MOTOROLA

Communications Division

SPECTRA™ Clean Cab Railroad Radio

Operator's Manual

68P02902A81

Issue B

FCC/DOC REQUIREMENTS

The FCC and DOC (Canada) require you to obtain a station license for your radio equipment before you transmit on it, but do not require an operating license or permit. The station licensee is responsible for ensuring that the transmitter power, frequency, and deviation are within maximum limits allowed by the station license.

The licensee of the station is at all times responsible for the proper operation of the equipment. No FCC or DOC License is required for personally maintaining the equipment. However, the licensee is cautioned that any changes or modifications to the equipment not expressly approved by Motorola could void the user's authority to operate the equipment. You must check the frequency and deviation of the transmitter on installation and at least once yearly.

SERVICE MANUAL ORDERING INSTRUCTIONS

The Service Manual for the Spectra Clean Cab Railroad Radio contains complete testing, servicing and operating instructions. It consists of the following items:

Part Number	Description
68P02902A82	Spectra Clean Cab Railroad Radio Service Manual
68P80102W61	Spectra Two-Way FM Radio Detailed Service Manual
79-00366M02	Motorola 3-Ring Binder, 1 1/2" Rings

These items are included in kit VLN5305B. This may be ordered by contacting your local Motorola Service Representative or by contacting Motorola directly at:

International Orders:

Motorola Inc.
Communications Group Parts Dept.
1313 E. Algonquin Road
Schaumburg, Illinois
60196

Canadian Orders:

Motorola Canada Ltd.
National Parts Department
3125 Steeles Ave. E.
North York, Ontario
M2H 2H6

GENERAL SAFETY INFORMATION

Proper use of the radio requires that the following precautions be taken:

DO NOT operate the transmitter of a mobile radio when someone outside the vehicle is within 0.6 meters (two feet) of the antenna.

DO NOT operate the transmitter of a fixed radio (base station, microwave and rural telephone rf equipment) or marine radio when someone is within 0.6 meters (two feet) of the antenna.

DO NOT operate the transmitter of any radio unless all RF connectors are secure and any open connectors are properly terminated.

In addition,

DO NOT operate this equipment near electrical blasting caps or in an explosive atmosphere.

All equipment must be properly grounded according to Motorola installation instructions for safe operation.

All equipment should be serviced only by a qualified technician.

WARNING

Because of the hazardous voltages involved in the 72-volt power supply, **the power supply compartment cover must be kept in place at all times**, except when specifically troubleshooting and servicing the power supply circuitry. Before opening the power supply compartment, disconnect the power from the radio set.

OPTIONS and ACCESSORIES

The following options and accessories are available for the SPECTRA Clean Cab Railroad Radio. All accessories are available from Motorola National Parts Department.

Options	Number
Wired In Microphone	MBW22
12 V Operation Only	MBW35
Keyless Thumbwheel Latch	MBW80
Ear Bracket for Padlock	MBW81
Front Panel Engraving	MBW183AA
Front Panel Engraving with Wired-In Mic	MBW183AB
30 Watt RF O/P (Canadian Option)	MBW261
Palm Microphone with AAR Connector	MBB392
Clip for Pry Protection	MBB592

Accessories		Number
Palm Microphone with AAR Connector		VMN1033
Handset with AAR Connector		TMN6082
Handset Hangup Cup (Non-Reverting)		TLN6489
Handset Hangup Cup With Reverting Switch		TLN6490
10' Power Cable		VKN4125
Clean Cab Mounting Plate		TDN6581
Antennas:	Rigid "Firecracker" Flange Mnt	TAD6010
	Conduit Mounting Whip	TAD6020
	4" Train Antenna (Sinclair 221)	TDD6110

Service Items		Number
Top/Bottom Housing Extension Test Cable		VKN4293
Spectra Railroad Radio Service Manual		VLN5305
Radio Service Software	3 1/2" Disk	MBRVN4000ASP
	5 1/4" Disk	MBRVN4001ASP
Radio Interface Box (RIB)		RLN4008
RIB-to-IBM PC-XT Interface Cable (25 pin)		30-80369B71
RIB-to-IBM PC-AT Interface Cable (9 pin)		30-80369B72
Radio-to-RIB Programming Cable		30-80369B73

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PART 1
OVERVIEW OF THE SPECTRA RAILROAD RADIO

1.1 General Description

The SPECTRA Clean Cab Railroad Radio is a 99 channel synthesized railroad locomotive radio. It operates on all 97 carrier frequencies as specified by the American Association of Railroads (AAR), and supports existing Tone and DTMF signalling systems. The SPECTRA railroad radio has been subjected to stringent mechanical and environmental testing to ensure that it meets the requirements of the harsh railroad environment.

The front panel incorporates pushbutton controls and a built-in microphone and speaker to make operation easier and more reliable. The bright indicators and alphanumeric display provide for a wide angle of visibility, allowing for several different mounting configurations.

The radio can be field-programmed, without disassembly of the unit, for unique frequencies and operating characteristics as system requirements are modified, making it a convenient and cost-effective unit.

1.2 Performance Specifications

GENERAL

Number of Frequencies:	99 Synthesized Channels (includes 97 AAR FAP Channels)			
Dimensions:	305mm L x 285mm W x 121mm H (12" L x 11.25" W x 4.75" H)			
Weight:	8 kg (18 lb)			
Primary Power:	12 Vdc nominal, negative ground or 72 Vdc, floating ground			
Frequency Range:	VHF Range II (146 - 174 MHz)			
Maximum Battery Current Drain:	Stand-by	Receiver	Transmit @ 40 W Rating	Transmit @ 30 W Rating
13.8 Vdc operation 72 Vdc operation	1.5 A 0.8 A	4.0 A 1.0 A	15.0 A 4.0 A	13.0 A 3.5 A

RECEIVER

Audio Output: Aux. connector Front panel speaker	5 watts @ less than 3% distortion into **ungrounded** 8 ohm load 10 watts @ less than 3% distortion into **ungrounded** 2 ohm load
Input Impedance:	50 Ohms
Frequency Stability:	±0.0005% of assigned center frequency from -30°C to +60°C (+25°C reference) (±0.00025% optional)
Channel Spacing:	30 kHz
Spurious and Image Rejection:	90 dB
Sensitivity: (EIA - RS204C) 20 dB quieting 12 dB SINAD	 0.50 µV 0.35 µV
Intermodulation: (EIA SINAD)	-80 dB
Selectivity: (EIA SINAD)	-85 dB @ 30 kHz
Maximum Freq. Separation:	28 MHz

TRANSMITTER

RF Output Power:	40 Watts USA 30 Watts Canada
Output Impedance:	50 Ohms
Frequency Stability:	±0.0005% of assigned center frequency from -30°C to +60°C (+25°C reference) (±0.00025% optional)
Spurious and Harmonics:	70 dB below carrier (for EIA specification RS152B)
Modulation:	16K0F3E, 16K0F1D, 15K0F2D
Audio Sensitivity:	360 mV ±3 dB for 60% maximum deviation @ 1000 Hz
Audio Response:	+1, −3 dB of a 6 dB/octave pre-emphasis characteristic from 300 to 3000 Hz
Audio Distortion:	Less than 3% @ 1000 Hz, 60% maximum deviation
FM Hum and Noise:	−50 dB (EIA method)
Maximum Freq. Separation:	28 MHz

NOTE: SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

1.3 Electrical Characteristics

The SPECTRA Railroad Radio is a synthesized carrier-squelch type mobile which has the capability of 99 independent transmit and receive channels. It transmits at 40 watts of RF output power in the range of 146-174 MHz. The receive and transmit RF capabilities are performed by a SPECTRA transceiver which is incorporated as a module within the radio set.

The radio is externally powered by a standard 72/64 Vdc floating ground input which is converted by a 72/12 Vdc power converter within the radio set. A 12 Vdc only option is available for 12 Vdc non-floating operation. Audio output is 10 watts into an ungrounded 2 ohm speaker.

The SPECTRA railroad radio uses an EEPROM (Electrically Erasable Programmable Read Only Memory) device to store user-specific tone, transmit, and receive frequency allocations, as well as other programmable characteristics. The radio is factory-programmed to have all 97 AAR Frequency Allocation Plan (FAP) frequencies, 12 DTMF tones, and 9 dispatch singletones. A service/data port allows the radio to be field-programmed for a wide range of special operating frequencies and options to suit the user's requirements.

1.4 Mechanical Characteristics

To withstand the demanding operating conditions of the railroad environment, the SPECTRA Railroad Radio comes in a rugged diecast metal chassis. The mobile has been designed to meet the AAR 12-2 Specification for Clean Cab locomotives for connectors, physical measurements and mounting requirements. In addition, the radio has been tested to MIL-STD-810C and MIL-STD-810D specifications for shock and vibration.

Within the metal enclosure is a SPECTRA transceiver module, a 72/12 Vdc dc power converter, the front panel boards, and the internal speaker and microphone. The modular design permits easy servicing by providing quick access to the major radio elements. Disassembly of the housing requires the removal of only four screws.

The lower housing contains the 72/12 Vdc converter, the main connectors, and slots in which to locate the rear connector panel and front panel housing. The upper housing contains the SPECTRA transceiver, the VHF RF power amplifier, and the necessary hardware to connect the transceiver to the front panel circuits, the 72/12 Vdc converter, the antenna port, and the rear connectors. If the mobile is equipped with an external speaker option, the upper housing will also contain an audio transformer.

The service/data port and handset connectors have been mounted on the rear panel board to aid in disassembly. All connectors are recessed to protect them from being damaged during installation, removal, or transport of the radio.

Security is provided by a key lock located at the back of the radio which secures the radio to the mounting tray. The screws for disassembly are accessible only from the bottom of the unit. An optional padlock locking ear is also available for additional security.

1.5 STANDARD SPECTRA RAILROAD RADIO FEATURES

The standard features of the SPECTRA railroad radio include the following:

- Programmed for all 97 AAR paired transmit and receive frequencies
- Handsetless operation. Built-in microphone and 10-Watt speaker assemblies are located in the front panel of the radio set
- Built-in 72 Vdc-to-12 Vdc power converter
- Clean Cab compatibility with AAR specified connectors
- Channel and tone displays adjust automatically for ambient light conditions
- 11-character alphanumeric vacuum fluorescent display
- Backlit and color-coded high reliability control buttons
- Generation of 12 DTMF tones and 9 singletones
- Transmit indicator
- Field-programmable for various operational parameters
- Data capability (4800 bits per second)
- ±0.0005% frequency stability
- Rugged die-cast metal housing and modular design
- Transmit time-out timer to keep frequently used channels clear (factory-set for 60-seconds)
- Rear-mounted key lock to provide security
- A carrying handle is included for ease of transportation

1.6 FIELD-PROGRAMMABLE FEATURES

The following is a summary of some of the field-programmable features which will add to or modify the standard radio features provided by the factory:

- Change minimum volume level which can be adjusted from the front panel
- Change transmit time-out timer durations
- Program any frequency in the 146-174 MHz band (99 transmit and receive channels maximum)
- Enable external audio (fixed level)
- Program transmit and receive channel lock-outs
- Program up to 99 Home channels with unique frequencies and names
- Enable handset hangup switch channel revert
- Program up to 12 singletone frequencies (and durations)
- Inhibit #, * or entire DTMF keypad (tone transmission only)
- Change DTMF tone duration, pretime, and hang time
- Set dispatcher call tone (DTMF or singletone) either slaved or independent of Home channel
- Program PTT ID (MDC 1200 format)
- Enable Private Line (CTCSS) or Digital Private Line operation
- Disable good-configuration-alert tone

For more details on these features, refer to the SPECTRA Railroad Radio Service Manual.

PART 2.
OPERATING INSTRUCTIONS

SECTION 1.
OVERVIEW OF OPERATIONS

2.1.1 Frequencies and Control Parameters

The SPECTRA railroad radio must be pre-programmed for the necessary transmit, receive and dispatch tone frequencies. A standard set of frequencies and control parameters are initially programmed at the factory and may be modified using an IBM™ Personal Computer and the SPECTRA Radio Service Software (RSS). Only those channels and tones which have been preprogrammed will be accessible to the operator. For details on the field programmable parameters, refer to SECTION 5 FIELD REPROGRAMMING.

2.1.2 Power-Up Procedure

Locomotive power is supplied to the radio via an AAR-specified power connector (J4000) at the back of the unit. The radio is operational whenever locomotive power is supplied to the power connector. In some cases, the radio is equipped with an optional on/off switch. When the radio is initially powered-up, it executes a brief self-diagnostics routine which lasts a few seconds. During this time, all front panel displays and indicators light, immediately followed by a display of "SELF CHECK". Once the self-check routine is finished (and no problems are detected), the displays indicate the default tone, transmit, and receive channels.

NOTE

If "FAIL xx/xx" appears continuously in the display, a power-up failure has been encountered. The radio will not function until corrective action is taken. If "ERROR xx/xx" appears briefly in the display, a non-critical error condition has been encountered (i.e. the radio will still operate) and the radio will produce an invalid-key-alert tone. In either case, servicing is required.

2.1.3 Operator Controls

Before operating the radio, the operator should become familiar with the various controls, indicators and alert tones which allow the operator to monitor and change the operating status of the radio. A brief overview of the controls, indicators, displays and alert tones is given in the next section.

2.1.4 Normal Mode

At all times, the SPECTRA railroad radio operates either in the "Normal" mode or one of four possible "Select" modes. In Normal mode, the basic radio operations are performed. The speaker volume can be adjusted. The displays indicate the selected dispatch tone, Home channel (if any), and transmit (TX) and receive (RX) channels on which dispatch and voice messages will be sent and received.

The numeric keypad, 0 through 9, # and *, represents the traditional telephone-type keypad. When the radio is in the Normal mode, this keypad is used to send standard DTMF tones.

The **DISP** key is used to transmit the selected dispatch call tone indicated in the DISP T/D display. This can be either a singletone (indicated by a "T" followed by a number) or a DTMF tone (indicated by a "D" followed by a number).

The radio can be field-programmed to transmit an MDC1200 format PTT ID message whenever the **PTT** key is pressed or released.

2.1.5 Select Modes

For changing channel selections and dispatch call tones, the radio has four Select modes as follows:

- Channel Select mode – allows the operator to change the selected TX/RX channel pair. Initiated using the **CHAN** key.
- Home Select mode – allows the operator to change the selected Home channel. Initiated using the **HOME** key. Each Home channel consists of a programmed TX and RX channel and (optionally) a dispatch call tone.
- Dispatch DTMF Select mode – used to select and transmit dispatch DTMF tones. Initiated using the **DTMF** key.
- Dispatch Tone Select mode – used to select and transmit up to twelve preprogrammed dispatch singletones. Initiated using the **TONE** key.

For any Select mode, the numeric keypad is reconfigured for number entry. Normally, separate alert tones indicate either success or failure in entering numbers. The display(s) which corresponds to the chosen Select mode will be updated.

Operating procedures for Select modes are covered in SECTION 4, CHANGING CHANNEL AND TONE SELECTIONS. Conditions which apply to each of the four Select modes are outlined below.

2.1.6 Channel Select Mode

The operator can select up to 99 independent preprogrammed TX and RX channels using the Channel Select mode. Channels must be selected as pairs (i.e. four digits must be entered, including leading zeros).

For valid completion of the Channel Select Mode, the selected TX and RX channels must be within the available range of preprogrammed channels and must not be locked out via the RSS.

2.1.7 Home Select Mode

Home channels are field-programmed via the RSS to allow the operator access to specific combinations of transmit, receive, and (optionally) dispatch DTMF or singletone frequencies. The radio may be programmed for a maximum of 99 Home channels, which may include any locked-out TX and RX channels.

In the case where the radio has up to nine programmed Home channels, the standard (default) display consists of a single digit (1 through 9) in the HOME display to indicate the currently selected Home channel. If the radio is programmed for 10 to 99 Home channels, the standard display consists of two digits (01 through 99) in the HOME display to indicate the currently selected Home channel. In either case, the TX and RX displays indicate the Home transmit channel and Home receive channel respectively.

In addition to number assignments, the radio may be programmed to display a unique alphanumeric name (up to eight-characters long) for each Home channel selection (e.g. "STATION2"). When a particular Home channel is selected, this name occupies the locations usually held by the TX, RX and HOME displays.

NOTE

If no Home channel is currently selected, the HOME display is blank.

If "Home TX/RX Only" option is enabled via the RSS, entering a valid Home channel selection updates the HOME, TX and RX channels while DISP T/D (the selected dispatch call tone) remains unaffected.

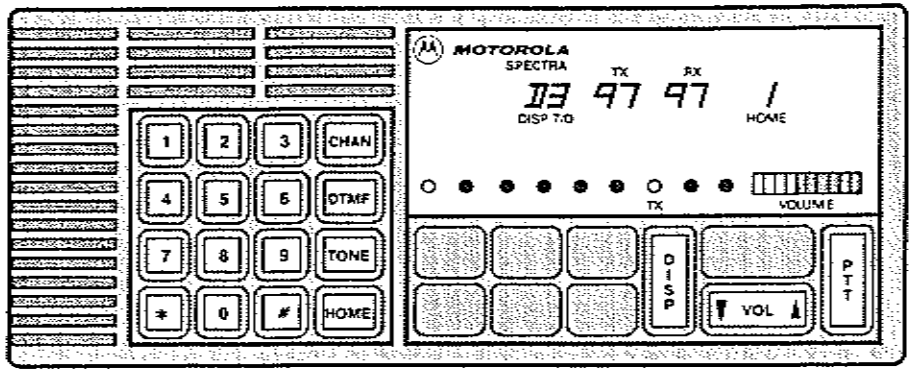
2.1.8 Dispatch DTMF Select Mode

The radio is capable of transmitting up to twelve DTMF tones (D0 to D9, D# and D*) using the DISP key. The DISP T/D display indicates the currently selected DTMF tone (if any) as a "D" followed by a single digit. This represents the DTMF tone which is transmitted upon selection of a particular tone, and retransmitted using the DISP key.

2.1.9 Dispatch Tone Select Mode

For singletone dispatch calls, the operator can select from a group of singletones which have been programmed into the radio (up to a maximum of twelve). The DISP T/D display indicates the currently selected singletone (if any) as a "T" followed by a single digit. This represents the singletone which is transmitted upon selection of the tone, and retransmitted using the DISP key. The number of available singletones and their frequencies are field-programmable via the RSS.

SECTION 2.
CONTROLS, INDICATORS, DISPLAYS AND ALERT TONES



Control / Display	Description
0	12-digit (numeric) keypad normally used to transmit DTMF dispatch call tones. Also used to enter Channel, Home, or Tone numbers when in the corresponding select mode.
CHAN	Channel key initiates the Channel Select mode for entry of TX and RX channels from the numeric keypad.
DTMF	DTMF key initiates the Dispatch DTMF Select mode to select & transmit a DTMF dispatch tone via the numeric keypad.
TONE	Tone key initiates the Dispatch Tone Select mode to select & transmit a singletone dispatch tone via the numeric keypad.
HOME	Home key initiates the Home channel Select prompt for entry of a programmed Home channel from the numeric keypad.
DISP	Dispatch key retransmits the preselected tone (DTMF or singletone) indicated in the DISP T/D display.
VOL	Volume rocker switch for up/down selection of speaker volume level.
PTT	PTT keys the transmitter for voice messages when using the front panel microphone.
TX	Tx indicator lights yellow whenever transmitter is enabled (PTT or Dispatch Calls).
VOLUME	Volume display indicates relative volume level within range 0 (minimum) to 10 (maximum). Minimum level is set via RSS.
DISP T/D	Dispatch Tone/DTMF display indicates the selected dispatch call tone ("T__" for singletone or "D__" for DTMF)
TX RX 97 97	TX and RX channel displays indicate the current transmitter and receiver channel selections.
HOME	Home channel display indicates the current Home channel selection. (Display is blank if no Home channel is selected.)

Alert Tones

The following audible tones are used to alert the operator to certain system conditions:

Good Configuration Alert – momentary high-pitched alert tone indicates the valid entry of a channel pair, singletone dispatch tone, DTMF dispatch tone, or Home channel change. This is the only tone which may be enabled/disabled via the RSS.

Invalid Key Alert – momentary low-pitched alert tone indicates that the operator has made an invalid keypad entry.

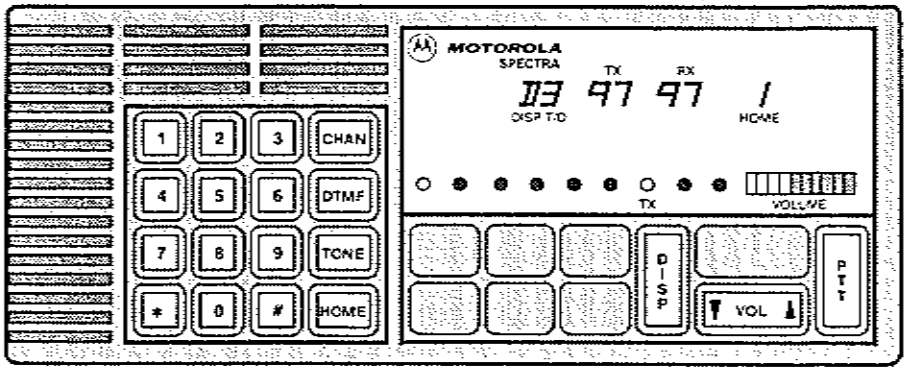
Time-Out Timer Alert – low-pitched continuous tone indicates that the present transmission will soon be disabled. This tone is generated until the PTT key (or the PTT switch on the optional handset) is released.

Volume Set Tone – sounds when the VOL rocker switch is pressed on a quiet channel to provide audible feedback of the volume level.

Display Intensity

A photo-detector circuit in the radio automatically adjusts the intensity of the displays to match the surrounding light conditions.

SECTION 3.
BASIC OPERATING INSTRUCTIONS



2.3.1 General

Basic operations are identical for all front panel configurations. Any changes to the front panel operation are noted in the appropriate section.

After power-up, the radio is ready to receive calls on the displayed RX channel. However, it may become necessary to adjust the speaker volume level as described below.

2.3.2 To Adjust the Volume

To adjust the volume to a comfortable level, execute the following:

Action	*Result*
1. Momentarily press the **VOL** rocker switch to the right to increase the volume level by one step, or to the left to decrease the volume level by one step.	The VOLUME bar graph display indicates the relative speaker audio level (each LED segment corresponds to two steps in the twenty-step range). If there is no voice audio being received, a volume-set tone is heard, while the volume switch is pressed, to provide an audible feedback.
2. Alternately, press and hold the **VOL** rocker switch to the right (to increase) or to the left (to decrease) until the desired volume level is set.	Holding the rocker switch causes the volume level to increase (or decrease) at a two-steps-per-second rate, until the maximum (or minimum) volume level is reached. The VOLUME bar graph display increments (or decrements) every other volume step to indicate the relative speaker audio level.

2.3.3 To Transmit Voice Messages

Before starting transmission, monitor the traffic on the selected channel to ensure that it is not in use.

To transmit voice messages, execute the following:

Action	*Result*
1. Press and hold the **PTT** key.	The radio is keyed and the TX indicator lights.

NOTE

The transmitter employs a Time-Out Timer (TOT) to limit the duration of a transmission to 60 seconds. A low-frequency, continuous alert tone signals the operator that the transmitter will be disabled in four seconds. To reset the TOT, release the **PTT** key.

Action	*Result*
2. Speak clearly in the direction of the front grill of the radio set with mouth 8 to 12" away.	Voice message is transmitted.
3. After finishing your message, release the **PTT** key and wait for a reply.	Radio is dekeyed and TX indicator goes out.

2.3.4 Sending DTMF Dispatch Tones

For DTMF tones, the minimum and maximum duration times, as well as the pretime, hang time, and deviation are field-programmable via the RSS.

To select and transmit a DTMF tone for dispatch calls, execute the following:

Action	*Result*
1. Momentarily press the **DTMF** key to initiate the Dispatch DTMF Select mode.	The DISP T/D display changes to a "D" followed by a flashing underscore. The numeric keypad is configured for number entry.

Action	*Result*
2. Before the 10-second time-out period, enter the new DTMF number using the numeric keypad.	When a valid key is pressed, the flashing underscore in the DISP T/D display changes to indicate the keypad entry. The transmitter is enabled, the TX indicator lights, and the selected tone is transmitted for the preprogrammed duration and is also heard at the speaker. The Dispatch DTMF Select mode is then terminated.

NOTE

The # key and/or the * key, or the entire DTMF keypad, may be disabled via the RSS. If the operator attempts to select a disabled DTMF tone, the radio produces an invalid-key-alert tone and the Dispatch DTMF Select mode is re-initiated. The operator must enter a new digit or exit the Select mode in one of the ways described under **2.4.1 Common Select Mode Conditions.**

Action	*Result*
3. To *retransmit* the displayed DTMF tone, press the **DISP** key.	The transmitter is enabled, the TX indicator lights, and the displayed DTMF tone is transmitted for the preprogrammed duration. The transmitted tone is also heard at the speaker output to confirm transmission. The displayed tone is transmitted for as long as the **DISP** key is pressed, within the limits of the programmed minimum and maximum duration times.

2.3.5 Sending Singletone Dispatch Tones

The minimum and maximum duration times for singletones, as well as the singletone frequencies, are field-programmable via the RSS.

To select and transmit a singletone for dispatch calls, execute the following:

Action	*Result*
1. Momentarily press the **TONE** key to initiate the Dispatch Tone Select mode.	The DISP T/D display changes to a "T" followed by a flashing underscore. The numeric keypad is configured for number entry.
2. Before the 10-second time-out period, enter the new singletone number using the numeric keypad.	When a valid key is pressed, the flashing underscore in the DISP T/D display is changed to indicate the keypad entry. The TX indicator lights and the selected tone is transmitted for the preprogrammed duration and is also heard at the speaker.

NOTE

If the operator attempts to select a singletone that has not been programmed, the radio produces an invalid-key-alert tone and the Dispatch Tone Select mode is re-initiated. The operator must enter a new digit or exit the Select mode in one of the ways described under **2.4.1 Common Select Mode Conditions** above.

Action	*Result*
3. To *retransmit* the displayed singletone, press the **DISP** key.	The transmitter is enabled, the TX indicator lights, and the displayed singletone is transmitted for the preprogrammed duration. The transmitted tone is also heard at the speaker output to confirm transmission. The displayed tone is transmitted for as long as the **DISP** key is pressed, within the limits of the programmed minimum and maximum duration times.

2.3.6 Sending DTMF Tones Using the Numeric Keypad

The programmable DTMF features apply to the numeric keypad in the same manner as described for the DTMF dispatch tones above.

To transmit a DTMF tone using the numeric keypad, execute the following:

NOTE

The # key and/or the * key, or the entire DTMF keypad, may be disabled via the RSS. If the DTMF keypad is disabled, it will continue to operate in the Select modes. If the operator attempts to send a disabled DTMF tone, the radio will produce an invalid-key-alert tone and the radio will not transmit.

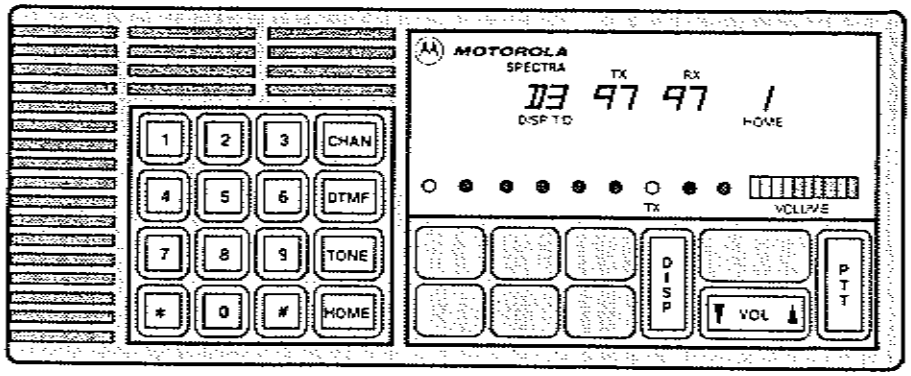
Action	*Result*
1. Press the appropriate key on the numeric keypad to transmit the required DTMF tone.	The transmitter will key for a programmed duration, the TX indicator lights, and the DTMF tone corresponding to the key pressed will be broadcast. The transmitted tone is also heard at the speaker output to confirm transmission.

NOTE

The DTMF tone is transmitted for as long as the corresponding key is pressed, within the limits of the programmed minimum and maximum duration times. The total transmit time includes any programmed pretime and hang time intervals.

Action	*Result*
2. If necessary, repeat the above step for each additional DTMF tone.	The above result will be repeated for each corresponding key pressed. If the second DTMF key is pressed before the first tone has completed its tone duration, the first tone is terminated and the second tone immediately starts broadcasting for its programmed duration. This operation is repeated for any subsequently pressed digits.

SECTION 4.
CHANGING CHANNEL AND TONE SELECTIONS



2.4.1 Common Select Mode Conditions.

In general, to enter a Select mode, the pertinent Select mode key is pressed. The corresponding display(s) change to dashes, with the data entry location being indicated by a flashing underscore. The numeric keypad is now configured to enter numbers.

NOTE

When the radio is in any Select mode, it continues to receive messages on the last selected RX channel.

Any Select mode is automatically terminated after one of the following conditions occurs:

a. Completion of a valid Select mode entry. The corresponding displays are updated and a configuration-good-alert tone is heard at the speaker (if it has not been disabled via the RSS).

b. After ten seconds of no keypad activity. The display reverts to the last selected display and an invalid-key-alert tone is heard at the speaker.

c. If after initiating a Select mode, the same Select mode key is pressed again before complete entry of the number information, then the display reverts to the last selected display.

d. If after initiating one Select mode, another Select mode key is pressed, then the first Select mode is terminated and the second is immediately initiated.

e. Pressing the **PTT** or **DISP** keys. The display reverts to the last selected display and the radio transmits either a voice message or a dispatch call tone respectively.

An operating procedure for each Select mode is detailed below.

2.4.2 Selecting TX and RX Channels

To select a new TX and RX channel pair, execute the following:

Action	*Result*
1. Momentarily press the **CHAN** key to initiate the Channel Select mode.	The TX and RX displays become dashes, with a flashing underscore appearing in the leftmost (TX tens) position. The numeric keypad is now configured for number entry.
2. Enter the first digit using the numeric keypad, including a leading zero if required. (The operator has 10 seconds after a key is pressed to press the next key before Select mode time-out occurs.)	The keypad number entry replaces the flashing underscore which moves right to the next position.
3. Enter the remaining three digits using the numeric keypad.	For a valid keypad sequence, the TX and RX displays are updated to indicate the keypad entries. A configuration-good-alert tone sounds (unless it is disabled via the RSS) when the fourth digit has been entered successfully. The Channel Select mode is terminated and the radio now transmits and receives on the new channel assignments.

NOTE

If either the TX or RX channel is invalid (i.e. not a valid preprogrammed channel or is locked out via the RSS), an invalid-key-alert tone sounds when the fourth digit is entered and the TX/RX displays become dashes as before. The operator may enter new digits or exit the Channel Select mode in one of the ways described under **2.4.1 Common Select Mode Conditions** above.

2.4.3 Selecting a Home Channel

To select a programmed Home channel, execute the following:

NOTE

If there are no Home channels programmed in the radio, pressing the **HOME** key causes an invalid-key-alert to sound and the Home Select mode is not entered.

Action	*Result*
1. Momentarily press the **HOME** key to initiate the Home Select mode.	The TX and RX channel displays are replaced by the word "HOME". Either a single flashing underscore (in radios with 9 or fewer Home channels), or a flashing underscore followed by a dash (in radios with 10 to 99 Home channels) appears in the HOME display.
2. Enter the required number of digits (one or two), including a leading zero if necessary, using digits **0** through **9** of the numeric keypad. In the case where two digits are required, the flashing underscore moves right to the next data-entry position after the first digit is entered. The # and * digits (and **0** as a single entry) are invalid Home channel identifiers.	For valid entries, the HOME display is updated to reflect the keypad selection. A good-configuration-alert tone is heard at the speaker (unless it has been disabled via the RSS) and the Home Select mode is terminated. The eight-character (maximum) alphanumeric name representing the selected Home channel appears in the TX, RX and HOME channel display fields. For the standard (default) configuration, the TX, RX and HOME display fields indicate the Home transmit channel, the Home receive channel, and the Home number respectively. The DISP T/D display (if applicable) is updated according to programmed information.

NOTE

If an error is made (i.e. selection not a valid programmed Home channel), an invalid-key-alert tone sounds when the last digit is entered and the flashing underscore returns to the first data-entry position. The operator must enter a new digit (or digits) or exit the Home Select mode in one of the ways described under **2.4.1 Common Select Mode Conditions** above.

After valid completion of the Home Select mode, the radio transmits and receives on the new channel assignments, and the selected dispatch call tone (if applicable) is updated.

2.4.4 Home / Channel Revert

It is possible for the operator to quickly toggle between the last selected Home channel and last selected TX/RX channel pair using the **HOME** and **CHAN** keys as outlined below.

To change the current selection from a TX/RX channel pair to the last selected Home channel, perform the following:

Action	*Result*
1. Press and hold the **HOME** key.	When the **HOME** key is first pressed, the Home Select mode is entered as described above. After the key has been held for 3 seconds, the radio reverts from the TX/RX channel pair to the last selected Home channel. A good-configuration-alert tone is heard at the speaker (unless it has been disabled via the RSS).

NOTE

If there is no previously selected Home channel, then the TX/RX channel pair is restored (i.e. no change). If the radio is currently on a Home channel when the **HOME** key is pressed, then the display reverts back to the current Home channel (i.e. no change).

Action	*Result*
2. Release the **HOME** key after completion of the revert feature.	The last selected Home channel is recalled to the display.

To change the current selection from a Home channel to the last selected TX/RX channel pair, perform the following:

Action	*Result*
1. Press and hold the **CHAN** key.	When the **CHAN** key is first pressed, the Channel Select mode is entered as described above. After the key has been held for 3 seconds, the radio reverts from the Home channel to the last selected TX/RX channel pair. A good-configuration-alert tone is heard at the speaker (unless it has been disabled via the RSS).

NOTE

If there is no previously selected TX/RX channel pair, then the Home channel is restored (i.e. no change). If the radio is currently on a TX/RX channel pair when the **CHAN** key is pressed, then the display reverts back to the current TX/RX channel pair (i.e. no change).

Action	*Result*
2. Release the **CHAN** key after completion of the revert feature.	The last selected TX/RX channel pair is recalled to the display.

2.4.5 Selecting DTMF Tones for Dispatch Calls

DTMF dispatch tones are automatically transmitted upon selection of a valid tone. To enter or change a DTMF dispatch tone, refer to **2.3.4 Sending DTMF Dispatch Tones.**

For DTMF tones, the minimum and maximum duration times, as well as the pretime, hang time, and deviation are field-programmable via the RSS. Also, the # key and/or the * key, or the entire DTMF keypad, may be disabled via the RSS. If the DTMF keypad is disabled, it will continue to operate in the Select modes.

2.4.6 Selecting Singletones for Dispatch Calls

Singletone dispatch tones are automatically transmitted upon selection of a valid tone. To enter or change a singletone, refer to **2.3.5 Sending Singletone Dispatch Tones.**

SECTION 5.
FIELD REPROGRAMMING

2.5.1 General

The SPECTRA Clean Cab Railroad Radio contains an EEPROM (Electrically Erasable Programmable Read Only Memory) to store operator-specific radio data and other parameters. Through the use of an IBM PC Computer, interface hardware and Radio Service Software Programming Disk, the SPECTRA railroad radio can be reprogrammed in the field any number of times to allow for changes to transmit, receive, and singletone frequencies, Home channel combinations, and time-out timer and dispatch tone durations.

The radio can be reprogrammed by any authorized Motorola Service Shop. Alternately, the radio can be field-programmed by connecting an IBM PC Computer (using the appropriate interface hardware) to connector J3006 and following the prompts and help screens contained within the Radio Service Software. (J3006 is the DB-15 connector located on the rear panel interconnect board at the back of the radio.)

In addition to reprogramming capabilities, the Radio Service Software can be used for periodic alignment of the radio, as well as the advanced alignment required whenever a board is replaced in the radio. For specific information regarding programming and alignment procedures, refer to the SPECTRA Radio Service Software User's Manual and the SPECTRA Railroad Radio Service Manual.

2.5.2 Reprogramming Item Requirements

The following is a list of items required for field reprogramming:

DESCRIPTION	MODEL #
Computer	IBM PC, PC-XT, PC-AT, or SYSTEM/2 Model 30/50
*Radio Interface Box (RIB)	RLN4008
*Cable - Radio to RIB	30-80369B73
*CABLE - IBM Computer to RIB:	
IBM PC, PC-XT, OR SYS/2 (25 pin)	30-80369B71
IBM PC-AT (9 pin)	30-80369B72
*Radio Service Software Programming Package:	
3½" Floppy Disk	VVN4185A
5¼" Floppy Disk	VVN4186A

To obtain the items marked with an asterisk, contact your nearest Motorola Service Shop or C&E Parts Department.

PART 3.
INSTALLATION

3.1 General

The SPECTRA railroad radio is designed to install in a standard AAR 12-2 clean cab mounting tray, and is fastened to the tray by a security lock located at the rear of the unit.

The radio is completely aligned, tested, and inspected before shipment. However, FCC regulations state that a station license must be obtained for each radio (mobile or base) installation by the owner of the equipment. The station licensee is responsible for ensuring the transmitter power, frequency, and deviation are within the limits permitted under the station license by checking the frequency and deviation of the transmitter upon installation and at least once yearly (refer to next paragraph). No operator's license is required to install or operate the radio.

3.2 Pre-Installation Tests

It is advisable that a pre-installation check be performed to ensure proper operation. Any adjustments to the transmit power, frequency, or deviation requires the use of an IBM™ Personal Computer, radio-to-computer interface, and the Radio Service Software (RSS). Complete information for performing the tests and adjustments is provided in the Maintenance and Alignment Procedures section of the SPECTRA Railroad Radio Service Manual, 68P02902A82.

For a complete pre-installation test, perform the following steps:

1. Using the RSS, check the test mode transmit frequency and adjust the reference oscillator warp frequency if required. This adjustment also corrects any receive frequency errors caused by a reference oscillator offset.
2. Measure the transmit power output and adjust if required.
3. Measure the transmit deviation on the low, mid, and high test modes and adjust if required.
4. Measure the transmit frequency on each channel.
5. Measure the receive frequency on each channel.
6. Measure the 12 dB SINAD signal level.
7. Check the antenna VSWR after installing the radio set.

3.3 Antenna Installation

Installation instructions are supplied with all Motorola antenna kits. Refer to the instruction sheet for your particular installation.

3.4 Clean Cab Mounting Tray Installation

Motorola recommends using the clean cab mounting tray for installation of the Spectra Railroad Radio. In most installations, the adaptor tray will already be secured to the control stand mounting brackets. In this case, follow the procedure outlined in **3.5, Radio Mounting**.

To install the clean cab mounting tray onto the control stand brackets or other mounting surface, carry out the following steps (refer to Figure 3-1):

NOTE

The radio set is installed, removed and serviced from the rear. In any installation, be sure to pick a location that allows easy access to both the front and rear of the radio.

1. Using the clean cab tray (1) as a template, locate and drill four holes using a 7/32" drill (hole sized for a 10-32 screw).

2. Mount the tray using four 10-32 flat head screws (2) which have been cut to length needed. Due to the clips on the underside of the clean cab tray, four 3/8" high spacer washers (3) must be used.

3. Install the lock washers (4) and hex nuts (5) as shown in Figure 3-1 Clean Cab Mounting Tray Detail. Tighten all nuts and screws securely.

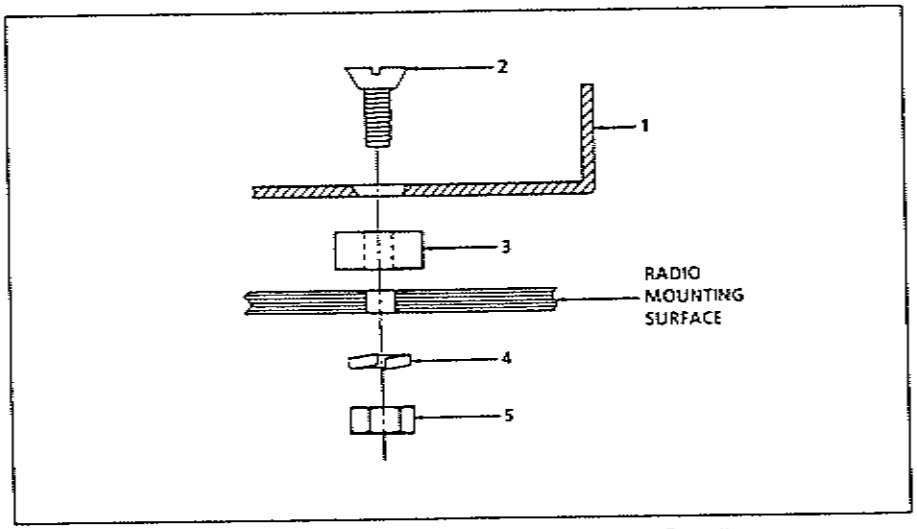


Figure 3-1. Clean Cab Mounting Tray Detail

Other mounting configurations may be implemented; however, these installations are the responsibility of the owner. Contact your Motorola Service Representative regarding your particular application.

3.5 Radio Mounting

To install the SPECTRA railroad radio within the clean cab mounting tray, carry out the following steps (refer to Figure 3-2):

1. Position the radio set (1) onto the rear of the clean cab mounting tray (2). Slide the radio down and into the tray until the extruded pockets on the underside of the radio engage into the tabs on the clean cab tray. Slide the tray forward so that the pins on the sides of the radio engage into the slots on the tray.

2. Lock the radio set into the tray by inserting the key into the lock (3) at the rear of the radio and turning the key counter-clockwise until it engages the latch into the slot on the clean cab tray and the key rotation is tight. (The key is removed at 90° increments.)

3. Attach the antenna connector to the antenna jack (4).

4. Attach handset (if so equipped) to the handset connector (5).

5. **With the primary power off**, attach primary power connector to power connector (6) of radio.

6. Turn on primary power. Radio set is now operational.

3.6 Radio Removal and Replacement

The radio may be removed and replaced for servicing only through the rear of the clean cab control stand. To remove the radio from the clean cab tray, perform the following procedure:

1. **Turn off the primary power.**

2. Remove all cables connecting to radio set.

3. Unlock the radio by inserting key in the rear panel lock and turning clockwise.

4. Slide the radio up and out from the clean cab tray through the rear of the control stand.

To replace the radio in the tray, follow the Radio Mounting procedure described above.

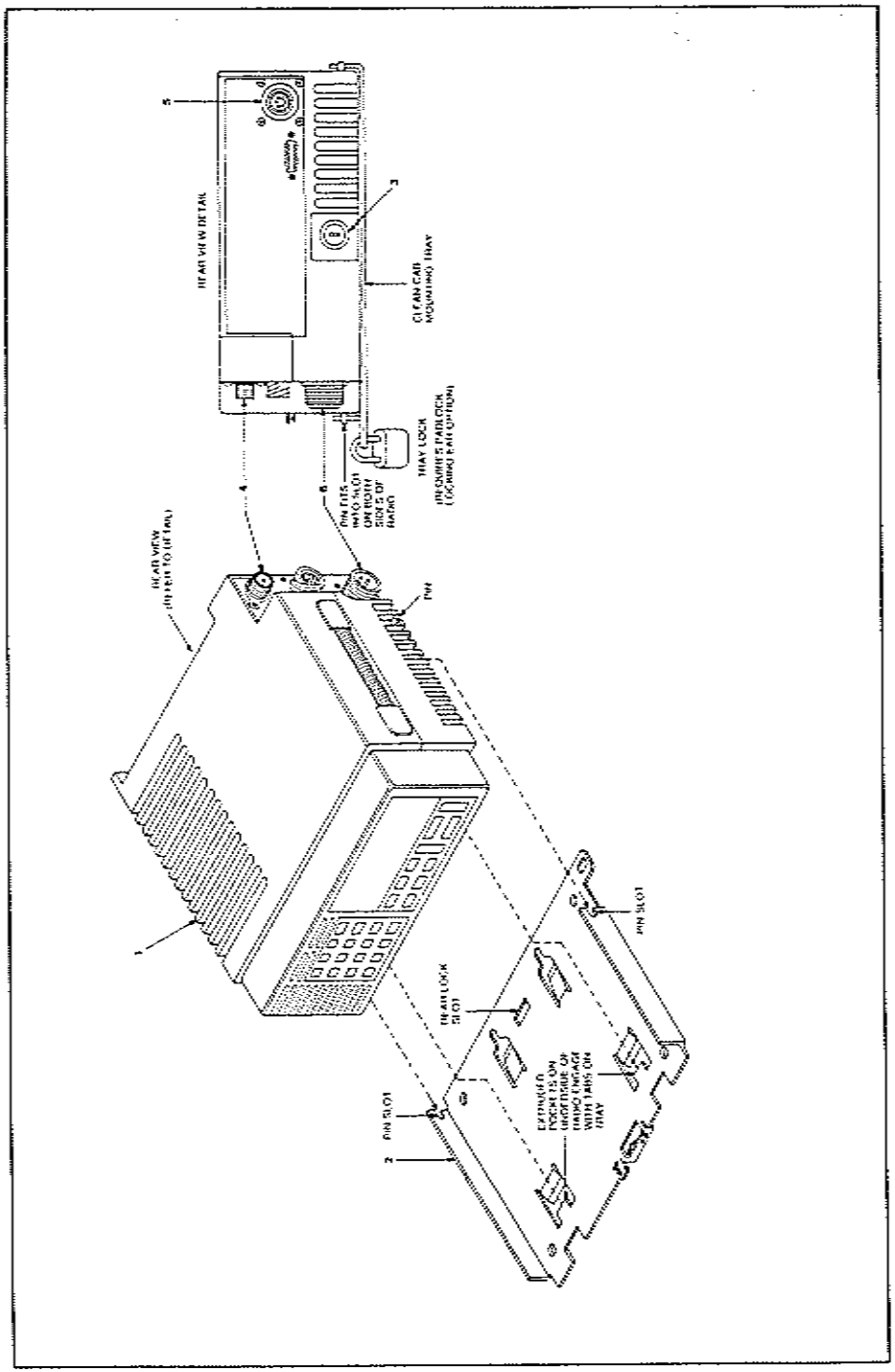


Figure 3-2. Radio Mounting In Clean Cab Tray