, **S-5**, or **S-FULL**).
- (3) Press and hold the [SET] key for one second to save your new setting and exit to normal operation.
- (4) Finally, carefully advance the **SQL** control such that both edge segments of the S-meter scale

begin to blink.

This adjustment can be set independently for each band. See the instructions regarding band change below.

If nothing happens when you press a button ...

the panel may be “locked” (this feature is normally used to prevent accidental changes to the settings of controls and switches). To unlock the front panel, use the following procedure:

- (1) Press and hold the [SET] key for one second, then rotate the **MAIN DIAL** knob to select “**20LOCK**”.
- (2) Press the [▶] key to change the display to “**OFF**”.
- (3) Press and hold the [SET] key for one second to save your new setting and exit to normal operation.

To re-lock the front panel, select to “**ON**” in step (2) above.

Band Change

Press the [SET] key momentarily, to change the operating band between VHF and UHF band.

Keypad Beeper

A key/button beeper provides useful audible feedback whenever a button is pressed. Each key and button has a different beep pitch, and each function has a unique beep combination.

If you want to turn the beeper off (or back on again):

- (1) Press and hold the [SET] key for one second, then rotate the **MAIN DIAL** knob to select “**06BEEP**”.
- (2) Press the [▶] key to change the display to “**OFF**”.
- (3) Press and hold the [SET] key for one second to save your new setting and exit to normal operation.

Display Brightness

The Omni-Glow display illumination has been specially engineered to provide high visibility with minimal disruption of your “night vision” while you are driving. The brightness of the display is manually adjustable, using the following procedure:

- (1) Press and hold the [SET] key for one second, then rotate the **MAIN DIAL** knob to select “**10D Dim**”.
- (2) Press either the [◀] or [▶] key to select a comfortable brightness level (**d1, d2, d3, d4, and OFF**).
- (3) Press and hold the [SET] key for one second to save your new setting and exit to normal

operation.

Display Contrast

The contrast of the display is manually adjustable too in this radio, using the following procedure:

- (1) Press and hold the **[SET]** key for one second, then rotate the **MAIN DIAL** knob to select “**09D Con**”.
- (2) Press either the **[◀]** or **[▶]** key to select a comfortable contrast level (**0~12**).
- (3) Press and hold the **[SET]** key for one second to save your new setting and exit to normal operation.

Frequency Navigation [“Dial” (VFO) Mode]

DIAL Tuning

This mode is used for selecting a frequency within the selected band of operation. In the “VFO” mode, the **MAIN DIAL** knob and microphone **[UP]** and **[DWN]** buttons allow the Variable Frequency Oscillator (VFO) to tune in the selected step size (or in 1 or 10 MHz step). When scanning in the VFO mode, the same step size are used as in manual tuning.

To select the 1 MHz range in which you wish to operate, press the **MAIN DIAL** knob momentarily, then rotate the **MAIN DIAL** knob. The 1 MHz digit of the frequency display will blink while “1 MHz Tuning” is enabled. Press the **MAIN DIAL** knob again (momentarily), you may rotate the **MAIN DIAL** knob to tune around the band in the selected synthesizer steps.

To select the 10 MHz range in which you wish to operate, press and hold the **MAIN DIAL** knob for 1/2 second, then rotate the **MAIN DIAL** knob. The 10 MHz digit of the frequency display will blink while “10 MHz Tuning” is enabled. Press and hold the **MAIN DIAL** knob again (more than 1/2 second), you may rotate the **MAIN DIAL** knob to tune around the band in the selected synthesizer steps.

If you wish to make a *major* frequency excursion:

- (1) First press and hold the **MAIN DIAL** knob for 1/2 second. You will observe that the 10 MHz digit is blinking, as you have now selected the “10 MHz step” frequency selection mode.
- (2) Rotate the **MAIN DIAL** knob to select a 10 MHz multiple nearest the desired operating frequency. Once you have reached the nearest 10 MHz step, press the **MAIN DIAL** knob momentarily, to put the transceiver in the “1 MHz step” tuning mode.
- (3) Now rotate the **MAIN DIAL** knob to select the desired 1 MHz segment, then press the **MAIN DIAL** knob momentarily again. The transceiver will now be ready for tuning the band in its regular tuning steps.

Direct Keypad Frequency Entry

The desired operating frequency may be entered directly from the microphone’s keypad.

To enter a frequency from the keypad, just press the numbered digits on the keypad in the proper sequence.

Examples:

To enter 146.520 MHz, press [1] → [4] → [6] → [5] → [2] → [0].

To enter 433.000 MHz, press [4] → [3] → [3] → [#].

AM Mode Activation

This radio automatically selects the AM mode when VHF frequency is set anywhere within the range 110-136 MHz, so as to allow monitoring of aircraft communications in this range. You may reason, however, to want to select the FM mode within this frequency range, or to change it back to AM from the FM mode, using the following procedure:

- (1) Press and hold the [SET] key for one second, then rotate the **MAIN DIAL** knob to select “**38AM**”.
- (2) Press the [▶] key to select “**INHIBIT**”.
- (3) Press and hold the [SET] key for one second to save your new setting and exit to normal operation.

Channel Step Selection

Tuning steps are factory present to default increments which are appropriate for the country to which this radio is exported. To change to another step size as following:

- (1) Press and hold the [SET] key for one second, then rotate the **MAIN DIAL** knob to select “**32STEP**”.
- (2) Press either the [◀] or [▶] key to select the desired step size (**5.0/10.0/12.5/15.0/20.0/25.0/50.0** kHz).
- (3) Press and hold the [SET] key for one second to save your new setting and exit to normal operation.

Transmission

To transmit, simply close the **PTT** (Push To Talk) switch on the microphone when the frequency is clear. Hold the microphone approximately 25 mm (1”) from your mouth, and speak into the microphone in a normal voice level. When your transmission is complete, release the **PTT** switch, the transceiver will revert to the receive mode.

During transmission, the Bar Graph deflects in the display, according to the power output selected.

The white keys (with numbers, letters, or the */# characters printed on them) on the microphone may be used for normal sending of DTMF tones for autopatch or repeater control use. Just press the **PTT** switch, and hold it in, while pressing the desired keys.

In the European version, press the [ACC] button on the microphone to transmit a 1750 Hz Burst Tone for repeater access.

Power Output Setting

Four power output levels are available on this transceiver: 5 watts (Low 3), 10 watts (Low 2), 20 watts (Low 1) and 50 watts (VHF) or 35 watts (UHF) on High.

To change the power level, press the [P2] button on the microphone to select one of four power setting. The power level may be stored in a memory register, if desired.

PTT Locking

The PTT circuitry may be locked out, so as to prevent unauthorized or otherwise undesired transmission.

To lock out the PTT and prevent transmission as following:

- (1) Press and hold the [SET] key for one second, then rotate the **MAIN DIAL** knob to select "19LckTx".
- (2) Press the [▶] key to select the desired mode (**BAND A**: PTT locked on VHF band only, **BAND B**: PTT locked on UHF band only, or **BOTH**: PTT locked on VHF/UHF bands).
- (3) Press and hold the [SET] key for one second to save your new setting and exit to normal operation.

To cancel PTT lock, select to "OFF" in step (2) above.

Repeater Splits

This transceiver offers three methods of setting up split frequency operation on repeaters:

- [1] Manual selection of preset repeater shifts;
- [2] Automatic Repeater Shift (ARS), providing automatic activation of repeater shifts during designated repeater frequency subbands; and
- [3] Independently stored transmit and receive frequencies (typically not corresponding to established repeater frequency shifts).

[1] Standard Repeater Shift

To activate the standard shift manually, just press the [▶] key: once for minus shift (-), again for plus shift (+), and again to return to simplex.

With repeater shift activated, you can temporarily reverse the transmit and receive frequencies by pressing the [◀] key. Use this feature to display the transmit frequency *without transmitting*, and to check the strength of signals on a repeater uplink frequency (so as to determine whether or not a particular station is within "Simplex" range, for example). The "r" icon will appear bottom left while "Reverse" shift is activated.

The repeater offset is fixed to 600 kHz on the VHF band and 1.6/5.0/7.6 MHz on the UHF band from the factory. You can change the offset by following procedure, if needed:

- (1) Press and hold the **[SET]** key for one second, then rotate the **MAIN DIAL** knob to select “**30Shift**”.
- (2) Press either the **[◀]** or **[▶]** key to set the desired offset. Note that the resolution of the “standard” repeater shift is to the nearest 50 kHz multiple.
- (3) Press and hold the **[SET]** key for one second to save your new setting and exit to normal operation.

[2] Automatic Repeater Shift

The ARS (Automatic Repeater Shift) feature in this transceiver allows easy and convenient repeater operation by automatically activating the repeater shift function whenever you tune to a standard repeater sub band. The ARS function is preset at the factory to conform to the standards for the country to which it is exported.

The ARS function is *enabled* at the factory. To *disable* it:

- (1) Press and hold the **[SET]** key for one second, then rotate the **MAIN DIAL** knob to select “**04ARS**”.
- (2) Press the **[▶]** key to change the display to “**OFF**”.
- (3) Press and hold the **[SET]** key for one second to save your new setting and exit to normal operation.

To enable the ARS function again, select to “**ON**” in step (2) above.

ARS operation is independent on the VHF and UHF channels. Therefore, you are allowed to have ARS enabled on VHF but *disabled* on UHF, if you like.

[3] Separate Transmit Frequency Memories

All memory channels can store independent receive and transmit frequencies, to accommodate occasional non-standard offsets with greater frequency resolution than is available using the “standard” shift feature.

- (1) First store the *receive* (repeater output) frequency. In the VFO mode, tune the transceiver to the desired receive frequency. Now press and hold the **[VFO/MR]** button on the microphone for one second.
- (2) Within five seconds of pressing the **[VFO/MR]** button, use the **MAIN DIAL** knob or microphone’s **[UP]**/**[DWN]** buttons to select the desired memory for storage (The occupied memory channel will be appears memorized frequency).
- (3) Now press the **[VFO/MR]** button momentarily to store the receive frequency into the selected memory.

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- (4) Next store the *transmit* (repeater input) frequency. Since you are still in the VFO mode, tune the transceiver to the desired transmit frequency.
- (5) Now press and hold the **[VFO/MR]** button for one second.
- (6) Press and hold the **PTT** switch, and press the **[VFO/MR]** button momentarily while holding in the **PTT** switch. This will not cause transmission, but rather it will instruct the transceiver that you are *programming* a separate transmit *frequency* into memory.

Memory Storage

To store a frequency into memory:

- (1) In the VFO mode, select the desired frequency, repeater shift, CTCSS tone, TX power level, and, if this is a packet channel, the desired baud rate (1200/9600).
- (2) Press and hold the **[VFO/MR]** button on the microphone for one second. A memory number or letter will appear blinking in the display.
- (3) Within five seconds of pressing the **[VFO/MR]** button, use the **MAIN DIAL** knob or microphone's **[UP]/[DWN]** buttons to select the desired memory for storage (The occupied memory channel will be appears memorized frequency).
- (4) Press the **[VFO/MR]** button again, this time momentarily, to store the displayed data into the selected memory channel slot. The memory label will stop blinking for a second, then will disappear (since you are still operating in the VFO mode).

Recalling Memories

From the VFO mode, momentarily press the **[VFO/MR]** button on the microphone to activates the memory mode (The "M" icon will appears bottom left corner on the display).

When more than one memory has been stored, use the **MAIN DIAL** knob to select a memory for operation. Alternatively, microphone's **[UP]** or **[DWN]** button may be used to stop or scan through the available memories. When using the microphone's buttons, press and release the button to move one step up or down; press and hold the **[UP]** or **[DWN]** button for one second to begin memory scanning.

The desired memory channel may be recalled directly from the microphone's keypad.

To recall a memory channel from the keypad, just press the digits on the keypad in the proper sequence.

Examples:

To recall memory channel #5, press **[5] → [*]**.

To recall memory channel #100, press **[1] → [0] → [0] → [*]**.

Home Channel Memories

If you assigned the “Programming key” function to the [HOME], you can operate the Home Channel Memories. See the “Programming the key assignment” on the page XX for details.

Convenient one-touch “Home” channel memories (one per band) are available to simplify return to your most-often-used frequency. These memories do not appear in the regular memory banks, simplify operation.

To recall the Home channel on the current band, just press the “Programming key” you be assigned momentarily (The “H” icon will appears bottom left corner on the display); press the “Programming key” again, recall the Home channel of the other band.

The factory default frequencies for the Home channels are 145.000 MHz for VHF and 433.000 MHz for UHF. You can re-program the Home channels in a manner identical to that used for the regular memories:

- (1) From the VFO mode, tune in the frequency you wish to store, and set all repeater shifts and other data just the way you do for “normal” memory channel storage.
- (2) Press and hold the [VFO/MR] button on the microphone for one second, then press the “Programming key” momentarily.

Note that there is only one Home channel for each band.

Press the [VFO/MR] button on the microphone to return to your *last-used* frequency (VFO or Memory).

Naming and Displaying Memories

You can name stores memories with an alphanumeric tag (up to seven characters) for easy reference.

To name a memory:

- (1) Recall the memory to be named.
- (2) Press and hold the [SET] key for one second, then rotate the **MAIN DIAL** knob to select “02ALPHc”.
- (3) You will notice the first entry’s place blink. Within the A/N entry mode, the [◀] or [▶] key selects *characters*, and pressing the [SET] key to move the character’s *entry place* to the right.
- (4) Press the [◀] or [▶] key to select the desired number, letter, or symbol, then press the [SET] key to move the next character’s place.
- (5) Do this as necessary to complete a name tag for your memory, then press and hold the [SET] key for one second to save the A/N name entry and exit to normal operation.

To turn on the memory name display:

- (1) Press and hold the [SET] key for one second, then rotate the **MAIN DIAL** knob to select “01ALPH”.

- (2) Press the [▶] key to change the display to “ON”.
- (3) Press and hold the [SET] key for one second so that the name just assigned (not the frequency) appears.

To re-turn on the frequency display, select to “OFF” in step (2) above.

Loading Memory into the VFO

You can easily select a memory and use that frequency as a starting point for VFO operation.

- (1) Recall the memory whose frequency which you wish copy to the VFO.
- (2) Press and hold the **MAIN DIAL** knob for one second to switch to the VFO mode.

You can now tune around the original memorized frequency. The memory contents are unaffected, but the previous VFO frequency is overwritten by this action.

Memory-Only Mode

Once memory channel programming has been completed, you may place the radio in a “Memory Only” mode, whereby VFO operation is impossible. This may be particularly useful during public-service events where a number of operators may be using the radio for first time, and ultimate simplicity of channel selection is desired.

To place the radio into the Memory Only mode, turn it off. Now press and hold in the [VFO/MR] button on the microphone while turning the radio on.

To return to normal operation, repeat the above power-on procedure.

Masking and Recovering Memories

With 184 total memories available, there frequently are situations where you may desire to “Mask” certain memories temporarily (except the Memory Channel “1”).

This feature is different from “Memory Skip Scanning,” described later; Masking hides the memory contents during scanning and manual operation, while Memory Skip Scanning hides the memory contents *only* during *scanning*.

To mask a memory:

- (1) Recall the memory to be masked.
- (2) Press and hold the [VFO/MR] button on the microphone for one second.
- (3) Press the [DISP/SS] button. This will cause the display to Memory Channel “1”, and the previously selected memory to be masked (not accessible during scanning nor by manual selection).

Important Note: The masked memory channel can not be un-hidden.

Scanning

Before activating the scanner, make sure that the **SQL** control is set to squelch off the background noise when no signal is present.

Scanning may be started or stopped with the microphone's **[UP]** or **[DWN]** button. The following techniques are used for scanning:

- (1) Press and hold either the **[UP]** or **[DWN]** button for one second in the *VFO mode* will causes upward or downward *band* scanning, respectively, to begin.
- (2) Press and hold either the **[UP]** or **[DWN]** button for one second in the *Memory mode* will causes memory channel scanning toward a higher- or lower-numbered *memory channel*, respectively.
- (3) Scanning pauses when a signal opens the squelch, and the decimal point on the display will blink. You can choose one of two scan-resume modes (described later).
- (4) To holt the scan manually, the easiest way is to push the **PTT** switch on the microphone momentarily (no transmission will occur while you are scanning). The scan may also be halted manually by pressing the microphone's **[UP]** or **[DWN]** button, or the microphone's **[VFO/MR]** button.

Scan-Resume Option

Two scan-resume modes are available on the radio:

- [1] In the **BUSY** mode, the scanner will remain halted for as long as there is carrier present on the channel; after the carrier drops at the end of the other station's transmission, the scanner will resume.
- [2] In the **TIME** mode, the scanner will halt for five seconds *only*, after which scanning will resume (whether or not the other station is still transmission).

To change the scan-resume mode, as following:

- (1) Press and hold the **[SET]** key for one second, then rotate the **MAIN DIAL** knob to select "**29SCAN**".
- (2) Press the **[▶]** key to select the desired scan-resume mode (**BUSY** or **TIME**).
- (3) Press and hold the **[SET]** key for one second to save your new setting and exit to normal operation.

Memory Skip Scanning

When you have some continuously-active channels in memories, you may wish to *skip* them for *scanning*, but still have them available for *manual selection*.

To mask a memory to be skipped during scanning, as following:

- (1) Recall the memory channel to be skipped.

- (2) Press and hold the **[SET]** key for one second, then rotate the **MAIN DIAL** knob to select “**31SKIP**”.
- (3) Press the **[▶]** key to select “**SKIP**”.
- (4) Press and hold the **[SET]** key for one second to save and exit to normal operation.

To re-enable a “skipped” memory channel, select to “**STOP**” in step (3) above.

Temporarily Memory Skip *(New Feature!)*

When press the **[SET]** key momentarily on the scan stop channel in the memory scanning, this memory channel skipped for scanning temporarily.

Programmable Band-Scan Limits

Besides band and memory scanning, this radio can be set to tune or scan only the frequencies between user-defined lower and upper limits. These limits are stores in special “Sub-Band Limit Memories” labeled **PMS-1L**, **PMS-1U**, **PMS-2L**, and **PMS-2U**, with “**L**” and “**U**” designations representing the Lower and Upper limit, respectively. To utilize this feature, use the following steps:

- (1) Store the lower edge of the desired scanning/tuning range in memory “**PMS-1L**”, and the upper edge in memory “**PMS-1U**” (or, alternatively, in memories “**PMS-2L**” and “**PMS-2U**”).
- (2) With any of these memories recalled, press the **MAIN DIAL** knob momentarily, to activate the Programmable Band-Scan Limits. The frequencies stored in memories “**L**” and “**U**” will now serve as tuning and scanning limits, thus creating a tuning sub-band (The “**p**” icon will appears bottom left corner on the display).

To cancel the sub-band limits and return to normal memory operation, press the **[VFO/MR]** button on the microphone momentarily. If you are scanning, or if you want to switch to VFO operation, press the **[VFO/MR]** button twice from the “limited sub-band” mode of operation.

Once you have stored the “**L**” and “**U**” memories, you can re-activate the sub-band limits by simply recalling either memory and pressing the **MAIN DIAL** knob. However, you cannot activate the sub-band limits when either of these memories in masked or marked for *Skip-Scanning*.

If you have stored sub-band limits in both the **PMS-1L/1U** and **PMS-2L/2U** memory registers, the scanning behaves somewhat differently: the transceiver will scan from the “**PMS-1L**” frequency to the “**PMS-1U**” frequency, then jump to the “**PMS-2L**” frequency and scan to the “**PMS-2U**” frequency, after which it will return to the “**PMS-1L**” frequency and repeat the process. If you want to have something stored in the “**PMS-2L**” and “**PMS-2U**” registers, but not include them in the scanning process, just mark them to be “Skipped” as described previously.

Smart Search Operation

The Smart Search feature may be used to load – automatically with no operator intervention – a special bank of up to 50 memory channels (per band) based on activity. Smart Search will sweep either the entire band or the portion of the band within the Programmable Band-Scan Limits and will load the special memory bank with the frequency and other data pertaining to those channels on which activity is found. The channels are loaded in the order in which they are encountered, not according to signal strength or by ascending frequency.

The Smart Search feature is especially useful when visiting a city for the first time, where you may be unfamiliar with the repeater frequencies; Smart Search discovers where the local activity is to be found, and automatically loads those frequencies for you.

Smart Search operation is simple to activate:

- (1) Press and hold the **[DISP/SS]** key for one second.
- (2) The Smart Search process will now cause the radio to scan upward on current band, loading channels on which it encounters a signal strong enough to open the squelch.
- (3) When 50 channels are loaded or scanner is reached band edge, the scanner will stop and the transceiver will revert to the starting frequency.
- (4) To recall the Smart Search Memories just stored, rotate the **MAIN DIAL** knob.
- (5) Press the microphone's **[VFO/MR]** button momentarily to exit the Smart Search mode.

Note that these memories are so-called “soft” memories; they will be lost if you initiate a new Smart Search.

Priority Channel Monitoring

In the U.S.A. version, the Priority function allows automatic checking for activity on a particular memory every five seconds while operating on the VFO or a different memory. When the receiver detects a signal on the designated “Priority” memory, operation automatically shifts to that memory while the signal is present (plus a few seconds). If you transmit while “paused” on the priority channel, priority monitoring will cease, and the transceiver will “hold” indefinitely on the priority channel.

We recommend that Memory Channel 1 is reserved by you as the “Priority” channel, as the transceiver will *only* check *Memory Channel 1* as the priority channel if you are operating in the memory mode. However, if you are operating in the VFO mode, priority operation will define the *last-used memory channel* as the priority channel.

To set up for priority monitoring:

- (1) Preset the **SQL** control to silence the background noise on a clear channel, then store the frequency to be the “Priority” channel into a memory location (this must be *Memory Channel 1* if you will be operating on other *memories* during priority monitoring).

- (2) Press the [**VFO/MR**] button on the microphone to operate in the VFO mode. If you are in the memory mode, select the memory on which you wish to operate (other than the priority channel).
- (3) Press the microphone's [**ACC**] button momentarily to start the priority monitoring (The "P" icon will appear bottom left corner on the display).

In the priority monitoring, the displayed frequency will shift to the priority memory briefly about every five seconds, while the receiver checks for the presence of a signal.

When no signal appears on the priority memory (causing the squelch to open), you can tune, transmit and receive on the VFO, or select and operate on other memories; however, you cannot scan (except manually, using the microphone's [**UP**] and [**DWN**] buttons), as the scanning logic circuits are already dedicated to the priority scanning activities.

If a station you wish to talk with appears on the priority memory, press the **PTT** switch momentarily while receiving their signal (no transmission will occur) to *hold* priority scanning. Otherwise, when a signal appears on the priority channel, priority monitoring will pause and the decimal on the display will blink. Priority monitoring will resume based on the setting of the regular scanning-resume mode – either after a 5-second pause, or after the carrier drops out.

To cancel the priority monitoring, press the microphone's [**VFO/MR**] button momentarily.

A few other rules govern priority operation:

- You may use any available memory as a priority channel in the above procedure when you are operation in the VFO mode. You may *not*, however, switch from the memory mode to the VFO mode, or vice-versa, without first *canceling* priority monitoring.
- You can not scan operation during priority operation.
- The priority function is not disabled by switching the transceiver off. If you were engaged in priority monitoring at the moment you turned the radio off, it will *assume* that you will want to continue priority monitoring during your next operating session, and will come up still in the priority mode when the transceiver is switched back *on*.

The Priority monitoring can be allows in the European version, so as to do, the "Programmable key" function change to the [**PRI**]. See the "Programming the key assignment" on the page XX for details.

Tone Squelch Modes

These systems allow silently monitoring until a call directed to you is received, and offer privacy on an otherwise busy channel.

CTCSS (Continuous Tone Coded Squelch System)

This imposes a coetaneous, subaudible tone on your transmitted audio. When decoded at the other station, this allows their squelch to open and receive your transmission. Some "closed" repeaters

use this to limit access, or to prevent signals intended for other repeaters (with the same input frequency) in fringe areas from locking up the repeater. There are 47 selectable CTCSS tones.

DCS (Digital Code Squelch)

DCS operation modulates a subaudible tone according to a digital protocol (continuous 32-bit synchronous code). DCS is widely used in the commercial land-mobile industry because of its superior performance and its 104 unique codes offer greater privacy than CTCSS.

To use either CTCSS or DCS, both stations must be on the same frequency, and have selected the same CTCSS tone or DCS code.

To select and activate CTCSS or DCS operation:

(1) Press the [**P1**] button to select the desired squelch type from the following:

- “**ENC**” (encode) appears when the CTCSS tone generator is activated for *transmission* only.
- “**ENC/DEC**” (encode & decode) appears when the CTCSS tone squelch is activated for both TX & RX (only signals “encoded” with the matching tone open the squelch).
- “**BELL**” (CTCSS bell paging) appears when the CTCSS bell paging is activated, as described detail later.
- “**DCS**” (digital code squelch) appears when digital code squelch system (TX & RX) is active.

(2) Press the **PTT** switch momentarily to save your new and exit.

Next, select the CTCSS tone, or DCS code that you and the other station have both agreed to use:

- If “**ENC**”, “**ENC/DEC**”, or “**BELL**” is selected:

(1) Press and hold the [**SET**] key for one second, then rotate the **MAIN DIAL** knob to select “**34TONEf**”.

(2) Press either the [**◀**] or [**▶**] key to choose the desired CTCSS tone.

(3) Press and hold the [**SET**] key for one second to save your new setting and exit to the normal operation.

- If “**DCS**” is selected:

(1) Press and hold the [**SET**] key for one second, then rotate the **MAIN DIAL** knob to select “**12DCS#**”.

(2) Press either the [**◀**] or [**▶**] key to choose the desired DCS code.

(3) Press and hold the [**SET**] key for one second to save your new setting and exit to the normal operation.

CTCSS/DCS setting are stored in each memory in the same manner and at the same tone as storing frequencies. To change the programmed tone/code or state, just recall it, reset the tone or function, and store the memory again. If you activate CTCSS/DCS on a PMS memory, it will be active when that memory pair is used to start PMS scanning or tuning.

DCS Tone Search Scanning

In operating situations where you don't know the DCS tone being used by another station, you can command the radio to listen to the incoming signal and scan in search of the tone being used.

To scan for the DCS tone in use:

- (1) Set the radio up for the DCS operation.
- (2) Press and hold the **[SET]** key for one second, then rotate the **MAIN DIAL** knob to select "**13DCS**".
- (3) Press the **[▶]** key to start scanning for the incoming DCS tone.

When the radio detects the correct tone, it halts on that tone, and audio is allowed to pass.

Press and hold the **[SET]** key for one second to exit to normal operation.

CTCSS Bell Paging

Bell Paging adds an alert ringer to CTCSS tone squelch operation, for added convenience. When you receive a call with a matching CTCSS tone, the ringer sounds to alert you to the call.

To activate the CTCSS Bell operation, press the **[P1]** button until the "**BELL**" appears on the display.

As before, calls without a matching CTCSS tone is ignored. That with a matching tone cause the transceiver to ring as the squelch opens while the caller transmits. Note that other stations do not need to have the CTCSS Bell function to call you: they can just use standard CTCSS encoding.

When you reply to a CTCSS Bell call, you may want to turn off the Bell function, or else the transceiver will ring every time your squelch opens.

You can store the CTCSS Bell Paging in a memory, along with different CTCSS tone and encode/decode states.

ARTS Auto Range Transpond System

This system uses DCS signaling to inform you when you and *another ARTS-equipped station* are within communications range. Both stations must first select DCS operation using the same DCS code.

Whenever you press the **PTT**, or every 30 seconds after ARTS is activated, your radio transmits a (subaudible) DCS signal. If the other radio is in range, the beeper sound (if enable) and "**ARTS IN**" will appear on the display.

Whether you talk or not, the radio continue to poll each other every 30 seconds while ARTS is activated. you can also have your radio transmit your callsign via CW every nine minutes, to comply with identification requirements.

If you move out range for more than one minute (two polls), your radio senses that no signal has

been received. Sounds the beep and the display changes to “**ARTS OUT**” (out of range). If you move back into range, your radio again beeps, and the display changes back to “**ARTS IN**”.

During ARTS operation, you *never* change the operating frequency or other settings; you must first terminate ARTS to resume normal operation. This is a safety feature to prevent accidental loss of contact due to channel change, etc.

Here is how to activate ARTS:

- (1) Press and hold the [SET] key for one second, then rotate the **MAIN DIAL** knob to select “**05ARTS**”.
- (2) Press the [▶] key to select the ARTS operating mode: “**RX** (receive-only)”, “**TX** (transmit-only)”, “**TRX** (transceive)” or “**OFF**”. The operating descriptions assume both radio are set to “**TRX**”.
- (3) Press and hold the [SET] key for one second to save the entry and exit. The display now shows “**ARTS OUT**”. After two pollings (one minute), a response is not detected, “**ARTS OUT**” appears continuously, otherwise “**ARTS IN**” is displayed as long as both stations remain in range.
- (4) To cancel ARTS operation, select to “**OFF**” in step (2) above.

ARTS Modes

In the previous ARTS description, both transceivers were set to the “**TRX**” (transceive) mode. There are two other ARTS modes available from MENU function, as outlined below:

RX – Use this mode if you only want your radio to listen, and not poll the other station (in which case their radio should be set to the “**TX**” mode). Here, your radio will beep and display “**ARTS IN**” or “**ARTS OUT**” to indicate the state of connection.

TX – Likewise, this puts your radio into a *transmit-only* “beacon” mode where you won’t hear the polling beeps (but you can still hear when the other station talks). When activated, you have *no display of whether the other station is in range*, or not (“**ARTS IN**” and “**ARTS OUT**” do not appear). You should have your CW IDer enabled when this mode is activated.

CW ID (Morse Identifier) Set up

The ARTS feature includes a CW identifier, as mentioned previously. The radio can be instructed to send “DE (*your callsign*) K” in Morse code every nine minutes during ARTS operation. The callsign may contain up to 7 characters.

Here’s how to program the CW IDer:

- (1) Press and hold the [SET] key for one second, then rotate the **MAIN DIAL** knob to select “**08CWID#**”.
- (2) You will notice the first entry’s place blink. Within the CW IDer entry mode, the [◀] or [▶] key selects *characters*, and pressing the [SET] key to move the character’s *entry place* to the

right.

- (3) Press the [◀] or [▶] key to select the desired number or letter, then pressing the [SET] key to move the next character's place.
- (4) Press and hold the [SET] key for one second to save the CW IDer entry and exit to normal operation.

To activate the CW IDer:

- (1) Press and hold the [SET] key for one second, then rotate the **MAIN DIAL** knob to select "07CWID".
- (2) Press the [▶] key to change the display to "ON".
- (3) Press and hold the [SET] key for one second to save your new setting and exit to normal operation.

To disable the CW IDer, select to "OFF" in step (2) above.

DTMF Autodialer Operation

Eight DTMF Autodialer memories are available on this radio. These DTMF Autodialer memories can store up to 16 digits of a telephone number for repeater autopatch or other use.

To load DTMF Autodialer memories, use following procedure:

- (1) Press and hold the [SET] key for one second, then rotate the **MAIN DIAL** knob to select "17DTMFw".
- (2) Press the [◀] key several times to select the DTMF Autodialer memory channel number into which you wish store a telephone number ("1" to "8")
- (3) Press the [▶] key momentarily.
- (4) Press the [◀] or [▶] key to select the first digit of the telephone number you wish to store.
- (5) When you have selected the correct digit, press the [SET] key momentarily. Press the [◀] or [▶] key to select the second of 16 available numbers in the current DTMF Autodialer memory resistor.
- (6) Repeat this procedure for each digit in the telephone number.
- (7) When entry of all digits is complete, press and hold the **MAIN DIAL** to enter another telephone number in another DTMF Autodialer memory channel, or press and hold the [SET] key for one second to save your new setting and exit to the normal operation.

To *transmit* the memorized telephone number, use the following procedure:

- (1) Hold the microphone's **PTT** switch to continue transmitting during the following steps.
- (2) Rotate the **MAIN DIAL** knob to select the DTMF Autodialer memory channel to be transmitted
- (3) While still holding the **PTT** switch in, press the [SET] key momentarily to transmit the tone string.

Once you have pressed the **[SET]** button above step, you can release the **PTT** switch, as Autodialer transmits the whole DTMF string automatically.

The speed at which the DTMF digits are sent can be changed. Two speed levels are available: Low (10 digits per second) and High (20 digits per second: default). To toggle between Low and High speed, use the following procedure:

- (1) Press and hold the **[SET]** key for one second, then rotate the **MAIN DIAL** knob to select “**16DTMFs**”.
- (2) Press the **[▶]** key to select the desired speed (“**50 ms**”: High speed or “**100 ms**”: Low speed).
- (3) Press and hold the **[SET]** key for one second to save your new setting and exit to the normal operation.

You can also set a longer delay between the time your transmitter is keyed and the first DTMF digit is sent. To set a delay time, use the following procedure:

- (1) Press and hold the **[SET]** key for one second, then rotate the **MAIN DIAL** knob to select “**15DTMFd**”.
- (2) Press either the **[◀]** or **[▶]** key to select the desired speed (**50/250/450/750/1000 ms**).
- (3) Press and hold the **[SET]** key for one second to save your new setting and exit to the normal operation.

Packet Operation

Packet operation only requires that you define the baud rate at which you wish to operate, 1200 bps or 9600 bps, and that you connect your TNC.

To select the Packet baud rate, use the following procedure:

- (1) Press and hold the **[SET]** key for one second, then rotate the **MAIN DIAL** knob to select “**21PKT**”.
- (2) Press the **[▶]** key to select the desired baud rate (**1200bps** or **9600bps**).
- (3) Press and hold the **[BAND/SET]** key for one second to save your new setting and exit to the normal operation.

The packet baud rate selection can be set independently for each band (VHF and UHF), and note that this data may be stored in memory channels.

Miscellaneous Setting

Time-Out Timer

The “Time-Out Timer” (TOT) feature is designed to force the transceiver into the “receive” mode after a present time period of continuous transmission (the default is 6 minutes). This feature prevents your transceiver from transmitting a “dead carrier” for a long period of time in the event

that the microphone **PTT** switch is accidentally locked in the “TX” condition.

The Time-Out Timer’s “switch-to-receive” time may be adjusted, in one minute increments, for any period between 1 and 60 minutes.

To change the default (6 minute) time setting as follows:

- (1) Press and hold the [**SET**] key for one second, then rotate the **MAIN DIAL** knob to select “**35TOT**”.
- (2) Press either the [**◀**] or [**▶**] key to select the desired time interval (between **1** and **60** minutes), or **OFF**.
- (3) Press and hold the [**SET**] key for one second to save your new setting and exit to the normal operation.

Automatic Power-Off

The “Automatic Power-Off” (APO) feature will turn the radio completely *off* after a user-defined period of **PTT** or key/button inactivity. If you do not press any front panel keys or buttons, rotate the **MAIN DIAL** knob or use the microphone’s keys and buttons, or transmit, and so long as the transceiver is not scanning or engaged in priority monitoring, the radio will shut itself off after the specified time period. This feature is useful in minimizing battery drain in a mobile installation if you forget to turn the transceiver off when you leave your vehicle.

To activate the APO feature as follows:

- (1) Press and hold the [**SET**] key for one second, then rotate the **MAIN DIAL** knob to select “**03APO**”.
- (2) Press either the [**◀**] or [**▶**] key to select the desired “switch-off” time (between **1** and **12** hours), or **OFF**.
- (3) Press and hold the [**SET**] key for one second to save your new setting and exit to the normal operation.

Cooling Fan Control

This radio automatically active the cooling fan when transmitting and after three minutes, or when chassis is over heating. However you can change the operating mode using following procedure:

- (1) Press and hold the [**SET**] key for one second, then rotate the **MAIN DIAL** knob to select “**18FAN**”.
- (2) Press the [**▶**] key to change the desired operating mode.

AUTO/TX: The cooling fan rotate high speed when both below conditions, but otherwise, the cooling fan rotate low speed.

AUTO: The cooling fan rotate high speed when the chassis is over heating, but otherwise, the cooling fan rotate low speed.

TX: The cooling fan rotate high speed when transmitting and after 30 seconds, but otherwise, the cooling fan rotate low speed.

OFF: The cooling fan rotate low speed continuously.

- (3) Press and hold the [**BAND/SET**] key for one second to save your new setting and exit to the normal operation.

MIC Gain Control

You can reduce the microphone input level when over deviation. To reducing the microphone input level as follow:

- (1) Press and hold the [**SET**] key for one second, then rotate the **MAIN DIAL** knob to select “**36TxNar**”.
- (2) Press the [**▶**] key to change the display to “**ON**”.
- (3) Press and hold the [**SET**] key for one second to save your new setting and exit to the normal operation.

To inquirers microphone input level, select to “**OFF**” in step (2) above:

Programming the key assignment

Default FT-90 key functions have been assigned to the front panel’s [**◀**] / [**▶**] keys, and microphone’s [**P1**] / [**P2**] / [**ACC**] buttons at the factory. These may be changed by the user, if you wish to make another function.

To programming the function:

- (1) Press and hold the [**SET**] key for one second, then rotate the **MAIN DIAL** knob Menu Item # to be assigned (**22Pg:←**, **23Pg:→**, **24Pg:P1**, **25Pg:P2**, or **26Pg:AC**).
- (2) Press the [**▶**] key to select the function you wish to assign to the key or button you selected in the previous step.
- (3) Rotate the **MAIN DIAL** knob to select another programmable key or button to modify, if desired, and repeat the above steps.
- (4) Press and hold the [**SET**] key for one second to save your new setting and exit to the normal operation.

DCS Code Inversion

The DCS system was first introduced in the commercial LMR (Land Mobile Radio) service, where it is now in widespread use. DCS is sometime referred to by its different proprietary names, such as DPL® (Digital Private Line®, registered trademark of motorola, Inc.).

DCS uses a codeword consisting of a 23-bit frame, transmitted (subaudible) at a data rate of 134.4 bps (bit/sec). Occasionally, signal *inversion* can result in the *complement* of a code to be sent or

received. This prevent receiver squelch from opening with DCS enabled, as the decoded bit sequence would not match that selected for operation. Typical situations that might cause inversion to occur are:

- Connection of an external receiver preamplifier.
- Operating through a repeater.
- Connection of an external linear amplifier.

Note that code inversion does *not* mean that any of the above listed equipment is defective !

In certain amplifier configurations, the output signal (phase) is inverted from the input. Small signal or power amplifiers having an odd number (1, 3, 5, etc.) of amplification stages may result in inversion of a transmitted or received DCS code.

While under most circumstances this should not occur (amplifier designs and industry standards take this into account), if you find that your receiver squelch does not open when both you and the other station are using a common DCS code, you or the other station (*but not both*) can try the following:

(1) Press and hold the [SET] key for one second, then rotate the **MAIN DIAL** knob to select “14DCSnr”.

(2) Press the [▶] key to select the following mode.

TRX NOR: Encoder; Normal, Decoder; Normal

RX REV: Encoder; Normal, Decoder; Reverse (Invert)

TX REV: Encoder; Reverse (Invert), Decoder; Normal

TRX REV: Encoder; Reverse (Invert), Decoder; Reverse (Invert)

(3) Press and hold the [SET] key for one second to save your new setting and exit to the normal operation.

Remember to restore the default setting to “TRX NOR” (Encoder; Normal, Decoder; Normal) when done.

Cross-Band Repeater Operation

This transceiver can be set up to operate as a full-featured cross-band repeater with a simple power-on procedure. This feature is useful for emergency portable work in a remote area, and for cross-band linking. However, remember these points before using the cross-band repeater function:

- Check the amateur radio rules and regulations for your country to ensure that type of operation is permitted.
- Pick your frequency pair carefully, so as not to cause harmful interference to other users. The use of cross-band repeaters has the potential to cause serious disruption of communications circuits, and the creation of harmful interference to coordinated repeaters is inconsiderate and may be illegal! If you are not sure of active repeater frequencies in your area, a safe rule is to stay off of the repeater sub-bands and use the FM simplex portion of each band. *Contact*

your area's frequency coordinator for guidance.

- Remember that the transmit duty cycle will be much higher during repeater service, so we recommend that the transmit power level be set to Low, to ensure cooler operation.

Transceiver CTCSS settings (Encode/Decode) may, of course, be selected for each band, allowing selective calling for your repeater. However, keep in mind that if the channels you use are so busy to motivate you toward CTCSS Decoding, you may not have chosen a good frequency pair on which to operate, as the potential for interference to other users is high.

Here is the procedure for setting up cross-band repeater operation:

- (1) Before enabling cross-band repeater operation, set the receiving frequency (repeater input) into the *memory*, and set the *transmit* frequency (repeater output) to the *VFO*, or vice versa, and set the **SQL** control such that background noise is silenced. Now turn the transceiver off.
- (2) With the transceiver turned *off*, press and hold the **[DISP/SS]** button while turning the transceiver on. The transmit and receiving frequencies appears on the display, indicating the cross-band repeater mode is enabled.
- (3) For cross-band repeater operation, change the transmit and receive **band** automatically depending on which channel the input signal is received.
- (4) To exit the cross-band repeater mode, turn the transceiver off when it is not transmitting. Then press and hold the **[DISP/SS]** button while turning the transceiver on. The transceiver will now come on in the "normal" (non-repeater) mode of operation.

Demonstration Mode

You can change the opening display to the demonstration display (default setting: indicate the current supply voltage).

Press and hold the **[SET]** button while turning the transceiver on, the display indicate the demonstration comments until the transceiver is operated.

Repeat the same step above, return to the normal opening display.

Comment wrightting

You also can change the demonstration comments, if desired, using following procedure:

- (1) Press and hold the **[SET]** key while turning the transceiver on, you will notice first entry's place of the *upper* comment area blinks.
- (2) Within the comment entry mode, rotate the **MAIN DIAL** knob to *select the characters*, and pressing the **[▶]** key to *move the character's entry place* to the right.
- (3) Rotate the **MAIN DIAL** knob select desired number, letter, or symbol, then press the **[▶]** key to move the next character's place.
- (4) Do this as necessary to complete a *upper* comment (up to 50 characters), press the **[SET]** key momentarily, you will notice first entry's place of the *lower* comment area blinks.

- (5) Repeat the above step (3) to set the *lower* comment (up to 50 characters).
- (6) Press the **[SET]** key to save the new comments and exit.

Resetting the CPU

- To resets all menu setting to factory-default, press and hold the **[SET]** key *and* **[DISP/SS]** button while turning the transceiver on.
- To CPU master reset for all memories and menu setting, press and hold the **[◀]** key, **[▶]** key, *and* **[DISP/SS]** button while turning the transceiver on.

Transceiver Cloning

You can transfer all data stored in one transceiver to another set by utilizing the handy “Cloning” feature. This requires a user-constructed Cloning cable which connects the **MIC** jacks on the two transceivers as shown below. To clone from one transceiver to another, use the following procedure:

- (1) Insert the Clone Cable into the **MIC** jack of each transceiver.
- (2) Turn both transceiver off, then press and hold the microphone’s **[ACC]** button on *each* radio while turning the power on again. The “**CLONE**” will appears on the display.
- (3) On the “destination” radio, press the **[DISP/SS]** button. The “**R**” will appears bottom left corner on the display.
- (4) Now, on the “source” radio, press the **[SET]** key. The “**T**” will appears bottom left corner on the display, and the cloning data transfers.
- (5) IF there is a problem during the cloning process, “**Error**” is displayed. Check your cable connections and try again.
- (6) If cloning successful, turn the “destination” radio off. Now turn the “source” radio off.
- (7) Remove the Clone Cable. Channel and operating data for both radios are now identical. They both may be turned on now for normal operation.

Menu System

The FT-90 Menu System is east to activated and set. Use the following procedure:

1. Press and hold the **[SET]** key for one second.
2. Rotate the **MAIN DIAL** knob to select the Menu item to be adjusted.
3. Press either the **[◀]** or **[▶]** key to adjust or select the parameter to be changed on the Menu item selected in step 2. above.
4. After completing your selection and adjustment, press and hold the **[SET]** key for one second to exit the Menu mode and return to normal operation.

Menu Selection Details

01ALPH

Function: Enable/disable the Alpha Numeric display.

Available Values: ON/OFF

Default Setting: OFF

02ALPHc

Function: Naming memory.

03APO

Function: Enable/disable the Automatic Power Off feature.

Available Values: 1 ~ 12 hour or OFF

Default Setting: OFF

04ARS

Function: Enable/disable the Automatic Repeater Shift.

Available Values: ON/OFF

Default Setting: ON

05ARTS

Function: Select the ARTS mode.

Available Values: TRX/TX/RX/OFF

Default Setting: OFF

06BEEP

Function: Enable/disable the key/button beeper.

Available Values: ON/OFF

Default Setting: ON

07CWID

Function: Enable/disable the CW IDer during ARTS operation.

Available Values: ON/OFF

Default Setting: ON

08CWID#

Function: Programming the CW IDer.

09D Con

Function: Setting the front panel display's contrast level.

Available Values: 0~12

Default Setting: 6

10D Dim

Function: Setting the front panel display's illumination level.

Available Values: d1/d2/d3/d4/OFF

Default Setting: d1

11DC IN

Function: Indicate the Supply Voltage.

12DCS#

Function: Setting the DCS code.

Available Values: 104 standard DCS codes

Default Setting: 023

13DCS

Function: Activate the DCS Scanner.

14DCSnr

Function: Select "Normal" or "Inverted" DCS code.

Available Values: TRX NOR (Encoder; Normal, Decoder; Normal)

RX REV (Encoder; Normal, Decoder; Reverse (Invert))

TX REV (Encoder; Reverse (Invert), Decoder; Normal)

TRX REV (Encoder; Reverse (Invert), Decoder; Reverse (Invert))

Default Setting: TRX NOR: (Encoder; Normal, Decoder; Normal)

15DTMFd

Function: Setting the DTMF Autodialer delay time.

Available Values: 50/250/450/750/1000 ms

Default Setting: 450 ms

16DTMFs

Function: Setting the DTMF Autodialer sending speed.

Available Values: 50/100 ms

Default Setting: 50 ms

17DTMFw

Function: Loading the DTMF Autodialer memory.

18FAN

Function: Set the cooling fan function.

Available Values: AUTO/TX, AUTO, TX, OFF

Default Setting: AUTO/TX

AUTO/TX: The cooling fan rotate high speed when both below conditions, but otherwise, the cooling fan rotate low speed.

AUTO: The cooling fan rotate high speed when the chassis is over heating, but otherwise, the cooling fan rotate low speed.

TX: The cooling fan rotate high speed when transmitting and after 30 seconds, but otherwise, the cooling fan rotate low speed.

OFF: The cooling fan rotate low speed continuously.

19LckTX

Function: Enable/disable the PTT lock.

Available Values: BAND A/BAND B/OFF

Default Setting: OFF

20LOCK

Function: Enable/disable the key/button lock.

Available Values: ON/OFF

Default Setting: OFF

21PCKT

Function: Set the transceiver's circuitry for the Packet baud rate to be used.

Available Values: 1200/9600 bps

Default Setting: 1200 bps

22Pg:←

Function: Programming the [◀] key assignment.

Available Values: TONE, PRI, SCAN UP, SCAN DWN, RPTR, REVERSE, TX PWR,
HOME CH, VFO/MR, T.BURST

Default Setting: LOW

23Pg:→

Function: Programming the [▶] key assignment.

Available Values: TONE, PRI, SCAN UP, SCAN DWN, RPTR, REVERSE, TX PWR,
HOME CH, VFO/MR, T.BURST

Default Setting: VFO/MR

24Pg:P1

Function: Programming the [P1] button assignment.

Available Values: TONE, PRI, SCAN UP, SCAN DWN, RPTR, REVERSE, TX PWR,
HOME CH, VFO/MR, T.BURST

Default Setting: TONE

25Pg:P2

Function: Programming the [P2] button assignment.

Available Values: TONE, PRI, SCAN UP, SCAN DWN, RPTR, REVERSE, TX PWR,
HOME CH, VFO/MR, T.BURST

Default Setting: HOME CH

26Pg:AC

Function: Programming the [ACC] button assignment.

Available Values: TONE, PRI, SCAN UP, SCAN DWN, RPTR, REVERSE, TX PWR,
HOME CH, VFO/MR, T.BURST

Default Setting: PRI

27RfSql

Function: Adjust the RF SQL threshold level.

Available Values: S-3/S-5/S-FULL/OFF

Default Setting: OFF

28RPTR

Function: Setting the Repeater Shift Direction.

Available Values: Shift -/Shift +/OFF

Default Setting: OFF

29SCAN

Function: Select the Scan Resume mode.

Available Values: BUSY/TIME

Default Setting: BUSY

30Shift

Function: Set the magnitude of the Repeater Shift.

Available Values: 0.00MHz ~ 99.95 MHz (50 kHz step)

Default Setting: Depends on transceiver version (U.S.A., European, etc.).

31SKIP

Function: Enable/disable the scan skip memory.

Available Values: SKIP/STOP

Default Setting: STOP

32STEP

Function: Setting the synthesizer steps.

Available Values: 5.0/10.0/12.5/15.0/20.0/25.0/50.0 kHz

Default Setting: Depends on the transceiver version (U.S.A., European, etc.).

33TONE

Function: Select the CTCSS/DCS Operation.

Available Values: ENC, ENC/DEC, BELL, DCS, OFF

Default Setting: OFF

34TONEf

Function: Setting the CTCSS Tone Frequency.

Available Values: 39 standard CTCSS Tones

Default Setting: 88.5 Hz

35TOT

Function: Set the TOT time.

Available Values: 1 ~ 60 minutes or OFF

Default Setting: 6 minutes

36TxNar

Function: Reducing the MIC Gain.

Available Values: ON/OFF

Default Setting: OFF

37TxPwr

Function: Set the Tx Output Power

Available Values: HIGH/MID1/MID2/LOW

Default Setting: HIGH

38AM

Function: Select the receiving mode.

Available Values: AUTO/ AM/INHIBIT

Default Setting: AUTO

SPECIFICATIONS

General

Frequency Ranges:	144-146 MHz or 144-148 MHz (144 MHz) 430-440 MHz or 430-450 MHz (430 MHz)
Channel Steps:	5/10/12.5/15/20/25/50 kHz
Emission Type:	F3, F2, F1
Antenna Impedance:	50 Ω . Unbalanced w/antenna Duplexer
Frequency Stability:	± 5 ppm (-5 $^{\circ}$ C to $+60$ $^{\circ}$ C)
Operating Temp. Range:	-20 $^{\circ}$ C to $+60$ $^{\circ}$ C
Supply Voltage:	DC 13.8 V ± 15 %, Negative Ground
Current Consumption:	300 mA (Receive Squelched) 100 mA (Tx, 144 MHz) 100 mA (Tx, 430 MHz)
Case Size:	100(W) x 30(H) x 138(D) mm (w/o knob)
Weight:	600 g

Transmitter

RF Power Output: 50/20/10/5 W (144 MHz), 35/20/10/5 W (430 MHz)

Modulation Type: Variable Reactance

Maximum Deviation: ± 5 kHz

Spurious Emission: At least 60 dB below

Microphone Impedance: 2 k Ω

Receiver

Circuit Type: Double-Conversion Superheterodyne

Intermediate Freq.: 45.05 MHz and 455 kHz

Sensitivity: 0.18 μ V @12 dB SINAD

Selectivity: 12 kHz/24 kHz (-6 dB/-60 dB)

AF Output: 2 W @8 Ω for 10 % THD

AF Output Impedance: 4 Ω – 16 Ω

Specifications are subject to change without notice or obligation.

Q2015-4 (**NJM2902V**) to the volume controller Q2001 (**M51132FP**).

The processed signal amplified by the audio power amplifier Q2004 (**LA4425A**), then applied to the 8 Ω loudspeaker or external speaker jack.

Squelch Control

When no carrier is received, noise at the output of the detector stage in Q1038 is amplified, band-pass filtered and detected by D1039 (**MA742**). The resulting DC squelch control voltage is passed to pin 33 of Q2021 (**HD6473337Y**).

While no carrier is received, pin 80 of Q2021 remains high. This signal is applied to SQL switch Q2003 (**2SC4617**) and Q2010 (**TC4W53FU**) to hold the AF line low to block receiver audio.

TRANSMITTING

AF Signal Path

Speech input from the microphone is delivered to the CNTL UNIT and passes through the MIC MUTE switch Q2018 (**TC4W53FU**), MIC amplifier Q2014-1 (**NJM2902V**), limiter amplifier Q2014-2 (**NJM2902V**), low-pass filter Q2014-3 (**NJM2902V**), and the buffer amplifier Q2014-4 (**NJM2902V**) to the volume controller Q2001 (**M51132FP**), and is then applied to VCO circuit on the MAIN UNIT.

VHF Signal Path

The speech signal is applied to VHF VCO consisting of Q4002 (**2SC5006**) and D4004 (**1SV286**).

The modulated signal from VHF VCO passes through the low-pass filter, buffer amplifier Q4006 (**TA4002F**), pre-drive amplifier Q1020 (**2SC3357-RF**), and drive amplifier Q1014 (**2SC2954**) to the VHF final amplifier Q1007 (**M68750**).

The transmit signal then passes through the antenna switch D1014, D1015 (both **UM9957F**) and is low-pass filtered to suppress away harmonic spurious radiation before delivery to the antenna.

UHF Signal Path

The speech signal is applied to UHF VCO consisting of Q4003 (**2SC5006**) and D4006 (**1SV286**).

The modulated signal from UHF VCO passes through the low-pass filter, buffer amplifier Q4006, pre-drive amplifier Q1020, and drive amplifier Q1016 (**2SC2954**) to the UHF final

amplifier Q1008 (**M68751R**).

The transmit signal then passes through the antenna switch D1016, D1017 (both **UM9957F**) and is low-pass filtered to suppress away harmonic spurious radiation before delivery to the antenna.

VHF Automatic Transmit Power Control

RF power output from the VHF final amplifier Q1007 is rectified by D1007 (**MA742**). The resulting DC is fed through the Automatic Power Controller Q1012 (**2SA1244**) to the pre-drive amplifier Q1020, drive amplifier Q1014, and the VHF final amplifier Q1007, thus allowing control of the power output.

UHF Automatic Transmit Power Control

RF power output from the VHF final amplifier Q1008 is rectified by D1008 (**MA742**). The resulting DC is fed through the Automatic Power Controller Q1012 (**2SA1244**) to the pre-drive amplifier Q1020, drive amplifier Q1016, and the UHF final amplifier Q1008, thus allowing control of the power output.

Push-To-Talk Transmit Activation

When the PTT switch is closed on the VHF frequency, pin 30 of microprocessor Q2021 goes low, as a result, pin 51 of Q2021 goes high. This signal is applied to the TX/RX controller Q1046 (**IMD10A**) and Q1052 (**UMD2N**), which activate the pre-drive amplifier Q1020, drive amplifier Q1016, and the VHF final amplifier Q1007. At same time, pin 54 and 55 of Q2021 goes low. This signal is applied to the TX/RX controller Q1005 and Q1052 (both **UMC5N**), which disable the receiver circuit.

When the PTT switch is closed on the UHF frequency, pin 30 of microprocessor Q2021 goes low, as a result, pin 50 of Q2021 goes high. This signal is applied to the TX/RX controller Q1051 (**IMD10A**) and Q1052, which activate the pre-drive amplifier Q1020, drive amplifier Q1016, and the UHF final amplifier Q1008. At same time, pin 53 and 55 of Q2021 goes low. This signal is applied to the TX/RX controller Q1010 and Q1015 (both **UMC5N**), which disable the receiver circuit.

PLL Frequency Synthesizer

PLL circuitry on the MAIN UNIT consists of VHF VCO Q4002, UHF VCO Q4003, VCO buffers Q4006, Q1036 (**2SC5226**), Q1037 (**2SC5226**), and PLL subsystem IC Q1039

(**M64076GP**), which contains a reference divider, serial-to-parallel data latch, programmable divider, phase comparator and charge pump.

VHF PLL Circuit

The VHF VCO output is buffered by Q1037, and applied to the prescaler section of Q1039. There the VCO signal is divided by 64 or 65, according to a control signal from the data latch section of Q1039, before being applied to the programmable divider section of Q1039.

The data latch section of Q1039 also receives serial dividing data from the microprocessor Q2021 on the CNTL UNIT, which causes the pre-divided VHF VCO signal to be further divided in the programmable divider section, depending upon the desired receive frequency, so as to produce a 5 kHz or 6.25 kHz derivative of the current VHF VCO frequency. Meanwhile, the reference divider section of Q1039 divides the 12.8 MHz crystal reference by 2560 (or 2048) to produce the 5 kHz (or 6.25 kHz) loop reference.

The 5 kHz or 6.25 kHz signal from the programmable divider (derived from the VHF VCO) and that derived from the crystal are applied to the phase detector section of Q1039, which produces a pulsed output depending on the phase difference between the input signals. This pulse train is then converted to DC, low-pass filtered, then fed back to varactor diodes D4002, D4003 (both **1SV281**) in the VHF VCO.

Changes in the DC voltage applied to the varactor diodes affect the reactance in the tank circuit VHF VCO, changing the oscillating frequency according to the phase difference between the signals derived from the VHF VCO and crystal reference oscillator. The VHF VCO is thus phase-locked to the reference frequency standard.

UHF PLL Circuit

The UHF VCO output is buffered by Q1036, and applied to the prescaler section of Q1039. There the VCO signal is divided by 64 or 65, according to a control signal from the data latch section of Q1039, before being applied to the programmable divider section of Q1039.

The data latch section of Q1039 also receives serial dividing data from the microprocessor Q2021 on the CNTL UNIT, which causes the pre-divided UHF VCO signal to be further divided in the programmable divider section, depending upon the desired receive frequency, so as to produce a 5 kHz or 6.25 kHz derivative of the current UHF VCO frequency. Meanwhile, the reference divider section of Q1039 divides the 12.8 MHz crystal reference by 2560 (or 2048) to produce the 5 kHz (or 6.25 kHz) loop reference.

The 5 kHz or 6.25 kHz signal from the programmable divider (derived from the UHF VCO) and that derived from the crystal are applied to the phase detector section of Q1039, which produces a pulsed output depending on the phase difference between the input signals. This pulse train is then

converted to DC, low-pass filtered, then fed back to varactor diodes D4001, D4005 (both **1SV281**) in the UHF VCO.

Changes in the DC voltage applied to the varactor diodes affect the reactance in the tank circuit UHF VCO, changing the oscillating frequency according to the phase difference between the signals derived from the UHF VCO and crystal reference oscillator. The UHF VCO is thus phase-locked to the reference frequency standard.

Power Supply

When press the PWR switch, pin 19 of microprocessor Q2021 goes low, as a result, pin 48 of Q2021 goes high. This signal is applied to the Q1017 (**2SB1301-ZQ**) and regulator IC Q1023 (**BA09FP**), which provides 9 volts for the TX and RX circuits.