MOTOROLA

Mobile Products Division

SPECTRA
UHF FM Two–Way Radio
25/40 Watts RF Power
Range 2: 438–470 MHz
Range 3: 450–482 MHz
Range 4: 482–512 MHz

Service Manual
68P80101W39–B

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Mobile Products Division

Spectra Service Manual
UHF FM Two–Way Radio

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Commercial Warranty (Standard) and Computer Software Copyrights PAW–0380

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SPECTRA UHF Introduction

Scope and Purpose

This manual contains all the information required to align the *SPECTRA* UHF radio, to service and repair the radio to the board or kit level, and to perform editing of selected codeplug data (mode names, scan lists, etc.) directly from the front panel.

The UHF band has adjacent channel assignments of 25 kHz, and the FCC specifies a maximum transmitter deviation of ± 5.0 kHz and a transmitter stability of ±5.0 ppm for this band.

An Installation Manual (Part Number 68P80101W36) is shipped with each radio along with an Operator's Manual. (The Operator's Manual part number is different depending on which model radio you have.) Refer to these publications for installation and operation procedures.

A Detailed Service Information Manual (Part Number 68P80101W33) is available from the Motorola C & E National Parts Department and is required for servicing the radio to the component level. In addition, since all radio boards utilize 100% surface–mount component technology, a hot air gas bonder is recommended for component–level servicing.

An IBM® Personal Computer and *SPECTRA* Radio Service Software are also required for servicing the *SPECTRA* radio. This software is available directly from Motorola C & E National Parts Department. Software, computer interfacing cables, and other service aids are listed in the following sections, along with ordering information.

The *SPECTRA* radio contains a new generation of advanced integrated circuits, with all RF and signalling parameters controlled by the radio's microprocessor. The service software is required to adjust codeplug control parameters after servicing most boards and critical components. This software also permits programming of all customer features, viewing of all trunking parameters, and contains some helpful service aids for troubleshooting purposes.

Important: Radio Model & Version Identification

This manual covers several models and more than one version of some models. Accordingly, model charts were prepared for the different models and also for the different versions. "Versions" are identified by the model number "suffix." Although the charts are very similar, there are subtle, but very important, differences. Determine, from the radio's identification label, which model and version is yours. Keep this information handy for future references. Determine the model and version of your radio as follows:

Typical Model Number— **D 4 4 K M A 7 J A 7 A K**

Model Version

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MXW–5868–O

Performance Specifications for *Spectra* Conventional and *SECURENET* 25W/40W UHF Radios

GENERAL

Channel Capability	128 Conventional UHF frequencies (A5 Model) 128 Conventional UHF frequencies (A7 Model)
Primary Power	12 VDC negative ground only
Dimensions	2.0" H x 7.1" W x 8.6" L (40 watt models) 2.0" H x 7.1" W x 7.5" L (10–25 watt models)
Weight	5.5 lbs. (40 watt models) 4.5 lbs. (10–25 watt models)
Metering	All adjustments and alignments are performed electronically using an IBM Personal Computer, a Radio. Interface Box (RIB) and Radio Service Software
Environmental	Meets MIL 810D environmental specifications for vibration, shock, rain, dust, and salt fog

Model	Frequency (MHz)	Minimum RF Power Output	Operation	Maximum Battery Current Drain		
				Standby @ 13.8 V	Receiver @ 13.8 V	Transmit @ Rated Power
D44KMA_____ D44KXA_____ D44ZXA_____	TX/RX: Range 3: 450–482 Range 4: 482–512	40 watts	+12 VDC	.5 A	2.5 A	12.5 A
D34XXA_____	TX/RX: Range 2: 438–470	10–25 watts	+12 VDC	.5 A	2.5 A	8.5 A

TRANSMITTER

Output Impedance	50 ohms
Spurious and Harmonic Emissions	More than 70 dB below carrier (for EIA spec. RS152B)
Frequency Stability	±.00050% (±.00025% optional) of assigned center frequency from –30°C to +60°C ambient (+25°C reference)
Modulation	15K0F2D, 16K0F1D, 16K0F3E
Audio Sensitivity	0.080 V ±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
Maximum Frequency Separation	32 MHz (438–470, 450–482 MHz) or 30 MHz (482–512 MHz)
FM Hum and Noise: EIA Method	–45 dB

RECEIVER

Channel Spacing	25 kHz
Sensitivity: (per EIA spec. RS204C) 20 dB quieting EIA SINAD	.5 uV/.3 uV std/Preamp .35 uV/.20 uV std/Preamp
Selectivity (EIA SINAD):	–85 dB @ ±25 kHz
Spurious & Image Rejection	90 dB/85 dB std/Preamp (85 dB with optional Preamp)
Intermodulation (EIA SINAD):	–85 dB/–80 dB std/Preamp except std –83dB @ 25 kHz
Input Impedance	50 ohms
Audio Output	5 watts @ less than 3% distortion
Maximum Frequency Separation	32 MHz (438–470, 450–482 MHz) or 32 MHz (480–512 MHz)
Frequency Stability D44KMA:	±.0005% (±.00025% optional) of assigned center frequency from –30°C to +60°C ambient (+25°C reference). For D44KXA, D44ZXA, and D34XXA: ±.00025%
	SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

FCC TRANSCEIVER DESIGNATION

ABZ89FT4736 (40 watts)

Model Chart for *Spectra* UHF Conventional 25/40 Watts Two–Way Mobile FM Radios Standard and Secure–Capable Models

R2=Range 2 (438–470 MHz)
R3=Range 3 (450–482 MHz)
R4=Range 4 (482–512 MHz)

CODE:

● = ONE ITEM SUPPLIED
O = OPTIONAL
⊗ = ALTERNATE

NOTE S–C = SECURE–CAPABLE

MODEL	DESCRIPTION	ITEM	DESCRIPTION
D34XXA5JC2AK	*SMARTNET* S–C LTD, 25W		
D34XXA5JC5AK	*SMARTNET* S–C STD, 25W		
D34XXA5JC7AK	*SMARTNET* S–C EXP, 25W		
D44ZXA5JC2AK	*SMARTNET* S–C LTD, 40W		
D44ZXA5JC5AK	*SMARTNET* S–C STD, 40W		
D44ZXA5JC7AK	*SMARTNET* S–C EXP, 40W		
D44KMA7JA3BK	HHCH, 40W		
D44KMA7JA5BK	STD, 40W		
D44KMA7JA7BK	EXP, 40W		
D44KXA7JA3BK	S–C HHCH, 40W		
D44KXA7JA5BK	S–C STD, 40W		
D44KXA7JA7BK	S–C EXP, 40W		
●	●	●	●	●	●	●	●	●	●	●	●	●	HBN6000A	PACKING
●	●	●	●	●	●	●	●	●	●	●	●	●	HKN4191A	CABLE
●	●	●	●	●	●	●	●	●	●	●	●	●	HSN4018A	SPEAKER
●	●	●											HLE6031A	HARMONIC FILTER HYBRID, R2
			●	●	●	●	●	●	●	●	●	●	HLE6033A	HARMONIC FILTER HYBRID, R3 & 4
●	●	●	●	●	●	●	●	●	●	●	●	●	HLN6015A	INSTALLATION HARDWARE
●	●	●											HLN6198A	TRANSCEIVER HARDWARE, R2
			●	●	●	●	●	●	●	●	●	●	HLN6059A	TRANSCEIVER HARDWARE, R3 & 4
●	●	●											HLN6196A	PA HARDWARE, R2
			●	●	●	●	●	●	●	●	●	●	HLN6057A	PA HARDWARE, R3 & 4
●	●	●											HLN6197A	INTERNAL CASTING HARDWARE
			●	●	●	●	●	●	●	●	●	●	HLN6073A	INTERNAL CASTING HARDWARE
						●	●	●					HRN6003B/C	RF BOARD 5 PPM
●	●	●											HRN6012A	RF BOARD CEPT 2.5 PPM
			●	●	●				●	●	●		HRN6006B/C	RF BOARD 2.5 PPM
●	●	●	●	●	●	●	●	●	●	●	●	●	HLN6094B	COMMAND BOARD
●	●	●	●	●	●								HLN6160A	MLM BOARD
							●	●	●	●	●	●	HLN6110B	MLM BOARD
							⊗	⊗	⊗	⊗	⊗	⊗	or HLN6142B	MLM BOARD (ALTERNATE)
●	●	●											HLE6046A	VCO CARRIER, R2
			O	O	O	O	O	O	O	O	O	O	HLE6000C	VCO CARRIER, R3
			O	O	O	O	O	O	O	O	O	O	or HLE6041C	VCO CARRIER, R4
●	●	●											HLE6102A	VCO HYBRID, R2
			O	O	O	O	O	O	O	O	O	O	HLE6103B	VCO HYBRID, R3
			O	O	O	O	O	O	O	O	O	O	or HLE6104B	VCO HYBRID, R4
●	●	●											HRE6002A	RXFE HYBRID, R2
			O	O	O	O	O	O	O	O	O	O	HRE6003A	RXFE HYBRID, R3
			O	O	O	O	O	O	O	O	O	O	or HRE6004A	RXFE HYBRID, R4
●	●	●	O	O	O	O	O	O	O	O	O	O	HAE4003A	ANTENNA, R2 & R3
			O	O	O	O	O	O	O	O	O	O	or HAE4004A	ANTENNA, R4
●	●	●											HLE6062A	PA BOARD, 25 WATT, R2
			O	O	O	O	O	O	O	O	O	O	HLE6043B	PA BOARD, 40 WATT, R3
			O	O	O	O	O	O	O	O	O	O	or HLE6044B	PA BOARD, 40 WATT, R4
●	●	●	●	●	●		●	●	●	●	●	●	HVN6026A	SOFTWARE
●	●	●	●	●	●		●	●		●	●		HLN6075B/C	CONTROL HEAD BOARD, STANDARD
●	●	●	●	●	●		●	●		●	●		HMN1052A	MICROPHONE
●	●	●	●	●	●		●	●		●	●		HLN5391A	HANG–UP CLIP
●	●	●	●	●	●		●	●		●	●		HLN5459A	CIRCUIT BOARD
●	●	●	●	●	●		●	●		●	●		HLN6044A	MIC HARDWARE
●	●		●	●			●			●			HLN6101A	CTRL HEAD HARDWARE, NO KEYPAD
		●			●			●			●		HLN6102A	CTRL HEAD HARDWARE, W/KEYPAD
●	●	●	●	●	●		●	●		●	●		HLN6066B	INTERCONNECT BOARD
						●			●				HLN6103A	HANG–UP BOX, HHCH
						●			●				HVN6012B	SOFTWARE, HANDHELD CONTROL HEAD
						●							HLN6089A	INTERFACE BOARD, HHCH
						●							HCN1053A	HANDHELD CONTROL HEAD
						●							HCN4039A	CIRCUIT BOARDS & HARDWARE
						●							HLN6087A	ESCUTCHEON KIT
						●							HLN6090A	HARDWARE KIT, HHCH
									●				HLN6097A	INTERFACE BOARD, HHCH (SECURE)
									●				HCN1054A	HANDHELD CONTROL HEAD (SECURE)
									●				HCN4040A	CIRCUIT BOARDS & HARDWARE
									●				HLN6088A	ESCUTCHEON KIT
									●				HLN6098A	HARDWARE KIT, HHCH (SECURE)

Model Chart for *Spectra* UHF Control Head Button Kits (All Package Models)

CODE:

● = ONE ITEM SUPPLIED

MODEL	A5 PACKAGE	A7 PACKAGE	C2 PACKAGE	C5 PACKAGE	C7 PACKAGE	ITEM	DESCRIPTION
	●		●			HLN6081B	STANDARD
		●			●	HLN6082A	EXPANDED
	●					HLN6095B	*SECURENET*, LTD
		●				HLN6096A	*SECURENET*, STD
			●			HLN6207A	*SMARTNET*, LTD
				●		HLN6208A	*SMARTNET*, STD
					●	HLN6209A	*SMARTNET*, EXP
				●		HLN6040C	PHONE/PAGE/EMERGENCY/MPL (FIELD OPTION)
		●				HLN6061C	EMERGENCY (FIELD OPTION)
	●					HLN6105B	EMER/*SECURENET* (FIELD OPTION)
					●	HLN6137B	1, 2PGE, 3, *SECURENET* (FIELD OPTION)
			●	●	●	HLN6193A	EMER/MPL (FIELD OPTION)

Feature Matrix for *Spectra* UHF Two–Way Trunked/Conventional Mobile FM Radios *SMARTNET* Models

MODEL C2	MODEL C5	MODEL C7			STANDARD FEATURES: (●) OPTION: (O)
●	●	●			8–CHARACTER ALPHANUMERIC DISPLAY
●	●	●			POWER–UP SELF–CHECK
●	●	●			FULL MIL810D SPECIFICATIONS
●	●	●			60 SECOND TIME–OUT TIMER
●	●	●			EXTERNAL SPEAKER
●	●	●			FAST LOCK SYNTHESIZER
●	●	●			VOLUME SET TONE
●	●	●			DIMMER CONTROL
●	●	●			IGNITION SENSE
●	●	●			MONITOR BUTTON
		●			NUMERIC DTMF KEYPAD
●	●	●			MDC PTT ID/EMERGENCY
	●	●			MDC AUTO SEL CALL DECODE
	●	●			MDC *CALL ALERT* DECODE
		●			MDC STATUS/MESSAGE
●	●	●			32 CONVENTIONAL CHANNELS
●	●				6 SYSTEMS/8 SUBFLEETS
		●			8 SYSTEMS/16 SUBFLEETS
●	●	●			TALKAROUND
●	●	●			25 WATTS POWER (VARIABLE TO 10 WATTS)
●	●	●			40 WATTS POWER (VARIABLE TO 20 WATTS)
●	●	●			TELEPHONE INTERCONNECT LIST
		●			UNLIMITED TELEPHONE INTERCONNECT
		●			OPERATOR–SELECTABLE TALKGROUP SCAN
	●	●			FIXED–LIST TALKGROUP SCAN
	●	●			FIXED–LIST PRIORITY TALKGROUP SCAN
		●			OPERATOR–SELECTABLE PRIORITY TALKGROUP SCAN
●	●	●			DUAL MODE OPERATION
		●			UNLIMITED *PRIVATE CONVERSATION* (PC) AND *CALL ALERT* (CA)
	●	●			*PRIVATE CONVERSATION* LIST AND *CALL ALERT* LIST
●	●	●			PC RESPONSE AND CA DECODE
●	●	●			EXTERNAL ALARM CAPABILITY
●	●				DYNAMIC REGROUPING
		●			DYNAMIC REGROUPING WITH REPROGRAM REQUEST
●	●	●			TRUNKED EMERGENCY ALARM/CALL
	●	●			AUTOMATIC MULTIPLE SITE SELECT (AMSS)
	●	●			SYSTEM SEARCH & LOCK (SS & L)
		●			TRUNKED STATUS/MESSAGE
O	O	O			CONTROL STATION OPERATION
O	O	O			REMOTE MOUNT CAPABILITY
O	O	O			DTMF MICROPHONE
O	O	O			HANDSET WITH HANGUP
O	O	O			KEY–LOCK MOUNT
O	O	O			EXTERNAL ALARM RELAYS
O	O	O			EXTERNAL EMERGENCY PUSHBUTTON
O	O	O			EMERGENCY FOOTSWITCH
O	O	O			10 WATT AUDIO
O	O	O			NOISE CANCELLING MICROPHONE

Note: This matrix lists those features available at time of printing. Consult your Motorola Representative for the most current list of standard and optional features.

Feature Matrix for *SPECTRA* UHF 40 watts Two–Way Conventional Mobile FM Radios "BK" Suffixed Models

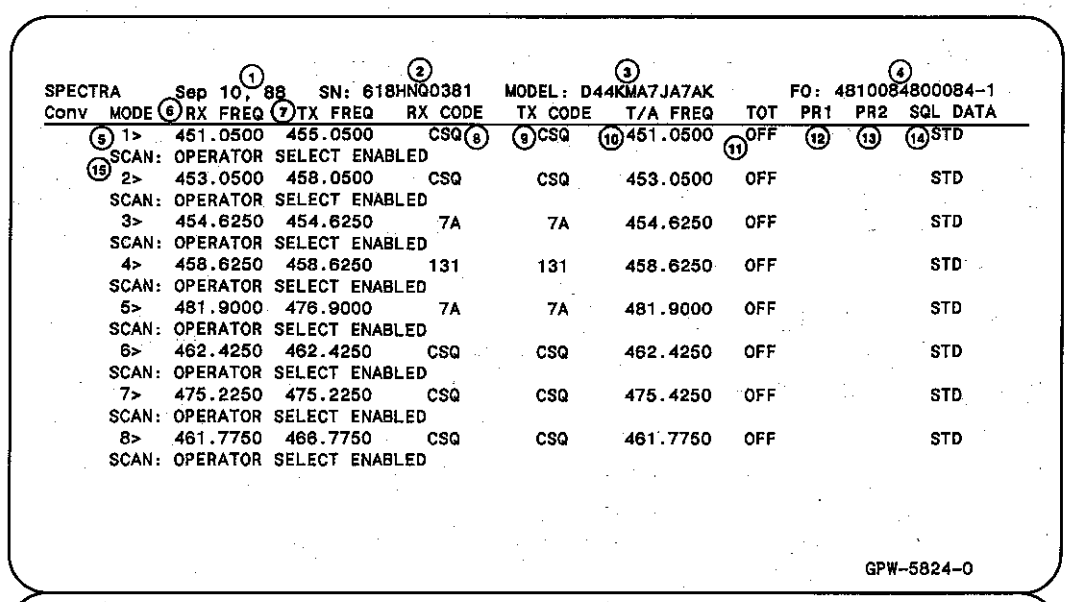
Model	MODEL A5	MODEL A7				
Standard features: (●) Option : (O)						
8–CHARACTER ALPHANUMERIC DISPLAY	●	●				
POWER–UP SELF–CHECK	●	●				
FULL MIL810D SPECIFICATIONS	●	●				
60 SECOND TIME–OUT TIMER	●	●				
EXTERNAL SPEAKER	●	●				
FAST LOCK SYNTHESIZER	●	●				
VOLUME SET TONE	●	●				
DIMMER CONTROL	●	●				
IGNITION SENSE	●	●				
MONITOR BUTTON	●	●				
NUMERIC DTMF KEYPAD	●	●				
MDC–1200 PTT ID/EMERGENCY	●	●				
MDC–1200 8 STATUS / 8 MESSAGE		●				
MDC–1200 CALL ALERT DECODE	●	●				
MDC–1200 AUTO SELECTIVE CALL DECODE	●	●				
128 CONVENTIONAL CHANNELS	●	●				
40 WATTS POWER (VARIABLE TO 20 WATTS)	●	●				
DTMF ENCODE LIST	●	●				
UNLIMITED DTMF ENCODE		●				
MODE–SLAVED *CHANNEL SCAN* WITH DUAL PRIORITY	●	●				
OPERATOR–SELECTABLE *CHANNEL SCAN* WITH DUAL PRIORITY	●	●				
CONTROL STATION OPERATION	O	O				
REMOTE MOUNT CAPABILITY	O	O				
DTMF MICROPHONE	O	O				
HANDSET WITH HANGUP	O	O				
RF PREAMPLIFIER	O	O				
2.5 PPM FREQUENCY STABILITY (TX/RX)	O	O				
KEY–LOCK MOUNT	O	O				
EXTERNAL ALARMS RELAY	O	O				
AUXILIARY SWITCH PANEL	O	O				
EMERGENCY FOOTSWITCH	O	O				
EXTERNAL EMERGENCY PUSHBUTTON	O	O				
3.5 dB GAIN ANTENNA (COVERS 10 MHz)	O	O				
5 dB GAIN ANTENNA (COVERS 5 MHz)	O	O				
10 WATT AUDIO	O	O				

Note: This matrix lists those features available at time of printing. Consult your Motorola Representative for the most current list of standard and optional features.

SPECTRA UHF FM Two–Way Radio Options Chart

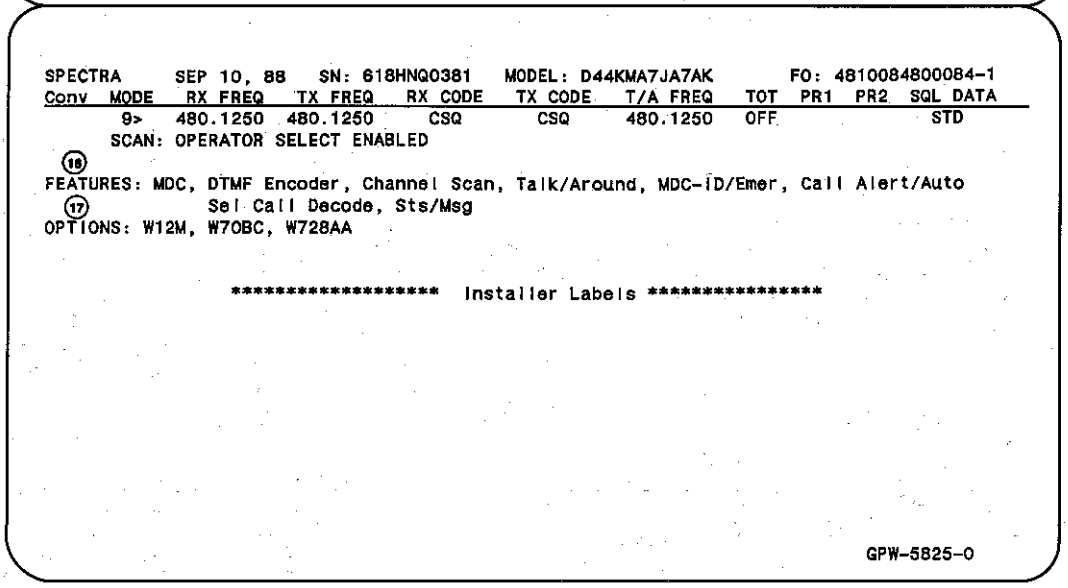
Option	Description	Kit Added	Kit Deleted
W116	External Alarm Relays	HKN4258B TLN4533A HLN6053A	—
W20	Touch Code Microphone	HMN1053A	HMN1052A
W470	Emergency Foot Switch	HLN5113B HLN6053A	—
W496	Remote Mount Kit w/ 17' Cable (AK Suffixed Models)	HKN4192A HLN6080A HLN6077A	HKN4191A HLN6066A
W496	Remote Mount Kit w/ 17' Cable (BK Suffixed Models)	HKN4192A HLN6080A HLN6116A	HKN4191A HLN6066A
W496	Remote Mount Kit w/ 17' Cable (*Securenet* Capable Models)	HKN4192A HLN6112A HLN6115A	HKN4191A HLN6066A
W665	Control Station	HKN4139A HLN6042A HMN1050A HPN3000A HLN6047A 6880101W87	HKN4191A HLN6015A HMN1052A HSN4018A 6880101W36
W688	External Emergency Button	HLN5131B HLN6053A	—
W81	Locking Installation kit	HLN6025A	—
W109	Handset with Hang–Up	HLN1220_	HMN1052A
W591	Auxiliary Switch Panel	HLN1196B	—
W12	RF Preamplifier 450–482 MHz 482–512 MHz	 HRE6013A HRE6014A	 HRE6003A HRE6004A
W728	2.5 PPM Frequency Stability (TX/RX)	HRN6006_	HRN6003_
W123	3.5 dB Gain Antenna (covers 10 MHz)	HAE4011A HAE4012A HAE4013A	HAE4003A HAE4004A
W124	5 dB Gain Antenna (covers 5 MHz)	RAE4014ARB RAE4015ARB RAE4016ARB	HAE4003A HAE4004A
W432	10 Watt Audio	HSN6001A	HSN4018A

RADIO INSTRUCTION SHEET



```
SPECTRA      Sep 10, 88   SN: 618HNQ0381   MODEL: D44KMA7JA7AK      FO: 4810084800084-1
Conv  MODE   RX FREQ   TX FREQ    RX CODE   TX CODE   T/A FREQ   TOT  PR1  PR2  SQL DATA
  1>   451.0500  455.0500     CSQ       CSQ      451.0500   OFF                   STD
SCAN: OPERATOR SELECT ENABLED
  2>   453.0500  458.0500     CSQ       CSQ      453.0500   OFF                   STD
SCAN: OPERATOR SELECT ENABLED
  3>   454.6250  454.6250      7A        7A      454.6250   OFF                   STD
SCAN: OPERATOR SELECT ENABLED
  4>   458.6250  458.6250     131       131      458.6250   OFF                   STD
SCAN: OPERATOR SELECT ENABLED
  5>   481.9000  476.9000      7A        7A      481.9000   OFF                   STD
SCAN: OPERATOR SELECT ENABLED
  6>   462.4250  462.4250     CSQ       CSQ      462.4250   OFF                   STD
SCAN: OPERATOR SELECT ENABLED
  7>   475.2250  475.2250     CSQ       CSQ      475.4250   OFF                   STD
SCAN: OPERATOR SELECT ENABLED
  8>   461.7750  466.7750     CSQ       CSQ      461.7750   OFF                   STD
SCAN: OPERATOR SELECT ENABLED
```

GPW-5824-O



```
SPECTRA      SEP 10, 88   SN: 618HNQ0381   MODEL: D44KMA7JA7AK      FO: 4810084800084-1
Conv  MODE   RX FREQ   TX FREQ    RX CODE   TX CODE   T/A FREQ   TOT  PR1  PR2  SQL DATA
  9>   480.1250  480.1250     CSQ       CSQ      480.1250   OFF                   STD
SCAN: OPERATOR SELECT ENABLED

FEATURES: MDC, DTMF Encoder, Channel Scan, Talk/Around, MDC-iD/Emer, Call Alert/Auto
          Sel Call Decode, Sts/Msg
OPTIONS: W12M, W70BC, W728AA

                  ********************  Installer Labels ****************
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GPW-5825-O

GENERAL

The radio instruction sheets shipped with each unit identifies factory programming information. A copy of the label is stored on the inside of radio top or bottom cover; a second copy is included in the shipping container. DO NOT DESTROY this information; it is needed to service the radio.

Each field of information, identified by callout numbers in the above illustration, is explained in the following paragraphs. The illustration shows a typical label for a conventional radio. The numbers in parenthesis here; e.g. (1), are keyed to the callouts (circled numbers) on the illustration.

(1) DATE: the date the label was printed.

(2) SERIAL NUMBER (SN): the radio's serial number.

(3) MODEL NUMBER: the radio's model number.

(4) FACTORY ORDER NUMBER (FO): the factory sales order number.

MODE INFORMATION

(5) MODE: the specific conventional user mode number.

(6) RX FREQ: the receive channel frequency in MHz.

(7) TX FREQ: the transmit channel frequency in MHz. If the mode is receive–only, this field says BLANK.

(8) RX CODE: the receiver PL, DPL, or CSQ code assignment.

(9) TX CODE: the transmitter PL, DPL, or CSQ code assignment.

(10) T/A FREQ: the transmit talkaround frequency in MHz. Models which are not capable of talkaround will say "N/A" in this field.

(11) TOT: the transmitter time–out–timer value in seconds.

(12)*PR1: the first priority scan selection. It will default to the selected mode.

(13) PR2: the second priority scan selection. It will be blank on all models (unprogrammed).

(14) SQL DATA: coded squelch mute/unmute type. This field will always be "STD", indicating that proper code detect is required to unmute the audio and loss of the proper code detect will immediately mute the audio.

(15)*SCAN: indicates the type of scan. If blank, the model has mode–selectable scan which must be enabled and a scan list entered with the field programmer.

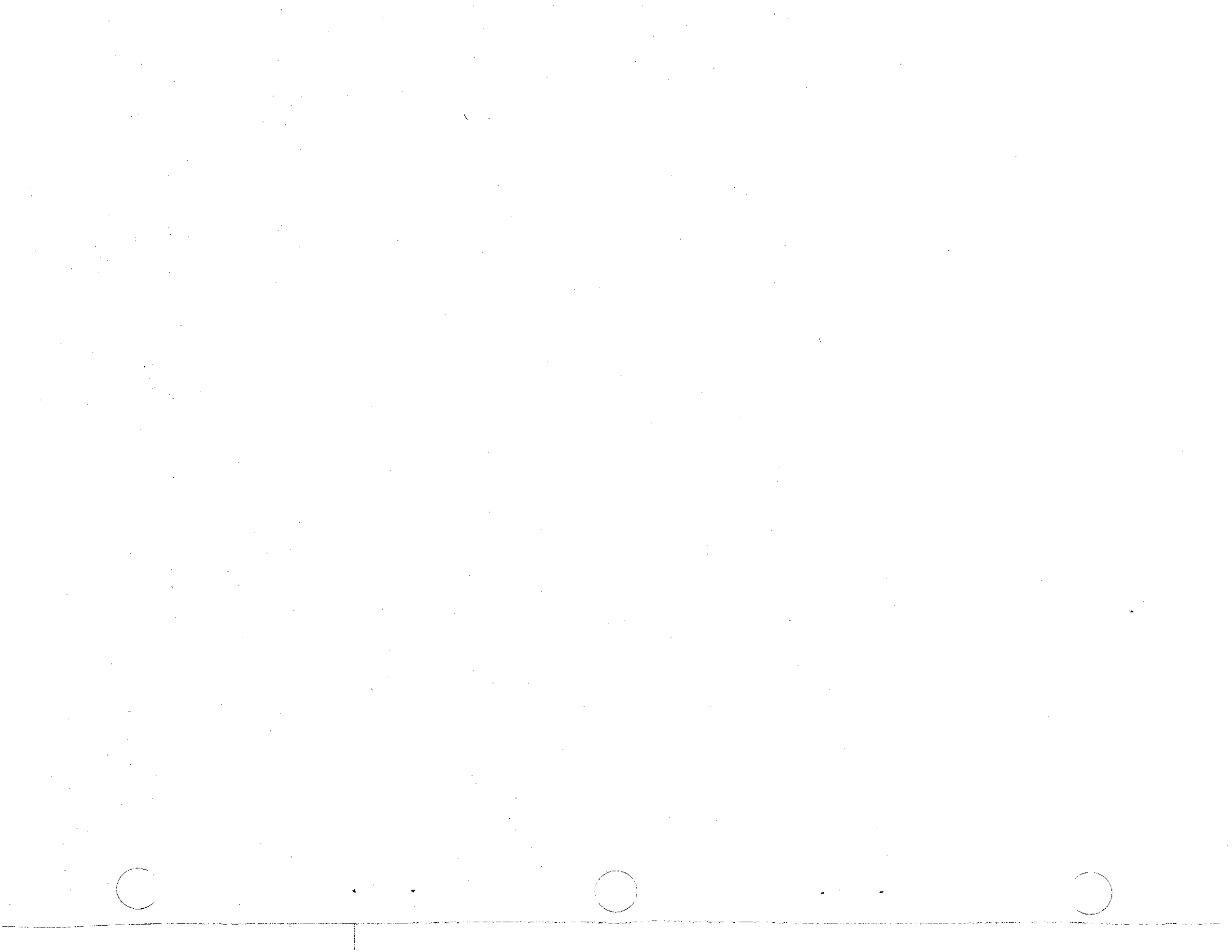
(16) FEATURES: the features included with the radio model.

Abbreviation	Feature
MDC	*MDC–1200* (PTT–ID, Data Operated Squelch, and Emergency)
Channel Scan	Conventional *Channel Scan*
DTMF Encoder	Conventional DTMF Encoder
Talk/Around	Conventional Talkaround Capability

(17) OPTIONS: the options ordered with the radio.

***Note**

If this field is shown as blank, the model has operator–selectable scan and does not have a scan list when shipped from the factory.



SPECTRA Radio Service Aids

Item	Part No.	Description
	RPX–4724B	**RF SERVICE CABLE KIT**. Interface cables needed to service the RF modules of the *SPECTRA* radio. Kit components are:
1	28–84606M01	Mini UHF connector (Male) for coax cable termination to radio. Adapts any coax of appropriate size (RG58 or equivalent) for mating to antenna connector.
2	30–80373B25	RX injection board output cable. Connects to the RX injection output of the VCO assembly for testing RX injection level (900 MHz models only).
3	30–80373B26	BNC male to SMB male cable to mate to PCB–mounted SMB female connectors.
4	30–80373B41	BNC female to Taiko–Denki male cable to mate to PCB–mounted Taiko–Denki female connectors. Cables 3 and 4 allow connection to: • VCO injection output to power amplifier for testing TX injection level. • receiver front end/mixer input for testing receiver and/or front end mixer while bypassing the antenna switch. • receiver front end/mixer output for testing the proper mixer conversion gain (use with HRF6002A and HRF6002B RXFE/Mixer Kits only) • synthesizer feedback input for testing feedback buffer and prescaler operation (use with HLF6002A and HLF6073A VCO Carrier Kits only) • RF board IF input for testing receiver back end sensitivity. • RX injection output of the VCO assembly.
5	30–80373B27	BNC male to SMB female cable for mating to cable mounted SMB male connectors.
6	01–80355A28	BNC female to Taiko–Denki female adapter for mating to cable–mounted Taiko–Denki male connectors. Cables 5 and 6 allow connection to: • power amplifier providing test input. • receiver input cable for testing RX loss through harmonic filter and antenna switch. • VCO synthesizer feedback level (use with HLF6002A and HLF6073A VCO Carrier Kits only) • receiver front end/mixer output for testing the proper mixer conversion gain.
		FIELD PROGRAMMING ITEMS
1	RPX–4719A	RADIO SERVICE SOFTWARE LICENSING AND INFORMATION PACKAGE. Identifies software license information necessary to purchase Radio Service Software listed below and lists the available radio service software.
2	RVN–4000 RVN–4001	RADIO SERVICE SOFTWARE (on 3 1/2" disc) RADIO SERVICE SOFTWARE (on 5 1/4" disc) For programming and servicing *SPECTRA* radios on *IBM* PC, *PC–XT*, or *PC–AT* computers equipped as follows: *IBM* DOS 3.1 or higher, an RS232 Asynchronous Serial Communications Adapter, and 640k byte (min.) RAM memory. Includes users manual 68P80101W48.
3	RLN–4008	RADIO INTERFACE BOX (RIB). Shifts voltage level to enable communications between the radio and the computer's RS232 Serial Communications Adapter. (Replaces 01–80353A74)
4	30–80369B71 30–80369B72	*IBM PC–XT* COMPUTER INTERFACE CABLE. *IBM PC–AT* COMPUTER INTERFACE CABLE. Connects the appropriate computer's RS232 Asynchronous Serial Communications Adapter to the Radio Interface Box. *IBM* PC and *PC–XT* computers use a 25–pin connector cable and *PC–AT* computers use a 9–pin connector cable.
5	30–80369B73	*SPECTRA* RADIO INTERFACE CABLE. Connects the *SPECTRA* radio to the Radio Interface Box.
		SERVICE MANUALS
	68P80101W33	*SPECTRA* DETAILED SERVICE INFORMATION.
	68P80101W36	*SPECTRA* RADIO INSTALLATION MANUAL.
	68P80182W71	MCT–3600/MCT–4800 RADIO INSTALLATION MANUAL.
	68P80101W35	*SPECTRA* VHF RADIO SERVICE MANUAL.
	68P80101W39	*SPECTRA* UHF RADIO SERVICE MANUAL.
	68P80101W37	*SPECTRA* 900 MHz RADIO SERVICE MANUAL.
	68P80102W33	*SPECTRA SECURENET* SERVICE SUPPLEMENT.
	68P80102W48	*SPECTRA* HHCH (A3 MODEL) SERVICE SUPPLEMENT.
	68P80102W54	*SPECTRA* 800 MHz RADIO SERVICE MANUAL.
	68P80102W79	*SPECTRA 9000* SERVICE SUPPLEMENT.
	68P80102W85	MCT–3600 (NYCTA) SERVICE SUPPLEMENT.
		SERVICE TOOLS
1	RSX–4057A	SURFACE MOUNTED COMPONENT/IC REMOVAL/REWORK STATION. Used to replace leadless components and IC's, providing precision–controlled spot heating for fast and easy repairs.
2	RPX–4725B	COMMAND AND CONTROL SERVICE CABLE KIT. Provides all the necessary board–extension cables for servicing digital and analog modules of the *SPECTRA* radios.
	01–80359A30	• MLM EXTENDER BOARD (p/o RPX–4725B). For servicing Memory Boards in current models.
3	RPX–4724B	RF SERVICE CABLE KIT. Provides all necessary cables for servicing the RF modules of the *SPECTRA* radio.
4	58–80367B21	MINI UHF MALE TO 'N' FEMALE ADAPTER.
5	58–80367B22	MINI UHF MALE TO UHF FEMALE ADAPTER.
6	28–84606M01	CRIMP–ON MINI UHF ANTENNA CONNECTOR.
7	66–80388A26	CRIMPING TOOL FOR MINI UHF ANTENNA CONNECTOR.
8	RSX–4044A	ADJUSTABLE TORQUE DRIVER WITH BITS.
9	66–80163F01	INSERTION AND EXTRACTION TOOL. For installing and removing wires from accessory connector.
10	01–80320B16	MAGNETIC SCREWDRIVER SET.
11	01–80370B87	L–SHAPED METRIC HEX KEY.
12	SLN–6435A	AUDIO ISOLATION TRANSFORMER. Required for all audio measurements. Audio PA output floats and must *NOT* be grounded.
13	01–80359A53	SERVICE CABLE (A3 Models Only). For servicing Interface Board.
14	TRN–7111	KEY VARIABLE LOADER CABLE ADAPTOR. Required for loading cipher keys into the *SPECTRA SECURENET* Mobile Radio. (a TKN8351 or TKN8531 cable is also required.)

1. Theory Overview

1.1 GENERAL (SEE FIGURE 1. FUNCTIONAL BLOCK DIAGRAM)

The *Spectra* UHF radio is a wideband, frequency synthesized, fixed tuned mobile radio covering the 438–470 (R2), 450–482 (R3) and 480–512 (R4) MHz band. The *Spectra* UHF radio is designed for use in 25 kHz channel spacing systems with maximum deviation of 5.0 kHz.

The *Spectra* radio consists of 6 major assemblies, four of which are in the main transceiver housing. These are:

- Command Board—includes the microprocessor, the plug–in memory board, miscellaneous audio and control stages.
- Receiver Front End assembly.
- RF Board contains receiver IF, demodulator, and the synthesizer logic and filtering.
- VCO/Buffer/Divider Board.

The remaining two assemblies are:

- Control Head which plugs into the front of the transceiver housing.
- Transmit Power Amplifier which plugs into the rear of the housing.

1.2 OPERATION

When the radio is receiving, the signal comes from the antenna connector, passes through the antenna switch on the transmit PA, to the receiver front end. The signal is mixed with the high–side injection signal from the VCO board, and then fed to the 109.65 MHz IF on the RF board. After another mix to the 450 kHz second IF, the signal is detected and fed to the command board, processed by the Audio Filter IC, and finally fed to the audio PA and speaker. All signalling filtering and detection is performed on the command board.

WARNING

The Audio PA (U450) is a DC–coupled bridge type amplifier with its outputs directly connected to the external speaker. Therefore, the speaker outputs must never be grounded. Use an audio isolation transformer (e.g. Motorola Part No. SLN6435A) to isolate test equipment from the Audio PA (U450)/speaker.

When the radio is transmitting, microphone audio is processed and routed through the audio filter IC for pre–emphasis and splatter filtering, and then fed to the synthesizer modulation ports. The injection is fed to the transmit power amplifier. The amplification level is controlled by the power control circuitry on the command board via the control voltage fed to the transmit power amplifier.

The synthesizer controls the VCO in both receive and transmit. The VCO operates at one half the desired injection frequency for receive and transmit frequency. Both receive injection and transmit frequencies are doubled. Synthesizer frequency programming is done by the microprocessor, and is controlled by information stored in the radio EEPROM. The radio microprocessor also controls all audio routing and switching, signalling generation and detection, reference oscillator warp, transmit deviation, transmit PA power level and current limiting, and, via the serial bus, control head interfacing.

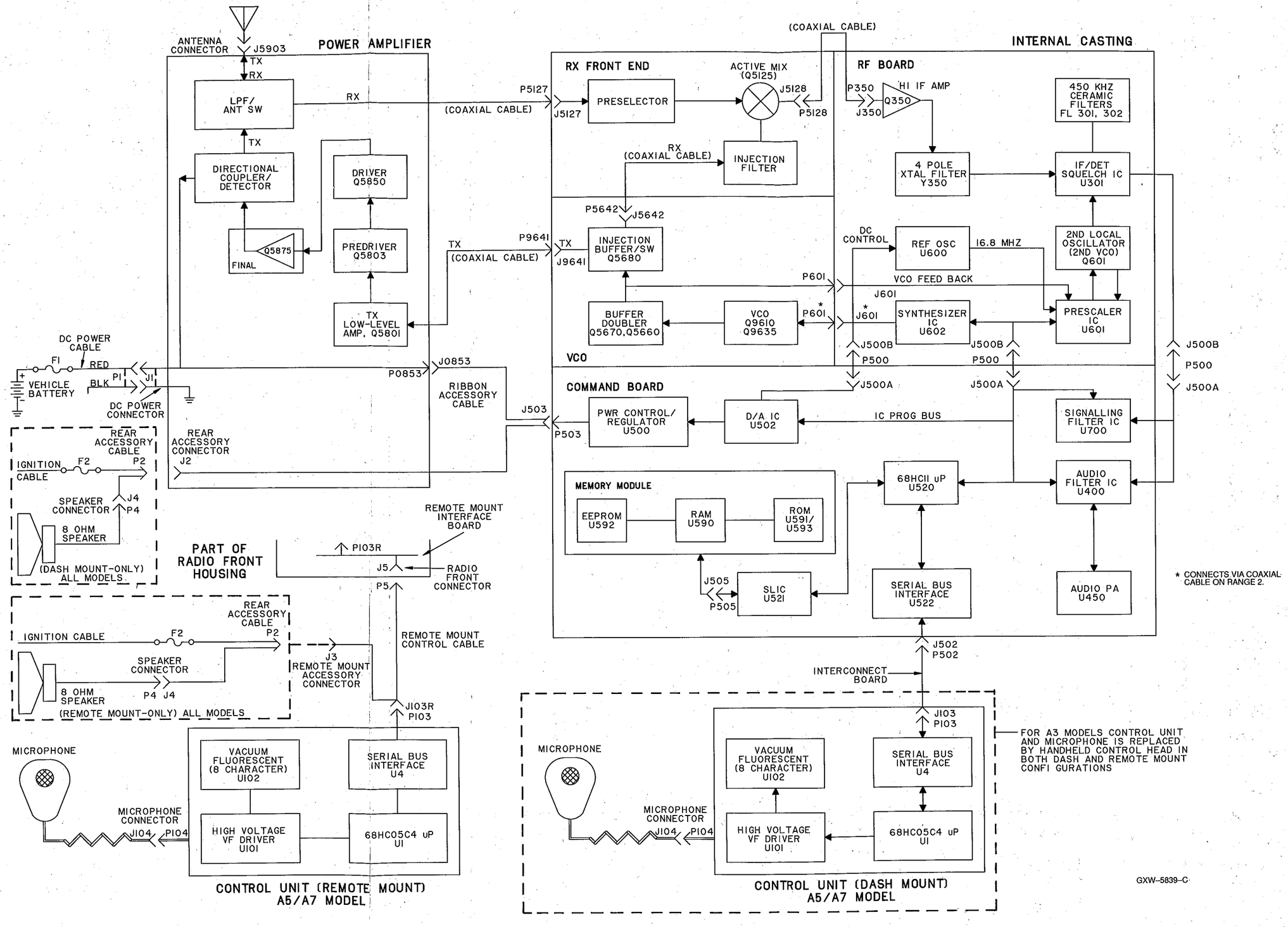


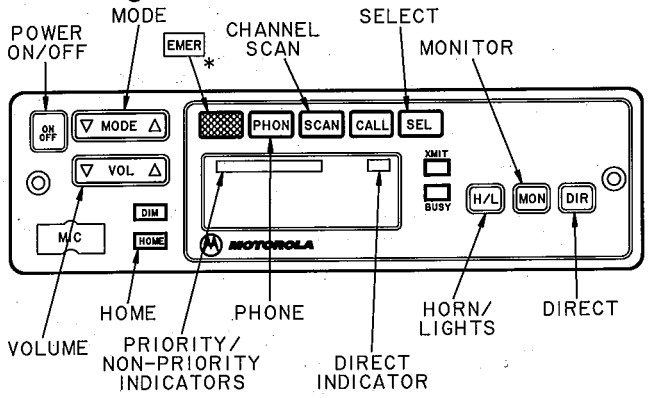
Figure 1. Functional Block Diagram

1.3 CONTROL HEAD

The *Spectra* UHF control head has solid state microprocessor circuitry that operates the standard and optional features built into the system.

1.3.1 Description of Controls (See Figure 2.)

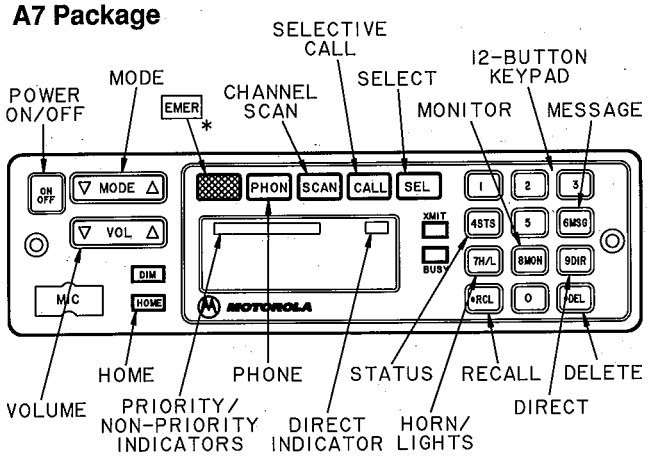
A5 Package



* OPTIONAL BUTTON (INCLUDED BUT NOT INSTALLED)

GXW-5802W28-A

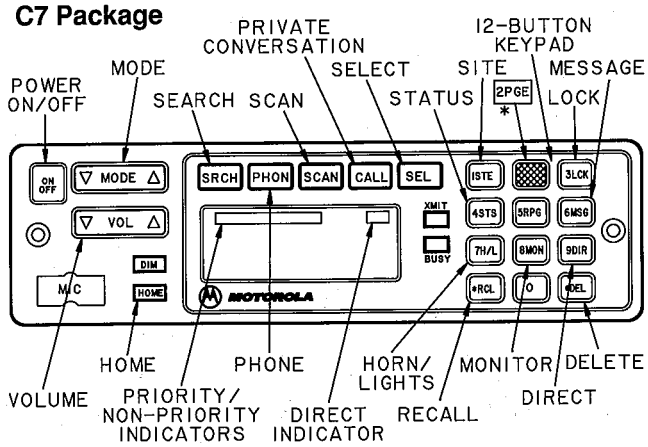
A7 Package



* OPTIONAL BUTTON (INCLUDED BUT NOT INSTALLED)

GXW-5802W02-A

C7 Package



*OPTIONAL BUTTON (INCLUDED BUT NOT INSTALLED)

GXW-6196W29-O

Figure 2. Typical Control Heads

POWER SWITCH—a push–push type switch for turning the radio on and off.

MODE—rocker switch for selecting modes and programming menus.

VOLUME—rocker switch for selecting volume level, editing names, and making certain radio adjustments.

DIM—button for controlling intensity of the display.

HOME—button for restoring pre–programmed mode, establishing programmed mode, selecting programming entries, etc.

MICROPHONE—connector; accepts any *Spectra 900* or *SYSTEMS 9000* microphone.

DISPLAY—Vacuum Fluorescent Display; 8–character alpha–numeric display shows all radio states or statuses; also functions as the ON/OFF indicator.

PRI–NPRI–DIR—indicators built into the VF display; these are acronyms for Priority and Non–Priority (used for Scanning), and Direct (used for Talkaround).

OPTION BUTTONS—on/off switches; options are: Phone, Scan, Call, and Emergency; Select, [**Sel**] is used to configure options.

12–BUTTON KEYPAD—(some models) is the traditional telephone–type keypad; several keys serve multiple functions:

- STE—(#1 on keypad models) used to force the radio to scan for a new site when the Automatic Multiple Site Select (AMSS) feature for wide–area coverage is in use.
- PGE—(#2 key) used to *Call Alert* another radio.
- LCK—(#3 key) used to "lock" the radio onto the current site when the AMSS feature is in use.
- STS—(#4 key) used alone or in conjunction with other keypad buttons and the SEL button to send in a status transmission, indicating a predetermined condition change.
- RPG—(#5 key) used to request a change in the radio's talkgroup assignment when the Dynamic Regrouping feature is in use.
- MSG—(#6 key) used alone or in conjunction with other keypad buttons and the SEL button to transmit a message, indicating a response or temporary condition.
- H/L—(#7 on keypad models) used to select/enable radio external alarms.
- MON—(#8 on keypad models) used to monitor for channel traffic.
- DIR—(#9 on keypad models) used for talkaround (mobile–to–mobile) conversations.
- RCL—(* key) used to review modes in scan and phone lists.
- DEL—(# key) used when editing stored lists.

1.3.2 Theory Overview

The pushbutton ON/OFF switch (S1) applies battery power to the control head, transceiver, and accessory connector via the SW B+ line. Jumpers JU1 and JU2, on the control head board are used to enable the IGNITION feature. JU1 is normally out and JU2 is normally in. This allows complete control over Transmit/Receive functions per Table 1.

*Table 1. Control Head Jumper Table***

Customer Options	JU1	JU2	Comments
1. RX & TX enabled via on/off switch on control head	OUT	OUT	Connect ignition cable* to "Battery Plus (+)" terminal.
2. RX & TX enabled via ignition switch	OUT	IN	Connect ignition cable* to "Ignition Switch."
3. RX enabled via on/off switch on control head; TX enabled via ignition switch	IN	OUT	Connect ignition cable* to "Ignition Switch."

* Ignition cable is a part of the cabling which plugs into the rear accessory connector (P2) on the back of the radio. The ignition cable must be connected to Pin P2–5 for Table 1 to be valid.

** Refer to Detailed Service Manual board overlays for jumper location.

Switched B+ is applied to a voltage regulator (U45), which supplies regulated 5 VDC to the microcomputer (U1) circuitry, the interface circuits, the vacuum fluorescent (VF) driver (U101), and to the comparator (U3).

The microcomputer (U1) communicates with the radio command board via the serial bus, scans the control head keyboard for activity, and generates the display information for the VF driver (U101) and VF display (U102). U1 uses a 4 MHz ceramic resonator (Y1) for its clock source.

When switched B+ is initially applied, the RESET line to pin U1–1 is held low for approximately 120 milliseconds before it goes high. The high resets U1 and starts it operating properly. A resultant signal at pin U1–38 provides a 1–kHz "tickle" pulse to the watchdog timer circuit in the serial input/output IC (U4), and provides a strobe signal to the VF display driver (U101). If the tickle pulse disappears for more than 120 milliseconds, the reset sequence is initiated and pin U4–9 goes high.

Table 2 illustrates the serial data bus logic states.

Table 2. Serial Data Bus Logic States

Data Line	No Bus Activity (Normal)	Bus Activity (Sending or Receiving Data)	In RESET*
Busy	Low	High	Low
$\overline{\text{Busy in}}$	High	Low	High
$\overline{\text{Busy out}}$	High	Low **	High
Bus +	High	Low and High	High
Bus –	Low	High and Low	Low
TX DATA	High	Low and High**	High
RX DATA	High	Low and High	High
RESET	Low	Low	High
$\overline{\text{RESET}}$	High	High	Low

* Data will be sent (bus activity) immediately after a reset.

** Sending only.

The VF display is an eight character, fourteen segment, alpha–numeric device. The anodes and the grids operate at approximately 34 VDC when ON and 0 VDC when OFF. The filament operates at approximately 2.4 VAC RMS.

The voltage for the VF Display is generated by a fixed frequency, variable duty–cycle controlled "flyback" voltage converter. The switching frequency is approximately 210 kHz.

Microcomputer line U1–6 controls the voltage converter, which provides approximately 37 VDC to the VF driver (U101–1) and approximately 2.4 VAC RMS across T60–4 and T60–6 to the VF display (U102–1 and U102–25).

1.4 TRANSCEIVER

1.4.1 Receiver Front–End.

The receiver front–end consists of a preselector, a mixer circuit, and an injection filter.

The mixer is designed for injection. The receiver injection (1st local oscillator) comes from the output of the VCO assembly via a coax cable. The injection filter is a factory tuned filter. The output of the filter is connected to the mixer.

The preselector is a factory tuned ceramic–block filter that is soldered to the mounting bracket underneath the mixer hybrid. The receiver signal is fed to the preselector from the antenna switch in the PA. The signal is then sent up to the mixer hybrid where it is connected to the mixer transistor (Q5125). The receiver injection is also fed to this point. The mixer output is at the 1st IF center frequency of 109.65 MHz. Typical conversion gain for the entire front end assembly is 2.5 dB. This signal is sent to the 1st IF on the RF board via a coaxial cable.

1.4.2 RF Board

The *Spectra* RF board contains the common synthesizer circuits and dual IF receiver and demodulation circuits. A 4–pole crystal filter at 109.65 MHz provides first IF selectivity; the filter's output is fed directly to the custom IF/demodulator IC. An amplifier (at 109.65 MHz), the second mixer, the second IF amplifiers (at 450 kHz), and the phase lock–loop type demodulator are on board the custom IC. Two ceramic filters (designed for 25 kHz channel spacing) in the second IF (450 kHz) provide selectivity for the radio.

Synthesizing for the first and second VCO is performed by the prescaler and synthesizer IC's. These IC's are programmed via a serial data bus from signals generated on the command board. DC voltage, also generated on the command board, sets the synthesizer's reference oscillator frequency of 16.8 MHz. This voltage is controlled by the microprocessor system's digital–to–analog converter (D/A), and is the only element of the RF board requiring alignment.

The second local oscillator runs at 109.2 MHz, and consists of a VCO which is frequency–locked to the reference oscillator. Part of the local oscillator's circuitry is in the prescaler IC.

A clamp and rectifier circuit on the RF board generates a negative DC voltage of –4 volts (nominal) for increasing the total voltage available to the first VCO and second local oscillator's VCO. The circuit receives a 300 kHz square wave output from the prescaler IC, then clamps, rectifies, and filters the signal for use as the negative steering line for the two VCO's.

1.4.3 Voltage Controlled Oscillator (VCO)

The VCO assembly generates variable frequency RF output signals controlled by the two steering lines. The negative steering line increases the tuning range of the VCO, while the positive steering line affects the synthesizer control loop to incrementally change the frequency.

The VCO generates a signal from 219–311 MHz frequency range. (See table 3. VCO Frequency.) This signal is fed to the doubler/buffer circuit which, in turn, doubles the VCO output frequency and amplifies it to the power level required by the TX buffer and RX first mixer. A PIN diode switch routes the signal to the TX port when the keyed 9.4V is high. Otherwise, the signal is routed to the RX port. The VCO assembly's synthesizer feedback output is the same as the doubler output frequency. Nominal power levels are shown in Table 4.

1.4.4 Command Board

The command board is in the top side of the radio housing. The board contains the radio's microcomputer with its memory and support circuits, voltage regulators, audio, signalling and power control circuits. Connected to the command board are the memory board, control head, RF board, RF PA/accessories, and the RX front end connector.

The microcomputer (U520) controls audio levels, signalling, receive/transmit frequencies, power levels, control head display, and other radio functions, using either direct logic control, or synchronous and asynchronous serial communications paths to the devices. The microcomputer executes a stored program located in PROM on the memory board. Data is transferred to and from the memory board via the microcomputer data bus. The memory location from which data is read, or to which data is written, is selected via the address lines. The upper eight address lines are applied directly from the microcomputer to the memory board while the lower address lines are latched by the Support Logic IC (U521) and then applied to the memory board.

The Support Logic IC (U521) acts as an extension of the microcomputer by providing logic functions such as lower address latch, reset, memory address decoding, and additional control lines for the radio.

The Serial Input/Output IC (U522) provides command board functions including buffers for PTT, Channel Active, Squelch Mute, Busy, and Data Transmission, and logic functions for Switched B+, Emergency, Reset, and power control.

The regulator and power control circuits include an Un–switched +5V (UNSW5V) discrete circuit, measured at Q521 emitter, and the Regulator/Power Control IC (U500) which produces both Switched +5V (SW5V), measured at U500–14, and 9.6V, measured at Q500 collector. The UNSW5V source is used by U500 as a reference for its Switched +5V source. UNSW5VFIL (filtered UNSW5V), measured at U520–26, is used for the microcomputer circuits. SW5V and 9.6V, from U500, are controlled via a digital transistor from U522 (Serial Input/Output IC). In the power control circuitry, U500 receives power set and limit inputs from the Digital–to–Analog IC, and feedback from the RF Power Amplifier. Based on those inputs, U500 produces a control voltage for the desired RF power level to the antenna.

The reset circuits consist of the power–on reset, high/low battery voltage reset, and the external bus system reset. The reset circuits allow the microcomputer to recover from an unstable situation, i.e. no battery on the radio, battery voltage too high or too low, and remote devices on the external bus not communicating.

The microcomputer controls the crystal pull circuit, via U521 and U520, to adjust the crystal oscillator's frequency on the microcomputer so that the E–clock's harmonics do not cause interference with the radio's receive channel.

The Signalling Filter IC (U700) performs signalling encode and decode functions. Receive signalling from the detector is limited in this IC, then routed to the microcomputer for actual decoding. For transmit signalling, clock signals from the microcomputer are filtered and routed to the Audio Filter IC (U400) to be combined with transmit audio. U700 requires a 2.1 MHz clock signal to be functional and is programmed using clock, data, and U700 select lines from the microcomputer.

Audio filtering, routing, and volume are controlled by the Audio Filter IC (U400). This IC performs PL/DPL encode and decode filtering as well as alert tone generation. It contains attenuators for volume, squelch, deviation, and compensation. TX and RX audio options connect through this IC. It requires a 2.1 MHz clock to be functional and is programmed using clock, data, and U400 select lines from the microcomputer.

Table 3. VCO Frequency

Mode	$\overline{\text{AUX 2}}$	$\overline{\text{AUX 1}}$	VCO Frequency Range (MHz)			Doubler Output (MHz)		
			Range 2	Range 3	Range 4	Range 2	Range 3	Range 4
TX	HIGH	HIGH	219.00—228.00	225.00—233.50	240.00—250.00	438.00—456.00	450.00—467.00	480.00—500.00
TX	HIGH	LOW	228.00—235.00	233.50—241.00	250.00—256.00	456.00—470.00	467.00—482.00	500.00—512.00
RX	LOW	HIGH	273.82—281.82	279.82—288.32	294.82—302.32	547.65—563.65	559.65—576.65	589.65—604.65
RX	LOW	LOW	281.82—289.82	288.32—295.82	302.32—310.82	563.65—579.65	576.65—591.65	604.65—621.65

Table 4. VCO Power Output (Typical, dBm)

Item	RX MODE	TX MODE
RX Injection	+12	N/A
TX Injection	N/A	+16
Synthesizer Feedback	–5	–5

1.5 POWER AMPLIFIERS

The Power Amplifier is a four–stage, discrete–transistor RF amplifier consisting of the following:

- low–level power controlling stage
- pre–driver
- driver
- final amplifier
- directional coupler
- antenna switch
- harmonic filter.

The PA amplifies the RF signal from 30 milliwatts to the 25/40 watt level. This theory should help isolate problems to the board level with circuit board replacement as the intended repair procedure.

1.5.1 Gain Stages

The first stage buffers the RF signal, filters harmonics, and acts as a variable amplifier to boost the signal from 30 mW to approximately 400 mW. The second stage is supplied from the regulated 9.6 volt source on 40 watt units and A+ on 25 watt units. It amplifies the signal to the 3 watt power level. The driver stage amplifies the signal to the 14 to 15 watt level. On the 40 watt unit, the final stage amplifies the signal to approximately 50 watts; on the 25 watt unit the final stage amplifies to approximately 35 watts. All of the amplifying stages are matched using transmission lines, capacitors, and inductors and are supplied with DC from either A+, Keyed 9.4, or 9.6 volt sources. Following the last gain stage, PIN diodes switch the signal flow either from the antenna to the receiver, or from the last gain stage to the antenna. Either way, the signal passes through a filter.

1.5.2 Power Control

A directional coupler and detector network controls power. It senses the forward power from the last gain stage and feeds the detected voltage back to the command board control circuitry where it is compared to a reference voltage set during power–set procedures. The DC feed voltage is corrected and supplied to the "controlled" stage of the power amplifier. Circuitry on the power amplifier board controls the gain of the first stage and is proportional to the DC control voltage.

1.5.3 Circuit Protection

Current and Temperature sensing circuitry on the power amplifier board feed sensed voltages to the command board for comparison. If the command board suspects a fault condition, it overrides the power control function and cuts the power back to a level that is safe for the conditions.

1.5.4 DC Interconnect

The ribbon cable connector carries sensed voltages for power and protection to the command board. It also carries A+ feed to the command board for distribution throughout the internal transceiver housing and it carries control voltage from the command board to the power amplifier board.

The rear battery connector (J1) carries A+ and A– from the battery to the power amplifier board. The red lead goes directly to the A+ terminal on the PA board. The black A– lead from the battery connector ties to the chassis and connection to the power amplifier board is made through the board mounting screws.

A– for the internal transceiver housing is through the RF coax ground connectors and through the mechanical connection of the power amplifier heatsink to the rest of the radio. During test conditions in which the power amplifier assembly (board and heatsink) are physically disconnected from the rest of the radio, it is acceptable to rely on the coax cable connections to carry A– to the internal housing.

2. Front Panel Programming and Adjustments

2.1 PROGRAMMING CONTROLS

The following control head buttons are used for programming:

[**Home**]—Used to select and/or store entries. After an entry is saved, the display changes to the next item to be changed or it reverts back to the previous menu level.

[**Mode**]—Used to scroll through the menu choices.

[**Volume**]—Used to scroll through values or letters and numbers for a particular parameter being programmed.

[**Sel**], [**Del**], [**Rcl**]—When available, used for scan list modifications.

A flashing character (cursor) or display indicates that an operator–initiated change is expected at that point.

Note

Not all *Spectra* radio models contain the same features; therefore the front panel programming capability will vary from model to model. Menu choices for features not contained in a particular unit will not be shown. Consult the feature matrix at the front of this manual for more information on the capability of your unit.

2.2 ENTER PROGRAMMING MODE (SEE FIGURE 3.)

To enter the front panel programming mode, turn the radio ON and press [**Home**] five times within 15 seconds after power up. "SELF CHK" display goes away, normal radio operation ceases, and the display changes to "SERVICE".

Note

With "SERVICE" displayed, you can press [**Home**] once to return to normal radio operation. The radio will return to the radio "home" mode.

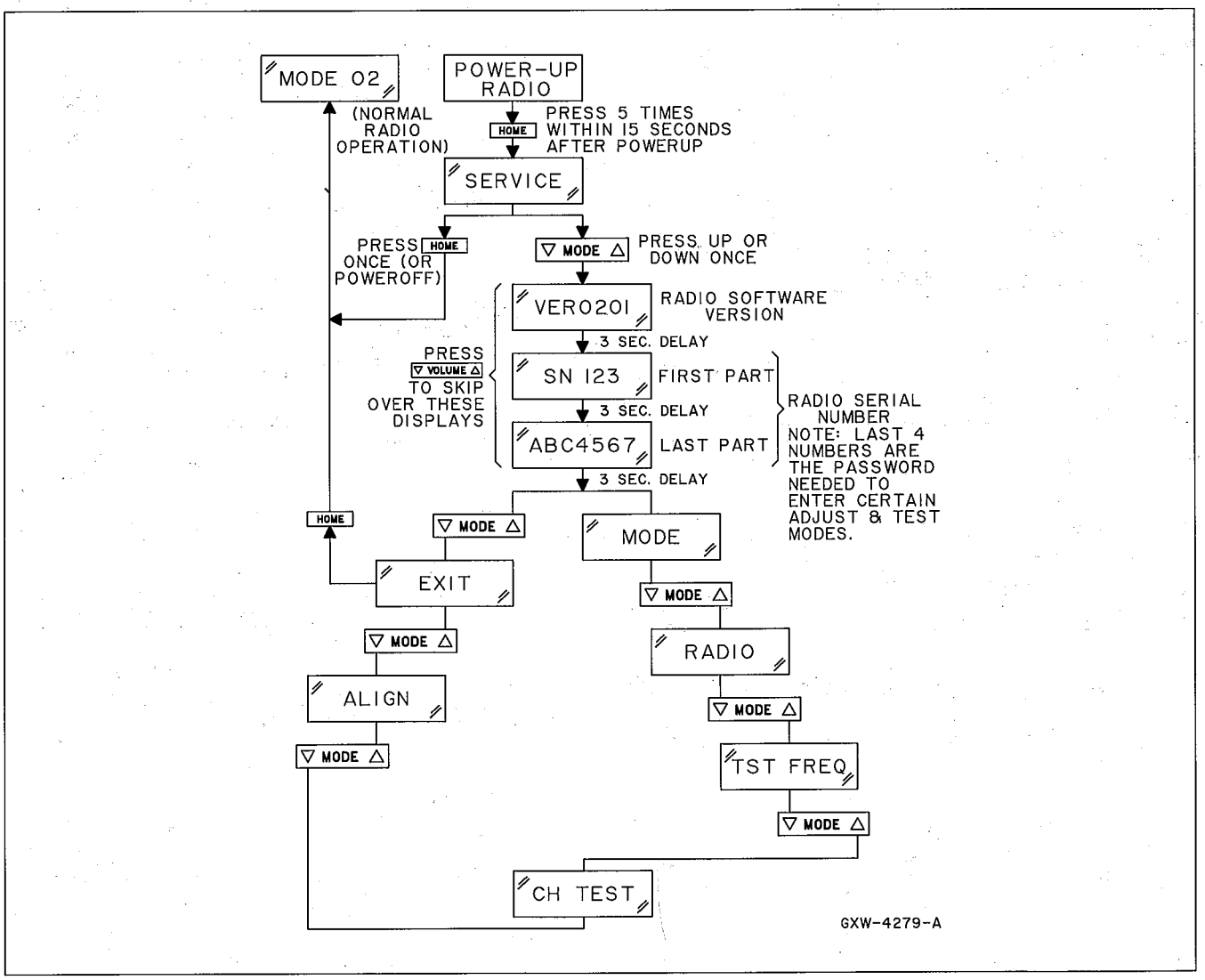


Figure 3. Top Level Menu

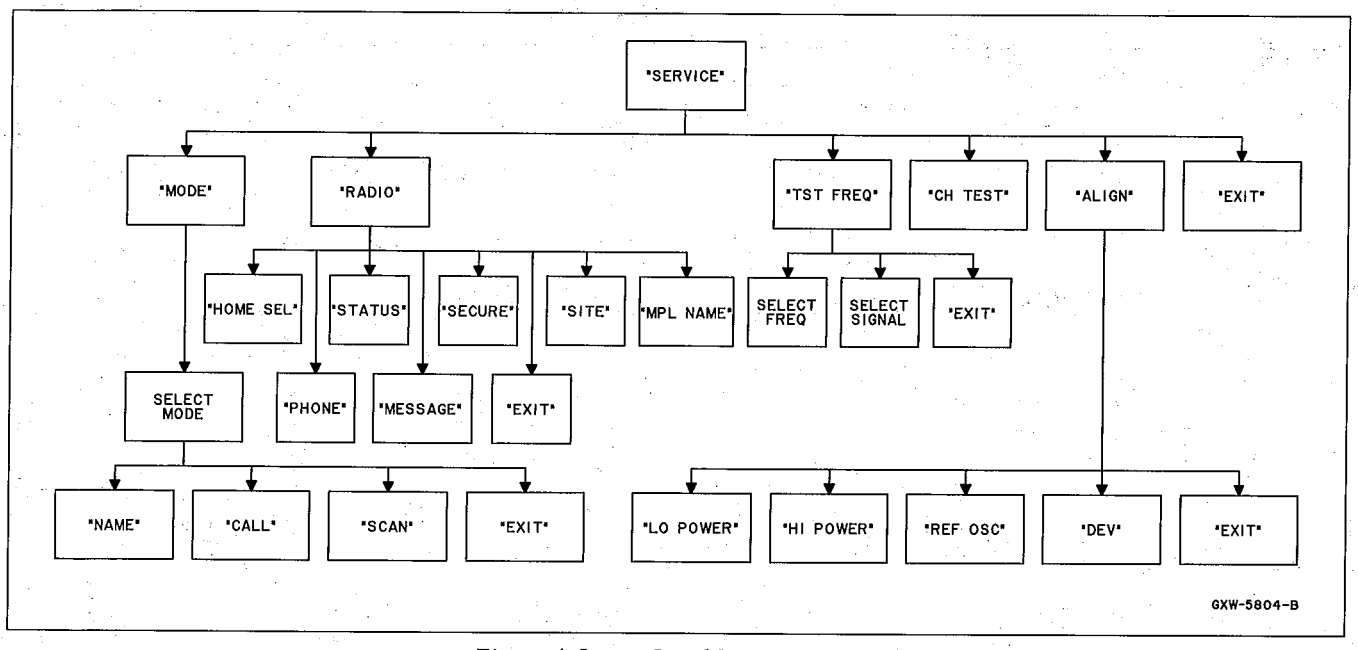


Figure 4. Lower Level Menu Structure

Press [**Mode**] up or down to continue program entry. The control head shows a three–second message, "VERXXXX" (the X's indicate the software version used in your radio). Then the display changes to two more three–second messages—the first is the first three digits of the radio serial number, shown as "S/N XXX", and the second is the last part of the serial number. (If desired, you may skip over the version number and serial number displays by pressing the [**Volume**] rocker after the [**Mode**] rocker has been pressed.) The next message, "MODE", will continue to display until you give another control head command.

2.3 TOP LEVEL MENU

Use the top level menu to select the particular function to be accessed. (See Figure 3.) After the entry sequence is complete, "MODE" is displayed. Five other selections are available at this level—RADIO, TST FREQ, CH TEST, ALIGN, and EXIT. (Figure 4 shows the menu structure and shows how to get from top level to the lower level menus.) Press [**Mode**] to access the different selections. You may scroll through the selections cycle in different directions, depending on which end of the [**Mode**] button you press. Exit the programming mode in one of two ways: scroll to "EXIT" and press [**Home**] or switch the radio's power off. When you turn the power back on, the radio resumes normal operation with any changes that were previously saved.

Select "MODE" to add or modify items associated with particular modes: mode names, call lists, and scan lists.

Select "RADIO" to add or modify items which affect overall radio operations such as the phone list, radio home mode, etc.

Select "TST FREQ" to enter the radio test mode.

Select "CH TEST" to enter the control head diagnostic routine.

Select "ALIGN" to enter a limited radio alignment routine.

Note

The Radio Service Software can be used to selectively disable individual functions in order to restrict access to certain radio parameters. Refer to the Radio Service Software User's Manual for information.

2.4 CHANGE PARAMETERS ASSOCIATED WITH A MODE (SEE FIGURE 5.)

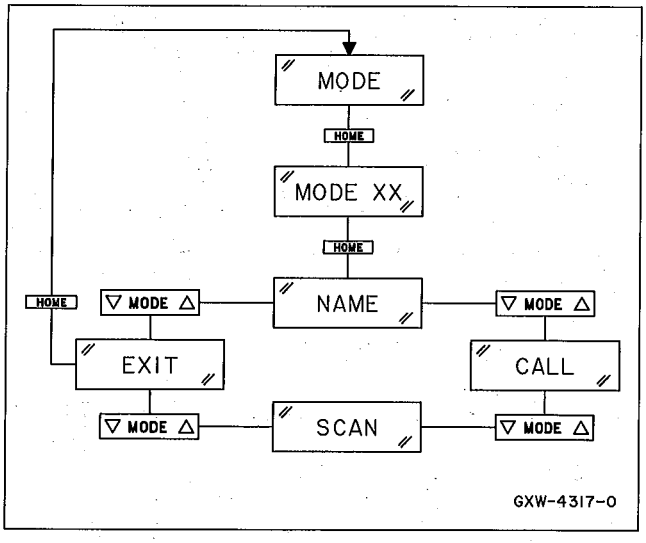


Figure 5. Mode Parameters Menu

(1) After selecting "MODE" from the top level menu, press [**Home**]. The display changes to a mode number/name (e.g. "MODE 1"). The mode name will be flashing to indicate that a selection is expected. Press [**Mode**] UP or DOWN to scroll through all the modes in your radio and the "EXIT" display.

Note

At the "EXIT" display, press [**Mode**] to repeat the cycle or press [**Home**] to return to the top level menu. Press [**Mode**] DOWN to cycle through all the modes in reverse order.

(2) Scroll through the modes until you find the one you want to modify. With that mode displayed, press [**Home**] to "select" the mode for modifications. At this point, the display changes to "NAME".

Note

By pressing [**Mode**], you can cycle the display to "CALL," "SCAN," "EXIT," and back to "NAME." Use this menu when you want to edit the mode names, selective–call or scan lists.

2.5 CHANGE MODE NAMES (SEE FIGURE 6.)

Note

Radio Service Software can be used to disable mode names. This will result in all modes being shown as "MODE XX" where XX represents the mode number. Attempting to change the mode name in Front Panel Programming will result in a bad key tone.

(1) With "NAME" displayed, press [**Home**]. The mode "selected" is displayed with the first character flashing. If you want to change the flashing character, press the [**Volume**] rocker up or down until the desired character is flashing in that position.

Note

When you press the [**Volume**] rocker, you will scroll through, and you may select from: the characters of the alphabet, numbers 0 through 9, _, –, or /. A plus sign (+) will also flash in the cycle, but it is not an allowed character. Use the + sign to program a blank space into the mode name. The letter "S" and the number "5" will be shown identically on the display. Use the radio keypad (if present) to enter numbers directly.

(2) Press [**Mode**] to advance the cursor to the next character, and, again use the [**Volume**] rocker to select the character you want.

(3) Repeat Step 2 until the display shows the name you want.

(4) Press [**Home**] to save the new mode name and return to the "NAME" display. If you wish to change another mode name, press [**Mode**] to scroll to "EXIT" and press [**Home**] to re–enter the "MODE" display. Repeat the above procedures (starting with paragraph 2.4) to change as many mode names as you want.

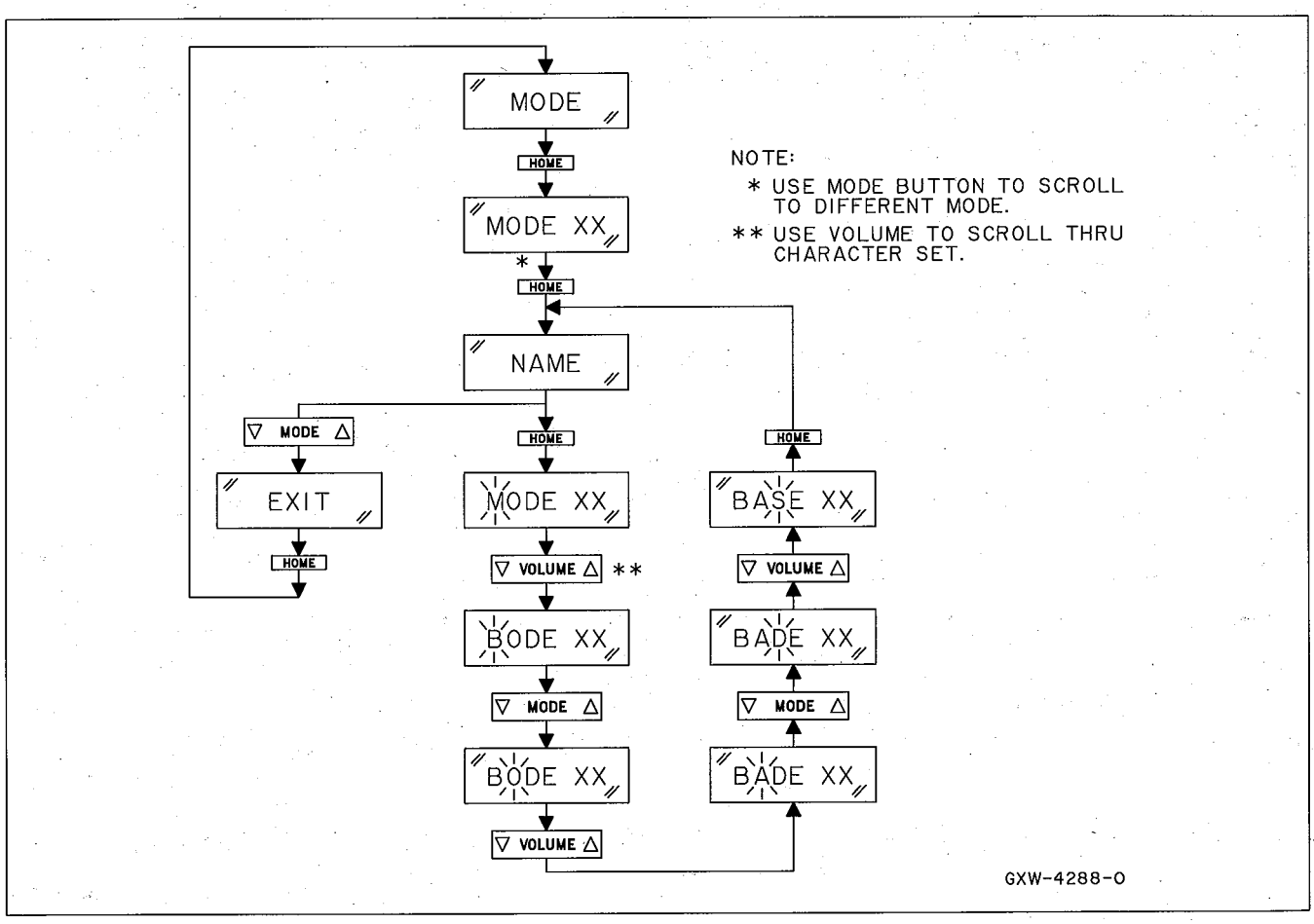


Figure 6. Changing Mode Names

2.6 EDIT SELECTIVE–CALL LIST

The "CALL" menu is much like the "MODE" menu. Use it to assign names and numbers to the radio's selective–call lists. Each list location has two operator–programmable elements—the unit name and the unit ID number. The listed ID numbers are up to six–digit numbers assigned to other mobile units and are used for making Selective calls. Not all radios have call list capability and some have the capability on only certain modes. The "CALL" menu is not seen on models that have no call list capability.

To enter the "CALL" menu, proceed as you would to enter the "NAME" menu. (See paragraph 2.4.) With "NAME" displayed, press [**Mode**] UP to scroll to the "CALL" menu. Press [**Home**]; the display changes to alternating displays, e.g. "UNIT 1" displays for 2 seconds, then "IDXXXXXX" (X's represent a previously programmed ID number) displays for 2 seconds. The default name are ID, as shipped from the factory, are "UNIT XX" and "ID_ _ _ _ _ _". The alternating display continues until you press [**Mode**] to go to another location or you press [**Home**] to "select" the displayed field for editing.

(1) To Edit the Unit Name:

With the display alternating, press [**Home**]. The display defaults to "UNIT XX" (or previously edited name) and the first character flashes. Change the name using the [**Volume**] and [**Mode**] buttons (or keypad if present) just like you would change the mode name (See paragraph 2.5). If you do not wish to change the name or, after you finish editing it, press [**Home**] to save the changes and/or advance to the ID number.

(2) To Edit the ID Number:

Go through Step 1, above, to advance the editor to the ID display. The display will show "ID_ _ _ _ _ _". You may edit the number using the [**Volume**] and [**Mode**] buttons (and keypad buttons on A7 models). If all 6 positions are not filled upon pressing [**Home**], the numbers that were entered will be right justified and saved. Further examination of this ID will show the ID in this right justified configuration.

If your radio has a 12–button keypad, you can delete the existing numbers with the [**Del**] button. Then enter up to six digits of the ID number with the keypad.

When you finish editing the number, press [**Home**] to save the changes and advance to the next list position. Each time you go to another location, you must again press [**Home**] if you wish to "select" the displayed location for editing. When you press [**Home**] to save the eighth location's number, the display shows "EXIT".

From the "EXIT" display, press [**Home**] to return to the "CALL" display. Press [**Mode**] to scroll to the "EXIT" display; then press [**Home**] to return to the top–level menu's "MODE" display.

2.7 EDIT SCAN LISTS (SEE FIGURE 7.)

The "SCAN" menu is used for mode–slaved or operator–selectable scan lists. Radio Service Software can also be used to edit mode–slaved or operator–selectable scan lists. Operator–selectable scan lists can also be modified using the [**Scan**] button. Operation of that feature is covered in the operator's manual.

If the radio has scan list capability, but the selected mode does not, "SCAN" will appear in the display, but an invalid key chirp will sound if you press [**Home**].

2.7.1 Conventional *Channel Scan*

For mode–slaved *Channel Scan* there is a different scan list of each conventional mode. For operator–select *Channel Scan* there is one list that all conventional modes use.

To enter the "SCAN" menu, select the desired conventional mode and proceed as you would to enter the "NAME" menu (See Para. 2.4). With "NAME" displayed, press [**Mode**] to scroll to the "SCAN" menu. Press [**Home**]; the display changes to the first eligible mode name. If that mode is already in the scan list, "NPRI" will be lit or "PRI" will light or flash. To add a mode to the list, or change a mode's status in the list, use the [**Sel**] button as follows:

If Display Has	Press [Sel]	Indicator Changes To	Mode Status is
No Indicators	Once	NPRI Lights	Non–priority
NPRI Lit	Once	PRI Lights	Second Priority
PRI Lit	Once	PRI Flashes	First Priority
PRI Flashing	Once	No Indicators	Non–listed

Note

Repeatedly pressing the [**Sel**] button cycles through the above four choices.

Only one "first" and one "second" priority mode is allowed per list. If you assign first–priority status to a mode in a list that already has such a mode, only the most recently assigned mode will be recognized as first priority; the other mode stays on the scan list, but is reduced to non–priority status. This same rule holds true for second priority.

The selected mode will always be a member of its own scan list and will be shown as "SEL MODE" when reviewing the scan list. If you try to remove it from the list, you will hear a invalid key chirp when you press the [**Sel**] button. You may, however, change its priority status. As shipped from the factory, the scan list will consist of the selected mode plus the first 15 eligible modes in the radio.

Press the [**Mode**] button to save the priority status entered for that mode and to advance to the next mode. Use [**Mode**] to scroll through all the eligible modes. As you scroll through the modes, the PRI and NPRI indicators identify the modes that are on the list. You may scroll through all the modes to the "EXIT" display, press [**Home**] to exit back to the "SCAN" display.

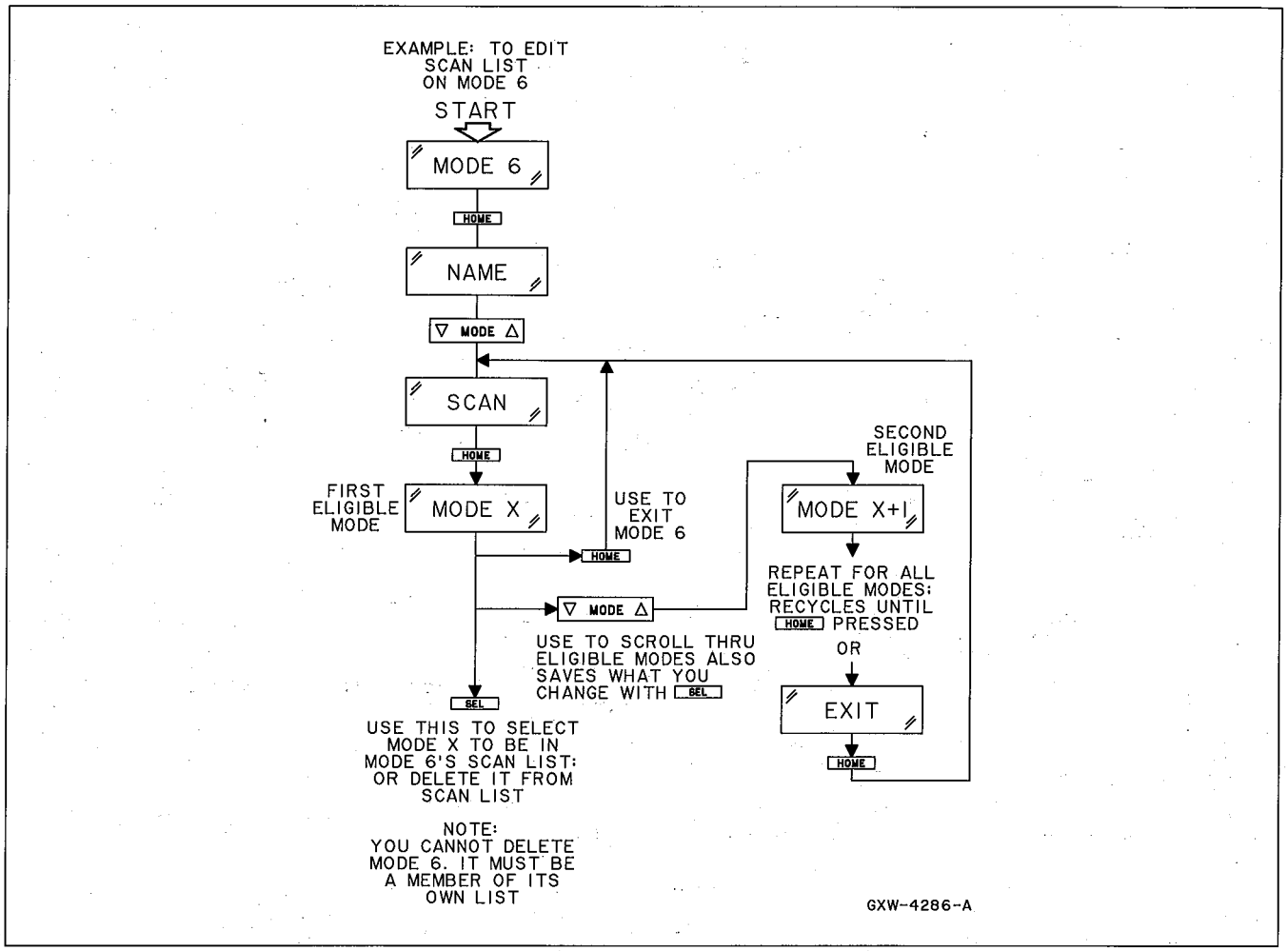


Figure 7. Editing Scan Lists

When the list is filled–up (reached its maximum size), additional attempts to select modes will cause the invalid key chirp and a "LST FULL" display when the **[Sel]** button is pressed. You must make a vacancy, that is delete a mode from the list, before you can add to a full list. To delete, press **[Mode]** to scroll to the mode you want to take off the list. Then simply press **[Sel]** until the PRI AND NPRI indicators are extinguished.

Note

On 12–button keypad radios, you may use **[Rcl]** to scroll through the present scan list and **[Del]** to delete unwanted modes from the list. You may also directly access desired modes by entering the mode numbers on the keypad, then pressing **[Sel]** to add to the scan list.

Exit the editing process with the **[Home]** button and return to the "SCAN" display. If you scroll from the "SCAN" to "EXIT" and press **[Home]**, you will return to the selected mode display.

2.7.2 Talkgroup Scan

Talkgroup scan lists are created like conventional mode–slaved scan lists. The type of scan you are allowed to have is determined by the radio model. Models designated as "B5", "B7", "B9", "C5", "C7", or "C9" contain talkgroup scan. Talkgroup scan allows for up to 16 modes (any in the radio) to be scanned, regardless of which trunked system or conventional system the modes are on.

For fixed–list talkgroup scan there is a different scan list for each trunked personality and each conventional mode. For operator–select talkgroup scan there is one list that all the modes will use.

The type of scan list to be edited will depend upon which mode/personality is selected when the "SCAN" menu is entered. (The mode is selected under the "MODE" display; see paragraph 2.4). The selected mode will always be a member of its own scan list and cannot be deleted; the selected mode is shown as "SEL MODE" when reviewing the scan list.

Editing Talkgroup Scan Lists—If the selected mode is contained in a trunked personality or conventional mode programmed for talkgroup scan, then you will be able to enter up to 15 modes from anywhere in the radio into the scan list, regardless of the trunked system or conventional mode on which they operate. Once the **[Home]** button has been pressed while the "SCAN" display is being shown, the display will change to show the first eligible mode name. If the mode is already in the list, "NPRI" will be lit. The **[Sel]** button toggles

the NPRI light on and off, indicating whether or not the displayed mode is in the scan list. (Recall that priorities cannot be designated in the talkgroup scan list – all modes are equally nonpriority). Use the [**Mode**] and [**Sel**] buttons to scroll through the eligible modes and edit the list, as described in section 2.7.1. TYPE II Fleetwide announcement modes and dynamic regrouping modes can not be entered into the list.

2.7.3 Priority Talkgroup Scan

(1) Description

Trunked models designated as "C5", "C7", or "C9" have priority talkgroup scan. This feature allows monitoring (scanning) of up to 16 modes, all of which must be on the same trunked system, or all of which must be conventional modes.

On a *SMARTNET* radio, if the radio is programmed for priority talkgroup scan operation and if the trunked system is properly equipped, then three levels of priority can be assigned to the modes in the scan list.

Priority talkgroup scan can be fixed–list or operator–select. For fixed–list, there is a different scan list for each trunked personality and for each conventional mode. For operator–select, there is one list per trunked system, and one list for all the conventional modes.

(2) Editing Priority Talkgroup Scan Lists

If the selected mode is contained in a trunked personality programmed for priority talkgroup scan, then you will be able to enter up to 15 modes *from within the same trunked system* to the scan list. Or, if the selected mode is conventional, then you will be able to enter any other conventional mode to the scan list. When the [**Home**] button is pressed while "SCAN" is displaying, the display will change to show the first eligible mode name. If the mode is already in the list, either "PRI" or "NPRI" will be lit. Use the [**Sel**] button to add modes to the list and/or change their priority status in exactly the same manner as conventional mode slaved scan (refer to section 2.7.1). Use the [**Mode**] and [**Sel**] buttons to scroll through the eligible modes and edit the list, as described in section 2.7.1.

2.8 CHANGE RADIO–WIDE PARAMETERS

After selecting "RADIO" from the top level menu, press [**Home**]. The display changes to "HOME SEL". Press [**Mode**] to access up to five other selections available at this level (depending on the model you have)—PHONE, STATUS, MESSAGE, SITE, SECURE, MPL NAME, and EXIT. Press [**Home**] to select the one you wish to modify.

2.9 SELECT RADIO HOME MODE

One of the enabled modes in the radio is the "home" mode that you can access quickly by pressing the [**Home**] button. The default home mode, as shipped from the factory, is the first mode, "MODE 1."

To change the radio home mode, proceed as you would to enter the "RADIO" menu (see paragraph 2.8). With "RADIO" displayed, press [**Home**] to enter the "HOME SEL" menu. Press [**Home**]; the display changes to a mode number/name (e.g. "MODE 1"). The mode name flashes to indicate that a selection is expected. Press [**Mode**] UP or DOWN to scroll through all the modes in your radio and to the "EXIT" display.

When the display is flashing the mode you want to designate as radio's "home" mode, press [**Home**] to "select" it. Your new "home" mode is defined and the display changes back to "HOME SEL". Use [**Mode**] UP or DOWN to scroll to "EXIT"; press [**Home**] to return to the top level menu.

2.10 EDIT PHONE LIST

The "PHONE" menu is much like the "CALL" menu. Use it to assign up to nine names and numbers to the radio's repertory phone list. Each list location has two operator–programmable elements – the name and the number. Not all radios have phone interconnect capability. The "PHONE" menu is not seen on models that have no phone interconnect capability.

To enter the "PHONE" menu, proceed as you would to enter the "RADIO" menu (See paragraph 2.8). With "HOME SEL" displayed, press [**Mode**] UP to scroll to the "PHONE" menu. Press [**Home**]; the display changes to alternating displays, e.g. "PHONE 1" displays for 2 seconds, then the number (if programmed) displays for 2 seconds. The default name, as shipped from the factory, is "PHONE X". The alternating display continues until you press [**Mode**] to go to another location or you press [**Home**] to "select" the displayed unit for editing.

(1) To Edit the Phone Name:

With the display alternating, press [**Home**]. The display defaults to "PHONE X" (or previously edited name) and the first character flashes. Change the name using the [**Volume**] and [**Mode**] buttons (or keypad if present) just like you would change a mode or call list (see paragraph 2.5.). If you do not wish to change the name or, after you finish editing it, press [**Home**] to save the changes and/or advance to the phone number.

(2) To Edit the Phone Number:

Go through Step 1, above, to advance the editor to the phone number display. An unprogrammed location's display will show a flashing "_" on the left side of the display. If a number has already been programmed, the leftmost number will be flashing. You may edit the number using the [**Volume**] and [**Mode**] buttons just like you would edit the mode name (See paragraph 2.5).

If your radio has a 12–button keypad, enter the phone number with the keypad. When you finish editing the number, press [**Home**] to save the changes and advance to the next list position. Each time you go to another location, you must again press [**Home**] if you wish to "select" the displayed location for editing. When you press [**Home**] to save the ninth location's number, the display shows "EXIT".

From the "EXIT" display, press [**Home**] to return to the "PHONE" display. Press [**Mode**] to scroll to the "EXIT" display; then press [**Home**] to return to the "RADIO"

display. Press [**Mode**] again to scroll to the "EXIT" display and press [**Home**] to return to normal radio operation.

2.11 CHANGE STATUS, MESSAGE, SITE, OR MPL NAMES

Some radio models are capable of sending status or message information and/or operating on one of several different radio systems (Sites) for wide area coverage and/or operator–selectable Multiple PL. Front panel programming can be used to customize the lists of statuses, messages, site, or MPL names, to your preference. The process of editing these lists is identical to changing mode names (see paragraph 2.5).

Note

Radio Service Software can be used to disable status, message, site, or MPL names. This will result in the names always being shown as "STS X", "SITE X", etc., where "X" represents the number. If so disabled, an attempt to change a name in Front Panel Programming will result in a bad key tone.

As shipped from the factory, there are eight names for the status and message lists, eight site names, and 16 MPL names. Their default names are "STS 1" through "STS 8", and "MSG 1" through "MSG 8", "SITE 1" through "SITE 8", and "MPL 1" through "MPL 16", respectively.

To edit the names, enter the "RADIO" menu (see paragraph 2.8), then use the [**Mode**] rocker, UP or DOWN, to select the list–type you wish to modify, STATUS, MESSAGE, SITE, or MPL. With the desired list displayed, press [**Home**]. The display changes to show one of the names in the list (e.g. "STS 1" or "SITE 4"). Press [**Mode**] to scroll through the list of names or press [**Home**] to "select" the displayed name for editing.

After pressing [**Home**] to select a name, that name will display with the first character flashing. Use the [**Volume**] and [**Mode**] buttons to change one of these names just like you would change a mode name (see paragraph 2.5).

After you finish editing the name, press [**Home**] to save the changes. Use the [**Mode**] button to advance to the next name or go to the "EXIT" display. From "EXIT", press [**Home**] to return to the list–type display. Repeat this process until all the desired list names have been changed.

Once all the list names are modified, use the [**Mode**] and [**Home**] buttons to return to normal radio operation by exiting at the top level menu.

2.12 CHANGE SECURE NAME CODES OR KEYS

Some radio models encrypt voice transmissions to provide secure *Private Conversation* capability. The encrypting process depends on codes or keys stored in the radio. The default names for these codes are "CODE 1, CODE 2," etc; the default for keys are "KEY 1", "KEY 2", etc. Use Front Panel Programming to customize these names to your preference. The process of editing these names is identical to the process for mode names.

To edit code names, enter the "RADIO" menu (see paragraph 2.8). Use the [**Mode**] rocker, UP or DOWN, to select the "SECURE" list type. Press [**Home**] to enter a SECURE menu. The display changes to show one of the code or key names in the list. Press [**Mode**] to scroll through the entire list of available codes or keys. Press the [**Home**] button to select the name you wish to edit.

After pressing [**Home**] to select a name, that name will display with the first character flashing. Use the [**Volume**] and [**Mode**] buttons to change one of these names just like you would change a mode name (see paragraph 2.5).

After you finish editing the name, press [**Home**] to save the changes. Use the [**Mode**] button to advance to the next name or go to the "EXIT" display. From EXIT, press [**Home**] to return to the list–type display. Repeat this process until all the desired list names have been changed.

Once all the list–type names are modified, use the [**Mode**] and [**Home**] buttons to return to normal radio operation by exiting at the top level menu.

2.13 ENTERING PASSWORD

To enter TST FREQ, CH TEST, or ALIGN menus, a password will be requested before you can actually enter those modes. To get to these menus, proceed as you would to enter the "MODE" menu. (See Para. 2.2.) With "MODE" displayed, press [**Mode**] to scroll to the "TST FREQ", "CH TEST", or "ALIGN". Press [**Home**]; the display shows "PSWD_ _ _ _" and the first space after "PSWD" blinks. Use the [**Vol**] and [**Mode**] buttons (or keypad, if present) to enter the password.

Note

The password defaults to the last four digits of the radio serial number. However, the password may be changed, and all front panel programming disabled, with the Radio Service Software Package.

Press [**Home**] to enter the password. If you fail to correctly enter the password, the previous display returns, and you must press [**Home**] again and reenter the password correctly. If another attempt fails, turn off the radio to exit, and re–enter the front panel programming mode, this time noting the correct final four digits of the serial number.

Note

If the password has been changed, obtain the new password from your supervisor.

2.14 "ALIGN" MENU

The "ALIGN" menu requires entry of the password number (See paragraph 2.12), however, if entered once for test mode or control head test, a password entry is not required again.

Note

Place the microphone in the hangup clip (grounded) while in the "ALIGN" menu to unsquelch the radio and allow receiver measurements to be made.

The parameters that can be aligned in this mode are transmit power out, reference oscillator warp, and deviation.

Use [**Mode**] to scroll through these menu choices:

(1) Select "LO POWER" for front panel low–level transmit power output adjustment.

(2) Select "HI POWER" for front panel high–level (rated) transmit power output adjustment.

(3) Select "REF OSC" for front panel reference oscillator frequency adjustment.

(4) Select "DEV" for front panel transmitter deviation adjustment.

(5) Select "EXIT" to return to the "ALIGN"display.

2.15 HIGH POWER ADJUSTMENT

WARNING

The radio transmit power is adjusted and tested at the factory under tightly controlled conditions with the most accurate test equipment available and should rarely require field adjustment. Each radio is set to the proper output level while connected to an accurate 50–ohm load impedance. Once the power level has been set, the internal power control/protection circuitry will reduce the power output whenever a load impedance significantly different from 50 ohms is sensed. If adjustment is required, be sure the load impedance is as close as possible to 50 ohms to ensure proper radio operation. Setting power to a level higher than rated power will reduce radio lifetime, and adds no perceptible improvement in system performance.

With "HI POWER" displayed, press [**Home**] to enter the adjustment mode. The display will show "HI 1 XXX", where the "1" represents the applicable test mode transmit frequency (See Table 5. Alignment Mode Frequencies) to be used, and "XXX" represents the current high level transmit power output setting in radio memory. There is no direct correlation between the value of "XXX" and the actual power in watts, however, the power level increases with the "XXX" value. Use [**Mode**] up to change to "HI 3 XXX", which is the highest test frequency.

When setting or measuring RF power, you must follow these guidelines to avoid measurement errors due to cable losses or non 50 ohm connector VSWR:

(1) All cables should be very short and have Teflon dielectric.

(2) Attenuators and 50 ohm loads should have at least 25 dB return loss.

(3) 'Mini UHF' to 'N' adapter 58–80367B21 can be used at the antenna connector. All other connectors should be 'N' type. No other adapters, barrel connectors, etc. should be used.

Connect the radio to the power meter and the 50–ohm load, and be sure the radio supply voltage is 13.6 VDC $\pm$0.2 V. Key the radio with the microphone PTT button, and adjust by pressing the [**Volume**] button up or down until the power meter indicates the rated power level. Then dekey the radio.

Press [**Home**] to save the new value and exit back to the "HI POWER" menu.

Use the [**Mode**] rocker button to scroll through the three test mode frequencies (HI 1 XXX, HI 2 XXX, and HI 3 XXX) and check each as described above. Always re–check for correct power level readings on all modes after power is readjusted.

2.16 LOW POWER ADJUSTMENT [ONLY AVAILABLE ON SPECIAL MODELS.]

WARNING

The radio transmit power is adjusted and tested at the factory under tightly controlled conditions with the most accurate test equipment available and should rarely require field adjustment. Each radio is set to the proper output level while connected to an accurate 50–ohm load impedance. Once the power level has been set, the internal power control/protection circuitry will reduce the power output whenever a load impedance significantly different from 50 ohms is sensed. If adjustment is required, be sure the load impedance is as close as possible to 50 ohms to ensure proper radio operation. Setting power to a level higher than that stated in Paragraph 3.1 will reduce radio lifetime, and adds no perceptible improvement in system performance.

Table 5. Alignment Mode Frequencies

Radio	F1		F2		F3	
Range	RX	TX	RX	TX	RX	TX
2	438.025	438.050	454.025	454.050	469.975	469.950
3	450.025	450.050	466.025	466.050	481.975	481.950
4	482.025	482.050	497.025	497.050	511.975	511.950

With "LO POWER" displayed, press [**Home**] to enter the adjustment mode. The display will show "LO 1 XXX", where the "1" represents the applicable alignment mode transmit frequency (See Table 5) to be used, and "XXX" represents the low level transmit power output setting in radio memory. There is no direct correlation between the value of "XXX" and the actual power in watts, however, the power level increases with the "XXX" value. Use [Mode] up to change to "LO 3 XXX", which is the highest test frequency.

Connect the radio to the power meter and the 50–ohm load, and be sure the radio supply voltage is 13.6 VDC ±0.2 V. Key the radio with the microphone PTT button, and adjust by pressing the [**Volume**] button up or down until the power meter indicates the desired low power level (do not set to less than half the rated power level). Then dekey the radio.

Press [**Home**] to save the new value and exit back to the "LO POWER" menu.

Use the [**Mode**] rocker button to scroll through the three test mode frequencies (LO 1 XXX, LO 2 XXX, and LO 3 XXX) and check each for power level of ±10% of initial power level set. Always re–check for correct power level readings on all modes after power is readjusted.

2.17 REFERENCE OSCILLATOR ADJUSTMENT

WARNING

The reference oscillator is preset at the factory under tightly controlled conditions with the most accurate test equipment available. Proper adjustment is critical to system operation. If adjustment is required, the radio's internal compartment must be stabilized at room temperature (25, ±3 deg C, 77 ±5 deg F) and a high–stability frequency counter (accuracy better than 0.1 ppm, traceable to the national frequency standard) must be used. Perform this adjustment as soon as possible after turning on the radio.

With "REF OSC" displayed, press [**Home**] to enter the adjustment mode. The display will show "REF1 XXX" where the "1" represents the applicable alignment mode transmit frequency to be used (see Table 5. Alignment Mode Frequencies), and XXX represents the current reference oscillator setting in radio memory. There is no direct correlation between the value of "XXX" and the actual frequency in MHz, however, the frequency increases with the "XXX" value.

Connect the frequency counter (refer to the WARNING above) and a 50–ohm load to the antenna connector. Use [**Mode**] to scroll to "REF 1 XXX". Key the radio with the microphone PTT and monitor the frequency counter for a transmit frequency that is within ±230 Hz of the transmit frequency for that test mode. If adjustment is required, operate the [**Volume**] rocker up or down until the correct frequency reading is obtained on the counter. If you cannot adjust the frequency within the prescribed range, the radio requires further servicing.

When adjustment is complete, use [**Home**] to save the new value and return to the "REF OSC" display.

2.18 DEVIATION ADJUSTMENT

WARNING

The transmit deviation is preset at the factory under tightly controlled conditions with the most accurate test equipment available. Correct deviation adjustment is critical for proper operation and for remaining within FCC specifications.

With "DEV" displayed, press [**Home**] to enter the adjustment mode. The display will show "DEV1 XX", where the "1" represents the applicable test mode transmit frequency (See Table 5) to be used, and "XX" represents the current transmit deviation setting in radio memory. There is no direct correlation between the value of "XX" and the actual deviation in kHz, however, the deviation level increases with the "XX" value.

Connect the radio to a modulation analyzer and set the analyzer for peak deviation measurement with a 15 kHz low–pass filter, no de–emphasis, and no high–pass filtering. Press [**Mode**] to scroll to "DEV 1 XX". Apply a 1–volt RMS, 1 kHz tone to the microphone audio and key the radio with the PTT button. Adjust by pressing the [**Volume**] button up or down to adjust the deviation reading to less than or equal to ±4.8 kHz; then dekey the radio. Press [**Home**] to save the new value and exit back to the "DEV" menu.

Note

The three DEV test modes are not independent. Changing any one of them changes the master DEV value and therefore changes the other two DEV modes.

Use the [**Mode**] rocker button to scroll through the three test mode frequencies (DEV1 XX, DEV2 XX, and DEV3 XX) and adjust each as described above. Deviation levels with all the various signalling types can also be checked by returning to the "TST FREQ" menu and accessing the desired test mode modulation and frequency (Refer to paragraph 4.9). (All modulation types should be less than ±4.8 kHz peak deviation on all frequencies.)

3. Alignment via IBM PC

Using an IBM PC, interface hardware, and associated software, field personnel can adjust the *Spectra* radio for either periodic alignment or advanced alignment required when a damaged or failed board is replaced. Simple prompts guide the user through the alignment procedures; the user need only know what procedures to access and the order in which those procedures must be executed.

Note

Reference oscillator, high and low power, and deviation adjustments may also be made from the radio front panel without the IBM PC. See Section 2, Front Panel Programming and Adjustments.

Standard Alignment Procedures (power set & current limit adjust, reference oscillator warping, and deviation alignment) are performed at the factory and should not be performed in the field unless field repairs have been made. Software in the PC cautions against advanced alignment (or Post Repair Alignment Procedures) except when board replacement has occurred. (See Figure 8, Service Alignment Diagram.)

Table 6 details the procedures required and the sequence in which the procedures must be performed after each specific board replacement. No alignment is required for parts replacement other than those shown in the table.

CAUTION

After alignment, exit the "SERVICE" menu entirely (to the "MAIN MENU") to save all changes properly. Failure to do so can result in an 'FL 01/82' failure (see Table 7).

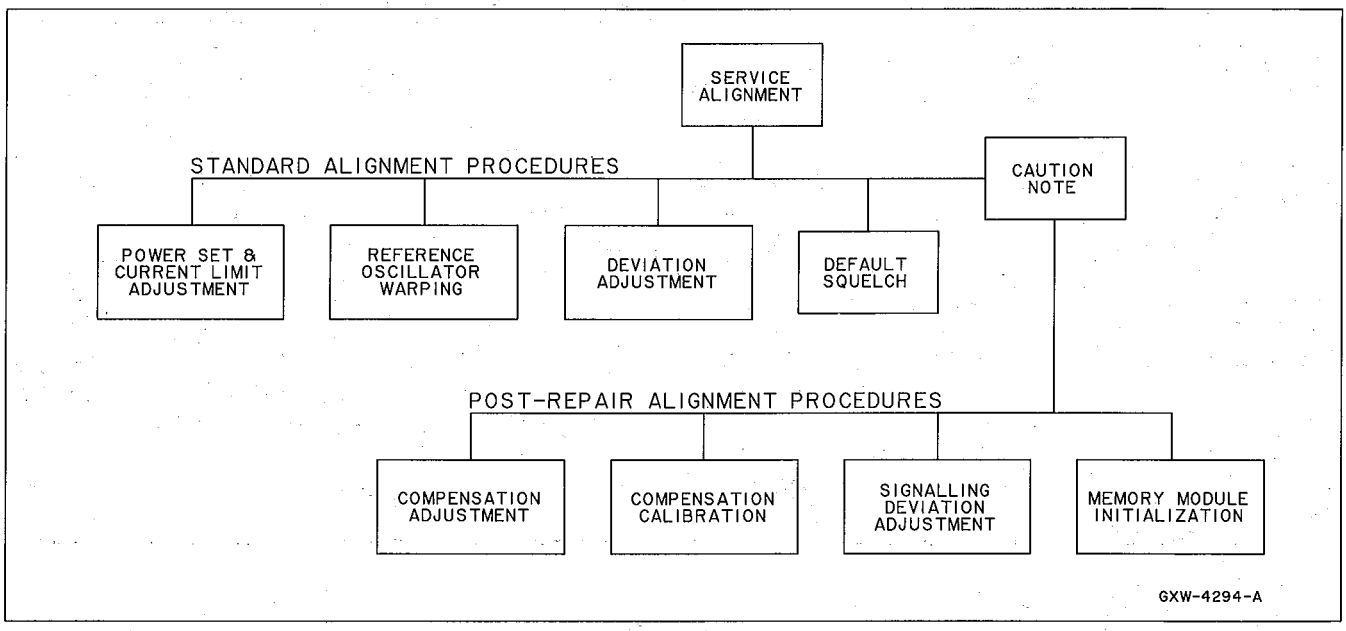


Figure 8. Service Alignment Diagram

Table 6. Alignment Procedures

Procedure > ITEM	Reference Oscillator Warping	Deviation Adjustment	Power Set & Current Limit	Compensation Adjustment	Compensation Calibration	Signalling Deviation Adjustment	Memory Module Initialize
RF BOARD	First	Third	N/A	Second	N/A	N/A	N/A
REFERENCE OSCILLATOR	Only	N/A	N/A	N/A	N/A	N/A	N/A
VCO BOARD	N/A	Third	N/A	Second	First	N/A	N/A
COMMAND BOARD	Second	Sixth	Third	Fifth	Fourth	Last	First
CONTROL HEAD BOARD	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PA BOARD	N/A	N/A	Only	N/A	N/A	N/A	N/A
MEMORY BOARD	N/A	N/A	N/A	N/A	N/A	N/A	Only

3.1 POWER SET AND CURRENT LIMIT ADJUTMENT

(1) Connect a power meter and a 50–ohm load (or Service Monitor) to the antenna connector using minimum cable length and as few adapters as possible.

Note

The Power Amplifier must be firmly mounted to the transceiver for accurate power adjustment.

(2) Connect DC power to the radio and switch radio power on.

(3) At the PC's "MAIN MENU" prompt, press F2 to select "SERVICE."

(4) At the "SERVICE" menu, press F2 to select "ALIGNMENT."

(5) At the "ALIGNMENT" menu, press F7 to select the TX High Power screen.

Note

For basic tune–up, skip the following steps that are followed by an asterisk (*); perform all the following steps after PA Board replacement.

(5a) At the High Power Set screen press the DOWN arrow key to adjust the power set relative value to 50. (This prevents excessive initial power output.)

Note

Microphone PTT should not be used during this procedure, as it may cause incorrect frequency selection.

(5b) Press F8, "PROGRAM VALUE," to save this value in the radio.

(5c)*Press F9, "SET TX I LIMIT," to enter Current Limit Adjustment screen.

(5d)*Press the UP arrow to step the current limit to a maximum value of 15. (This does not equate to 15–amps radio current.)

(5e)*Press F8 to program value; then press F10 to return to the High Power Set screen.

(6) Press F3, "MID TEST FREQ", to place the radio on the middle test frequency. Press F6, "TOGGLE PTT," to key the radio. Use UP or DOWN arrow keys to adjust the relative value to obtain the correct power output.

Note

DO NOT use the Microphone PTT during this procedure; while that DOES cause the radio to transmit on the test mode, it also corrupts the alignment data.

Note

Set power to rated plus 10%; i.e. set 40–watt radio to 44.0 watts. Power can be set on any test frequency, but only one setting (the most recent) will be saved.

(6a)*Press F6 to de–key; then press F8 to program this value.

Note

Adjust transmit current limit to a level slightly above the maximum current drain under normal conditions. Determine which test mode (1, 2, or 3) draws the most current and set current limit on that mode.

(6b)*Determine highest–current drain test mode as follows;

- Press F3 to return to the Current Limit screen.
- Press F2, "LOW TEST FREQ", to place the radio on the lowest test frequency. Press F6 to key radio and measure the total radio current drain. (Computer should display "TRANSMITTER ON 438.050 [R2], 450.050 [R3] or 482.050 [R4] MHz".) Press F6 again to de–key radio.
- Press F3, "MID TEST FREQ", to change to the midrange test frequency. Key radio and measure current drain. (Computer should display frequency.) De–key radio.
- Press F4, "HI TEST FREQ", to change the the highest test frequency. Key radio and measure current drain. (Computer should display frequency.) De–key radio. Use the F2, F3, or F4 key to return to the highest–current mode.

(6c)*Press F6 to key the radio.

(6d)*Decrease the current limit relative value until the power output just begins to drop; then increase the value by one increment.

(7) Press F6 to de–key; then press F8 to program this value.

(7a)*Press F10 to exit Current Limit screen.

(8) Press F10 to exit High Power Set screen.

(9) At the "ALIGNMENT" menu, press F8 to select the TX Low Power screen. Adjust the value to the same setting used for high power set and press F8 to program the value.

Note

Power can be set on any test frequency but only one setting (the most recent) will be saved.

(10) This completes Power Set and Current Limit Adjustment. Press F10 as needed to return to the MAIN MENU or to other SERVICE screens.

3.2 REFERENCE OSCILLATOR WARP ALIGNMENT PROCEDURE

Adjustment of the reference oscillator is critical for proper radio operation. Improper adjustment will not only result in poor operation but also, a misaligned radio will interfere with other users operating on adjacent channels. For this reason, the reference oscillator should be checked every time the radio is serviced. The frequency counter used for this procedure must have a stability of 0.1 ppm or better.

Note

The radio internal circuitry must be at room temperature (25, ±3 deg. C; 77, ±5 deg. F) to properly center the adjustment. Additionally, the radio should not be heated from transmitting or operating at a loud audio setting for a long period of time. Turn the radio off and let the radio cool thoroughly to room temperature before setting the reference oscillator.

(1) Connect the frequency counter and a 50–ohm load (or Service Monitor) to the antenna connector.

(2) Connect DC power to the radio and switch radio power on.

(3) At the PC's "MAIN MENU" prompt, press F2 to select "SERVICE."

(4) At the "SERVICE" menu, press F2 to select "ALIGNMENT."

(5) At the "ALIGNMENT" menu, press F5 to select the Reference Oscillator warp screen.

(6) At the Reference Oscillator Warp screen press F6, "TOGGLE PTT," to key the radio and use the UP or DOWN arrow keys to adjust the reference oscillator frequency by selecting the relative value that yields the frequency closest to the desired frequency.

Note

When you press F6, "PTT TOGGLE," you place the radio into Test Mode 1 and you cause the radio to transmit. Do NOT use the Microphone PTT during this procedure; while that DOES cause the radio to transmit on the test mode, it also corrupts the alignment data.

(7) Press F6 to de–key the radio; then press F8 to program the value.

(8) This completes Reference Oscillator Warp adjustment procedure. Press F10 as needed to return to the MAIN MENU or to other SERVICE screens.

3.3 TRANSMIT DEVIATION ALIGNMENT PROCEDURE

Note

Compensation should not require any adjustments, however, if for any reason such adjustments are needed, adjust compensation per paragraphs 3.4 and 3.5 before you attempt to align deviation.

The transmit deviation should be checked any time the radio is serviced and must be readjusted whenever any compensation adjustments are made.

(1) Connect a modulation analyzer (or Service Monitor) to the antenna connector using minimum cable length and as few adapters as possible. Apply a 1–volt RMS, 1–kHz tone to the microphone audio. Set the Modulation analyzer to read peak deviation.

(2) Connect DC power to the radio and switch radio power on.

(3) At the PC's "MAIN MENU" prompt, press F2 to select "SERVICE."

(4) At the "SERVICE" menu, press F2 to select "ALIGNMENT."

(5) At the "ALIGNMENT" menu, press F3 to select the TX Deviation screen.

(6) At the TX Deviation screen press F6, "TOGGLE PTT," to key the radio. (The programmer defaults to the Low Test mode.) Use the UP or DOWN arrow keys to adjust the deviation to ±4.7 kHz, maximum. Press F6 to de–key the radio.

(7) Press F3 to move to the next test mode. Then press F6 to again key the radio.

(8) Check the deviation and readjust as necessary. Press F6 to de–key the radio.

(9) Press F4 to move to the last test mode and check the deviation again, pressing F6 to key the radio; readjust as necessary.

(10) Press F8 to program the value.

(11) This completes TX Deviation adjustment. Press F10 as necessary to step back to the MAIN menu or to other SERVICE screens.

3.4 COMPENSATION ALIGNMENT PROCEDURE

Compensation alignment balances the modulation sensitivity of the VCO and reference modulation (synthesizer low–frequency port) lines. Compensation alignment is critical to the operation of signalling schemes that have very low frequency components (e.g. DPL) and could result in distorted waveforms if improperly adjusted.

Compensation alignment should only be required after replacing (or servicing) the command board, the RF board, or the VCO. Use either of the following methods, depending on test equipment availability.

Note

The 1 kHz tone used to set deviation in Step 3.3 must not be connected during the compensation adjustment as it will sum with the 11 Hz or 67 Hz tones.

3.4.1 METHOD 1

This method requires a modulation analyzer or meter with a frequency response to less than 10 Hz modulating frequency. This is the preferred, more accurate method. If, however, such test equipment is not available, use Method 2.

(1) Connect the modulation meter to the antenna connector using minimum cable length and appropriate power attenuators for the meter input level.

(2) Connect DC power to the radio and switch radio power on.

(3) At the PC's "MAIN MENU" prompt, press F2 to select "SERVICE."

(4) At the "SERVICE" menu, press F4 to select "ADVANCED ALIGNMENT."

(5) At the "ADVANCED ALIGNMENT" menu, press F3 to select the TX Compensation screen.

(6) At the TX Compensation screen, press F4 to key the radio with an 11 Hz tone modulation.

Note

By pressing F4, "PTT 11 HZ," you place the radio into Test Mode 2, causing it to transmit. Microphone PTT should not be used during this procedure, as it will cause the radio to transmit on the mode presently displayed on the control head and will not generate the necessary tone.

(7) Note the level of deviation on the analyzer and press F4 to de–key the radio. (Use average deviation, if available, on the analyzer.)

(8) Press F6 to key the radio again. This generates a 67 Hz tone.

(9) Use the UP and DOWN arrow keys to adjust the compensation value until the deviation is within ±0.2 dB (2.3%) of the value noted in Step 7. Repeat steps 6 through 9.

(10) Press F6 to de–key; then press F8 to program the value.

(11) This completes TX Compensation adjustment procedure. Press F10 twice to return to the "SERVICE" menu and adjust deviation per paragraph 3.3.

3.4.2 METHOD 2

This method for setting TX Compensation can be used if a modulation analyzer or meter, as described in Method 1, is not available. This method requires the radio be disassembled so that the RF board is exposed and test point TP603 on that board can be accessed with an AC millivoltmeter.

(1) Connect DC power to the radio and switch radio power on.

(2) At the PC's "MAIN MENU" prompt, press F2 to select "SERVICE."

(3) At the "SERVICE" menu, press F4 to select "ADVANCED ALIGNMENT."

(4) At the "ADVANCED ALIGNMENT" menu, press F3 to select the TX Compensation screen.

(5) At the TX Compensation screen, press F6 to key the radio with a 67 Hz tone modulation.

Note

By pressing F6, "PTT 67 HZ," you place the radio into Test Mode 2, causing it to transmit. Microphone PTT should not be used during this procedure, as it will cause the radio to transmit on the mode presently displayed on the control head and will not generate the necessary tone.

When measuring the voltage on TP603 with the AC millivoltmeter, keep the ground leads as short as possible to keep noise to a minimum level.

(6) Use the UP and DOWN arrow keys to adjust the compensation value for a null AC voltage at TP603.

(7) Press F6 to de–key; then press F8 to program the value.

(8) This completes TX Compensation adjustment procedure. Press F10 twice to return to the "SERVICE" menu and adjust deviation per paragraph 3.3.

3.5 TX COMPENSATION CALIBRATION ALIGNMENT PROCEDURE

Alignment of compensation calibration points is a a way of correcting for deviation sensitivity vs RF frequency variations in the VCO. These points must be checked and adjusted if the VCO is replaced. There are two frequency zones for compensation calibration points. Adjust these independently.

(1) Connect a modulation analyzer (or Service Monitor) to the antenna connector using minimum cable length and as few adapters as possible. Apply a 1–volt RMS, 1–KHz tone to the microphone audio. Set the modulation analyzer to read average deviation. If meter can't measure average, then peak devation is acceptable.

(2) Connect DC power to the radio and switch radio power on.

(3) At the PC's "MAIN MENU" prompt, press F2 to select "SERVICE."

(4) At the "SERVICE" menu, press F4 to select "ADVANCED ALIGNMENT."

(5) At the "ADVANCED ALIGNMENT" menu, press F4 to select the TX Compensation Calibration screen.

Note

There are two compensation calibration points to be set. Use the F6 key only to key the radio since the programmer calculates the correct frequency for each point and programs the radio to operate at that frequency. Do not use the microphone PTT.

When using this menu, and upon saving the values, the programmer recalculates and stores both the compensation calibration and the compensation values. These may not be the same as those displayed before storing the final values.

(6) Using F6 to key and de–key the radio, measure the deviation on both compensation frequencies. Note the highest frequency.

(7) Set the compensation adder of the highest deviation frequency to zero using the up/down arrows.

(8) Go to the highest deviation frequency and press F6 to key the radio. Set a reference of the deviation and press F6 to de–key the radio.

(9) Go to the next frequency and press F6 to key the radio. Using the up/down arrows, set the deviation to with ±0.25 dB. Press F6 again to de–key the radio.

(10) Once both frequencies have the same deviation (i.e. completed compensation calibration alignment), press F8 to program the values.

(11) Press F10 to exit this alignment screen.

(12) This completes TX Compensation Calibration adjustment procedure. The radio must now be re–aligned for both TX Compensation Alignment and TX Deviation.

Compensation Set Frequencies		
Range	**Number**	**Freq.**
2	1	448.500
2	2	464.050
3	1	460.500
3	2	476.500
4	1	490.025
4	2	505.025

3.6 SIGNALLING DEVIATION ADJUSTMENT

Signalling deviation should be checked any time the radio is serviced and must be adjusted whenever any of the modulation circuitry has been replaced. Before adjusting signalling deviation, radio compensation/deviation adjustments must be made. No adjustments are required for PL, DPL, or Trunking Connect Tone deviation.

(1) Connect the modulation analyzer (or Service Monitor) to the antenna connector. Set modulation analyzer to read peak deviation.

(2) Connect DC power to the radio and switch radio power on.

(3) At the PC's "MAIN MENU" prompt, press F2 to select "SERVICE."

(4) At the "SERVICE" menu, press F4 to select "ADVANCED ALIGNMENT."

(5) At the "ADVANCED ALIGNMENT" menu, press F8 to select the "SIGNALLING DEVIATION."

(6) At the "SIGNALLING DEVIATION" menu, select the desired signalling type by pressing the appropriate key:

F3	DTMF
F4	MDC
F6	TRUNKING HIGH SPEED DATA
F7	*SECURENET*

Note

Only the signalling types used on the radio being aligned must be adjusted. If the radio is a Dual Mode radio, both Conventional and Trunking features must be adjusted. DTMF must be adjusted if used on either Conventional or Trunked modes. On Conventional radios without MDC or DTMF, these adjustment procedures are not required. On radios without *SECURENET*, this adjustment procedure is not required.

(7) At the selected signalling screen, press F6 to key the radio.

(8) Use the UP and DOWN arrow keys to adjust deviation. Stop adjustment at the deviation value closest to the value shown below:

DTMF	3.00 kHz
MDC	3.50 kHz
SECURENET	4.00 kHz
TRUNKING H.S.	3.20 kHz

(9) Press F6 to de–key the radio; then press F8 to program the deviation value.

(10) Press F10 to return to the "SIGNALLING DEVIATION" menu. Select another signalling type and repeat steps 6 through 9. Repeat until all signalling types are adjusted.

(11) This completes Signalling Deviation adjustment procedure. Press F10 as needed to return to the MAIN MENU or to other SERVICE screens.

3.7 DTMF ENCODER MICROPHONE DEVIATION ADJUSTMENT

To adjust the DTMF deviation level of a Touch Code Encoder (DTMF) microphone, enter the front panel test frequency menu as described in paragraph 4.9 of this manual and select the second test frequency and Carrier Squelch (CS) signalling type. (DO NOT attempt to adjust the Touch Code microphone deviation level while in the Radio Service Software signalling deviation adjustment—an error will occur when the microphone is keyed).

After selecting the proper test mode, observe the Touch Code DTMF deviation on a modulation analyzer or service monitor (set for peak deviation reading) while repeatedly pressing the "#" button. Each button press causes the radio to transmit for 1.2 seconds. The correct deviation level is 3.75 kHz.

If adjustment is required, insert a long tuning tool (Motorola Part No. 66–84974L01) through the microphone rear housing access hole located to the right of the nameplate. To set the deviation, rotate the tone deviation potentiometer.

Important

Set the level during the 1.2 seconds following the press of the "#" button in order to get an accurate reading.

4. Troubleshooting and Repair

4.1 POWER–UP SELF CHECK DISPLAYS

When you power up the radio, the control head goes through a self–test routine to check for system failures. Table 7 lists the error messages that may appear in the display, followed by the possible causes and remedies.

Table 7. Power–Up Self Check Display

Condition	Display	Possible cause	Remedy
A	FL 01/81	The pattern stored in the Memory Board ROM is incorrect.	Replace Memory Board.
B	FL 01/82	The pattern stored in the Memory Board EEPROM is incorrect.	a. Reprogram EEPROM from ARCHIVE file if available. See paragraph 4.7.4, step 6a.
			b. Replace Memory Board.
C	FL 01/83	Radio has conditions A and B.	
D	FL 01/84	Memory Board EEPROM is blank.	Replace Memory Board.
E	FL 01/85	Radio has conditions A and D.	
F	FL 01/86	Radio has conditions B and D.	
G	FL 01/87	Radio has conditions A, B and D.	
H	FL 01/88	Memory Board RAM defective.	Replace Memory Board.
I	FL 01/89	Radio has conditions A and H.	
J	FL 01/8A	Radio has conditions B and H.	
K	FL 01/8B	Radio has conditions A, B and H.	
L	FL 01/8C	Radio has conditions D and H.	
M	FL 01/8D	Radio has conditions A, D and H.	
N	FL 01/90	Serial Bus Failure. May be a control head failure, a radio command board failure, or a cabling failure.	a. See Control Head Troubleshooting.
			b. Check rear options connector cabling.
			c. Replace Command Board.
O	FL 01/92	The pattern stored within the microcomputer EEPROM is incorrect.	Initialize EEPROM (see paragraph 4.7.5).
P	FL 01/93	Radio has conditions A and O.	
Q	FL 01/94	Microcomputer EEPROM is blank.	Replace Command Board.
R	FL 01/95	Radio has conditions A and Q.	
S	FL 05/81	Control Head ROM is defective.	Replace Control Head Board.
T	FL 05/88	Control Head RAM is defective.	Replace Control Head Board.
U	ER 01/02	Radio has an error with its EEPROM; one or more modes in the radio has an incorrect pattern in the Memory Board EEPROM. Radio will function normally until a corrupted mode is accessed; then "FAIL 002" will be displayed (see below).	a. Reprogram EEPROM from ARCHIVE file if available. See paragraph 4.7.4, step 6a.
			b. Replace Memory Board.
V	BLANK DISPLAY BUT TX AND BUSY LED'S LIT BRIEFLY AT POWER UP	Display malfunction.	Replace Control Head Board.
W	FAIL 001	Synthesizer out–of–lock condition.	See Synthesizer Troubleshooting.
X	FAIL 002	The mode which has been accessed has an incorrect pattern in the Memory Board EEPROM. (Refer to ER 01/02 above, Item S).	a. Reprogram EEPROM from ARCHIVE file if available. (See paragraph 4.7.4, step 6a.
			b. Replace Memory Board.
Y	FAIL 999	Serial number in the Memory Board and the microcomputer do not match; Radio will not function but will enter test mode.	Replace the Memory Board with the proper one.

4.2 CONTROL HEAD TROUBLESHOOTING

4.2.1 Display Messages

Failure messages, "FL XX/XX", or error messages, "ER XX/XX", are related to radio command board problems in all cases except the following:

- FL 05/81—control head microprocessor ROM error; replace Control Head Board.
- FL 05/88—control head microprocessor RAM error; replace Control Head Board.
- FL 01/90—serial data bus failure; may be either a control head failure, a cabling failure, or a radio command board failure.

4.2.2 Control Head Problems

The following symptoms are caused by a control head problem:

- Flickering "SELF CHK" but no failure message.
- Control head powers up but button presses have no apparent effect.
- A few segments (or characters) will not light on display.
- Very bright display; varies with supply voltage.
- Very dim display.

If the display does not function or if button presses have no effect, remove the control head and perform the control head test (See Paragraph 4.10). If it fails to produce the desired results, remove the control head board and install a new board. If it passes the test, check for cabling or command board problems.

4.3 TRANSMITTER TROUBLESHOOTING

When setting or measuring RF Power at UHF, you must follow these guidelines to avoid measurement errors due to cable losses or non–50 ohm connector VSWR:

(1) All cables should be very short and have Teflon dielectric.

(2) Attenuators and 50 ohm loads should have at least 25 dB return loss.

(3) 'Mini UHF' to 'N' adaptor 58–80367B21 can be used at the antenna connector. All other connectors should be 'N' type. No other adapters, barrel connectors, etc. should be used.

Figure 8A shows the preferred test set–up using no cables.

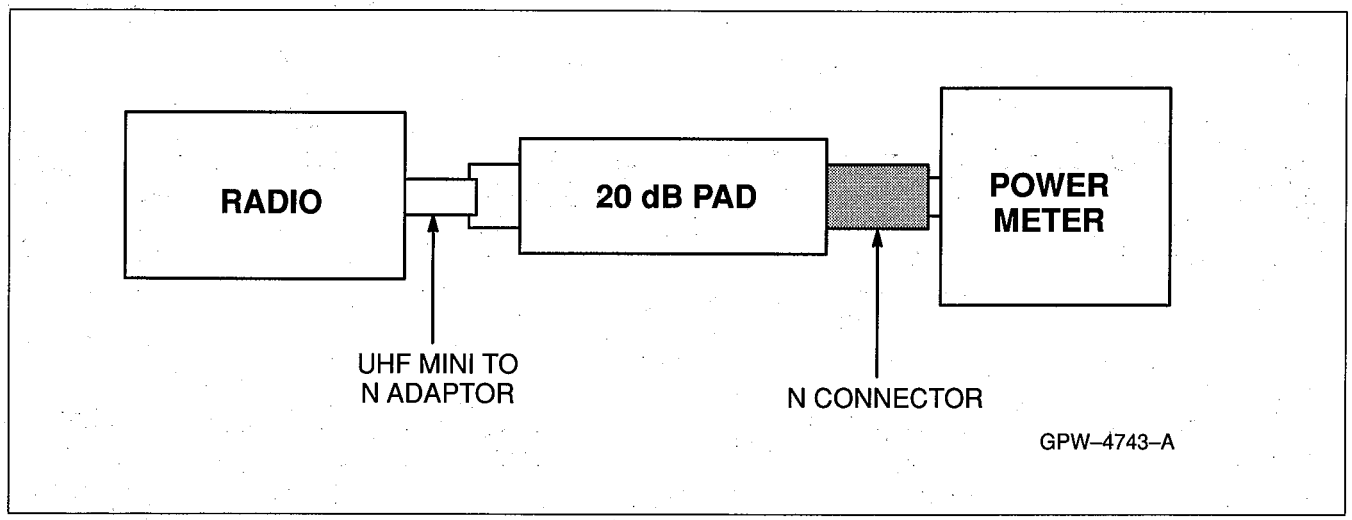


Figure 8A. Transmitter Troubleshooting Preferred Test Setup

Table 8. Transmitter Troubleshooting Chart

Symptom	Possible Cause	Correction or Test (Measurements Taken at Room Temperature)
No RF power out.	1. TX power level	Check TX power level programming (from front panel or programmer).
	2. No keyed 9.4 V from command board.	Check for keyed 9.4 V on Pin 15 of J500 w/transmitter keyed. If none then replace command board.
	3. No injection to power amplifier.	a. Check the lock line (pin 14 of J500); if not less than 2 volts then go to synthesizer troubleshooting chart.
		b. Measure injection; should be ≥ +15 dBm; If low replace VCO board.
	4. Power Amplifier.	Measure PA control voltage (Pin 2 of P503); if > 10 volts replace PA board.
	5. Power control circuit	If PA control voltage above was < 10 volts, replace command board. (on command board).
No modulation.	1. VCO board.	a. All modulation testing should be done w/ the radio keyed & 1 Vrms on the microphone high line of the microphone.
		b. Is there > 300 mV rms @ pin 11 of J500? If so then replace VCO board.
	2. Command board.	If there is the correct voltage @ 19 of P501 and not at pin 11 of J500 then check deviation and compensation programming; if OK then replace command board.
Distorted modulation	1. Command board.	(These measurements should be made w/1 kHz tone @ 80 mV rms injected @ the microphone high line.)
		Is the output of the command board (pin 11 of J500) distorted? If so replace command board.
	2. Compensation not set/working (DPL distorted).	Check compensation setting; if compensation won't adjust, go to "Can't Set Compensation" below.
	3. VCO board.	Replace VCO board.
Bad microphone sensitivity.	1. Check deviation and compensation	Reset if necessary.
	2. Microphone.	Speaking loudly into the microphone, monitor the output voltage; if it is not > 1 Vp–p then replace the microphone.
	3. Command board.	W/80 mV rms on the mic high line, monitor the VCO mod line (pin 11 on J500); voltage should be > 200 mV rms; if not replace command board.
	4. VCO board.	If correct voltage was found on pin 11 of J500 then replace the VCO board.
No/low signalling (PL, DPL, MDC).	1. Check programming.	
	2. Command board.	Check for proper modulation at pin 11 of J500; if not there, than replace command board.
Can't set compensation.	1. Command board.	a. All modulation testing should be done w/ the radio keyed & 1 Vrms on the mic high line of the microphone; check that normal voice deviation is OK; otherwise go to "No modulation" or "Bad microphone sensitivity".
		b. Set deviation & compensation controls to maximum; voltage & pin 17 of J500 should be > 3 Vp–p; voltage @ pin 11 of J500 should be > 3 Vp–p; if not, replace command board.
	2. RF board.	If maximum deviation can be set to > 5.0 kHz, but compensation cannot be set, then replace RF board; otherwise, replace VCO board.

Table 8 lists a number of transmitter–related symptoms which may occur that interrupt normal radio operation. Use this chart to help troubleshoot and repair transmitter problems to the board level. This chart does not attempt to isolate problems to the component level.

4.4 RECEIVER TROUBLESHOOTING

Table 9 lists a number of receiver–related symptoms that may interrupt normal radio operation. Use this chart to help troubleshoot and repair receiver problems to the board level. This chart does not attempt to isolate problems to the component level.

WARNING

The Audio PA (U450) is a DC–coupled bridge type amplifier with it outputs directly connected to the external speaker. Therefore, the speaker output must never be grounded. Use an audio isolation transformer (e.g. Motorola Part No. SLN6435A) to isolate test equipment from the Audio PA (U450)/ speaker.

Table 9. Receiver Troubleshooting Chart

Symptom	Possible Cause	Correction or Test (Measurements Taken at Room Temperature)
Radio dead; display does not light up.	1. Blown fuse.	Check fuse in red lead of power cable (or green lead if used).
	2. On/off switch (Control head).	Check for SWB+ @ pin 31 of J0502 on the Command Board; if not there check for SWB+ @ pin 4 of P103 on the control head.
	3. Regulators (Command Board).	Check for 9.6 V on pin 10 of J500 and +5 V on pin 1 of J500; if not there, then check for A+ at pin 30 of J502; if OK then replace command board.
Radio dead; display lights up.	1. Audio PA circuit.	Check continuity of F500 on command board; if open, check for speaker leads shorted to ground, replace.
	2. Synthesizer (RF Board).	Check the synthesizer A Clock line (pin 14 J500); if not less than 2 volts, then go to synthesizer troubleshooting chart.
	3. Regulators (Command Board).	Check for 9.6V on pin 10 of J500 and +5 V on pin 1 of J500; if not there, then check for A+ at pin 30 of J502 and SWB+ at pin 31 of J502; if OK replace command board.
No receiver audio or receive does not unsquelch.	1. Audio PA circuit.	a. Is PL or DPL enabled? If so, check with PL/DPL.
		b. Check continuity of F500 on command board; if open, check for speaker leads shorted to ground, replace.
	2. Regulators (Command Board).	Check for 9.6 V on pin 10 of J500 and +5 V on pin 1 of J500; if not there, then check for A+ at pin 30 of J502 and SWB+ at pin 31 of J502; if OK then replace command board.
	3. RF board.	a. Is there > 3 Vp–p of noise on pin 4 of J500 (demodulator output, no RF signal)? If not, replace RF board.
		b. With the squelch set to 0 is there > 100 mV rms on pin 5 of J500? If so, replace command board.
		c. Is the squelch output line (pin 8 of J500) > 3 V (active)? If not, replace RF board.
	4. Command board.	Replace command board.
Audio distorted or not loud enough.	1. Synthesizer not on frequency/working.	Check synthesizer frequency; if off by more than 250 Hz, then go to synthesizer troubleshooting chart.
	2. RF board.	a. Run the remaining tests with a 1 mV RF, 1 kHz tone @ 3.0 kHz deviation into into the antenna connector.
		b. Is the voltage @ pin 4 of J500 >75 mV rms and < 9% distortion? If not, replace the RF board.
	3. Command board.	Replace command board.
RF sensitivity poor.	1. Synthesizer not on frequency/working.	Check synthesizer frequency; if off by more than 250 Hz, then go to synthesizer troubleshooting chart.
	2. Antenna switch (amplifier board).	Check insertion loss from antenna connector to Rx front end coax from the PA; If loss is less than 1.5 dB then the problem is in the transceiver housing.
	3. Receiver front end assembly or VCO board.	a. Measure the gain of the front end assembly by injecting a signal at the desired receive frequency and measuring the output level at 109.65 MHz; Check conversion gain shown in RX FE Section.
		b. If conversion gain is low, then check the supply voltage fed into the front end on the center conductor of the output coax to the RF board; if it is less than 9V, check the RF board.
		c. Check the injection level from the VCO board; if it is less than +9 dBm, then replace the VCO board; if injection is OK then replace Rx front end assembly.
	4. RF board.	Check the sensitivity into the RF board @ 109.65 MHz. If greater than –119.5 dBm then replace the RF board (Caution: there is 9.6 VDC on the center conductor of this coax).
Radio will not squelch.	RF board or Command board.	a. With no RF signal applied to the radio, advance squelch control to maximum setting (15). Is there > 3.0 Vp–p of noise on pin 4 of J500? If not, replace RF board.
		b. Is there > 2 Vp–p @ pin 6 of J500? If not replace RF board.
		c. Is there > 2 Vp–p @ pin 5 of J500? If not replace RF command board.
		d. Is pin 8 of J500 > 2V? If so, replace RF board; if not replace command board.
Radio will not turn off.	1. On/off switch (Control head).	Check for SWB+ @ pin 31 of J0502 on the Command Board; if not there check for SWB+ @ pin 4 of P103 on the control head.
	2. Command board.	Does SWB+ on pin 31 of J502 switch on and off as the control head switch is operated? If so, replace the command board.

Table 10. Synthesizer Troubleshooting Chart

Symptom	Possible Cause	Correction or Test (Measurements Taken at Room Temperature)
Does not lock on any channel.	1. VCO.	With radio in receive mode; remove steering line jumper JU203; measured level at VCO connector pin 1 should be 0 dBm ±6 dB; frequency should be 0–20 MHz below lowest frequency for range listed in table 3 ; if not, replace VCO board.
	2. Reference oscillator.	Is there >1.5 Vp–p of 2.1 MHz on pin 21 of J500? If not replace reference oscillator or RF board.
	3. Command board.	Do both the chip select lines (pins 16 & 20 of J500) go low during mode changes; is there data on the clock & data lines going into the RF board (pins 18 & 19 of J500)? If not, replace command board.
	4. RF board.	Replace RF board.
Does not lock on some channels in RX and/or TX	1. Programming (EEPROM).	Check mode programming information to ensure that the correct frequency programming information has been entered.
	2. VCO.	With radio in receive mode; remove steering line jumper JU203; measured level at VCO connector pin 1 should be 0 dBm ±6 dB; frequency should be 0–20 MHz below lowest frequency for range listed in table 3; if not, replace VCO board.
	3. RF board.	Replace RF board.
	4. RF board.	Check the AUX bit states (pin 9 & 11 J601) per table 3 $\overline{\text{AUX}}$ LOW ≤ .6V $\overline{\text{AUX}}$ HIGH ≥ 8.0V If wrong, replace RF board.
Synthesizer locks on wrong frequency.	1. Synthesizer not locked.	Check synthesizer lock line (pin 14 of J500); if > 1V then synthesizer is not locked; go to Synthesizer not locked guide above.
	2. Reference oscillator not on frequency/working.	a. Check Reference oscillator frequency; should be 16.8 MHz ±4 Hz; THIS MUST BE MEASURED @ 25 deg. C (77 deg. F) ±3 deg. C TO BE ACCURATE.
		b. Retune reference oscillator if frequency is incorrect.
	3. Command board.	If reference oscillator won't tune on frequency, is reference control voltage (pin 2 of J500) tuning over 1.5 to 4.3 volts and is the 5 volt supply 5V ±.2V? If not, replace command board; otherwise replace reference oscillator.
	4. Programming (EEPROM)	Check mode programming information to ensure that the correct frequency programming information has been entered.
	5. RF board.	Replace RF board.

4.5 SYNTHESIZER TROUBLESHOOTING

Table 10 lists a number of synthesizer–related symptoms which may occur that interrupt normal radio operation. Use this chart to help troubleshoot and repair synthesizer problems to the board level. This chart does not attempt to isolate problems to the component level.

4.6 HANDLING BOARDS CONTAINING CMOS IC DEVICES

Many of the integrated–circuit devices used in communications equipment are of the CMOS (Complementary Metal Oxide Semiconductor) type. Because of their high open–circuit impedance, CMOS IC's are vulnerable to damage from static charges. Everyone involved in handling, shipping, and servicing them must be extremely careful not to expose them to such damage.

CMOS IC's do have internal protection, but it is effective only against overvoltages in the hundreds of volts, such as those that could occur during normal operations. Overvoltages from static discharge can be in the thousands of volts.

To avoid damaging CMOS IC's, take the following precautions when handling, shipping, and servicing them.

(1) Before touching a circuit module, particularly after having moved around in the service area, touch both hands to a bare metal earth–grounded surface. This discharges any static charge you may have accumulated.

Note

Wear a conductive wrist strap (Motorola Part No. RSX–4015A) to minimize the buildup of static charges on your person while you are servicing CMOS equipment.

WARNING

When wearing a conductive wrist strap, be careful near sources of high voltages. By grounding you thoroughly, the wrist strap also increases the danger of lethal shock from accidental contact with such a source.

(2) Whenever possible, avoid touching any electrically conductive parts of the circuit module with your hands.

(3) Be sure that all electrically powered test equipment is grounded. *Attach the ground lead* from the test equipment to the circuit module before connecting the test probe. Similarly, disconnect the test probe before removing the ground lead.

(4) When you remove a circuit module from the system, lay it on a sheet of aluminum foil or other conductive surface connected to ground through 100,000 ohms of resistance.

WARNING

If the aluminum foil is connected directly to ground, you may get a shock if you touch it and another electrical circuit at the same time.

(5) Replacement modules shipped separately from the factory will be packaged in a conductive material. Any modules being transported from one area to another should be wrapped in a similar material (aluminum foil may be used). NEVER USE NON–CONDUCTIVE MATERIAL for packaging these modules.

4.7 BOARD REPLACEMENT

This section details the procedures necessary to remove and replace the printed circuit boards in the *Spectra* radio. After troubleshooting and determining which board needs to be replaced, disconnect the test equipment, the antenna cable, and unhook the DC power.

WARNING

Disconnect all DC power to the radio before removing any boards from the radio. Failure to remove power can result in unit damage caused by transients or accidental shorts.

Locate the exploded view drawing of the radio in the back of this section. Keep it handy for reference when disassembling and reassembling the radio.

When installing a new circuit board, all mounting screws should be "started" before any are torqued. This helps assure proper board alignment with the chassis.

After installing a new board, refer to the chart in Paragraph 4.8.2 and perform the alignment procedures indicated for the replaced board.

Important

After performing alignment procedures, always exit the "SERVICE" menu entirely (to the MAIN MENU) to save all changes properly. Failure to do so can result in an "FL 01/82" failure (see Table 7).

4.7.1 Control Head Board

(1) Unplug the microphone and remove the two front panel screws. Grasp the front panel firmly and carefully unplug the assembled control head from the radio.

(2) Lay the control head face down on your work surface.

(3) Remove six screws (use a Torx T10 driver). Carefully, separate the PC board, internal spacer, and keypad from the front panel. Do not disturb the buttons and front panel.

(4) Remove keypad from the PC board.

Note

Before you "unsnap" the PC board, notice that the board slips under a hook on the right and "snaps" on the left. This will facilitate assembly.

(5) Remove the PC board from the internal spacer. The PC board "snaps" into and out of the spacer.

(6) Snap the new PC board into the internal spacer. Before you press the keypad into the board, make sure that the conductive pads in the board and the keypad are clean and free of any foreign material.

(7) Assemble the new PC board, internal spacer, and keypad onto the front panel and install the six screws in the sequence shown in Figure 9.

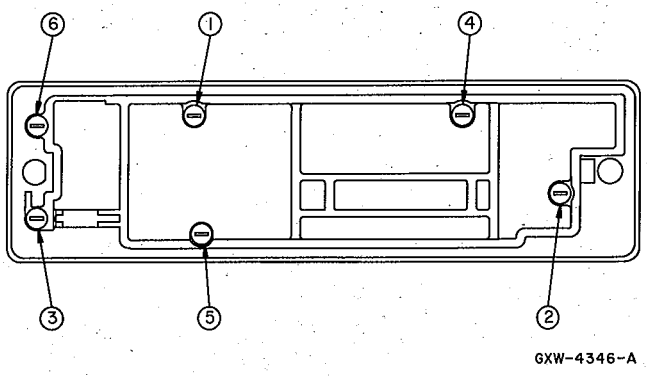


Figure 9. Control Head Assembly Screw Sequence

CAUTION

Take care to avoid misalignment of connector pins. Remove the radio top cover to allow visual inspection during connector alignment.

(8) Plug the interconnect board into radio, then plug control head assembly into radio and fasten with the two front panel screws.

4.7.2 Power Amplifier Board

(1) Back End Removal

(a) 40–watt only—Remove four screws (use Torx T15 driver) from PA cover; remove cover, PA shield, and harmonic filter cover.

(b) Remove the two Allen head screws (use metric 3.0 mm Allen wrench) from the heatsink.

(c) Carefully separate the PA assembly from the transceiver chassis.

Note

Before disconnecting, note which RF cable goes to the VCO (TX injection) and which goes to the RX front end. This will facilitate assembly.

(d) Disconnect the large ribbon cable connector from the command board, the small connector from the PA board,

and the two RF cables from their respective boards in the transceiver chassis.

(2) Install Back End

(a) Connect the large ribbon cable connector to the command board connector. Connect the small connector to the PA. Connect the RF cables to their respective boards in the transceiver chassis.

(b) Be careful not to pinch the RF or ribbon cables; position the PA assembly on the chassis. Install the two Allen head screws through the heatsink. Before tightening the mounting screws, check that command board connector and RF connectors are in place. Then tighten mounting screws.

(c) 40–watt only—Install harmonic filter cover and PA compartment shield; install PA cover.

(3) Alignment

Perform the "Power Set and Current Limit Adjustment." See Paragraph 3.1 for procedures.

4.7.3 Memory Board

Note

If you want to keep the information currently stored in the radio code plug, save its contents using the IBM PC and Radio Service Software before you remove the original memory board. Refer to the Radio Service Software User's Manual for more information.

(1) Remove the radio top cover. Lift off the memory board cover.

CAUTION

To remove the memory board, gently pry the board up at the center of the connector end of the board (see Figure 10). This will help prevent damage or bending of the connector pins.

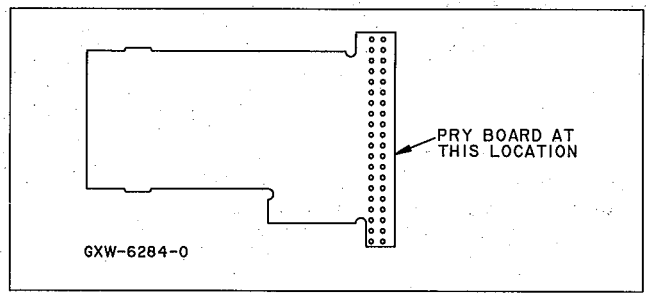


Figure 10. Removing memory board

(2) Remove the original memory board and replace it with the new board at connector P0505 on the command board.

(3) Reassemble the memory board and radio covers.

Note

Replacement memory boards are pre–programmed to enable the radio to function only at a test–mode level. To restore the radio to complete operation, you must initialize the memory board via the Radio Service Software "BOARD REPLACEMENT" procedure.

CAUTION

Once initialized, a replacement memory board may not be initialized a second time. Use the radio test modes to ensure that replacing the memory board will solve the problem before you initialize it.

To initialize the Memory Board:

(1) Connect the IBM PC and the DC power source to the radio. Switch the radio power on.

(2) At the PC's "MAIN MENU" prompt, press F2 to select "SERVICE."

(3) At the "SERVICE" menu, press F6 to select "BOARD REPLACEMENT."

(4) At the "BOARD REPLACEMENT" menu, press F4 to select the "MEMORY BOARD."

(5) At the "MEMORY BOARD" menu, perform the steps indicated on the screen, beginning with Step 1. Use the ENTER key to move to the next step. Only the function key for the step indicated will be active.

(6) After completing Step 3, restore the customer code plug data using one of the following methods:

(a) Retrieve Archive File via the GET/SAVE menu and then program the code plug;

or,

(b) For conventional models, re–enter conventional data via the CHANGE/VIEW menu; then use GET/SAVE: to download a replacement codeplug image.

Note

TCMS will not contain customer MODE NAMES, SCAN LISTS, etc.

4.7.4 Command Board

(1) Remove the radio top cover.

(2) Remove the control head and the PA assembly.

(3) Remove the cover over the Memory Board; disconnect the Memory Board and Option Board. See caution note in memory board replacement section.

(4) Disconnect the PA connector and the control head connector.

(5) Remove the heatsink clip from the power transistor on the command board. Remove 6 mounting screws (use Torx T15 driver).

(6) Carefully lift the command board from the housing, making sure that the floating header is with the RF Board.

(7) To reassemble the command board, first apply a thin coat of thermal compound (e.g. Motorola Part No. 11–83166A01) to the audio final mounting surface.

Note

Do not use a thick coating of compound; such could degrade the thermal efficiency of the heatsink.

Note

Make sure the male–to–male command board header is fully seated in the RF board before installing the command board.

(8) Install the new command board and clip the power devices to the chassis, being sure that the insulator is in place behind the devices.

(9) Install the mounting screws, starting with the screw holding down the audio final.

(10) Connect the Memory Board and Option Board; install the Memory Board shield.

(11) Re–connect the two connectors.

(12) Install the PA assembly, the control head, and the radio covers.

Note

Replacement command boards are pre–programmed to enable the radio to function only at a test–mode level. To restore the radio to complete operation, you must initialize the command board via the Radio Service Software "BOARD REPLACEMENT" procedure.

CAUTION

You must use the radio's Memory Board to initialize a replacement command board and once initialized with that Memory Board, the command board will not function properly with any other Memory Board. Use the radio test modes to ensure that replacing the command board will solve the problem *before you initialize it.*

To initialize the command board microcomputer:

(1) Connect the IBM PC and the DC power source to the radio. Switch the radio power on.

(2) At the PC's "MAIN MENU" prompt, press F2 to select "SERVICE."

(3) At the "SERVICE" menu, press F6 to select "BOARD REPLACEMENT."

(4) At the "BOARD REPLACEMENT" menu, press F3 to select the "COMMAND BOARD."

(5) At the "COMMAND BOARD" menu, perform the steps indicated on the screen, beginning with Step 1. Use the ENTER key to move to the next step. Only the function key for the step indicated will be active.

(6) When alignment is complete, press F10 to exit.

(7) See the chart in Paragraph 4.8.2 and perform the other alignment procedures indicated.

4.7.5 Receiver Front End

(1) Remove the radio top cover. Remove the two mounting screws and unplug the control head. Disconnect the coax cable that passes through the front of the chassis from the RF board.

(2) Remove the PA assembly and disconnect the coax cable that passes through the rear of the chassis to the receiver front end.

(3) Remove four screws, the front end cover, and carefully lift the receiver front end board from the chassis.

Note

Be careful to insert the RX injection coax straight into the receptacle on the VCO board, and be sure it is fully inserted. Be careful not to bend the tip of the coax, which provides the contact for the connection.

(4) Install the new assembly, being careful not to damage the RF connection that passes through the chassis to the VCO.

(5) Re–connect both coax cables, then install the front end cover and four mounting screws. Install the PA assembly, control head, and radio cover.

Note

No alignment is required.

4.7.6 VCO Assembly

(1) Remove the radio bottom cover. Remove the PA assembly and disconnect the TX injection coax that passes through the chassis to the VCO board.

(2) Remove the RF board cover. Disconnect the coax cable from the RF board (25–watt only).

(3) Remove the six mounting screws and the cover. Carefully lift up the board far enough to expose the RX injection coax underneath, which runs from a receptacle on the VCO through a hole in the chassis to the Receiver Front–end assembly. Unplug the coax from the receptacle on the VCO board. Then lift straight up on the VCO board to remove it from the chassis.

(4) To install the new board, plug in the RX injection coax (from the Receiver Front End) into the receptacle near the outer edge of the board. Align the opposite–edge connector with the RF board connector and snap it into place.

Note

Be sure the board and gasket are straight and that the board does not bind as the screws are tightened, pulling the board down to the cavity ledge. Tighten screws evenly to avoid warping the board. It is very important to use proper screw torque to ensure proper operation in vibration environments.

(5) Connect the PA board's RF cable to the VCO board connector (through the chassis). Connect the coax cable to the RF board (25–watt only).

(6) Install the VCO cover and six mounting screws.

(7) Install the PA assembly and the radio cover.

(8) See the chart in Paragraph 4.8.2 and perform the alignment procedures indicated.

4.7.7 RF Board

(1) See the previous paragraph and remove the VCO board. Remove the control head. Then disconnect the RF cable that passes through the chassis to the RF board.

(2) Remove six mounting screws and remove the RF board.

(3) Install the new board and connect the RF cable through the front of the chassis to the RF board. Install the five mounting screws, but wait to tighten them until after you install the VCO board.

Note

Make sure the male–to–male command board header is fully seated in the command board before installing the RF board.

(4) Install the VCO board; then tighten the RF and VCO board mounting screws. It is very important to use proper screw torque on both boards to ensure proper operation in vibration environments.

(5) Install the control head and radio covers.

(6) See the chart in Paragraph 4.8.2 and perform the alignment procedures indicated.

4.8 SPECIAL REPAIR PROCEDURE

4.8.1 Minimum RF Performance Tests for Board Replacement. (See Table 11.)

4.8.2 Alignment via IBM PC

Table 12 details the procedures required and the sequence in which the procedures must be performed after each specific board replacement. These alignment procedures are detailed in the alignment section of this manual. Follow the details carefully and in the exact sequence specified. Failure to comply may result in improper radio operation.

4.8.3 Power Amplifiers

Apply a thin coat of thermal compound (e.g. Motorola Part No. 11–83166A01) to the Pre–driver, driver and final device heatsink mounting surfaces.

Note

Do not use a thick coating of compound; such could degrade the thermal efficiency of the heatsink.

Do not bend or twist the PA board. Such stress may crack the surface mount components and hybrid circuits.

Tighten mounting screws on the pre–driver heatsink, driver and final devices before you attempt to transmit. This will insure proper thermal conduction.

Tighten the antenna connector nut (refer to Table 13 for torque value) to ensure the connector is well grounded.

4.8.4 Dash Control Head Board

When reassembling the control head, make sure the microphone pins are properly inserted through the elastomeric keypad. Also make sure the elastomeric keypad inserts are secured to the PC board.

After re–assembly, check every key or button to ensure that each works properly (see the Control Head Test).

Table 11. Minimum RF Performance Tests for Board Replacement

TEST (Take Measurements at room temperature)	READING
12 dB SINAD into antenna connector 12 dB SINAD into RX Front End J3102 12 dB SINAD into RF Board J350 (@109.65 MHz)	–116.0 (non–Preamp) and –121 (Preamp) dBm (Maximum) –116.5 (non–Preamp) and –121.5 (Preamp) dBm (Maximum) –118.5 dBm (Maximum)
VCO Output TX Injection J3641 (TX, TA mode) VCO Output RX Injection J3642 (RX mode)	+18 dBm (Maximum), +15 dBm (Minimum) +14 dBm (Maximum), +9 dBm (Minimum)
Synthesizer Feedback P0601 Pin 3 (All Modes)	+1 dBm (Maximum), –12 dBm (Minimum)
Recovered Audio Level (For 3.0 kHz Deviation @1 kHz, J500–4)	250 mV RMS (Maximum), 150 mV RMS (Minimum)
Power Amp Output:: TX Injection into PA Power Out at antenna connector (Note 1) Power at RX Connector (Note 1) RX Insertion Loss (Note 2)	 32 milliwatts ≥ 44 watts ≤ 15 milliwatts ≤ 1.0 dB

Notes:

1. Measure with K9.4, V drive, 9.6 V applied at 12–Pin DC connector PA board and 13.8 V applied to External DC power connector and TX injection provided.
2. Measure with Pin, K9.4 and V drive set to zero, 9.6 and A+ voltages applied as in Note 1, above.

Table 12. Alignment Procedures

Procedure > Item	Reference Oscillator Warping	Deviation Adjustment	Power Set & Current Limit	Compensation Adjustment	Compensation Calibration	Signalling Deviation Adjustment	Memory Module Initialize
RF BOARD	First	Third	N/A	Second	N/A	N/A	N/A
REFERENCE OSCILLATOR	Only	N/A	N/A	N/A	N/A	N/A	N/A
VCO BOARD	N/A	Third	N/A	Second	First	N/A	N/A
COMMAND BOARD	Second	Sixth	Third	Fifth	Fourth	Last	First
CONTROL HEAD BOARD	N/A	N/A	N/A	N/A	N/A	N/A	N/A
P.A. BOARD	N/A	N/A	Only	N/A	N/A	N/A	N/A
MEMORY BOARD	N/A	N/A	N/A	N/A	N/A	N/A	Only

4.8.5 Command Board

Note

This assumes PA is attached, control head is detached, and control head interconnect board is disconnected.

(1) Before re–assembly, apply a thin coat of thermal compound (e.g. Motorola Part No. 11–83166A01) to the bottom of the audio PA (U0450).

(2) Insert the command board into the PA accessory connector (J503) before inserting it into the RF board connector (P500). It may be necessary to angle the command board towards the PA.

(3) Ensure the accurate placement of the insulator between Q500, Q502, and Q521 and the chassis wall.

(4) Start all six of the mounting screws before tightening any. Then tighten evenly to ensure you do not warp the board.

(5) Reconnect the control head interconnect board (J103) to the command board connector (J502). Secure the control head with two screws. Reconnect the memory board (via P505) and option board (if any) prior to installing covers.

(6) Refer to Paragraph 4.7.4 to re–align the radio.

4.8.6 Fastener Torque Chart

Table 13 lists the various fasteners by part number and description, followed by the torque values and the location where used. Torque all fasteners to the recommended value when assembling the radio.

4.9 TEST FREQUENCY MENU

The test mode is part of the diagnostics built into the radio and is entered through the front panel programming sequence. (See Section 2 of this manual, and specifically, paragraph 2.12 for password entry.)

After the password is successfully entered, the radio enters a test mode where basic radio and signalling measure-

ments are made at three separate frequencies across the band. The first six characters of the display show the 6 least significant digits of the selected receive or transmit frequency, and the last two characters indicate the type of signalling or modulation selected. For example, the first receive frequency upon entry to the test mode is 450.025 MHz and the signalling is carrier squelch. The display shows "450025CS". When transmitting, the display will change to the transmit frequency. The three test frequencies are:

Radio Range	Test Freq.	RX Freq.	TX Freq.
2	1	438.025 MHz	438.050 MHz
	2	454.025 MHz	454.050 MHz
	3	469.975 MHz	469.950 MHz
3	1	450.025 MHz	450.050 MHz
	2	466.025 MHz	466.050 MHz
	3	481.975 MHZ	481.950 MHz
4	1	482.025 MHz	482.050 MHz
	2	487.025 MHz	497.050 MHz
	3	511.975 MHz	511.950 MHz

The signalling types are shown in Table 14.

In test mode, use the [**Volume**] rocker to adjust volume. However, the volume display in test mode is in 256 increments, not in the usual 16. This allows more precise setting of rated audio, etc. Use the [**Home**] button to move the cursor back and forth between the frequency and signalling type. The first digit will flash to indicate which type is currently selected. Use [**Mode**] to scroll through the available selections.

When in receive mode, reception of a properly modulated signal at the proper frequency is indicated by the radio as follows:

BUSY LIGHT FLASHES—Proper RF frequency being received with proper signalling

BUSY LIGHT STAYS ON—Proper RF frequency being received.

To check for proper demodulation, apply an RF carrier at 1000 microvolts modulated with the signal frequency and deviation level indicated in Table 15. The table also shows which integrated circuit is tested by the various signalling types.

Note

For trunked models, make sure the microphone is removed from the grounded hangup clip so that the radio busy light is extinguished before you apply the signal.

When in transmit mode, DTMF modulation produces a sidetone in the speaker. All signalling types will continually modulate the transmitted signal for detection/measurement by external instruments.

Refer to paragraph 3.7 of this manual for instructions on adjustment of Touch Code Encoder microphone DTMF modulation level.

To exit the test mode, press [**Mode**] and scroll to the "EXIT" display that follows the last frequency and/or signalling type. Press [**Home**] to exit and return to the "TST FREQ" display.

Table 13. Fastener Torque Chart

Part Number	Description	Repair Torque (in.-lbs.)	Where used
N/A	7/16 hex nut	6–8	Mini–UHF antenna connector.
03–80114M02	Screw, machine M5X10	10–12	Radio mounting
03–10911A11	Screw, machine M3X8	6–8	PA boards device attachment
03–10911A10	Screw, machine M3X6	6–8	TO–39 heatsink (PA; Q3804))
03–10943M15	Screw, tapping M3.5X8	6–8	All PC board attachment (except for control head and remote dash board).
03–80102P01	Screw, tapping M3.5X10	6–8	Mid power PA cover and top and bottom radio covers
03–10945A11	Screw, plastite M3X16	6–8	Control head and remote dash board attachment.
03–10945A14	Screw, plastite M3X8	6–8	Remote control cable cover.
03–80043L01	Screw, tapping M3X10	6–8	External power connector. Accessory clip.
03–80077M01	Screw, hex M3X18	6–8	Control head mounting. Remote front housing mounting.
03–80077M02	Screw, hex M4X16	10–12	Mid power heatsink mounting
03–80077M04	Screw, hex M3X22	6–8	Remote cable mounting.
03–84244C06	Wing screw M5X10	10–12	Radio mounting

Table 14. Signalling Types

	Display	Modulation	Demodulation	Type
1	CS	None	None	Carrier Squelch
2	PL	100 Hz	100 Hz	PL
3	PC	11 Hz	None	PL (Compensation Adjust)
4	PD	67 Hz	None	PL (Deviation Adjust)
5	DL	100 Hz	100 Hz	DPL
6	LS	100 Hz	100 Hz	Trunked Lowspeed
7	M6	1500 Hz	1500 Hz	MDC–600
8	MC	1500 Hz	1500 Hz	MDC–1200
9	HS	1500 Hz	1500 Hz	Trunked Highspeed
10	DF	1477 & 941 Hz	None	DTMF Digit #
*11	SN	*SECURENET* Data	*SECURENET* Data	*SECURENET*

* On certain models

Notes:

1. Sine waves used for trunked, MDC, and DPL signalling modulation/demodulation rather than actual data signalling.
2. Volume level is 256 steps versus normal 16 to aid in setting rated audio level.
3. Transmitter timeout timer is disabled.
4. Microphone audio is disabled during MDC, DTMF, and trunked highspeed modulation.
5. Synthesizer always in narrowband configuration during transmit.
6. "Normal" radio operation is disabled (i.e. cannot initiate or receive calls, edit operator selectable scan list, etc.).
7. For trunked radios, place the microphone in the hangup clip (grounded) while in the "TEST FREQENCY" Menu to unsquelch the radio and allow receiver measurements to be made.

Table 15. Checking Modulation Frequency and Deviation

Signalling Type	Modulation Frequency	Deviation Level	IC Tested
Trunking High Speed	1500 Hz	690 Hz	Signalling Filter (SFIC)
Trunking Low Speed	100 Hz	250 Hz	Signalling Filter (SFIC)
MDC 600/1200	1500 Hz	880 Hz	Signalling Filter (SFIC)
PL/DPL	100 Hz	250 Hz	Audio Filter (AFIC)
SECURENET	*SECURENET* Data	4000 Hz	*SECURENET* Board

4.10 CONTROL HEAD TESTING

The control head test mode is part of the diagnostics built into the radio and is entered through the front panel programming sequence. (See Section 2 of this manual, and specifically, paragraph 2.12 for password entry.)

This test mode allows you to perform button and display tests to verify proper operation.

After the password is successfully entered, the radio enters the control head test mode and sends a special test sequence to the the control head. This mode can also be entered via the IBM field programmer. The menu is located at function key F8 under the SERVICE AID: TEST MODE menu.

When the control head sees the test mode command, it responds by displaying the control head software version number on the display as "VXX XX" for two seconds. Afterwards, the self test proceeds through a 15–1/2 second self–check as shown in Figure 11.

When the display gets to "KEY TEST", you may verify key/switch operation. With each press of a properly functioning button, or with each closing of a properly functioning accessory switch, the display shows the interpreted key number. Figure 12 shows the control head and the key number that should display for each key.

Note

Both PTT and MODE cause "KEY 01" to display, however, proper operation of these controls will be verified through normal radio operation. Both MODE and VOLUME buttons display their same respective key numbers whether pressed in the UP or DOWN direction. However, verify both directions as though each direction were an individual switch.

Pressing PTT will also cause the VIP OUT 1 line to be activated (toggled). The hang up button (HUB) will cause VIP OUT 2 to be toggled and changing the VIP IN 3 will cause VIP OUT 3 to be toggled. Refer to the radio and control head schematics for the location of these lines.

Press [**Home**] five times in succession to exit the diagnostic mode and return to the "CH TEST" display; or switch the radio power off temporarily to exit diagnostics and return to normal radio operation.

TIME	DISPLAY	PURPOSE
2-SECONDS	(ALL SEGMENTS LIGHT)	TO IDENTIFY OPEN (NON-FUNCTIONAL) DISPLAY SEGMENTS
1/2 SEC.	^ PRI ^ NPRI ^ DIR ^	TO IDENTIFY ANY GRID-TO-GRID AND/OR GRID-TO-PLATE (ANODE) SHORTS.
1/2 SEC.	^ **PRI** ^ NPRI ^ DIR ^	
1/2 SEC.	^ PRI **^** NPRI ^ DIR ^	
1/2 SEC.	^ PRI ^ **NPRI** ^ DIR ^	
1/2 SEC.	^ PRI ^ NPRI **^** DIR ^	
1/2 SEC.	^ PRI ^ NPRI ^ **DIR** ^	
1/2 SEC.	^ PRI ^ NPRI ^ DIR **^**	
2-SECONDS	**A B C D E F G H**	TO IDENTIFY ANY INDIVIDUAL ANODE-TO-ANODE (PLATE-TO-PLATE) SHORTS BY DISPLAYING RECOGNIZABLE CHARACTERS THEREBY QUICKLY DETECTING SEGMENT FAILURES.
2-SECONDS	**I J K L M N O P**	
2-SECONDS	**Q R S T U V W X**	
2-SECONDS	**Y Z 0 1 2 3 4 5**	
2-SECONDS	**6 7 8 9 _ - /**	
(STAYS ON)	**K E Y T E S T**	(AWAITS TECHNICIAN INPUTS)

NOTE: BOLD CHARACTERS INDICATE THE LIT PART OF THE DISPLAY

GXW-4318-0

Figure 11. Control Head Self-Test

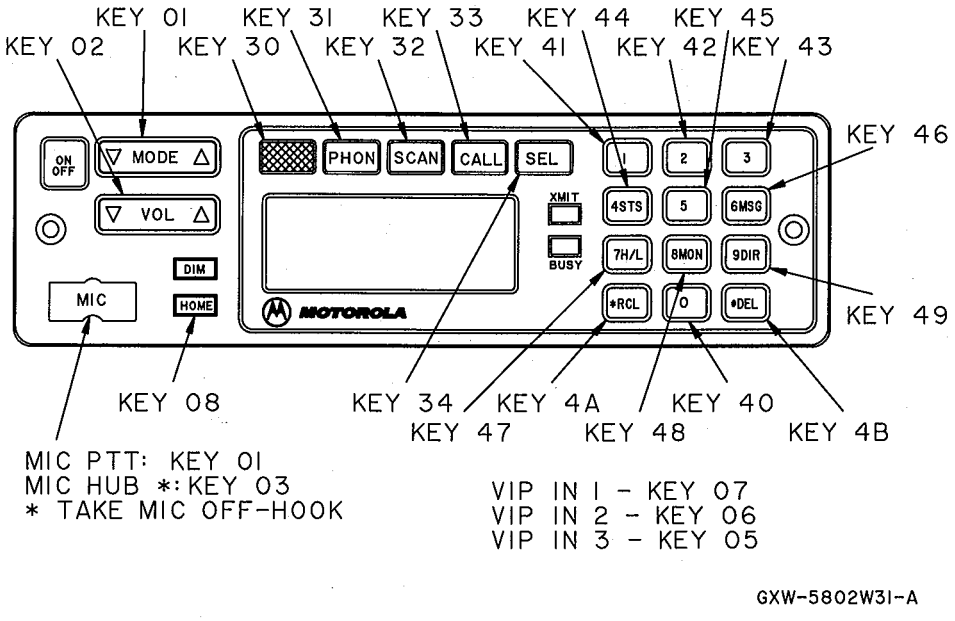
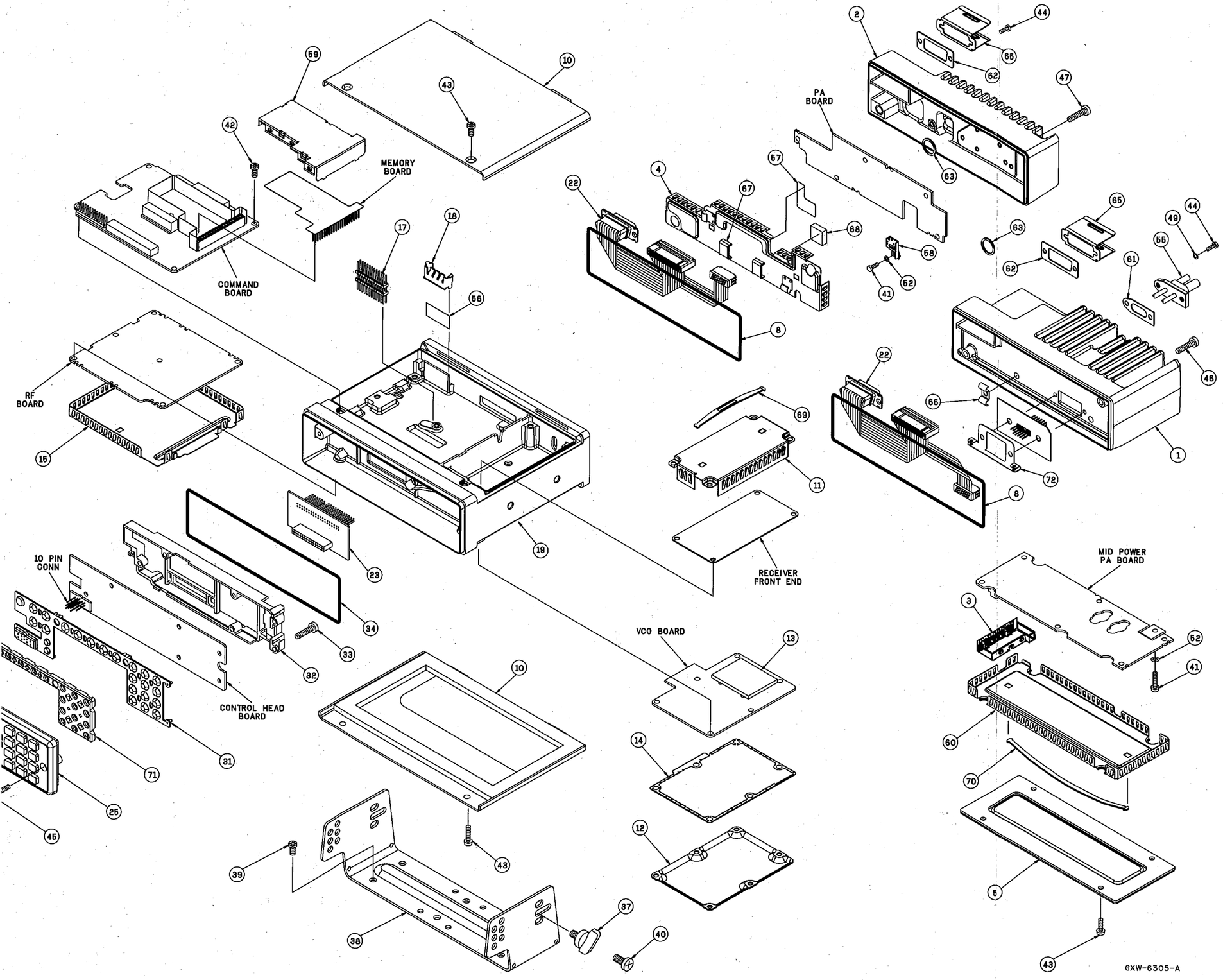


Figure 12. Front Panel Diagnostics; Key Closure Displays



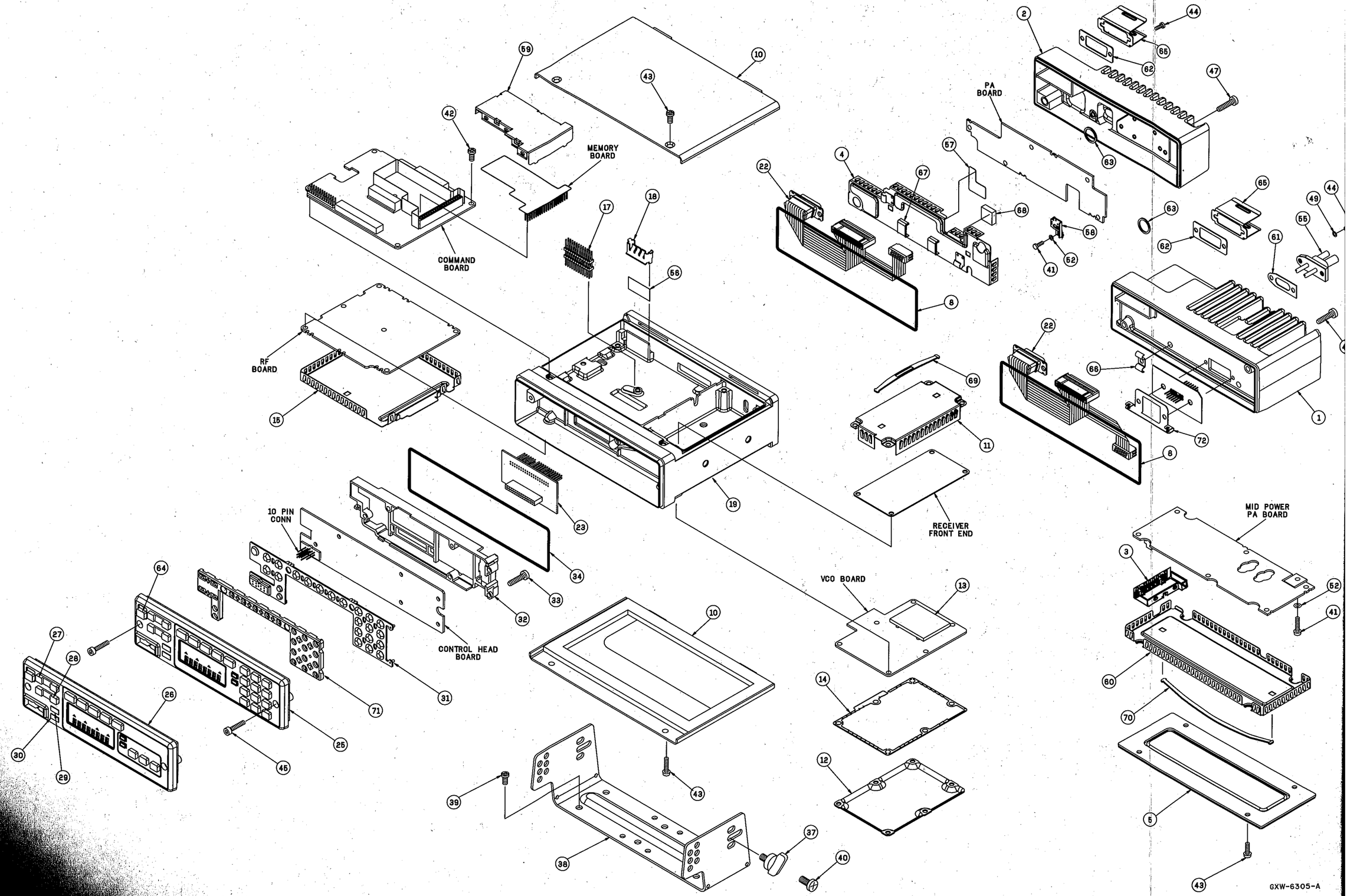
parts list

UHF *Spectra* Mechanical Parts Exploded View — 6M MXW–6304–A

ITEM	MOTOROLA PART NO.	DESCRIPTION
1	26–80010M02	heatsink, mid–power
2	26–80009M02	heatsink
3	26–80189N01	shield, PA board
4	26–80099P01	shield PA board
5	15–80048N01	cover, mid–power PA
8	32–80053P01	gasket, heatsink
10	15–80264N01	cover, includes gasket
11	15–80098L01	cover, receiver front–end
12	15–80097L01	cover, VCO board
13	15–80223N02	cover, VCO hybrid
14	32–80247N01	gasket, VCO
15	15–80099L01	shield, RF board
17	28–80260M01	header, floating
18	42–80007M01	clip, regulator
19	27–80082N01	chassis, consolidated
22	30–80239N02	cable, PA ribbon
23	HLN6066	interconnect board
25	15–80010P01	housing, front cover, with keypad
26	15–80010P02	housing, front cover, without keypad
27	38–80009P01	pushbutton rocker, MODE
28	38–80009P02	pushbutton rocker, VOLUME
29	38–80092J01	pushbutton key, DIM
30	38–80092J02	pushbutton key, HOME
31	75–80189L03	keypad
32	43–80269N01	spacer, internal frame
33	03–10945A14	screw, tapping (6 used)
34	32–80289L01	gasket, housing
37	03–84244C06	screw, machine, wing 5.0 x 0.8 x 10
38	07–80086N01	trunnion, mounting
39	03–12002B14	screw, self–drilling x 1 (6 used)
40	03–80114M02	screw, machine, 5 x 0.8 x 10 (4 used)
41	03–10911A11	screw, machine, 3.5 x 0.5 x 8
42	03–10943J15	screw, tapping, 3.5 x 0.6 x 8 (board mtg)
43	03–80102P01	screw, tapping, 3.5 x 0.6 x 10 (8 used)
44	03–80043L01	screw, metric, 3.0 x 10 (4 used)
45	03–80077M01	screw, control head mounting (2 used)
46	03–80077M02	screw, hex socket (2 used)
47	03–80077M03	screw, hex socket (2 used)
49	04–00131974	washer, flat
52	04–80217E01	washer, compression
55	09–80272N02	connector, power
56	14–80001M01	insulator, regulator
57	14–80143M01	insulator, shield
58	26–80187N02	heatsink, TO39
59	26–80118M01	shield, command board
60	26–80186M01	shield, PA
61	32–80015M01	gasket, power connector
62	32–80088M01	gasket, accessory connector
63	32–80089M02	gasket, antenna
64	38–80227M02	cap, on/off switch
65	42–80016M03	clip, accessory connector
66	42–80281N01	clip, coax, PA
67	42–80265M02	clip, coax PA (2 used)
68	43–80104N01	spacer, PA shield
69	55–84300B01	handle (2 used)
70	55–84300B04	handle
71	61–80186L01	lightpipe
72	42–80192N01	clip, coax
	non–referenced parts	
	75–05295B01	pad, crystal
	75–80094M03	shock pad, VF display (3 used)

5/15/90

Mechanical Exploded View and Parts List for *Spectra* UHF Radio
PW–6303–A
5/15/90


MEMORY BOARD
COMMAND BOARD
RF BOARD
10 PIN CONN
CONTROL HEAD BOARD
PA BOARD
VCO BOARD
RECEIVER FRONT END
MID POWER PA BOARD
GXW-6305-A

5. Control Station Operation

5.1 DESCRIPTION

Option W665 allows a *Spectra* mobile radio to be used as a control station in a fixed location. This option includes the following items for use with the customer specified radio:

HKN4139A	Control Station Power Cable
HLN6042A	Base Tray
HLN6047A	Base Tray Installation Hardware
HMN1050A	Desk Microphone
HPN3000A	Control Station Power Supply
6880101W87	Control Station Operation Manual

5.2 INSTALLATION PLANNING

5.2.1 Antenna System

Selecting the antenna system for your control station depends on factors beyond the scope of this manual. Consult your Motorola representative for assistance in selecting the best antenna to suit your particular needs.

5.2.2 Radio Location

Choose a control station location that is close to where the antenna cable enters the building. Be sure 117 VAC, 60 Hz power is available. Make sure there is enough space around the radio to permit cooling.

5.3 INSTALLATION AND OPERATION

Note

Refer to the appropriate operator's manual supplied with the radio for operating information.

(1) The Control Station Wiring Diagram, PW–4320, shows how the radio, base tray and power supply interconnect.

(2) Place the radio on top of the base tray and attach it with two wing nuts. Plug accessory cable connector (P2) into radio rear accessory connector (J2).

(3) Insert lugged ignition wire (red lead) of accessory cable into power supply cable connector (P6, position 6). Plug power cable connector (P6) into power supply connector (J6).

(4) Plug radio power connector (P1) from power supply cable to radio connector (J1).

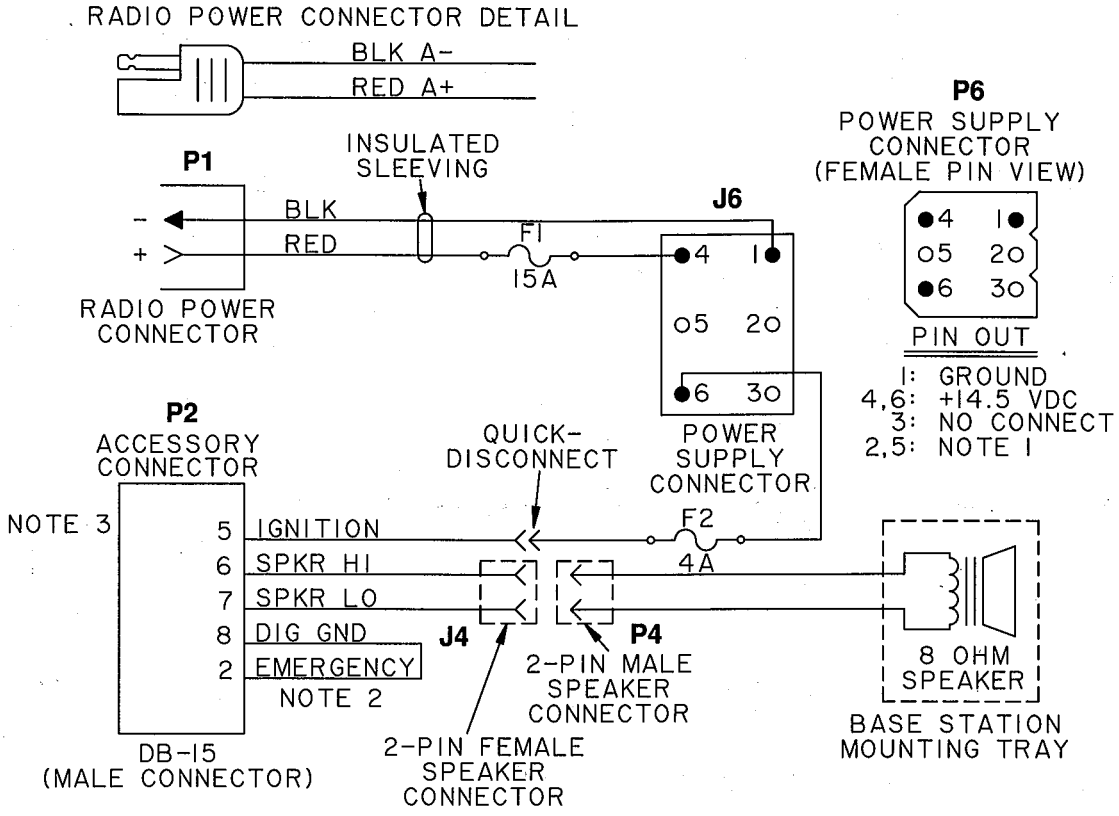
(5) Connect female 2–pin speaker connector (J4) to male 2–pin speaker connector (P4).

(6) Connect an in–line wattmeter between the radio antenna connector and the antenna system.

(7) Plug the base DC power supply into the 117 VAC, 60 Hz outlet. Turn the power supply AC POWER switch ON.

(8) Key the transmitter and check the antenna system VSWR. If the VSWR is 1.5:1 or lower, disconnect the wattmeter and connect the antenna coaxial cable to the radio antenna jack. If VSWR is greater than 1.5:1, consult the manual supplied with the antenna. Radio power output should not be readjusted with the radio keyed into the antenna system. Consult the Adjustment and Alignment section of the manual for proper power set procedure.

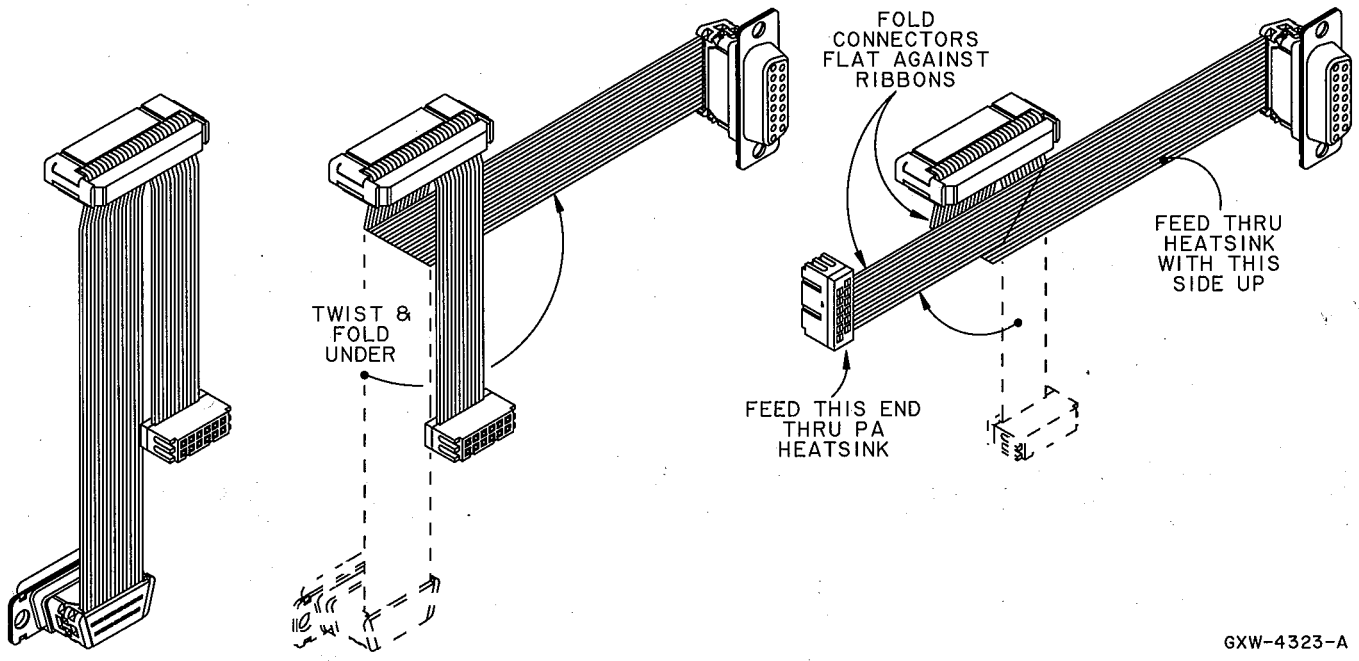
(9) Test the radio and accessories for proper operation. A brief conversation with a mobile unit in your system will indicate whether operation is satisfactory or not.



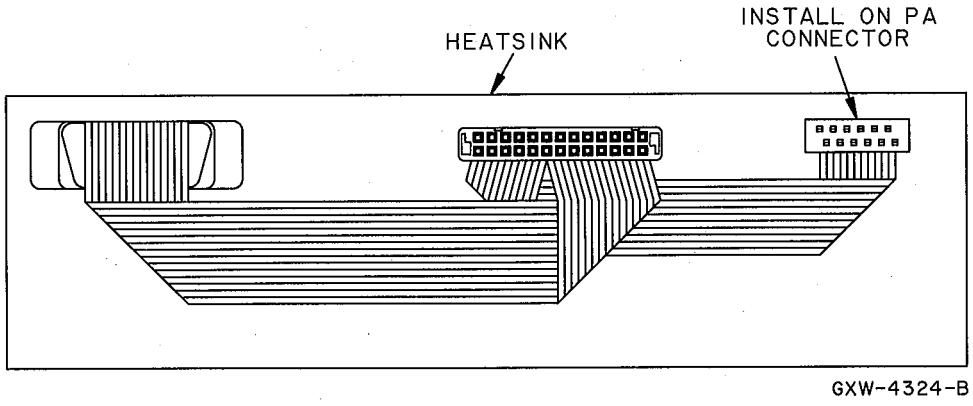
NOTES:

1. PINS 2 AND 5 OF POWER SUPPLY CONNECTOR ARE USED TO "POWER-UP" BASE STATION SUPPLY BY REMOTE CONTROL ON SOME MODELS. THESE PINS MAY BE AT AC LINE VOLTAGE LEVELS! REFER TO POWER SUPPLY SCHEMATIC FOR DETAILS.
2. A JUMPER WIRE FROM PIN 2 TO PIN 8 IS LOCATED INSIDE THE ACCESSORY OPTION CONNECTOR SHELL. DO NOT REMOVE THIS JUMPER UNLESS AN EMERGENCY SWITCH IS BEING CONNECTED. THE RADIO WILL AUTOMATICALLY "POWER-UP" WITHOUT THIS JUMPER WIRE IN PLACE! SEE EMERGENCY INSTALLATION SECTION FOR COMPLETE DETAILS.
3. SEE ACCESSORY CONNECTOR PIN-OUT DIAGRAM FOR COMPLETE DETAILS.

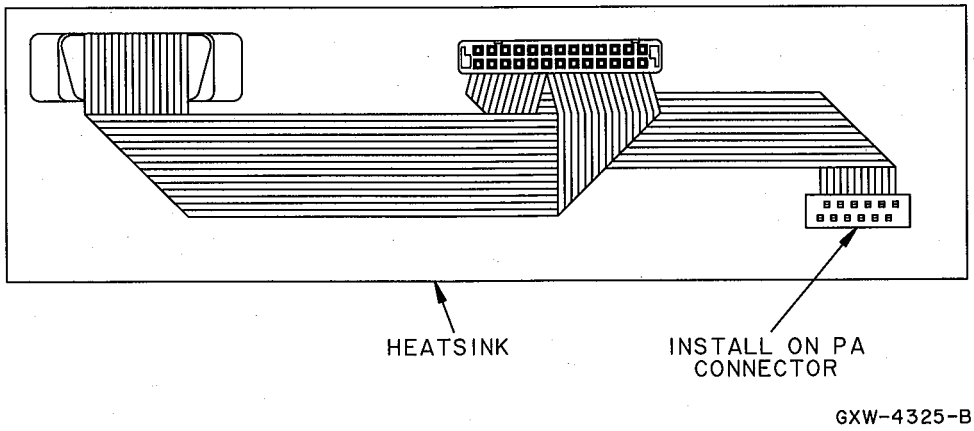
GXW-4278-O



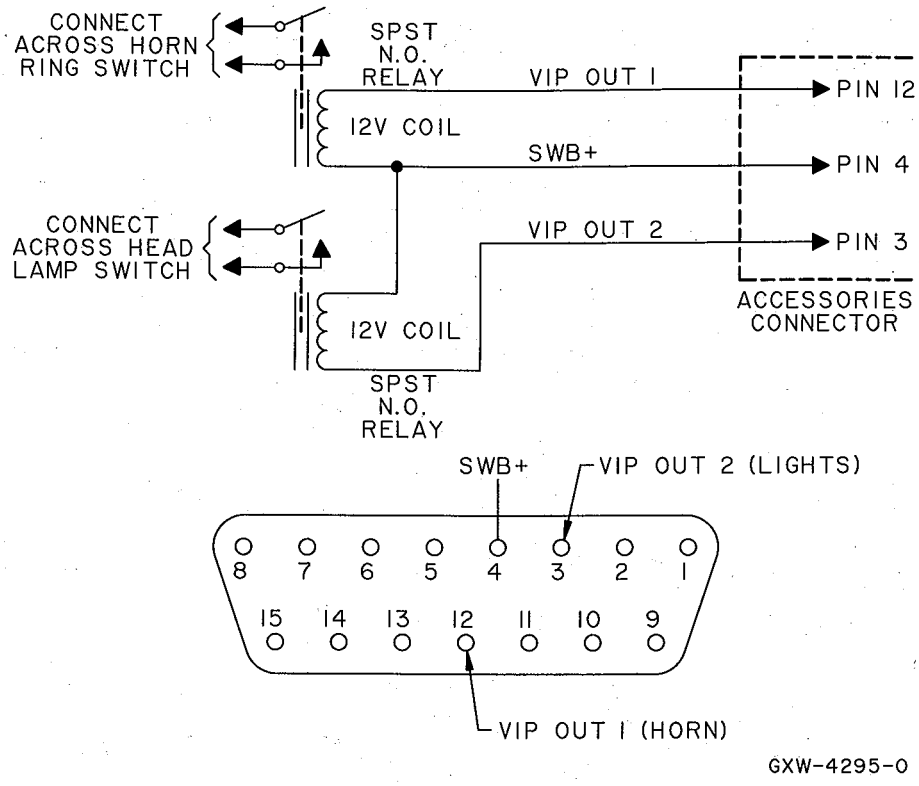
FOLDING RIBBON CABLE FOR INSTALLATION



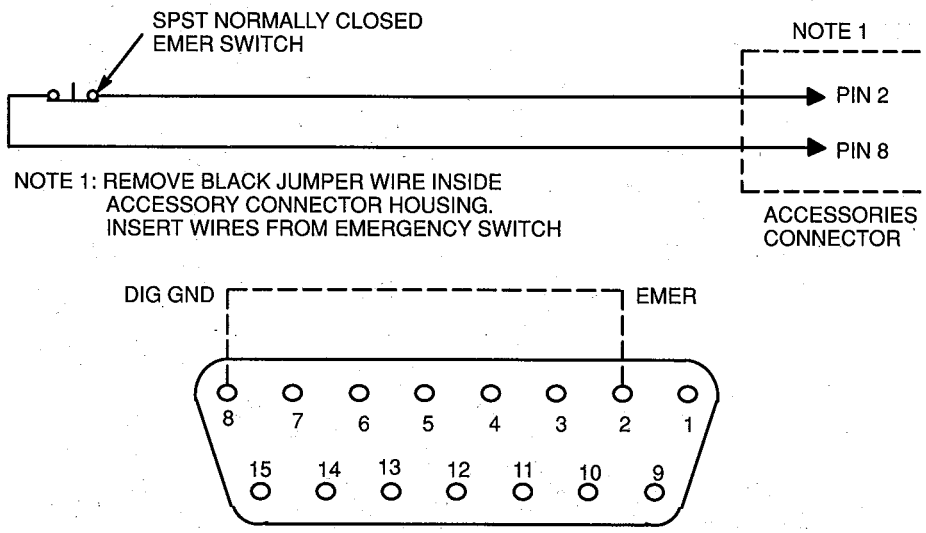
INSTALLING RIBBON CABLE (10 THRU 25 WATT)



INSTALLING RIBBON CABLE (30 THRU 50 WATT)



HORN/LIGHTS WIRING DIAGRAM



WARNING

All *SPECTRA* products must have accessory connector pins 2 and 8 connected together to allow the radio to power down. Opening this connection by REMOVING the accessory connector, or pressing the emergency switch, will turn–on the radio. Failure to maintain a normally closed path could drain the vehicle battery if left unchecked.

WARNING

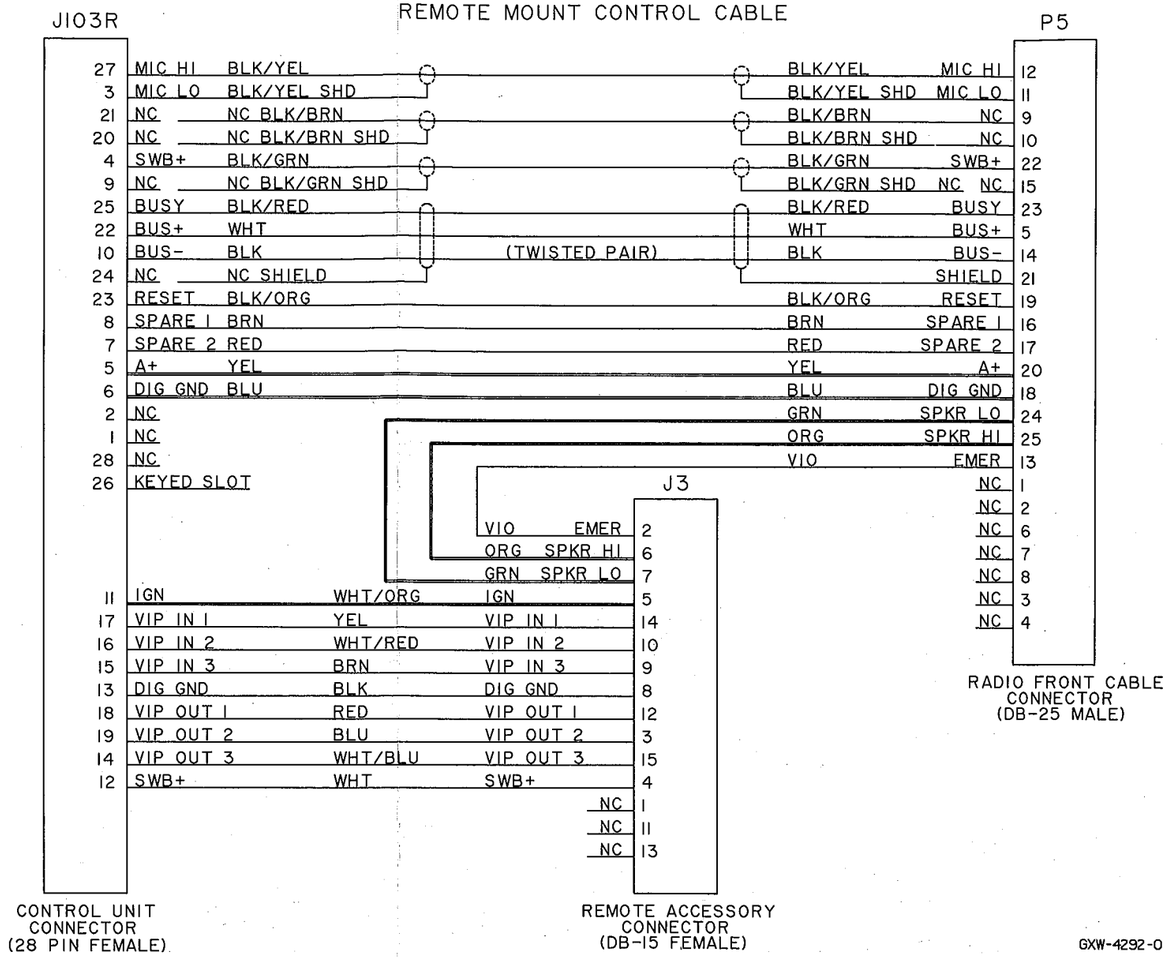
EMERGENCY equipped radios are capable of TRANSMITTING without warning.

GPW–4296–O

EMERGENCY SWITCH WIRING DIAGRAM

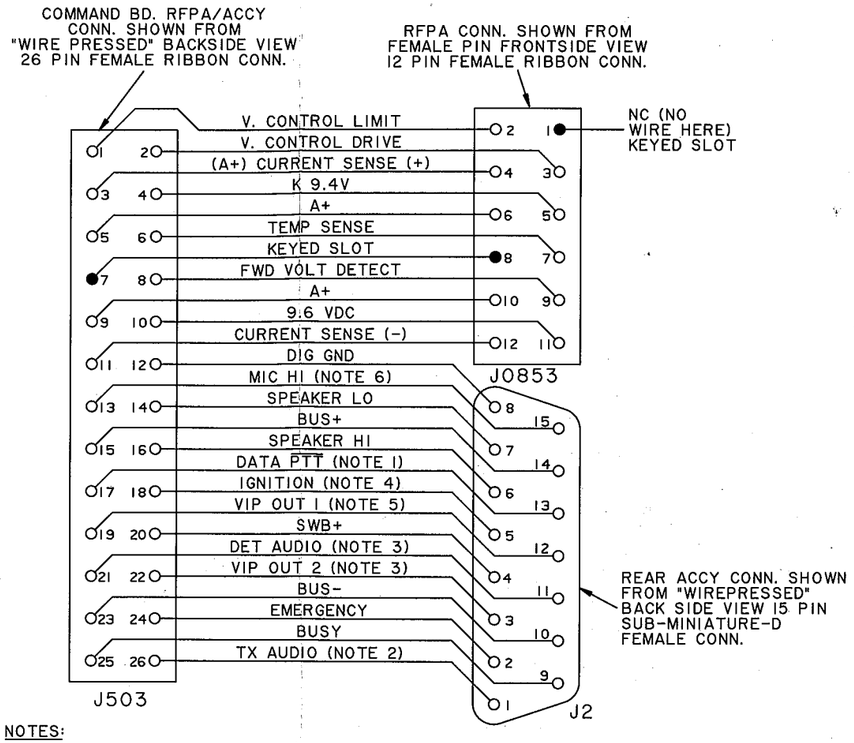
Wiring Diagram for Horn/Lights and Emergency Features
PW–4327–A
3/01/89

REMOTE MOUNT CONTROL CABLE



GXW-4292-0

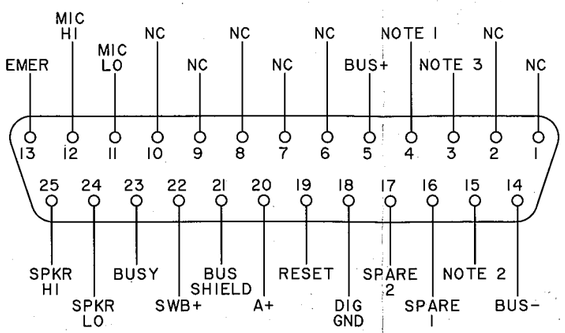
RIBBON CABLE



NOTES:
1. SWB+ SENSE IN "SP" CUSTOMER APPLICATIONS.
2. SERIAL BUS RESET IN "SP" CUSTOMER APPLICATIONS.
3. VOICE INHIBIT IN "SP" CUSTOMER APPLICATIONS.
4. SWB+ IN "SP" CUSTOMER APPLICATIONS.
5. DATA INHIBIT IN "SP" CUSTOMER APPLICATIONS.
6. GROUND OR SERIAL BUS RESET IN "SP" CUSTOMER APPLICATIONS.

GXW-6249-0

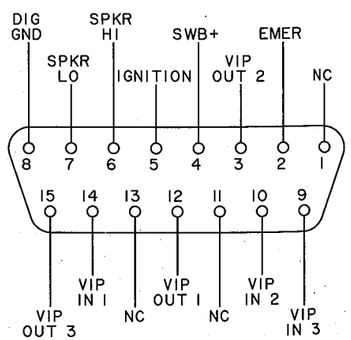
RADIO FRONT CONNECTOR J5
(DB-25 CONNECTOR FEMALE PIN-VIEW)



NOTES:
1. $\overline{PTT}$ IN SP CUSTOMER APPLICATIONS.
2. TX AUDIO IN SP CUSTOMER APPLICATIONS.
3. DET AUDIO IN SP CUSTOMER APPLICATIONS.

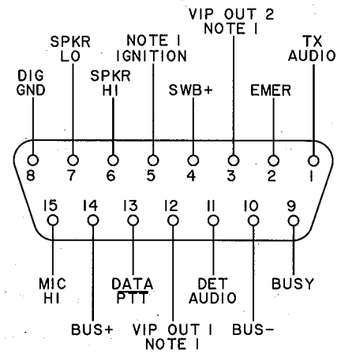
GXW-4281-0

J3
REMOTE MOUNT ACCESSORY CONNECTOR



GXW-4283-0

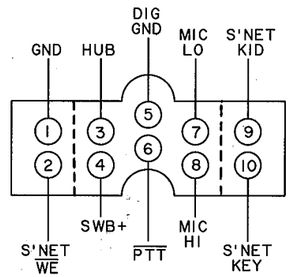
J2
REAR ACCESSORY CONNECTOR



NOTES:
1. FUNCTIONAL ONLY IN DASH-MOUNT CONFIGURATION, N.C. IN REMOTE-MOUNT CONFIGURATION.

GXW-6250-0

P104
MICROPHONE JACK

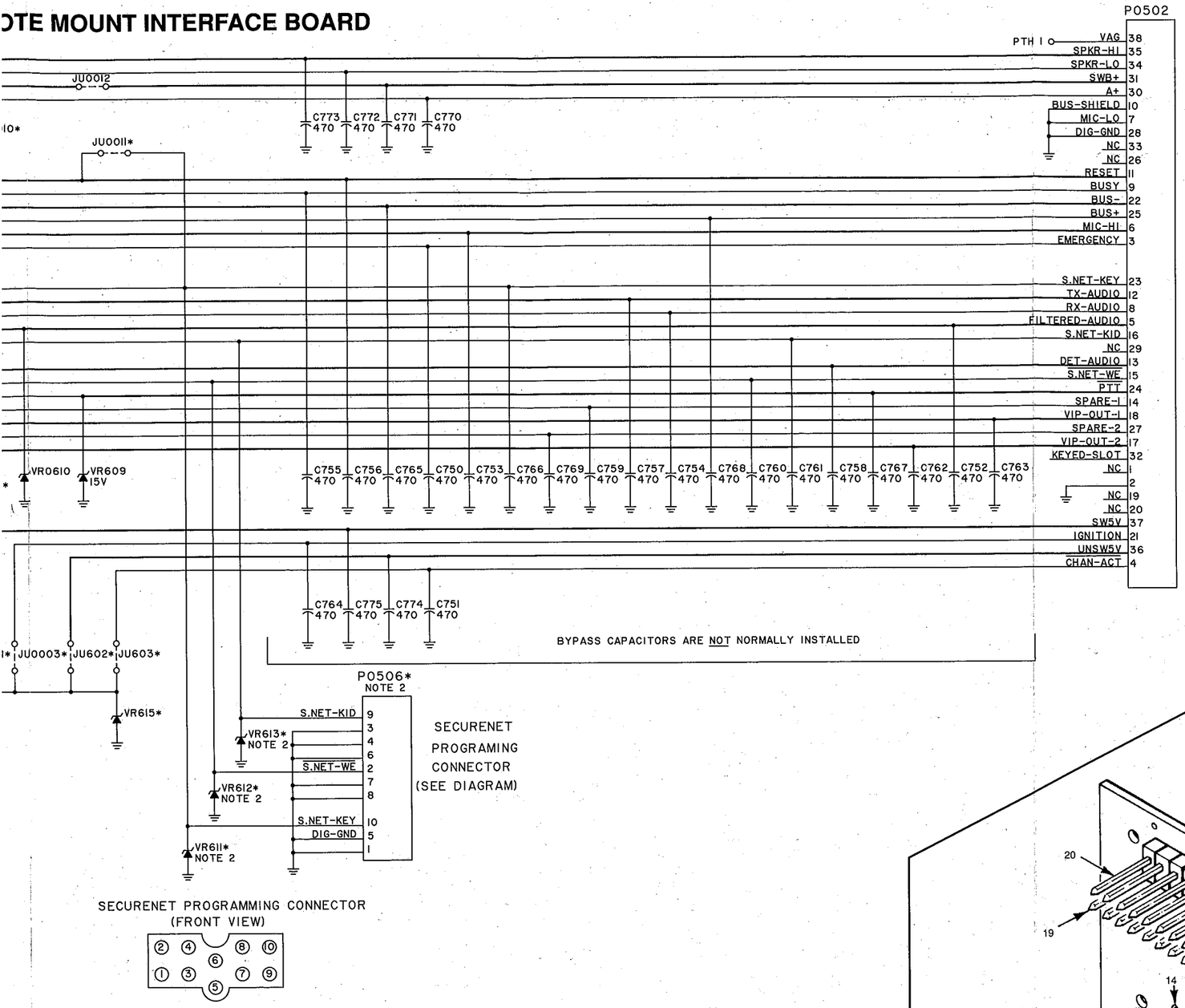


DETAIL SHOWN FROM CONTROL UNIT FRONT VIEW (MALE PIN VIEW)

GXW-6251-0

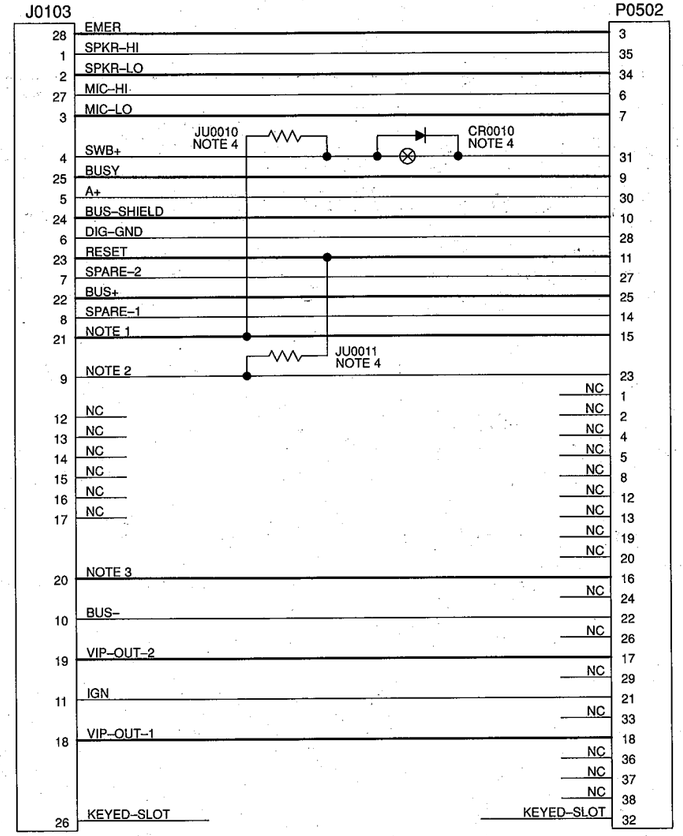
Wiring Diagrams and Pin–Outs for Ribbon Cable, Remote Mount, Control Cable, and Microphone Cable
PW–6234–O
2/15/89

ÞTE MOUNT INTERFACE BOARD



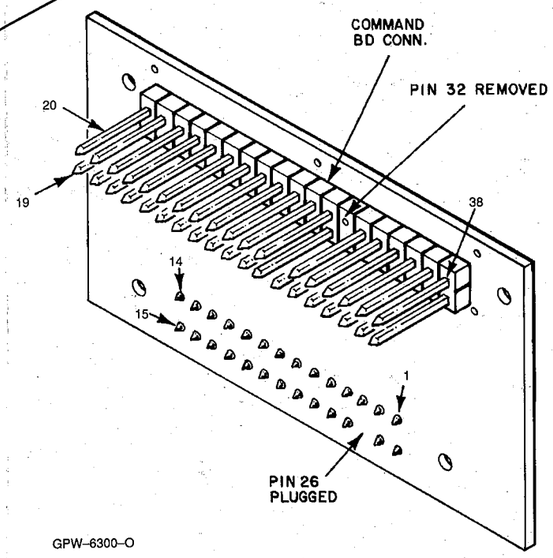
SECURENET PROGRAMMING CONNECTOR
(FRONT VIEW)

CONTROL HEAD INTERCONNECT BOARD



NOTE 1: CONTROL HEAD SWITCHED B+.
NOTE 2: SERIAL BUS RESET.
NOTE 3: DETECTED AUDIO.
NOTE 4: JU0010,JU0011,CR0010 INSTALLED FOR AVL OPTION.
TRACE CUT (⊗) ONLY WHEN CR0010 INSTALLED.

GPW-6269-A



GPW-6300-O

parts list

HLN6066A/B Control Head Interconnect Board — MXW-5959-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
connector receptacle		
J103	09-80113M03	vertical, dual row, 28 position
connector plug		
P502	28-80102M08	vertical, 38 position

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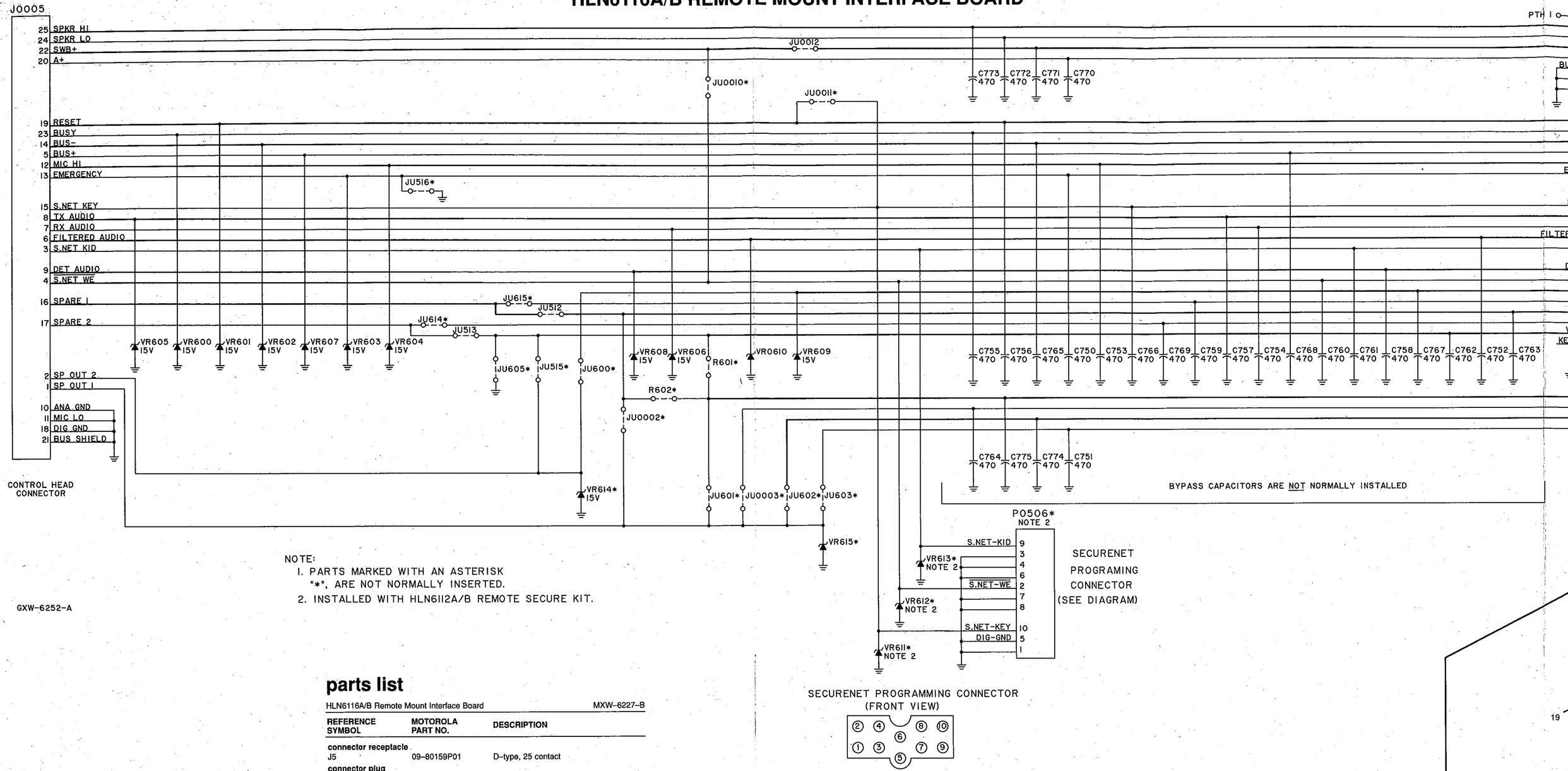
HLN6116A/B REMOTE MOUNT INTERFACE BOARD



NOTE:
1. PARTS MARKED WITH AN ASTERISK "*", ARE NOT NORMALLY INSERTED.
2. INSTALLED WITH HLN6112A/B REMOTE SECURE KIT.

GXW-6252-A

parts list

HLN6116A/B Remote Mount Interface Board — MXW-6227-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
connector receptacle		
J5	09-80159P01	D-type, 25 contact
connector plug		
P502	28-80102M09	vertical, 38 position
jumper		
JU12	06-11077A01	0-ohm resistor
JU512, 513	06-11077A01	0-ohm resistor
voltage regulator (see note)		
VR600-610	48-82958R91	zener, 15V
	mechanical parts	
	03-00139581	screw, machine, 4-40 x 5/16 (2 used)

9/15/89

APPENDIX

KNOW YOUR RADIO'S MODEL NUMBER!

The last 4 digits of your model number are very important to the proper use of this service manual. There are multiples of certain documents, each of which applies only to certain models. Identify your model number and compare its last four digits with the Model/Suffix digits listed below. Read across the page to identify which of the multiple documents applies to your radio. Models marked with an asterisk (*) are the current production models, manufactured after March 15, 1989, and documents supporting those models are in the main part of the manual. If you determine that your radio is NOT the current production radio, find the documents that support your radio in the following list and in the following appendix.

MODEL/SUFFIX LAST 4 DIGITS	MODEL CHART	FEATURE MATRIX	RADIO EXP. VIEW	WIRING DIAGRAMS	INTERFACE BOARDS
A5AK, A7AK	MXW–5826	MXW–5822	PW–5838	PW–4321	PW–5962
*A5BK, A7BK	MXW–6301	MXW–6302	PW–6303	PW–6234	PW–6235

Model Chart for *SPECTRA* UHF Two–Way Conventional Mobile FM Radio 40 watts RF Power "AK" Suffixed Models

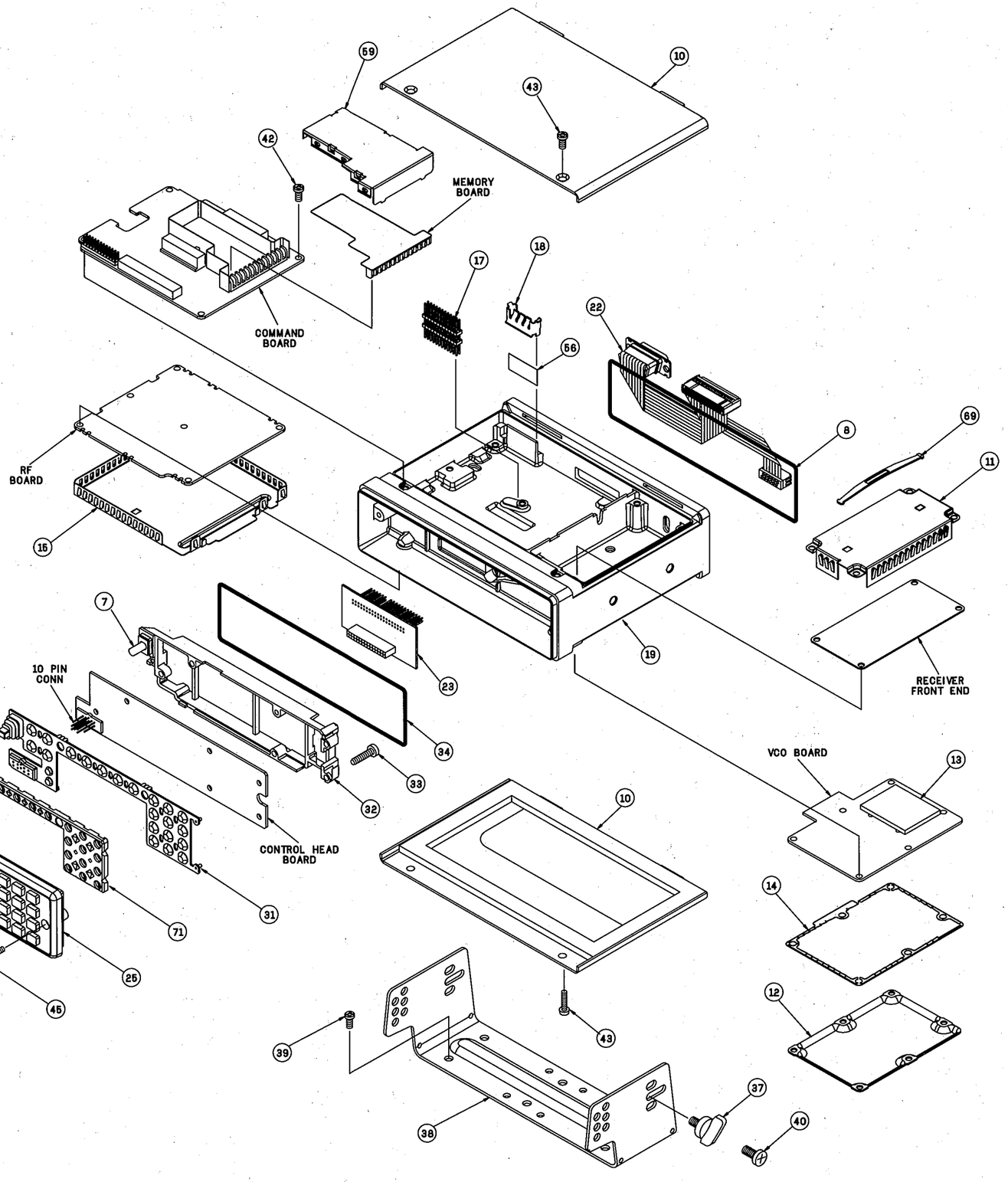
CODE:

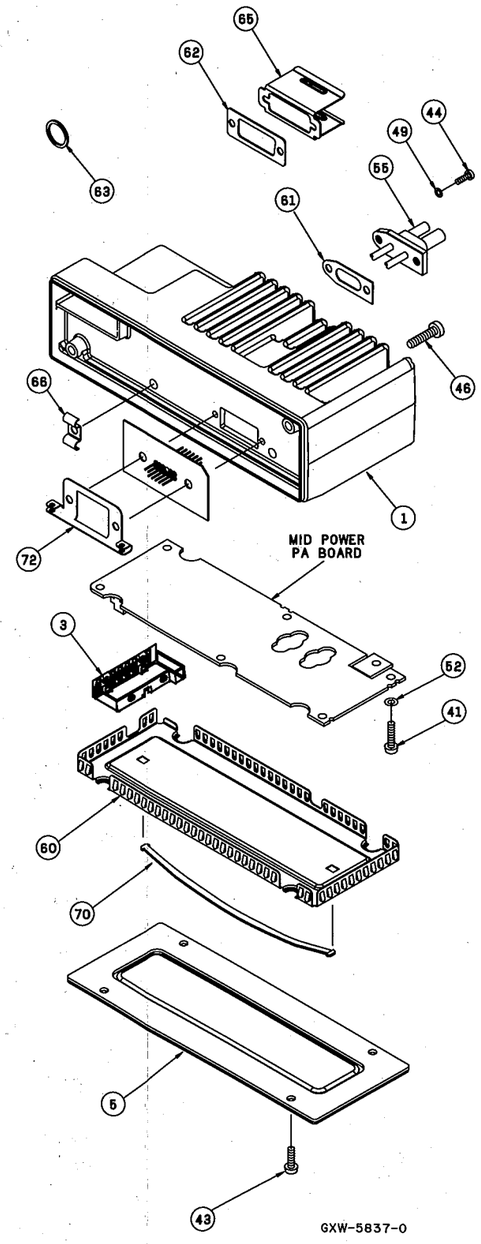
● = ONE ITEM SUPPLIED

model description	D44KMA7JA5AK (RANGE 3) STANDARD	D44KMA7JA7AK (RANGE 3) EXPANDED	D44KMA7JA5AK (RANGE 4) STANDARD	D44KMA7JA7AK (RANGE 4) EXPANDED		item	description
	●	●				HAE4003A	ANTENNA ROOF MT, 450–482 MHz
			●	●		HAE4004A	ANTENNA ROOF MT, 482–512 MHz
	●	●	●	●		HBN6000A	PACKING
	●	●	●	●		HLE6000A	VCO CARRIER BOARD
	●	●	●	●		HLE6033A	HARMONIC FILTER HYBRID (Range 3 and Range 4)
	●	●				HLE6043A	PA BOARD, 40 WATT (Range 3)
			●	●		HLE6044A	PA BOARD, 40 WATT (Range 4)
	●	●				HLE6103A	VCO HYBRID (Range 3)
			●	●		HLE6104A	VCO HYBRID (Range 4)
		●		●		HLN6001B	CONTROL HEAD HARDWARE (WITH KEYPAD)
	●		●			HLN6026B	CONTROL HEAD HARDWARE (NO KEYPAD)
	●	●	●	●		HLN6015A	INSTALLATION HARDWARE
	●	●	●	●		HLN6029B	MLM HARDWARE
	●	●	●	●		HLN6059A	TRANSCEIVER HARDWARE
	●	●	●	●		HLN6066A	CONTROL HEAD INTERCONNECT BOARD
	●	●	●	●		HLN6073A	RADIO HARDWARE
	●	●	●	●		HLN6074A	COMMAND BOARD
	●	●	●	●		HLN6078A/B	CONTROL HEAD BOARD
	●		●			HLN6081A	A5 BUTTONS (INSTALLED)
	●		●			HLN6105A	A5 BUTTONS (OPTIONAL)
		●		●		HLN6082A	A7 BUTTONS (INSTALLED)
		●		●		HLN6061A	A7 BUTTONS (OPTIONAL)
	●	●	●	●		HLN6086A	SERVICE MANUAL
	●	●	●	●		HMN1052A	MICROPHONE
	●	●				HRE6003A	RECEIVER FRONT END (Range 3)
			●	●		HRE6004A	RECEIVER FRONT END (Range 4)
	●	●	●	●		HRN6003A	RF BOARD
	●	●	●	●		HSN4018A	SPEAKER
	●	●	●	●		HVN6011A	SOFTWARE
	●	●	●	●		HKN4191A	MOBILE POWER CABLE
	●	●	●	●		HLN6057A	PA HARDWARE (DASH MOUNT)

Feature Matrix for *SPECTRA* UHF 40 watts Two–Way Conventional Mobile FM Radios "AK" Suffixed Models

Model	MODEL A5	MODEL A7				
Standard features: (●) Option : (O)						
8–CHARACTER ALPHANUMERIC DISPLAY	●	●				
POWER–UP SELF–CHECK	●	●				
FULL MIL810D SPECIFICATIONS	●	●				
60 SECOND TIME–OUT TIMER	●	●				
EXTERNAL SPEAKER	●	●				
FAST LOCK SYNTHESIZER	●	●				
VOLUME SET TONE	●	●				
DIMMER CONTROL	●	●				
IGNITION SENSE	●	●				
MONITOR BUTTON	●	●				
NUMERIC DTMF KEYPAD	●	●				
MDC–1200 PTT ID/EMERGENCY		●				
MDC–1200 8 STATUS / 8 MESSAGE		●				
MDC–1200 CALL ALERT DECODE		●				
MDC–1200 AUTO SELECTIVE CALL DECODE		●				
128 CONVENTIONAL CHANNELS	●	●				
40 WATTS POWER (VARIABLE TO 20 WATTS)	●	●				
DTMF ENCODE LIST	●	●				
UNLIMITED DTMF ENCODE		●				
MODE–SLAVED *CHANNEL SCAN* WITH DUAL PRIORITY	●	●				
OPERATOR–SELECTABLE *CHANNEL SCAN* WITH DUAL PRIORITY		●				
CONTROL STATION OPERATION	O	O				
REMOTE MOUNT CAPABILITY	O	O				
DTMF MICROPHONE	O	O				
HANDSET WITH HANGUP	O	O				
KEY LOCK MOUNT	O	O				
EXTERNAL ALARM RELAYS	O	O				
EMERGENCY FOOTSWITCH	O	O				
EXTERNAL EMERGENCY PUSHBUTTON	O	O				
10 WATT AUDIO	O	O				
RF PREAMPLIFIER	O	O				
2.5 PPM FREQUENCY STABILITY (TX/RX)	O	O				





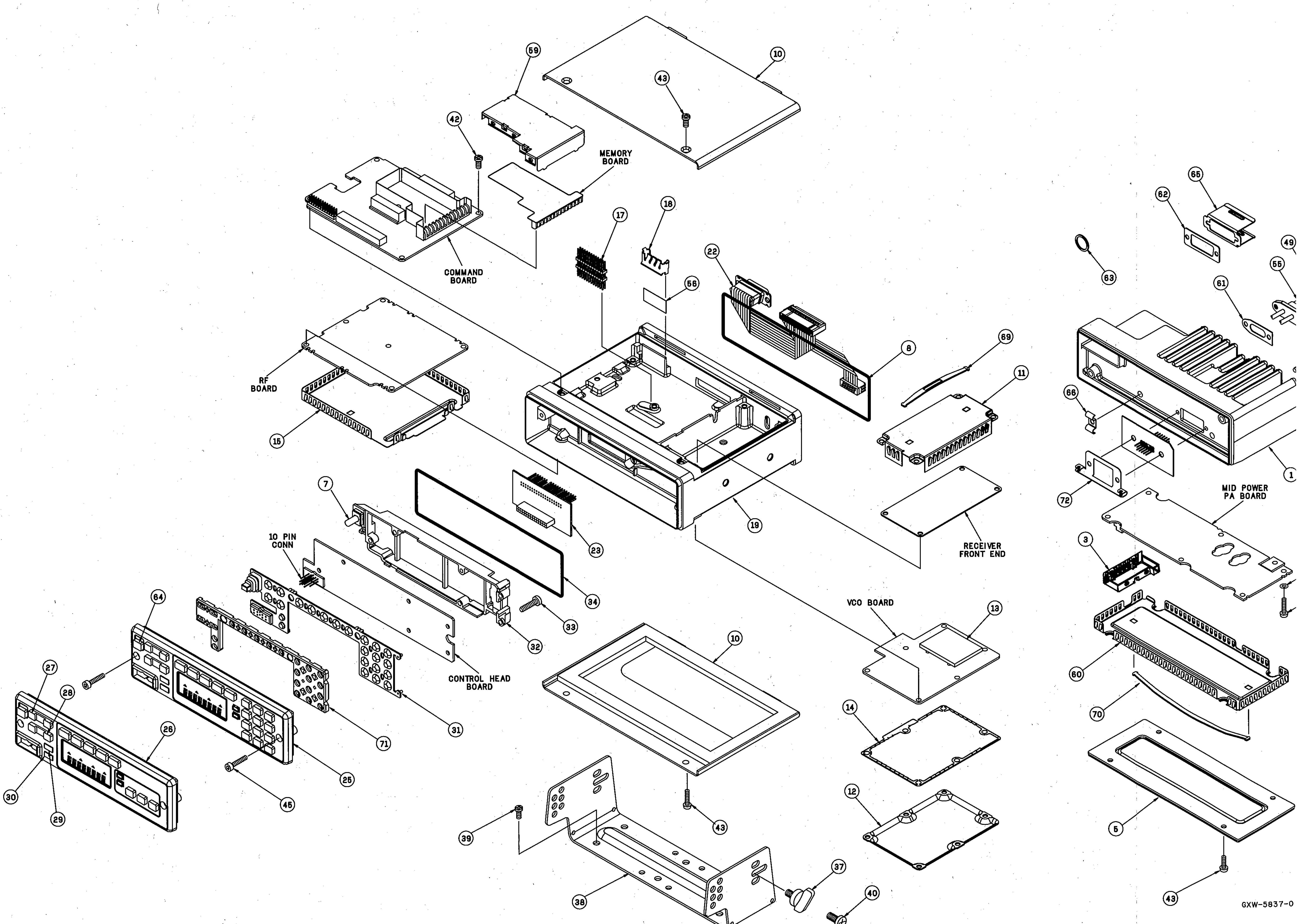
parts list

UHF *SPECTRA* Mechanical Parts Exploded View — MXW–5836–A

ITEM	MOTOROLA PART NO.	DESCRIPTION
1	26–80010M02	heatsink, mid–power
3	26–80189N01	shield, PA board
5	15–80048N01	cover, mid–power PA
7	40–80199N01	switch, power
8	32–80053P01	gasket, heatsink
10	15–80264N01	cover, includes gasket
11	15–80098L01	shield, receiver front–end
12	15–80097L01	cover, VCO board
13	15–80223N02	cover, VCO hybrid
14	32–80247N01	gasket, VCO
15	15–80099L01	shield, RF board
17	28–80260M01	header, floating
18	42–80007M01	clip, regulator
19	27–80082N01	chassis, consolidated
22	30–80239N02	cable, PA ribbon
23	HLN6066A	interconnect board
25	15–80010P01	housing, front cover, with keypad
26	15–80010P02	housing, front cover, without keypad
27	38–80009P01	pushbutton rocker, MODE
28	38–80009P02	pushbutton rocker, VOLUME
29	38–80092J01	pushbutton key, DIM
30	38–80092J02	pushbutton key, HOME
31	75–80189L02	keypad
32	43–80208L02	spacer, internal frame
33	03–10945A14	screw, tapping (6 used)
34	32–80289L01	gasket, housing
37	03–84244C06	screw, machine, wing 5.0 x 0.8 x 10
38	07–80086N01	trunnion, mounting
39	03–00136756	screw, tapping, 10–16 x 5/8 (6 used)
40	03–10908B08	screw, machine, 5 x 0.8 x 10 (4 used)
41	03–10911A10	screw, machine, 3.5 x 0.5 x 6
42	03–10943M15	screw, tapping, 3.5 x 0.6 x 8 (board mtg)
43	03–10943R61	screw, tapping, 3.5 x 0.6 x 10 (8 used)
44	03–80043L01	screw, metric, 3.0 x 10 (4 used)
45	03–80077M01	screw, control head mounting (2 used)
46	03–80077M02	screw, hex socket (2 used)
49	04–00131974	washer, flat
52	04–80217E01	washer, compression
55	09–80272N01	connector, power
56	14–80001M01	insulator, regulator
59	26–80118M01	shield, command board
60	26–80186M01	shield, PA
61	32–80015M01	gasket, power connector
62	32–80088M01	gasket, accessory connector
63	32–80089M02	gasket, antenna
64	38–80227M01	cap, on/off switch
65	42–80016M03	clip, accessory connector
66	42–80281N01	clip, coax, PA
69	55–84300B01	handle (2 used)
70	55–84300B04	handle
71	61–80186L01	lightpipe
72	42–80192N01	clip, coax
non–referenced parts		
	75–05295B01	pad, crystal
	75–80094M01	shock pad, VF display (2 used)

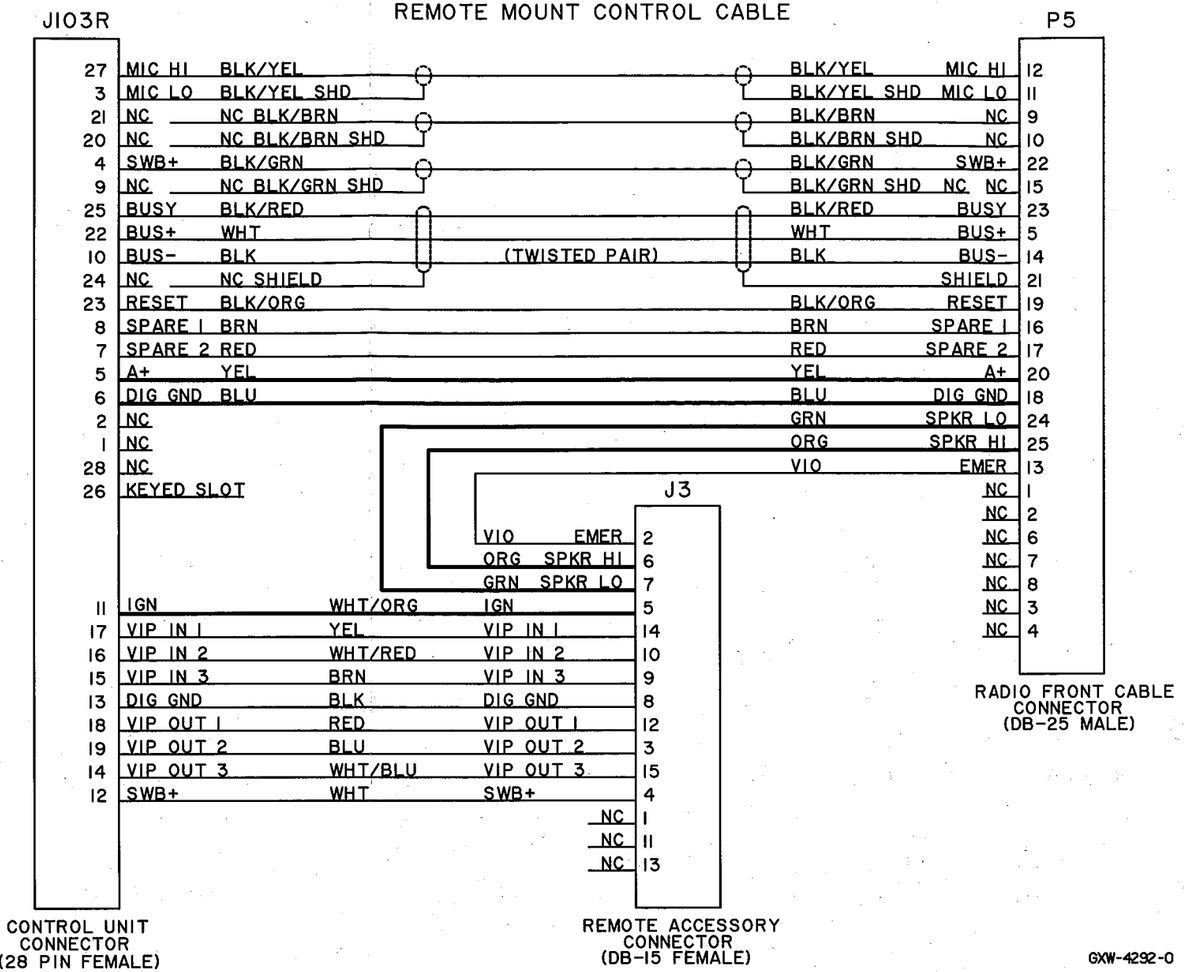
9/15/88

Mechanical Exploded View and Parts Lists
for *SPECTRA* UHF Radio
PW–5838–A
2/20/89



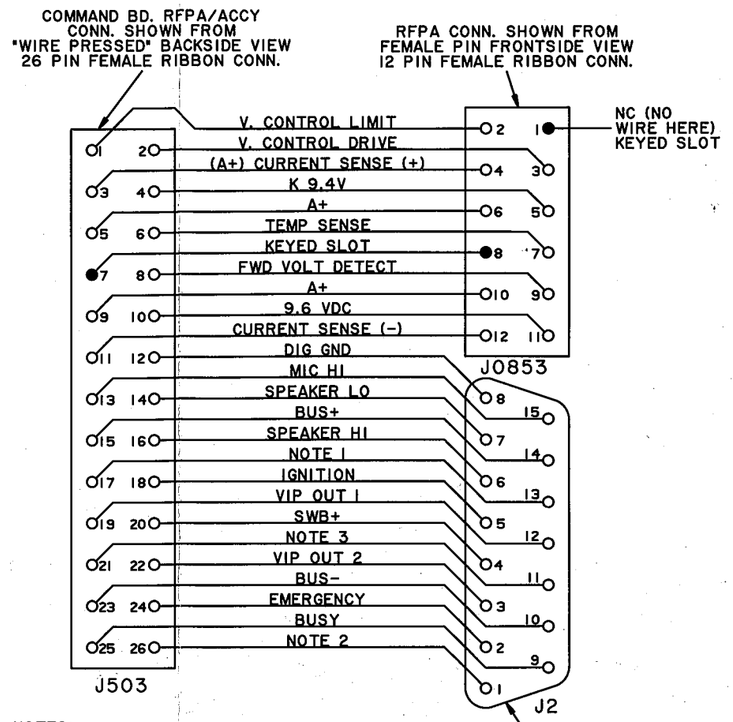
MEMORY BOARD
COMMAND BOARD
RF BOARD
10 PIN CONN
CONTROL HEAD BOARD
RECEIVER FRONT END
VCO BOARD
MID POWER PA BOARD
GXW-5837-0

REMOTE MOUNT CONTROL CABLE



GXW-4292-0

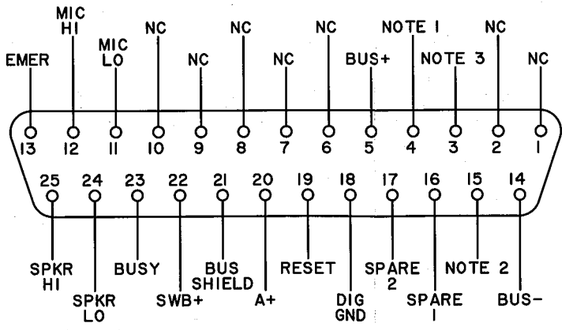
RIBBON CABLE



NOTES:
1. $\overline{\text{PTT}}$ IN SP CUSTOMER APPLICATIONS.
2. TX AUDIO IN SP CUSTOMER APPLICATIONS.
3. DET AUDIO IN SP CUSTOMER APPLICATIONS.

GXW-4280-0

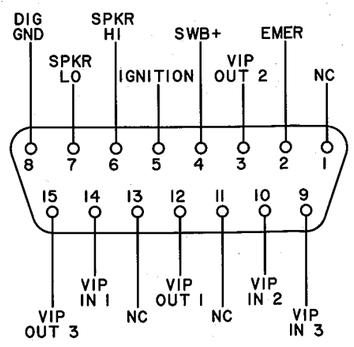
RADIO FRONT CONNECTOR J5 (DB-25 CONNECTOR FEMALE PIN-VIEW)



NOTES:
1. $\overline{\text{PTT}}$ IN SP CUSTOMER APPLICATIONS.
2. TX AUDIO IN SP CUSTOMER APPLICATIONS.
3. DET AUDIO IN SP CUSTOMER APPLICATIONS.

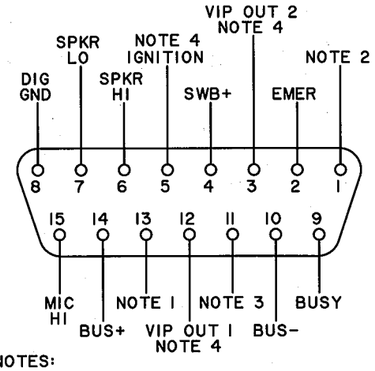
GXW-4281-0

J3 REMOTE MOUNT ACCESSORY CONNECTOR



GXW-4283-0

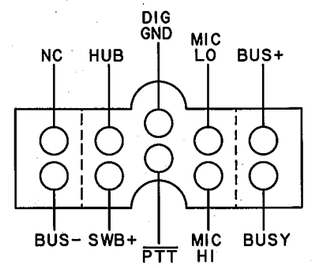
J2 REAR ACCESSORY CONNECTOR



NOTES:
1. $\overline{\text{PTT}}$ IN SP CUSTOMER APPLICATIONS.
2. TX AUDIO IN SP CUSTOMER APPLICATIONS.
3. DET AUDIO IN SP CUSTOMER APPLICATIONS.
4. FUNCTIONAL ONLY IN DASH-MOUNT CONFIGURATION. N.C. IN REMOTE-MOUNT CONFIGURATION.

GXW-4282-0

P104 MICROPHONE JACK

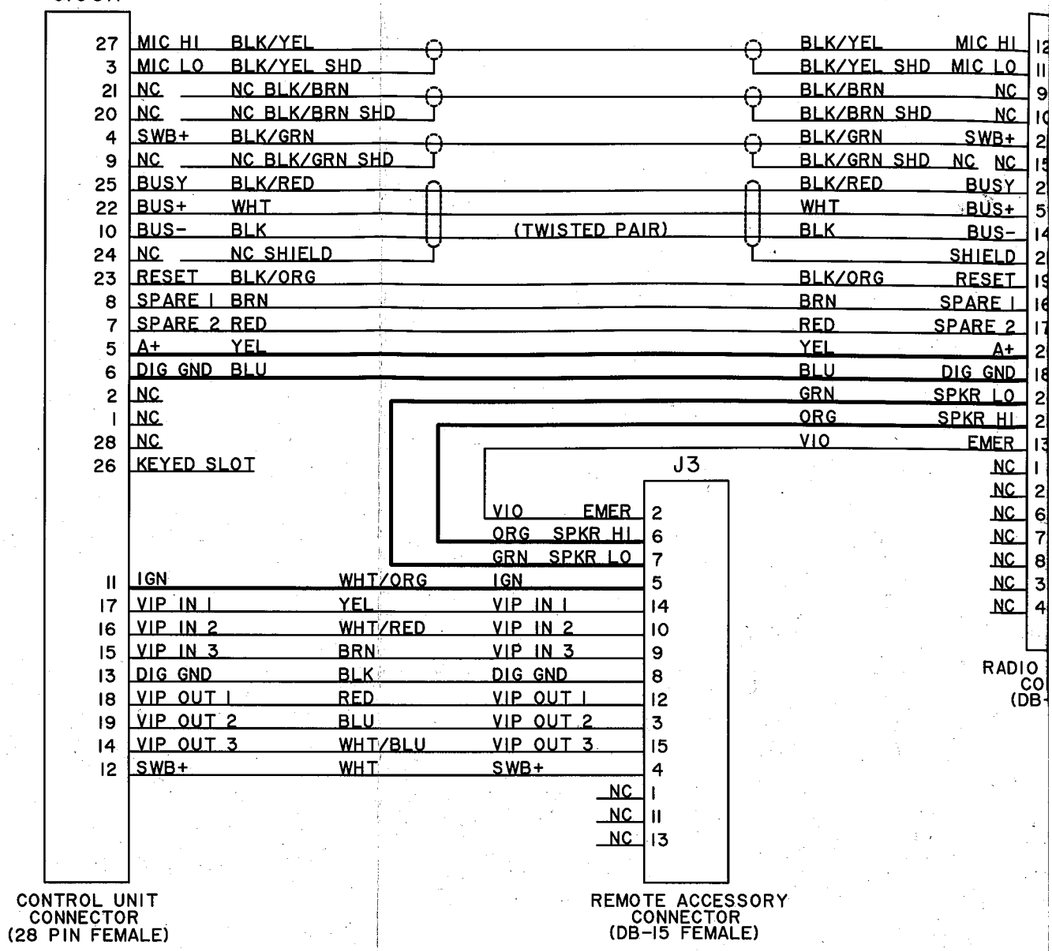


DETAIL SHOWN FROM CONTROL UNIT FRONT VIEW (MALE PIN VIEW)

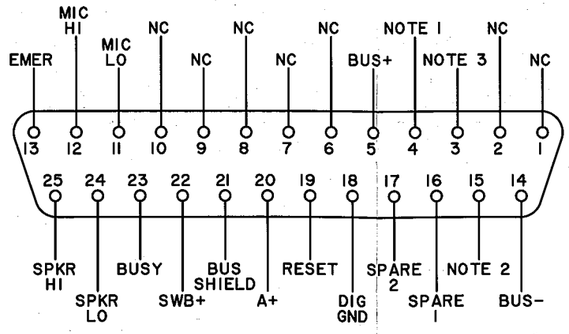
GXW-4284-0

Wiring Diagrams and Pin–Outs for Ribbon Cable, Remote Mount, Control Cable, and Microphone Cable
PW–4321–C
10/15/88

REMOTE MOUNT CONTROL CABLE



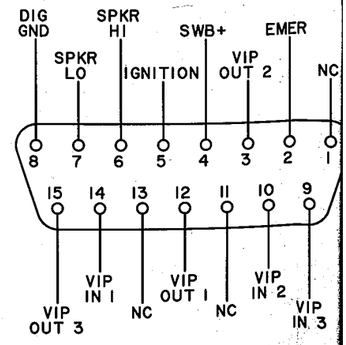
RADIO FRONT CONNECTOR J5 (DB-25 CONNECTOR FEMALE PIN-VIEW)



NOTES:
1. $\overline{PTT}$ IN SP CUSTOMER APPLICATIONS.
2. TX AUDIO IN SP CUSTOMER APPLICATIONS.
3. DET AUDIO IN SP CUSTOMER APPLICATIONS.

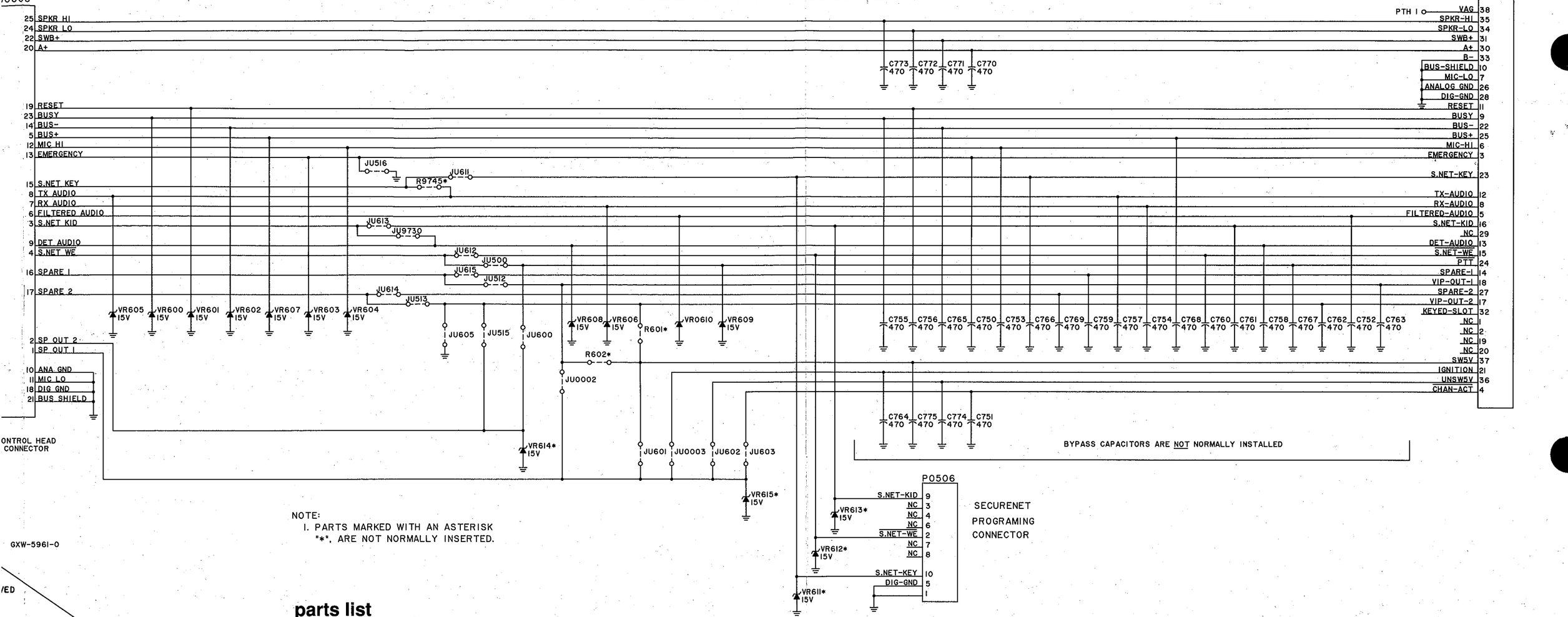
GXW-4281-0

J3 REMOTE MOUNT ACCESSORY CONNECTOR



GXW-4283

HLN6077A REMOTE MOUNT INTERFACE BOARD



NOTE:
1. PARTS MARKED WITH AN ASTERISK "*", ARE NOT NORMALLY INSERTED.

GXW-5961-0

parts list

HLN6077A Remote Mount Interface Board — MXW–5455–B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
connector receptacle		
J5	09–80049N01	D–type, 25 contact
connector plug		
P502	28–80102M09	vertical, 38 position
voltage regulator (see note)		
VR600–610	48–82958R91	zener, 15V
	mechanical parts	
	03–00139581	screw, machine, 4–40 x 5/16 (2 used)

10/15/88

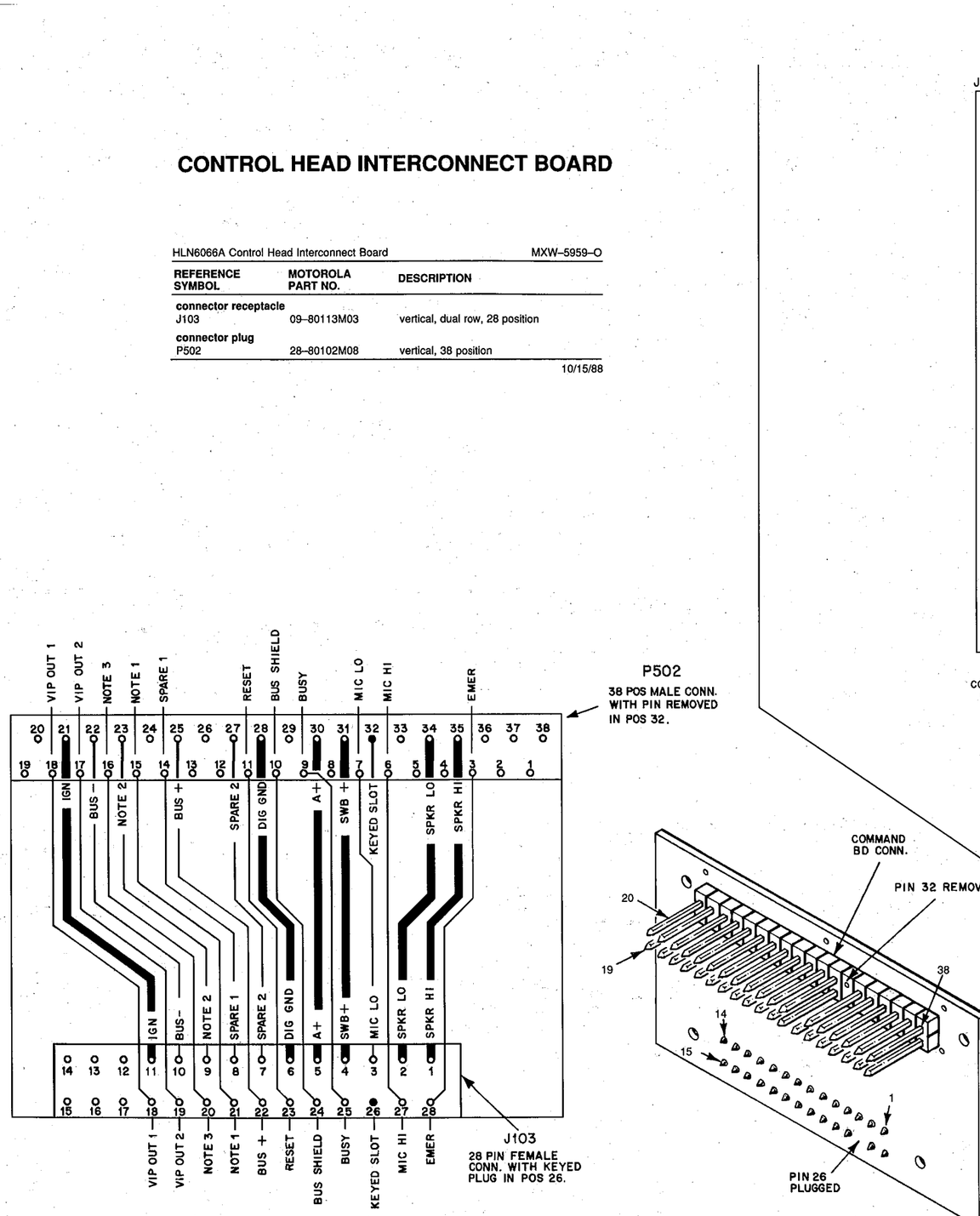
Note: For best performance, order diodes, transistors, and integrated circuit devices by Motorola part number.

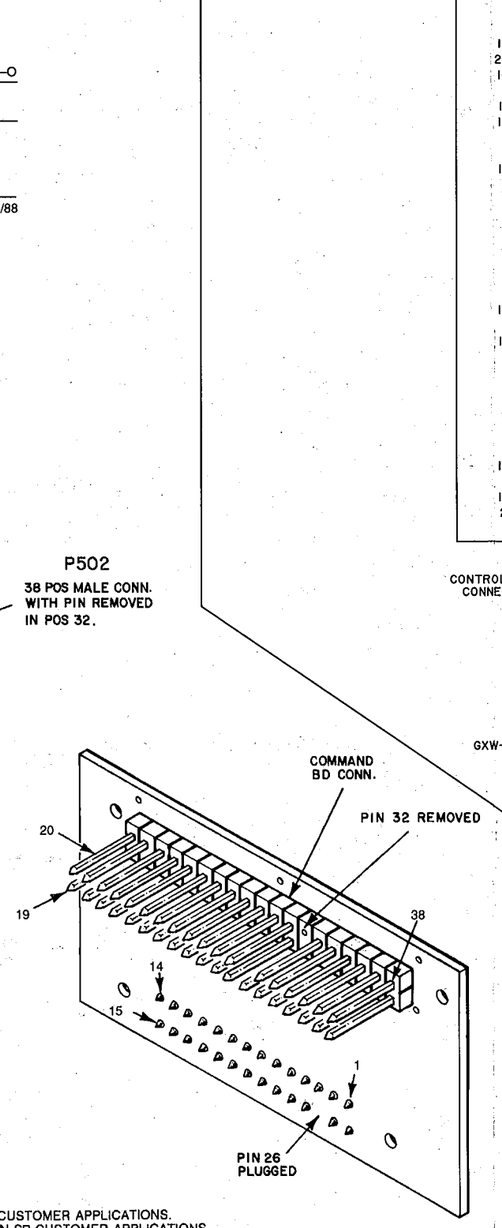
CONTROL HEAD INTERCONNECT BOARD

HLN6066A Control Head Interconnect Board — MXW–5959–O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
connector receptacle		
J103	09–80113M03	vertical, dual row, 28 position
connector plug		
P502	28–80102M08	vertical, 38 position

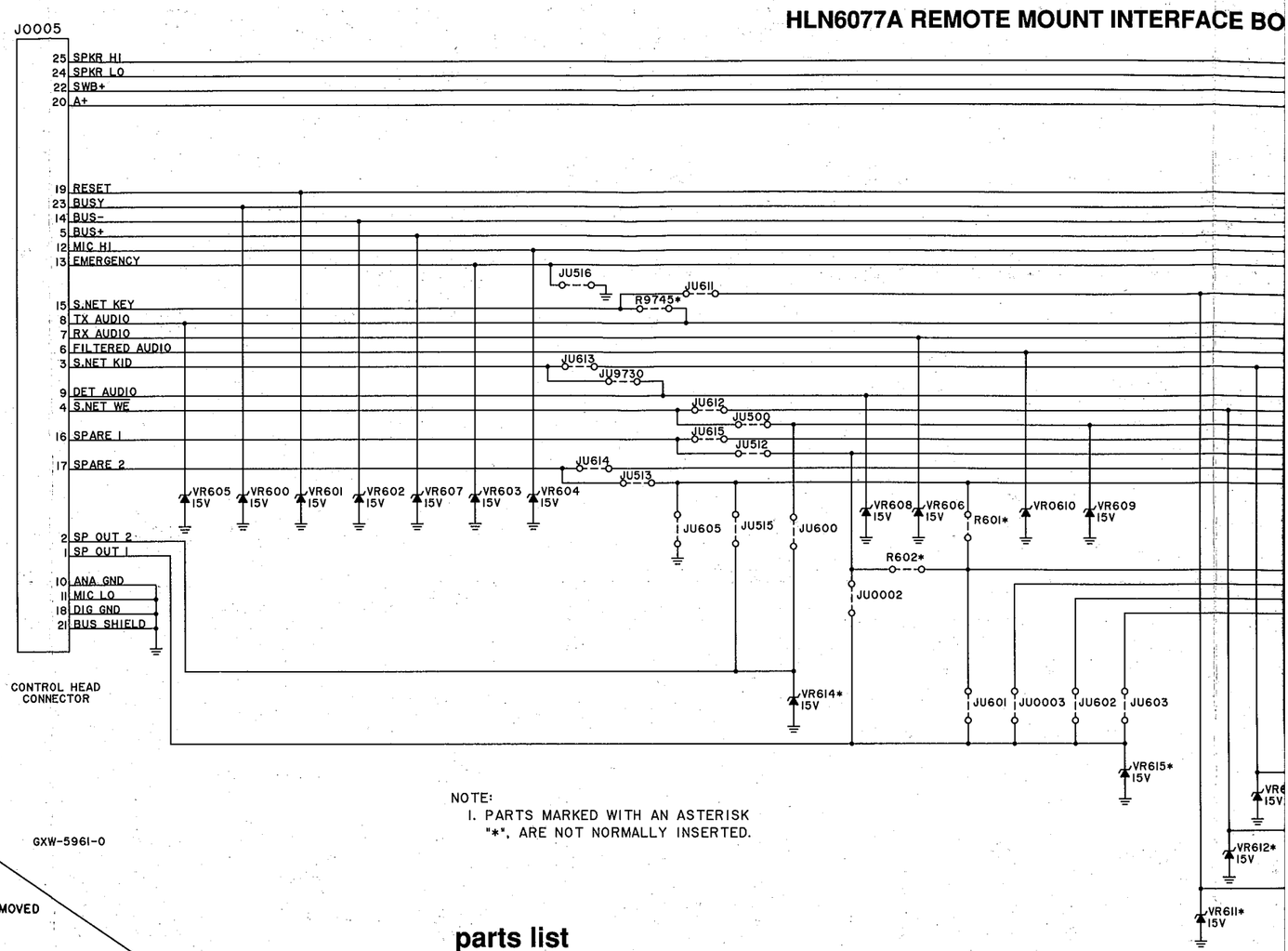
10/15/88





NOTE 1: $\overline{\text{PTT}}$ IN SP CUSTOMER APPLICATIONS.
NOTE 2: TX AUDIO IN SP CUSTOMER APPLICATIONS.
NOTE 3: DET AUDIO IN SP CUSTOMER APPLICATIONS.

HLN6077A REMOTE MOUNT INTERFACE BO



NOTE:
1. PARTS MARKED WITH AN ASTERISK "*", ARE NOT NORMALLY INSERTED.

parts list

HLN6077A Remote Mount Interface Board — MXW–5455–B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
connector receptacle		
J5	09–80049N01	D–type, 25 contact
connector plug		
P502	28–80102M09	vertical, 38 position
voltage regulator (see note)		
VR600–610	48–82958R91	zener, 15V
	mechanical parts	
	03–00139581	screw, machine, 4–40 x 5/16 (2 used)

10/15/88

Note: For best performance, order diodes, transistors, and integrated circuit devices by Motorola part number.