



Spectra®/Spectra® 9000
900 MHz Two-Way FM Radios
4, 12, and 30Watts RF Power
Service Manual



Spectra®/Spectra® 9000
900 MHz Two-Way FM Radio
4, 12, and 30 Watts RF Power

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PERFORMANCE SPECIFICATIONS FOR SPECTRA CONVENTIONAL 4 WATT AND 30 WATT RADIOS

GENERAL

Channel Capability	128 Conventional 900MHz frequencies (A4 Model)
	128 Conventional 900MHz frequencies (A5 Model)
	128 Conventional 900MHz frequencies (A7 Model)
Primary Power	12Vdc negative ground only
Dimensions	2.0" H x 7.1" W x 8.6" L
Weight	5.5 lbs.
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 @ 13.8V	Receiver @ 13.8V	Transmit @ Rated Power
D37KMA7JA5_K	TX: 896-902 RX: 935-941 935-941	30 watts	+12Vdc	.5A	2.5A	14.5A
D37KMA7JA7_K	TX: 896-902 RX: 935-941 935-941	30 watts	+12Vdc	.5A	2.5A	14.5A
D37KMA7JA7_K	TX: 896-902 RX: 935-941 935-941	4 watts	+12Vdc	.5A	2.5A	4.5A
D37KMA7JA4_K	TX: 896-902 RX: 935-941 935-941	30 watts	+12Vdc	.5A	2.5A	14.5A

TRANSMITTER

Output Impedance	50 ohms
Spurious and Harmonic Emissions	More than 70dB below carrier (for EIA spec. RS152B)
Frequency Stability	±.00015% of assigned center frequency from -30°C to +60°C ambient (+25°C reference)
Modulation	10K0F1D, 11K0F2D, and 11K0F3E
Audio Sensitivity	0.080V ±3dB for 60% maximum deviation @1000Hz
Audio Response	+1, -3dB of a 6dB/octave pre-emphasis characteristic from 300 to 3000Hz
Audio Distortion	Less than 2% @ 1000Hz, 60% maximum deviation
Maximum Frequency Separation	6MHz within each of two groups, 896-902 and 935-941MHz
FM Hum and Noise: EIA Method	-40dB

RECEIVER

Channel Spacing	12.5kHz
Sensitivity:	(per EIA spec. RS204C)
20dB quieting	.40µV
EIA SINAD	.30µV
Selectivity: EIA SINAD	-70dB @ ±12.5kHz; -80dB @ ±25kHz
Spurious & Image Rejection	90dB
Intermodulation: EIA SINAD	-70dB @ ±12.5kHz; -80dB @ ±25kHz
Input Impedance	50 ohms
Audio Output	105dB SPL @ less than 3% distortion
Maximum Frequency Separation	6MHz
Frequency Stability	±.00015% of assigned center frequency from -30°C to +60°C ambient (+25°C reference)

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
ALL MEASUREMENTS IN TEST MODE WITH HEARCLEAR DISABLED.

FCC TRANSCEIVER DESIGNATION

ABZ89FT5665 (30 watts)	ABZ89FT5703 (4 watts)
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PERFORMANCE SPECIFICATIONS FOR SPECTRA PRIVACY PLUS
TRUNKED/CONVENTIONAL 900 MHz RADIO

PERFORMANCE SPECIFICATIONS FOR SPECTRA SMARTNET
TRUNKED/CONVENTIONAL 900 MHz RADIO

PERFORMANCE SPECIFICATIONS FOR SPECTRA 9000 RADIOS
(900 MHz, 30 WATTS)

PERFORMANCE SPECIFICATIONS FOR SPECTRA 9000 CONTROL UNIT AND SPEAKER

CONTROL UNIT

Dimensions (excluding mounting bracket)	6.5" W x 3.375" H x 1.687" D (166 mm x 87 mm x 42 mm)
Weight	1 lb. (465 g)
Current Drain	300 mA

SPEAKER

Dimensions (excluding mounting bracket)	5" W x 5" H x 2.5" D (127 mm x 127 mm x 63 mm)
Weight	1.5 lb. (680 g)

MODEL CHART FOR SPECTRA 900 MHz CONTROL HEAD BUTTON KITS

(All Package Models)

MODEL									
A4 Package									
A5 Package									
A7 Package									
B2 Package									
B5 Package									
B7 Package									
C2 Package									
C4 Package									
C5 Package									
C7 Package									
		ITEM		DESCRIPTION					
	*			HLN5033A	Privacy Plus Limited				
		*		HLN5034B	Privacy Plus Standard				
			*	HLN5035A	Privacy Plus Expanded				
				*	HLN5039A	SMARTNET Expanded			
		*	*	*	*	HLN5040C	PHONE/PAGE/EMERGENCY/MPL Field Option		
	*					HLN5061C	EMERGENCY, Field Option		
*						HLN5081B	Conventional Standard		
	*					HLN5082A	Conventional Expanded		
*	*					HLN5105C	EMER/SECURENET, Field Option		
					*	HLN5135A	SMARTNET Standard		
					*	HLN5137B	1, 2PGE, 3, SECURE, Field Option		
			*			HLN5138A	SMARTNET Limited		
			*	*	*	*	HLN5193B	EMER/MPL, Field Option	
*						HLN5249A	Secure, Rotary		
*						HLN5250A	Conventional, Rotary		
				*		HLN5294A	SMARTNET, Rotary		
	*					HLN5095B	SECURENET, Standard		
	*					HLN5095A	SECURENET, Expanded		

CODE * = ONE ITEM SUPPLIED

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MODEL CHART FOR SPECTRA 9000 TWO-WAY RADIO 900 MHz, 30 WATTS RF POWER

MODEL			DESCRIPTION
T37KGA5JB9AK			Privacy Plus Trunked/Conventional
T37KGA5JC9AK			SMARTNET Trunked/Conventional
T37KMA7JA9AK			Conventional
ITEM			DESCRIPTION
•	•	•	HBN4036A Packing
•	•	•	HBN6006A Packing
•	•	•	HCN1073B Control Unit
•	•	•	HLN6284A Control Unit Circuit Panel
•	•	•	HLN5562A Control Unit Hardware
•	•	•	HYN4026A Control Unit Software
•	•	•	HKN4192A Mobile Power Cable
•	•	•	HKN4356B 17 Ft. Cable
•	•	•	HLF6022A Harmonic Filter
•	•	•	HLF6084C YCO Carrier Board
•	•	•	HLF6072C YCO Hybrid
•	•	•	HLF6075B PA Board
•	•	•	HLN4921A Control Unit Trunion
•	•	•	HLN4952A Fuse Kit, Green and Orange Leads
•	•	•	HLN5488A Installation Hardware
•	•	•	HLN6071A Radio Hardware Mid-Power
•	•	•	HLN6094C Command Board
•	•	•	HLN6111A Transceiver Hardware
•	•	•	HLN6150A HearClear Board
•	•	•	HLN6161B Interconnect Board
•	•	•	HLN6162A Remote Control Unit Hardware
•	•	•	HMN1061A Microphone
•	•	•	HRF6003A Receiver Front End Board
•	•	•	HRN6007A/B RF Board
•	•	•	HSN4018A Speaker
•	•	•	RR44935A Antenna

CODE: • = OFF IT'S BUILT IN.

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MODEL CHART FOR SPECTRA 9000 CONTROL UNIT BUTTON KITS

(All Package Models)

MODEL				
A9 PACKAGE				
B9 PACKAGE				
C9 PACKAGE				
			ITEM	DESCRIPTION
•	•	•	HLN5066A	'SCAN'
•	•	•	HLN5072A	'HL'
•	•	•	HLN5074A	'CALL'
•	•	•	HLN5076A	'RCL'
•	•	•	HLN5078A	'DEL'
•	•	•	HLN5079A	'SEL'
•	•	•	HLN5083A	'EMER'
•	•	•	HLN5085A	'SQL'
•	•	•	HLN5087A	'HOME'
•	•	•	HLN5090A	'PHON'
•	•	•	HLN5091A	'DR'
•	•	•	HLN5095A	BLANK
•	•	•	HLN5096A	PLUG
	•	•	HLN5268A	'PAGE'
		•	HLN5256A	'SRCH'
		•	HLN5257A	'LOCK'
		•	HLN5258A	'SITE'
		•	HLN5259A	'RPGM'
•		•	HLN6167B	STS, MSG, EMER (FIELD OPTION)
•		•	HLN5092A	' Q '
	•		HLN6193B	EMER MPL (FIELD OPTION)

CUL.

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- ONE ILV RUFFLE

FEATURE MATRIX FOR SPECTRA 900 MHz CONVENTIONAL RADIO

(Listed are current-suffixed models only, as listed in current Model Chart)

MODEL				DESCRIPTION
A4 PACKAGE				
A5 PACKAGE				
A7 PACKAGE				
A9 PACKAGE				
•	•	•	•	8-CHARACTER ALPHANUMERIC DISPLAY
			•	11-CHARACTER ALPHANUMERIC DISPLAY
•	•	•	•	POWER-UP SELF-CHECK
•	•	•	•	FULL ML 810D SPECIFICATIONS
•	•	•	•	60-SECOND TIME-OUT TIMER
•	•	•		3dB GAIN ANTENNA
•	•	•	•	EXTERNAL SPEAKER
•	•	•	•	FAST LOCK SYNTHESIZER
	•	•	•	VOLUME SET TONE
•	•	•	•	DIMMER CONTROL
•	•	•	•	HEAR CLEAR AUDIO ENHANCEMENT
•	•	•	•	IGNITION SENSE
•	•	•	•	MONITOR BUTTON
		•	•	NUMERIC DTMF KEYPAD
•	•	•	•	MDC PTT-D/EMERGENCY
•	•	•	•	128 CONVENTIONAL CHANNELS
•	•	•	•	TALKAROUND
•	•	•	•	30 WATTS POWER
•	•	•	•	DTMF ENCODE LIST
		•	•	UNLIMITED DTMF ENCODE
•	•	•	•	MODE-SLAVED CHANNEL SCAN
•	•	•	•	OPERATOR-SELECTABLE CHANNEL SCAN
•	•	•	•	MDC AUTO SEL CALL DECODE
•	•	•	•	MDC CALL ALERT/ DECODE
		•	•	MDC STATUS MESSAGE
o	o	o		CONTROL STATION OPERATION
o	o	o	o	REMOTE MOUNT CAPABILITY
o	o	o	o	DTMF MICROPHONE
o	o	o	o	HANDSET WITH HANGUP
o	o	o	o	KEY-LOCK MOUNT
o	o	o	o	EXTERNAL ALARM RELAYS
o	o	o	o	EXTERNAL FOOTSWITCH
o	o	o	o	EXTERNAL EMERGENCY PUSHBUTTON
o	o	o	o	10 WATT AUDIO
o	o	o	o	NOISE CANCELLING MICROPHONE

MAEPF-22031-0

STANDARD FEATURES: (•) OPTION: (o)

NOTE: Your local distributor may have additional options. For all your vehicle equipment needs, consult your distributor for the most complete list of standard and optional features.

FEATURE MATRIX FOR SPECTRA 900 MHz PRIVACY PLUS RADIO

(Listed are current-suffixed models only, as listed in current Model Chart)

MODEL			
B2 PACKAGE			
B5 PACKAGE			
B7 PACKAGE			
DESCRIPTION			
*	*	*	8-CHARACTER ALPHANUMERIC DISPLAY
*	*	*	POWER-UP SELF-CHECK
*	*	*	FULL MIL-STD SPECIFICATIONS
*	*	*	60 SECOND TIME-OUT TIMER
*	*	*	3dB GAIN ANTENNA
*	*	*	EXTERNAL SPEAKER
*	*	*	FAST LOCK SYNTHESIZER
*	*	*	VOLUME SET TONE
*	*	*	DIMMER CONTROL
*	*	*	HEAR CLEAR AUDIO ENHANCEMENT
*	*	*	IGNITION SENSE
*	*	*	MONITOR BUTTON
*	*	*	NUMERIC DTMF KEYPAD
*	*	*	MDC PTT ID/EMERGENCY
*	*	*	10 CONVENTIONAL CHANNELS
*	*	*	10 SYSTEMS/10 SUBFLEETS
*	*	*	2 SYSTEMS/2 SUBFLEETS
*	*	*	15 SYSTEMS/10 SUBFLEETS
*	*	*	TALKAROUND
*	*	*	4 WATTS POWER
*	*	*	12 WATTS POWER
*	*	*	30 WATTS POWER
*	*	*	TELEPHONE INTERCONNECT LIST
*	*	*	UNLIMITED TELEPHONE INTERCONNECT
*	*	*	OPERATOR-SELECTABLE TALKGROUP SCAN
*	*	*	FIXED-LIST TALKGROUP SCAN
*	*	*	DUAL MODE OPERATION
*	*	*	UNLIMITED PRIVATE CONVERSATION (PC) - WITH CALL ALERT (CA)
*	*	*	PC RESPONSE WITH CA DECODE
*	*	*	EXTERNAL ALARM CAPABILITY
*	*	*	MDC AUTO SEL CALL DECODE
*	*	*	MDC CALL ALERT DECODE
*	*	*	MULTIPLE PL (MPL)
◇	◇	◇	CONTROL STATION OPERATION
◇	◇	◇	REMOTE MOUNT CAPABILITY
◇	◇	◇	DTMF MICROPHONE
◇	◇	◇	HANDSET WITH HANGUP
◇	◇	◇	KEY-LOCK MOUNT
◇	◇	◇	EXTERNAL ALARM RELAYS
◇	◇	◇	EXTERNAL FOOTSWITCH
◇	◇	◇	EXTERNAL EMERGENCY PUSH BUTTON
◇	◇	◇	10 WATT AUDIO
◇	◇	◇	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.

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CODE

(*) STANDARD FEATURES

(◇) OPTION

SPECTRA SMALL PUSHBUTTON PART NUMBER TABLE		SPECTRA LARGE PUSHBUTTON PART NUMBER TABLE		SPECTRA LARGE PUSHBUTTON PART NUMBER TABLE	
PART NUMBER	GRAPHIC LEGEND	PART NUMBER	GRAPHIC LEGEND	PART NUMBER	GRAPHIC LEGEND
3880196P01	1	3880197P01	--	3880197P69	Aux
3880196P02	2	3880197P02	MPL	3880197P70	QC II
3880196P03	3	3880197P03	Scan	3880197P71	Mute
3880196P04	4	3880197P04	DVP	3880197P72	Pri
3880196P05	5	3880197P05	PA	3880197P73	Blu
3880196P06	6	3880197P06	Sirn	3880197P74	Div
3880196P07	7	3880197P07	Wail	3880197P75	RTT
3880196P08	8	3880197P08	Hi/Lo	3880197P76	Send
3880196P09	9	3880197P09	Man	3880197P77	Front
3880196P10	0	3880197P10	H/L	3880197P78	Bid
3880196P11	*	3880197P11	Sts	3880197P79	ZONE
3880196P12	#	3880197P12	Call	3880197P80	TRBL
3880196P13	2abc	3880197P13	Msg	3880197P81	OVHD
3880196P14	3def	3880197P14	Rcl	3880197P82	UNGD
3880196P15	4ghi	3880197P15	Mode	3880197P83	RSSI
3880196P16	5jkl	3880197P16	ExRd	3880197P84	VRS
3880196P17	6mno	3880197P17	Del	3880197P85	A/B
3880196P18	7prs	3880197P18	Sel	3880197P86	Chan
3880196P19	8tuv	3880197P19	Mon	3880197P87	PRTT
3880196P20	9wxy	3880197P20	DTMF	3880197P88	RtRn
3880196P21	* Rcl	3880197P21	Yelp	3880197P89	Emp#
3880196P22	#Del	3880197P22	MVS	3880197P90	Pass
3880196P23	1Ste	3880197P23	Play	3880197P91	Cir
3880196P24	2Pge	3880197P24	Rply	3880197P92	URG
3880196P25	3Lok	3880197P25	Rcrd	3880197P93	A
3880196P26	4Sts	3880197P26	Emer	3880197P94	B
3880196P27	5Rpg	3880197P27	Ext	3880197P95	C
3880196P28	6Msg	3880197P28	F/R	3880197P96	D
3880196P29	7H/L	3880197P29	Alt	3880197P97	E
3880196P30	8Mon	3880197P30	Tel	3880197P98	F
3880196P31	9Dir	3880197P31	Sql	3880197P99	G
3880196P32	Mon	3880197P32	DES	3880083R01	K
3880196P33	H/L	3880197P33	Txt	3880083R02	L
3880196P34	DIR	3880197P34	Indv	3880083R03	T/Z
3880196P35	Urg	3880197P35	Pvt	3880083R04	30
3880196P36	RTT	3880197P36	Site	3880083R05	Entr
3880196P37	Home	3880197P37	AA	3880083R06	M/WT
3880196P38	Dim	3880197P38	Sub	3880083R07	MAck
		3880197P39	Home	3880083R08	Time
		3880197P40	Menu	3880083R09	SRun
		3880197P41	Rpgm	3880083R10	ERun
		3880197P42	Step	3880083R11	STrp
		3880197P43		3880083R12	ETrp
		3880197P44	Phon	3880083R13	LvTe
		3880197P45	Dir	3880083R14	ArTe
		3880197P46	Text	3880083R15	LvGg
		3880197P47	Rvw	3880083R16	ArGg
		3880197P48	Sec	3880083R17	P/in
		3880197P49	0	3880083R18	P/out
		3880197P50	L/S	3880083R19	Serv
		3880197P51	S/S	3880083R20	0/S
		3880197P52	Emer	3880083R21	Rev
		3880197P53	Stdy	3880083R22	Stby
		3880197P54	ECC	3880083R23	Sts 1
		3880197P55	Rptr	3880083R24	Sts 2
		3880197P56	State	3880083R25	Sts 3
		3880197P57	Reg	3880083R26	Sts 4
		3880197P58	AirHn	3880083R27	Sts 5
		3880197P59	TB Scn	3880083R28	Sts 6
		3880197P60	SCC	3880083R29	Sts 7
		3880197P61	Srch	3880083R30	Sts 8
		3880197P62	Lock	3880083R31	Drv
		3880197P63	Page	3880083R32	Bdg#
		3880197P64	Rear	3880083R33	LnBl
		3880197P65	Xfer	3880083R34	RtBl
		3880197P66	ST	3880083R35	LnRn
		3880197P67	VHF	3880083R36	▲
		3880197P68	UHF	3880083R37	▼

SPECTRA 900 MHz FM TWO-WAY RADIO OPTIONS CHART

Option	Description	Kit Added		Kit Deleted	
W116	External Alarm Relays	HKN4258B	Cable Relay		
		TLN4533A	Relays		
		HLN6053A	Tool Insertion/Extraction		
W20	Touch-Code™ Microphone	HMN1053A	Microphone Touch-Code™	HMN1052A	Microphone
W470	Emergency Foot Switch	HLN5113B	Emergency Foot Switch		
		HLN6053A	Tool Insertion/Extraction		
W665	Control Station	HKN4139A	Power Cable	HKN4191A	Power Cable
		HLN6042A	Base Tray	HLN6015A	Trunnion/Hardware
		HMN1050A	Desk Microphone	HMN1052A	Microphone
		HPN3000A	Power Supply	HSN4018A	Speaker
		HLN6047A	Installation Hardware	RRA4935A	Antenna
		6880101W87	Instruction Manual	6881070C85	Installation Manual
W688	External Emergency Button	HLN5131B	Switch Pushbutton Emer		
		HLN6053A	Tool Insertion/Extraction		
W81	Locking Installation Kit	HLN6025A	Locking Installation		
W109	Handset with Hang-Up	HLN1220_	Handset with Hang-Up	HMN1052A	Microphone
W432	10 Watt Audio	HSN6001A	3.2 ohm Speaker	HSN4018A	Speaker
W239	Noise Cancelling Microphone	HMN4030A	Noise Cancelling Mic	HMN1052A	Microphone
W355	DEK Status/Message (8)	HLN1341A	DEK Status		
		6880101W22	Instruction Manual		
		6880103W09	Instruction Manual		
W374	DEK (8) Status/ (18) Message	HLN1340A	DEK Status Message		
		6880101W22	Instruction Manual		
		6880103W09	Instruction Manual		
W269	Siren/Public Address	HKN4265A	Fuse Cable		
		HKN4363B	Siren Cable		
		HLN1185B	Siren/PA		
		HLN1240B	DEK Siren/PA		
		6880101W10	Instruction Manual		
W496	Remote Mount Kit w/17' cable	AALN4005B	Back Housing Kit	HKN4191A	Power Cable
		HKN4192A	Power Cable 20'	HLN6285A	Interconnect Board
		HKN4356B	Control Cable 17'		
		HLN4952A	Fuse Kit		
		HLN6161B	Interconnect Board		
		HLN6162A	Hardware		
		HLN6231A	Hardware		
W589	Public Address	HKN4255A	Fuse Cable		
		HKN4363B	Siren Cable		
		HLN1185B	Siren/PA		
		HLN1339A	DEK PA		
		6880101W10	Instruction Manual		
W995	Zone/Mode	HLN6296A	Four Up/Down Buttons		
W566	Single Tone™	HLN6297A	Button, Single Tone™		
	Conventional Operation				

SPECTRA 9000 900 MHz FM TWO-WAY RADIO OPTIONS CHART

Option	Description	Kit Added		Kit Deleted	
W116	External Alarm Relays	HKN4258B TLN4533A	Cable Relay Relays		
W20	Touch-Code Microphone	HMN1032B	Touch-Code Microphone	HMN1061A	Microphone
W470	Emergency Foot Switch	HLN5113B HLN5151A	Emergency Foot Switch VIP Jumper		
W355	DEK Status/Message (8)	HLN1228B 6880101W22	DEK Status Instruction Manual		
W374	DEK (8) Status/ (8) Message	HLN1229B 6880101W22	DEK Status/Message Instruction Manual		
W269	Siren/Public Address	HKN4265A HKN4363A HLN1185B HLN1240B 6880101W10	Fuse Cable Siren Cable Siren/PA DEK Siren/PA Instruction Manual		
W688	External Emergency Button	HLN5131B HLN5151A	Switch Emergency VIP Jumper		
W81	Locking Installation Kit	HLN6025A	Locking Installation		
W109	Handset with Hang-Up	HLN1220_	Handset w/Hang-Up	HMN1061A	Microphone
W432	10 Watt Audio	HSN6001A	3.2 ohm Speaker	HSN4018A	Speaker
W239	Noise Cancelling Microphone	HMN4013A	Noise Cancelling Mic.	HMN1061A	Microphone
W589	Public Address	HKN4265A HKN4363A HLN1185B HLN1238B 6880101W10	Fuse Cable Siren Cable PA DEK PA Instruction Manual		
W591	Auxiliary Switch Panel	HLN1196B	Auxiliary Switch Panel		
W827	Omit Conventional Operation				
W566	Single Tone Conventional Operation	HLN6297A	Button, Single Tone		
W995	Zone/Mode	HCN1066C	9000 Zone/Mode Control Head	HCN1073A	9000 Control Head
W996	System/Subfleet	HCN1067C	9000 Sys/Sub Control Head	HCN1073A	9000 Control Head

SPECTRA RADIO SERVICE AIDS

ITEM	PART NO.	DESCRIPTION
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. (Early Versions)
68P80102W61	Spectra DETAILED SERVICE INFORMATION. (Latest Version)
68P81070C85	Spectra RADIO INSTALLATION MANUAL.
68P80102W71	MCT-3600/MCT-4800 RADIO INSTALLATION MANUAL.
68P81070C95	Spectra VHF RADIO SERVICE MANUAL.
68P81071C05	Spectra UHF RADIO SERVICE MANUAL.
68P81074C40	Spectra 900 MHz RADIO SERVICE MANUAL.
68P80102W33	Spectra SECURENET SERVICE SUPPLEMENT.
68P80102W48	Spectra HHCH (A3 MODEL) SERVICE SUPPLEMENT.
68P81074C45	Spectra 800 MHz RADIO SERVICE MANUAL.
68P80102W85	MCT-3600 (NYCTA) SERVICE SUPPLEMENT.
68P81071C55	OPERATORS INSTRUCTIONS

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.
3.	01-80300B09 RPX-4724B	MLM EXTENDER BOARD (p/o RPX-4725B). For servicing Memory Boards in current models. 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 ADAPTER. Required for loading cipher keys into the Spectra SECURENET Mobile Radio. (A TKN8351 or TKN8531 cable is also required.)
	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.

SPECTRA RADIO SERVICE AIDS (cont.)

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. 30-8037B27

6. 01-80355A28

BNC male to SMB female cable for mating to cable mounted SMB male connectors.
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.
-

RADIO INSTRUCTION SHEET

I. GENERAL

The radio instruction sheets shipped with each unit identify factory programming information. A copy of the label 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 illustration, is explained in the following paragraphs. The illustration shows a typical label for a conventional radio. The numbers in parentheses here, for example, (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.

II. TRUNKED MODE INFORMATION

- (5) TRUNK: the trunked mode information
- (6) MODE:m the specific trunked user mode number
- (7) PERS: the personality number referred to below in personality information for the specified mode.
- (8) SBF/TLK: the hexadecimal talkaround number for the specific mode number. User group (fleetwide) modes are identified as "FW" in this field.
- (9) FAILSOFT: the failsoft frequency in MHz for the specific user mode. If the mode is on a system equipped for AMSS wide area coverage, this field will say "AMSS". The failsoft frequencies will be contained under the Trunked System Information below.

III. CONVENTIONAL MODE INFORMATION

- (10) CONV: the conventional mode information.
- (11) MODE: the specific conventional user mode number.
- (12) RX FREQ: the receive channel frequency in MHz.
- (13) TX FREQ: the transmit channel frequency in MHz.
- (14) RX CODE: the receiver PL, DPL, or CSQ code assignment.
- (15) TX CODE: the transmitter PL, DPL, or CSQ code assignment.

- (16) T/A FREQ: the transmit talkaround frequency in MHz. Models which are not capable of talkaround will say "N/A" in this field.
- (17) TOT: the transmitter time-out timer value in seconds.
- (18) * PR1: the first priority scan selection. It will default to the selected mode.
- (19) PR2: the second priority scan selection. It will be blank on all models (unprogrammed).
- (20) 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.
- (21) * SCAN: the modes scan list. If blank the operator has operator-selectable scan and does not contain a scan list as shipped from the factory.
- (22) RADIO NAME: the radio name assigned at the time of order processing.
- (23) REPLACEMENT SERIAL NUMBER (RSN): identifies the original radio serial number when replacement code plugs have been ordered.

IV. TRUNKED SYSTEM INFORMATION

- (24) PERSONALITY INFO: the trunked personality information referenced by each trunked user mode.
- (25) TYPE: the type of trunking protocol used by the system (TYPE I or TYPE II)
- (26) SYS ID: the trunked system ID information in hexadecimal.
- (27) SITE ID: the site ID for AMSS wide area coverage system; single site systems will always be 000.
- (28) IND ID: the individual ID information in hexadecimal.
- (29) FLT/USRG ID: the user group ID information hexadecimal. If there is no user group for the personality; this field will be blank.
- (30) CT: the connect tone frequency in Hz.
- (31) TOT: the transmitter time-out timer value in seconds.
- (32) DEC ID: the individual six-digit identification number in decimal format. This is the same ID which appears with the "THIS IS" display in Private Conversation.
- (33) CC FREQ: the system control channel frequencies in MHz.

(34) CONFIG: identifies the presence of available radio options as follows:

- PI - Phone Interconnect
- CA - Call Alert
- PC - Private Conversation
- TS - Trunked Scan
- SM - Status Message
- DR - Dynamic Regrouping
- AM - Automatic Multiple Site Select (AMSS)
- EA - Emergency Alarm
- EC - Emergency Call
- PT - Push-to-talk ID.

(35) CALL LIST: the call list information (in six-digit decimal ID format) used for Private Conversation or Call Alert. This field will be blank for all models (unprogrammed0).

(36) FS FREQ: the AMSS failsoft frequencies in MHz (if present).

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

(38) 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.

Abbreviation	Feature
MDC ID/Emer	MDC-1200 (PTT-ID Data Operated Squelch, and Emergency
Channel Scan	Conventional Channel Scan
DTMF Encoder	Conventional DTMF Encoder
Talk/Around	Conventional Talkaround Capability
System Scan	Trunked System Scan (Earlier Models)
Enhanced Call	Enhanced Private Conversation
System Search	System Search & Lock Wide Area Coverage Feature (SMARTNET Models Only)
Trunk Scan	Trunked Talkgroup Scan (SMARTNET Earlier Models Only)
Talkgroup Scan	Talkgroup Scan (Privacy Plus and SMARTNET Later Models)
Emer	Trunked Emergency Alarm/Call (SMARTNET Models Only)
MDC Call Alert/Auto Sel Call decode	MDC-1200, Call Alert Decode Selective Decode
MDC Sts/Msg	MDC-1200 8 status/8
Phone	Message Telephone Interconnect

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SPECTRA Sep 9, 87 SN: 604TST0003 MODEL: D37KGA5JB7_K FO: 0000000101010102
TRUNK MODE PERS SBF/TLK FAILSOFT MODE PERS SBF/TLK FAILSOFT MODE PERS SBF/TLK FAILSOFT
(5) 1> (6) 1 (7) 001 (8) 896.0125 (9) 7-> 1 007 896.0225 13-> 1 00D 896.0325
2-> 1 002 896.0425 8-> 1 008 896.0525 14-> 1 00E 896.0125
3-> 1 003 896.0125 9-> 1 009 896.0225 15-> 1 00F 896.0325
4-> 1 004 896.0425 10-> 1 00A 896.0525 16-> 1 FW 896.0125
5-> 1 005 896.0225 11-> 1 00B 896.0135
6-> 1 006 896.0145 12-> 1 00C 896.0155
17-> 2 001 AMSS 20-> 1 004 AMSS 23-> 1 007 AMSS
18-> 2 002 AMSS 21-> 1 005 AMSS 24-> 1 008 AMSS
19-> 2 003 AMSS 22-> 1 006 AMSS
25-> 3 001 896.0625 27-> 3 003 896.0625 29-> 3 005 896.0625
26-> 3 002 896.0625 28-> 3 004 896.0625
Conv (10) MODE (11) RX FREQ (12) TX FREQ (13) RX CODE (14) TX CODE T/A FREQ TOT (17) PR1 PR2 SQL DATA
30-> 896.9875 937.9875 CSQ (15) CSQ (16) 937.9875 60 (18) (19) STD (20)
(21) SCAN: OPERATOR SELECT ENABLED
31-> 896.9875 937.9875 7A 7A 937.9875 60 STD
SCAN: OPERATOR SELECT ENABLED
32-> 897.1500 937.1500 131 131 937.1500 60 STD
SCAN: OPERATOR SELECT ENABLED

```

```

SPECTRA Sep 9, 87 SN: 604TST0003 MODEL: D37KGA5JB7_K FO: 0000000101010102
(22) RADIO NAME: Joes Unit (26) (23) RSN: (29) (30) (32)
PERSONALITY INFO (24) (25) TYPE SYS ID SITE ID IND ID FLT/USRG ID CT TOT DEC ID
1> (33) MOTOROLA FW EXPERMTL II 3038 000 (27) 0038 (28) 00B 105 30 700016
CC FREQ: 896.0125 896.0270 896.0375 896.0500 CONFIG: CA PC PI TS
(35) CALL LIST: User Defined (34)
2> PQE/DE/FACTORY TEST II 2003 001 0038 00B 105 30 718012
CC FREQ: 896.0125 896.0250 896.0375 896.0500 CONFIG: CA PC PI TS
896.0625 896.0585 896.0625 896.0025
(36) FS FREQ: 896.0655 896.0785 896.0620 896.0625
896.0650 896.0685 896.0655 896.0625
CALL LIST: User Defined
3> MOTOROLA FW EXPERMTL II 0302 000 0040 000 105 30 700016
CC FREQ: 896.0625 896.0570 896.0475 896.0300 CONFIG: CA PC PI TS
CALL LIST: User Defined
(37) FEATURES: System Scan, MDC ID/Emer/Call Alert Decode/Auto Sel Call Decode, DTMF Encoder, Channel Scan, Enhanced Call, Talk/Around, Phone
(38) OPTIONS: W208K, W116AH, W688AK, W665AA
*****Customer Copy*****

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1. GENERAL INFORMATION

THEORY OVERVIEW

I. GENERAL (See Functional Block Diagram)

The Spectra® 900 MHz radio is a wideband, frequency synthesized, fixed-tuned mobile radio covering the 896-902; 935-941 MHz band. The Spectra line includes models that are capable of either trunked or conventional operation, and certain models that are capable of both. Receiver frequencies are in the 935-941 MHz range; transmitter frequencies are 896-902 MHz for normal operation and 935-941 MHz for talkaround (mobile-to-mobile) operation. 900 MHz service is a 12.5 kHz channel spacing, 2.5 kHz deviation system.

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

- Command board - includes the microprocessor, the plug-in memory board, and miscellaneous audio and control stages; the HearClear™ board plugs into the command board.
- Receiver front end assembly.
- RF board contains receiver IF, demodulator, and the synthesizer logic and filtering.
- VCO/doubler board.

The remaining two assemblies are:

- Dash- or remote-mount control head assembly, which is connected, directly or remotely, to the front of the transceiver by the interconnect board, or remote interconnect board and control cable. This assembly contains two printed circuit boards: the control head board and an interconnect board.
- Transmit power amplifier (PA) which plugs into the rear of the housing.

II. 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 low-side injection signal from the injection doubler, 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 HearClear board and the audio filter IC, and finally fed to the audio PA and speaker. All signalling, filtering, and detection is performed on the command board.

CAUTION

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 (for example, Motorola Part No. SLN6435A) to isolate test equipment from the audio PA (U450)/speaker.

When the radio is transmitting, microphone audio is processed by the HearClear board, 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 PA module.

The synthesizer controls the VCO in both receive and transmit. The VCO operates at one-half the desired injection frequency, and is doubled and fed through the injection switch to the appropriate stage. 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 tuning, transmit deviation, transmit PA power level and current limiting, and, via the serial bus, control head interfacing.

III. CONTROL HEAD (SPECTRA)

The Spectra control head has solid-state microprocessor circuitry that operates the standard and optional features built into the system. See paragraph 1.6 for Spectra 9000 control head.

A. Description of Controls (See Figure 1)

POWER SWITCH - a push-type switch for turning the radio on and off (pushbutton control heads). A rotary switch is used on the rotary control head models, which also controls volume.

MODE - A rocker switch (pushbutton control heads) or rotary switch (rotary control heads) for selecting modes and programming menus.

VOLUME - rotary switch, which also controls power (rotary control heads) or rocker switch (pushbutton control heads) for selecting volume level, editing names, and making certain radio adjustments.

DIM - button for controlling intensity of the display.

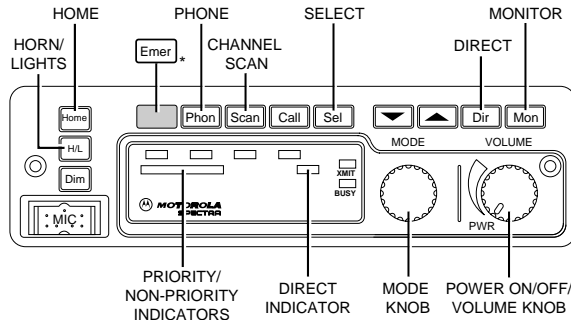
HOME - button for restoring preprogrammed mode, establishing programmed mode, selecting programming entries, etc.

MICROPHONE - connector; accepts any Spectra or Spectra 9000 microphone. With remote control head option, the microphone can also plug into the rear of the control head.

DISPLAY - Vacuum fluorescent (VF) display; eight-character alphanumeric display shows all radio states or statuses; also, functions as the ON/OFF indicator.

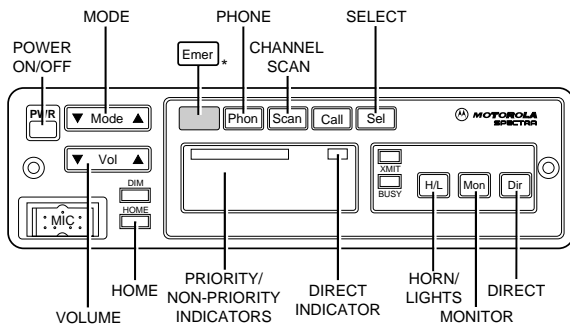
PRI, N PRI, DIR - indicators built into the VF display; these are acronyms for priority and non-priority (used for scanning), and Direct, used for talkaround).

SPECTRA ROTARY CONTROL HEAD



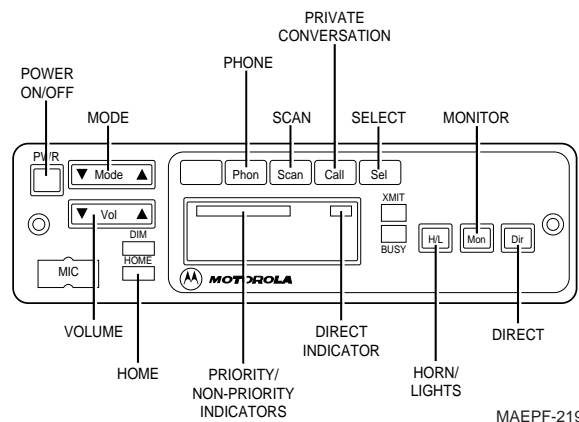
* OPTIONAL BUTTON (INCLUDED BUT NOT INSTALLED) MAEPF-21375-A

SPECTRA CONVENTIONAL PUSHBUTTON CONTROL HEAD



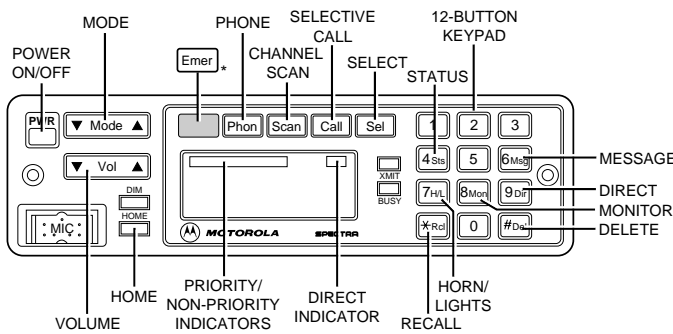
* OPTIONAL BUTTON (INCLUDED BUT NOT INSTALLED) MAEPF-21376-B

SPECTRA PRIVACY PLUS PUSHBUTTON CONTROL HEAD



MAEPF-21911-B

SPECTRA CONVENTIONAL EXPANDED PUSHBUTTON CONTROL HEAD



* OPTIONAL BUTTON (INCLUDED BUT NOT INSTALLED)

MAEPF-21377-B

SPECTRA SMARTNET EXPANDED PUSHBUTTON CONTROL HEAD

DESCRIF
ILLUSTRATO
HR
EDITOR
PR

LETTERING REQUIRES

MAEPF-21951-B

Figure 1. Typical Spectra Control Heads

OPTION BUTTONS - on/off switches; options include: emergency, search, phone, scan, and call; the select button **Sel** is used to support the 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.

- **Lck** - (#3 key) used to lock the radio onto the current site when the AMSS feature is in use.
- **Sts** - (#4 key) used 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 to transmit a message, indicating a response or temporary condition.

- **H/L** - (#7 key) used to select/enable radio external alarms.
- **Mon** - (#8 key) used to monitor for channel traffic.
- **Dir** - (#9 key) 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.

B. Theory Overview

The pushbutton ON/OFF switch (S1) or rotary switch (on rotary control heads) 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 shown in 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 1kHz 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
Busy in	High	Low	High
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
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, alphanumeric 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).

IV. TRANSCEIVER

A. Receiver Front End

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

The mixer is designed for low-side injection. The receiver injection (first local oscillator) comes from the doubler output of the VCO assembly (825-831 MHz) via a coax cable. The injection filter is a printed pattern on the mixer hybrid substrate and is laser-tuned at the factory. The output of the filter is connected to the mixer device.

The preselector is a fixed-tuned ceramic-block filter that is soldered to the mounting bracket underneath the mixer hybrid. The receive signal (935-941 MHz) 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 (Q9126). The receive injection is also fed to this point. The mixer output is at the first IF center frequency of 109.65 MHz. Typical conversion gain for the entire front-end assembly is 7.5 dB. This signal is sent to the first IF on the RF board via a coaxial cable.

B. RF Board

The Spectra RF board contains the common synthesizer circuits and dual-conversion demodulation circuits. A four-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 12.5 kHz channel spacing) in the second IF (450 kHz) provide noise selectivity for the radio.

Synthesizing for the first and second VCO is performed by the prescaler and synthesizer ICs. These ICs 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 (D/A) converter, and is the only element of the RF board requiring alignment on HRN6000A and HRN6002A Kits.

The second local oscillator runs at 109.2 MHz (low-side injection), and consists of a VCO which is frequency-locked to the reference oscillator. Part of the local oscillator's circuitry is on-board the prescaler IC. On all RF board kits other than HRN6000A and HRN6002A, R6634 is adjusted in the factory to tune the oscillator.

A clamp and rectifier circuit on the RF board generates a negative dc voltage of -6.25 volts (nominal) for increasing the total voltage available to the first VCO and second local oscillator's VCO. The circuit receives a 300kHz square wave output from the prescaler IC, then clamps, rectifies, and filters the signal for use as the negative steering line for the two VCOs.

C. 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 the 412-471 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 set of PIN diodes switches the TX or RX outputs on or off according to the keyed 9.4V control signal. The VCO assembly's synthesizer feedback output is the same as the VCO frequency (doubler input). Nominal power levels are shown in Table 4.

D. HearClear™ Board

The HearClear board is an audio shaping circuit designed to decrease the effects of multipath fading in 900 MHz bands that have 12.5 kHz channel separation. Multipath fading is more pronounced at 900 MHz because of reduced system deviation. Primarily, through dynamic attenuation and companding, the HearClear IC reduces noise caused by fading.

In the HearClear IC, the flutter-fighter circuitry dynamically attenuates the audio signal when either a fade occurs or high-frequency noise (greater than 3 kHz) is present. Companding, similar to that used in cellular radios, further reduces the audible effects of fading by lowering the noise floor of the audio signal.

E. Adaptive Transmit Control

The adaptive transmit control circuitry reduces adjacent-channel interference for the 12.5 kHz channel spacing in the 900 MHz mobile frequency band.

The received signal strength is continuously sampled, and a history of the last several seconds is recorded. The peak signal over this time is compared to a factory-stored value in internal EEPROM. This threshold value corresponds to a signal strength of approximately -55 dBm. Each time the PTT is pressed, the comparison is made. If the received signal was stronger, reduced transmit parameters (power, deviation, and splatter) are used. If the received signal is less than the threshold for the previous 10 seconds, full transmit parameters are used.

Full parameters are used for trunking ISW and talkaround, regardless of the received signal history.

Table 3. VCO Frequency

Mode	AUX 1	AUX 2	VCO Freq. Range (MHz)	Doubler-buffer Output (MHz)
RX	HIGH	HIGH	412.675 – 415.675	825.35 – 831.35
TX	HIGH	LOW	448 – 451	896 – 902
TA	LOW	LOW	467.5 – 470.5	935 – 941

Table 4. VCO Power Output (Typical, dBm)

Item	RX Mode	TX Mode	TA Mode
RX Injection	+3.5	-10	-10
TX Injection	-	+21	+21
Synthesizer Feedback	-5	-5	-5

F. 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, HearClear 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 activity, 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 unswitched +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 (U521-1), high/low battery voltage reset, and the external bus system reset (U522 and U521 circuits). The high/low battery voltage can be located one of two places. If U521 has part number 51-83977M87, the circuit is in U521. If U521 has part number 51-83977M72, the circuit is on the HearClear board. The reset circuits

allow the microcomputer to recover from an unstable situation; that is, 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 frequency'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.

V. POWER AMPLIFIERS

This information applies to all 4-watt, 12-watt, and 30-watt models. The primary difference among the three transmitters is the addition of a final stage on the 30-watt. Also, the 4-watt and 30-watt transmitters have larger heatsinks and circuit boards. This theory should help isolate problems to the board level with circuit board replacement as the intended repair procedure.

A. Gain Stages

The first gain stage is a low-level transmit buffer which boosts power, typically, from 90 milliwatts to 320 milliwatts. This stage drives the power module which increases power to 15 watts. The power module is the last gain stage in the 4-watt and 12-watt radios; however, in the 30-watt radio, an additional final stage boosts power, typically, to 43 watts. Following the last gain stage of either model, 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 low-pass filter.

B. Power Control

Power is controlled with a directional coupler and detector network that senses the forward power from the last gain stage. The detected voltage is fed back to the command board control circuitry where it is com-

pared to a reference voltage set during power-set procedures. The dc feed voltage is corrected and supplied to the controlled stages in the power amplifier module. A pass device for the control voltage is located in the power amplifier compartment.

C. Circuit Protection

Current- and temperature-sensing circuitry on the power amplifier board feeds 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.

D. 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.

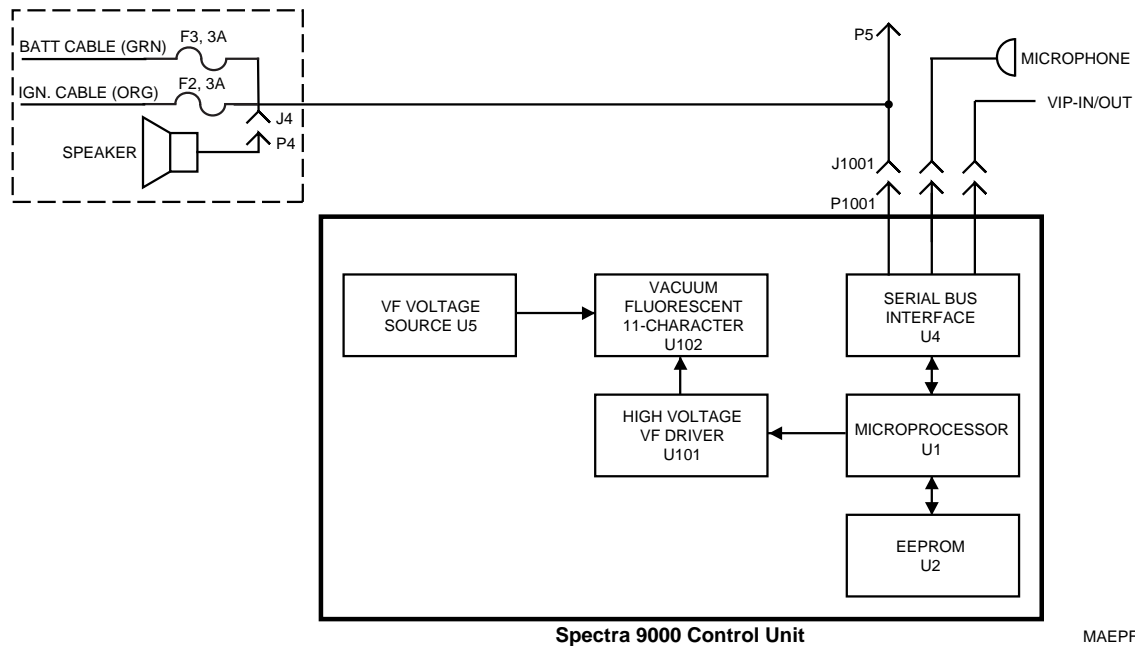


Figure 2. Functional Block Diagram for Spectra 9000 Control Head

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Figure 3. Typical Systems 9000 Control Unit

VI. CONTROL UNIT (Spectra 9000)

NOTE

Spectra 9000™ radios use the Systems 9000™ Control Unit. The differences between control units is in the programming software and button legends.

The Systems 9000 control unit is a microcomputer-based unit that processes all the button inputs and displays used by the radio and the options. It also interfaces with the vehicle via the vehicle interface ports (VIP).

A. Description of Controls (see Figure 3).

1. Power Switch

The power switch is a slide switch on the right-hand bottom surface of the control unit. It turns the radio and its accessories on and off.

2. Display

The 11-character vacuum-fluorescent display's primary function is to display mode numbers, mode names, volume level, and the status of options. It also functions as an on-off indicator for the entire system, and plays an integral role in the operator's reconfiguration of options.

3. Option Buttons

Located above the display window is a row of six buttons for turning options on and off. Below each is a small indicator light to show the status of the option.

4. XMIT and BUSY Indicators

Above the six option buttons are XMIT and BUSY indicators. The XMIT indicator lights when the radio is

transmitting. The BUSY indicator lights when the selected channel is busy.

5. Scan Indicators

In the right-hand side of the display window are the NON-PRI and PRI indicator lights. When scan operation detects activity on a non-priority (NON-PRI) channel, the NON-PRI light comes on. Activity on a second-priority channel causes PRI to light. First-priority channel activity causes PRI to flash.

6. Mode Rocker Switch

Below the display window is the **Mode** rocker. Pressing the right side of this rocker switch increases the mode number. Press the left side to decrease the mode number. If you press and hold the switch, it scrolls the mode numbers up or down. The mode names appear in the display window.

7. Vol Rocker Switch

Below the display window, beside the **Mode** switch, is the **Vol** rocker. Press and release to check volume setting. The display shows "**VOLUME** _ _" and a number value (0-15). Press and hold the right side of the rocker to increase the volume setting. Press and hold the left side to decrease volume. The number value scrolls up or down to the desired level.

The **Vol** rocker also controls the volume level of the public address (PA) and external radio speaker (ExRd) options when they are enabled. The display window shows "PA VOL_ _" when public address is on and **Vol** is pressed.

8. HOME and Sel Buttons

Press **HOME** to go to the radio's preprogrammed HOME mode. Press **HOME** instead of **Mode** to change modes. Hold **HOME** until a beep sounds to enter the configuration state. The display shows an entry prompt. Use the keypad to enter your new mode choice and press **HOME** again. The mode is now changed without scrolling.

Use the **Sel** button when configuring an option. See the descriptions of the options for more specific information.

9. DIM Button

Above the keypad, on the right side of the control unit, is the control for the brightness of the display and button backlighting. When you turn on the system, the display comes on at the highest level. Press **DIM** once to reduce the brightness of the display to medium level, and twice for low brightness level. Press **DIM** a third time to turn the display and button backlighting off. This is called the surveillance mode.

10. Keypad

The keypad is for changing the status of options and entering numbers to the display. See the Operator's Manual for a complete description of button operation.

B. Theory of Operation

1. General

The Spectra 9000 control unit has solid state microprocessor circuitry that operates the standard and optional features built into the system. The control unit design allows installation in even the smallest of down-sized vehicles. Systems that have many options simply require more control unit buttons, not larger control units.

The control unit may be field programmed to alter the information stored in certain areas of its electronic memory. Some options are also added by field programming.

2. Display

The control unit has an 11-character alphanumeric vacuum fluorescent display for indicating the following:

- Mode Names
- Squelch Level
- Volume Level
- Status Codes
- Message Codes
- Telephone Numbers
- Identification Numbers
- Alarm Displays
- Option Status

3. Controls and Indicators

A 12-button keypad contains traditional alphanumeric keys. These keys double as function keys for radio options. All buttons are backlit to allow operation in low light. Six ON/OFF option buttons and indicator lights above the display window tell whether these options are on or off.

Other indicators include BUSY, XMIT, PRI, and NON-PRI. BUSY lights when activity is detected on the channel. The XMIT (transmit) indicator lights when transmitting.

When activity occurs during a scan sequence, the NON-PRI (non-priority) or PRI (priority) light is on. If the detected activity is on a NON-PRI mode, the NON-PRI light is on. If the activity is on PRI mode, the PRI indicator lights for second-priority modes, and flashes for first-priority modes.

4. Control Board

The control board's microprocessor (MPU) communicates on the serial bus, receives and interprets keypad data, and controls the volume. The MPU sends ASCII data to a decoder to control the display, and sends data to turn the LEDs on or off. The control board has a watchdog timer that senses the need for a system reset. The vehicle interface ports are also controlled on this board.

5. Microprocessor (MPU)

The MPU operates in mode 2 (expanded bus with internal ROM active). Table 5 gives jumper placements for different modes. The clock frequency is 4.9152 MHz that results in an internal operating frequency of 1288 kHz. The limited number of I/O ports is augmented by using a serial-to-parallel shift register (U3) to scan the keyboard, and to switch the VIP drivers (Q28, Q29, Q30, and Q33).

Table 5. Mode Jumper Placement

Microprocessor Mode	JU3	JU6
No. 1—Expanded mode with external ROM only.	IN	OUT
No. 2—Expanded mode with internal ROM active.	OUT	IN
No. 3—Single Chip	OUT	OUT

6. Watchdog Timer

The watchdog timer consists of U5 (comparator) and Q4 (SCR). On system power-up, C06 pulls the inverting input of U5 high, while R10 and R11 hold the non-inverting input at VCC/2. The output goes low and the microprocessor resets.

As C06 charges through R14, the voltage on the inverting input drops below that of the non-inverting input, the output goes high, and the microprocessor can start operating. R14 is now pulling up on C06, and the inverting-input voltage begins to rise.

During this interval, the processor generates tickle pulses to periodically fire Q4, preventing the inverting-input voltage from rising above the non-inverting input voltage and repeating the reset cycle. If the tickle pulses stop for more than 150 mSec, the reset cycle is repeated

7. EEPROM

The EEPROM stores customer data, including mode names, button functions, and VIP settings. The customer data can be altered only by enabling the STORE function (grounding the MIC HI line), an automatic function of the control unit programmer. Power strobing minimizes EEPROM power consumptions. Jumpers configure the EEPROM for the uses listed in Table 6.

Table 6. EEPROM Jumper Table

Jumper	Use/Placement
JU1	Used for fixture options
JU2	IN for 630 1X Microprocessor
JU4	IN for 2K EEPROM; OUT for 8K EEPROM (option W930)
JU5	IN for 8K EEPROM (option W930); OUT for 2K EEPROM

8. Bus Transceiver

The serial bus transceiver consists of Q1, Q2, Q3, and U4 (CA3140). Q1, Q2, and Q3 transmit data on the bus, while U4 acts as a comparator to receive data from the bus.

9. Vacuum-Fluorescent Voltage Converter

Voltage for the vacuum-fluorescent display is generated by a fixed-frequency, variable-duty-cycle driven, flyback voltage converter. Q31 and Q32 form an emitter-coupled astable multivibrator that runs at about 150 kHz. The square wave output from this circuit is integrated by R71 and C39 to form a triangle that is applied to the non-inverting input of half of U5.

During start up, the inverting input is biased at 3.7 volts by R66 and R67. Q23 is on while the non-inverting input voltage is below 3.7 volts. This allows current to flow to T1, building a magnetic field. When the triangle wave exceeds 3.7 volts, Q23 turns off and the magnetic field collapses, inducing negative current in T1.

This current flows through either CR13 or CR14, charging C27 and C28. As the voltage on C28 increases beyond -35 volts, CR13 begins to conduct, pulling U5's inverting input below 3.7 volts. This decreases the cycle time that Q23 is on to the time needed to produce -35 volts on C28. The -41 volt supply is not regulated, but it tracks the -35 volt supply.

Similarly, the ac supply for the vacuum-fluorescent filament is not regulated, but is controlled to within one volt by an inductor on the display board.

10. Vehicle-Interface Ports (VIP)

The VIP outputs are driven by a serial-to-parallel shift register. Output transistors (Q28, Q29, Q30) can sink 300 mA current. Primarily, these transistors control external relays. The relay is connected between the collector and switched B+.

Each VIP input transistor (Q25, Q26, Q27) is connected to a dedicated input port through transistors used for input protection. These VIP inputs are connected to ground with either normally-open or normally-closed switches.

11. Power Supplies

Both the +5 and the +9.4 volt supplies are linear regulators. The +9.4 supply is built with a discrete transistor (Q11). The regulation is provided by VR09. The +5 volt supply is a 7805, three-terminal regulator IC.

12. Ignition Sense Circuits

Q7 senses the vehicle ignition's state, disabling transmit when the ignition is off. For negative-ground systems, the orange lead is typically connected to the fuse box (+12V). For more information, see the cable kit section.

13. EEPROM Write-Protect Circuit

Q12, Q13, and associated circuitry guard against inadvertently writing into the EEPROM. When MIC HI is grounded, Q21 (normally on) is turned off. A hot-carrier diode (CR24) ensures that Q21 turns off. CR24 is normally off so it does not interfere with the MIC HI line.

CR19 forces the system to be write-protected during reset; this is especially crucial during system power-up.

14. Display Board

This board contains the main operator interface points of the system, including the vacuum-fluorescent display, the status indicator LEDs, and the user keypad.

15. Vacuum-Fluorescent Display

The vacuum-fluorescent (VF) display is an 11-digit, 14-segment display that needs three separate voltages to operate: the cathode needs -35 volts to accelerate electrons to the anode; the grid needs -40 volts to totally shut off current flow; the filament needs 3.8 volts ac at 80 mA. These voltages are obtained from the VF up-converter on the controller board.

16. Vacuum-Fluorescent Display Driver

This IC (U101) receives ASCII data from the controller board, decodes it into 14-segment display data, and then scans the display with the data. Once properly loaded into the driver, the displayed data is refreshed without any further processor action. The display driver is periodically reset by the actions of transistors Q118, Q119, and Q110 that watch the clock line from the

processor to the display driver. When the clock line is held low for more than 600 mSec, the display driver resets and new display data follows.

17. Voltage Supply

The ac voltage present on Q23 of the controller board is used to obtain the -10 volts needed to run the display driver IC. This voltage is fed through L101 to limit the current, and then rectified by CR107 and shunt regulated by CR108.

18. Status LEDs

These LEDs are driven by the display driver as though they were decimal points on the VF display. Level shifting transistors are required for this since the display driver uses 39 volts for control signals.

19. Backlight LEDs

The same microprocessor signal that turns the VF power supply on and off also operates the backlight LEDs. Q120 supplies base current to the individual LED driver transistors. The driver transistors act as constant current sources to the LEDs. Backlight LEDs CR115,

CR116, CR117, and CR118 are connected to thermistor R163 by way of Q108. This circuit allows more current to flow through these LEDs at room temperature and reduces current as the temperature rises.

C. Control Unit Maintenance

1. Disassembly of Control Unit (see Figure 4)

NOTE

Before disassembling the control unit, note the location of the labeled buttons.

Remove the two 30mm slotted screws that hold the front and back of the control unit together. The two halves separate at the top; at the bottom, they are held together by the flex cable that interconnects the circuit boards. Place the unit so that the PC boards are facing up.

Remove the five 8mm screws in the display board and carefully remove the front of the control unit housing. Keep the front housing parts as a complete unit (including the front housing, buttons, and display board light pipe). Always keep the front of the display housing face down when handling.

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Figure 4. Disassembly of the Control Unit

Remove the two 16mm self-tapping screws on the control board. Remove the back of the control unit housing. Remove the black gasket around the switch and set it aside. Remove the shields from the top and bottom of the control board. All components should be easily accessible.

NOTE

When working with chips and SOT parts, use extreme caution when heating. Never reuse a chip or SOT part; always replace with correct Motorola parts.

2. Reassembly of the Control Unit

Ensure that the orange gasket is still around the outside of the control cable mini D connector. If it was removed, replace it, ensuring a snug fit to the PC board. Replace the gasket around the power switch. Replace the shields on the top and bottom of the control board. Place the control board in the back housing, being careful to put the toggle switch arm in the proper position in the ON/OFF button actuator.

Torque the two 16mm self-tapping screws to 6-8 in.-lbs. Ensure that the ON/OFF actuator slides back and forth easily. Carefully check to see that all buttons are still in place, then place the display board in the front housing. Torque the five 8mm self-tapping screws to 6-8 inch-lbs. Ensure the black gasket is around the outside groove of the front housing. When mating the front and back housings, ensure the flex cable slides behind the control board and is not pinched. Torque the two 30mm slotted screws to 9-10 in.-lbs.

D. Vehicle-Interface Ports

The vehicle-interface ports (VIP) allow the control unit to operate outside circuits and to receive inputs from outside the control unit. There are three VIP outputs that are used for relay control. There are also three VIP inputs that accept inputs from switches. See the cable kit section for typical connections of VIP input switches and VIP output relays.

1. VIP Output Connections

The VIP output pins are located on the back of the control unit below the area labeled **VIP**. These connections are used to control relays. One end of the relay should be connected to switched B+, while the other side is connected to a software controlled ON/OFF switch inside the control unit.

Table 7. VIP Output Connections

VIP OUTPUT NO.	SWITCHED B+ PIN NO.	ON/OFF SWITCH PIN NO.	DEFAULT FUNCTION IS CHANGED WITH FIELD PROGRAMMER
1	18	2	HORN RELAY (ALARM)
2	19	1	LIGHT RELAY (ALARM)
3	35	34	SIREN-HORN TRANSFER

Table 8. VIP Input Connections

VIP OUTPUT NO.	GROUND PIN NO.	ON/OFF SWITCH PIN NO.	DEFAULT FUNCTION IS CHANGED WITH FIELD PROGRAMMER
1	20	4	SIREN; HORN RING
2	21	3	EMERGENCY (IF OPTION PRESENT)
3	36	37	NONE

The relay can be normally-on or normally-off, depending on how the VIP outputs are configured. The control unit provides for three of these VIP output connections. See Table 7.

The function of these VIP outputs can be defined by field programming the control unit. Typical applications for VIP outputs are external horn/lights alarm and horn ring transfer relay control. For further information on VIP outputs, see the control unit programming manual.

2. VIP Input Connections

The VIP input pins are located on the back of the control unit below the area labeled **VIP**. These connections are used to accept inputs from switches. One side of the switch is connected to ground, while the other side is connected to a buffered input to the control unit. The switch can be normally-closed or normally-open, depending on how the VIP inputs are configured. The control unit permits three of these VIP input connections. See Table 8.

The function of these VIP inputs is defined by field programming the control unit. Typical applications for the VIP inputs are for a foot switch or a horn ring switch. For further information on VIP inputs, see the control unit programming manual.

E. Power Connections

CAUTION

Use only Systems 9000 cable kits. Connection to other cable kits or control panels may cause electrical damage.

Replace the fuse in the in-line fuseholder of the red power cable coming from the radio in the trunk. Connect the green (and/or orange) fused wire(s) coming from the control unit to the ungrounded terminal (or source) of the battery.

Pull all excess cabling into the trunk. Clamp the cables to the vehicle body or chassis with the cable clamps supplied. Drill 1/8" mounting holes; attach the clamps with four #8 x 3/8 in. tapping screws and four 1/4 in. lockwashers. Ensure that all in-line fuses are installed.

FRONT PANEL PROGRAMMING AND ADJUSTMENTS

I. 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. (When told to press, turn on rotary control head model.)
- Vol** Used to scroll through values or letters and numbers for a particular parameter being programmed (except on rotary control head model, see NOTE below).
- Sel, Del, Rcl** When available, used for scan list modifications.

NOTE

The rotary control head has rotary **MODE** and **VOLUME** knobs. Rotating the **MODE** knob clockwise increases the steps, and counterclockwise decreases the steps. Scroll buttons are used on the rotary control head for programming instead of the **Vol** rocker switch used on the other Spectra radio control heads. On rotary control heads, you must use the scroll buttons instead of the **VOLUME** knob to get the full range of selections available.

NOTE

For Spectra 9000 radios, **Mode**, **Volume**, **Select**, and **HOME** are always in the locations shown in Figure 5 for front panel programming, even if the control head buttons have been reprogrammed with radio service software.

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.

II. ENTER PROGRAMMING MODE (See Figure 6.)

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.

Press **Mode** up or down to continue program entry. The control head shows a 3-second message, "VER XXXX" (the X's indicate the software version used in your radio). The display changes to two more 3-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 **Vol** after **Mode** has been pressed.) The next message, "MODE" or "ZONE," if zone/mode is enabled, will continue to be displayed until given another control head command.

III. TOP-LEVEL MENU

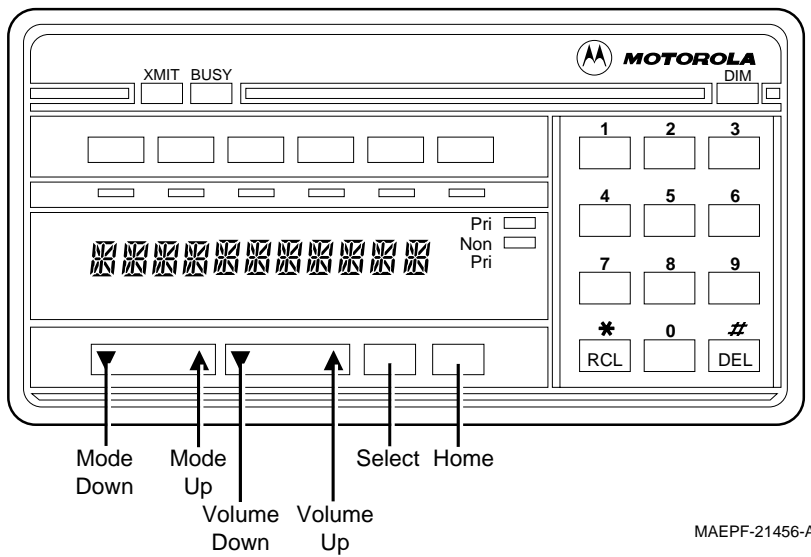
Use the top-level menu to select the particular function to be accessed (see Figure 6). After the entry sequence is complete, "MODE" (or "ZONE") is displayed. Five (or six if zone/mode is enabled) other selections are available at this level: **"MODE"** (or "ZONE"), "RADIO" ("PHONE" for earlier models), "TST FREQ," "CH TEST," "ALIGN," and "EXIT." (Figure 7 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 "ZONE" to add or modify items associated with particular zones: zone names and zone-slaved scan lists.

NOTE

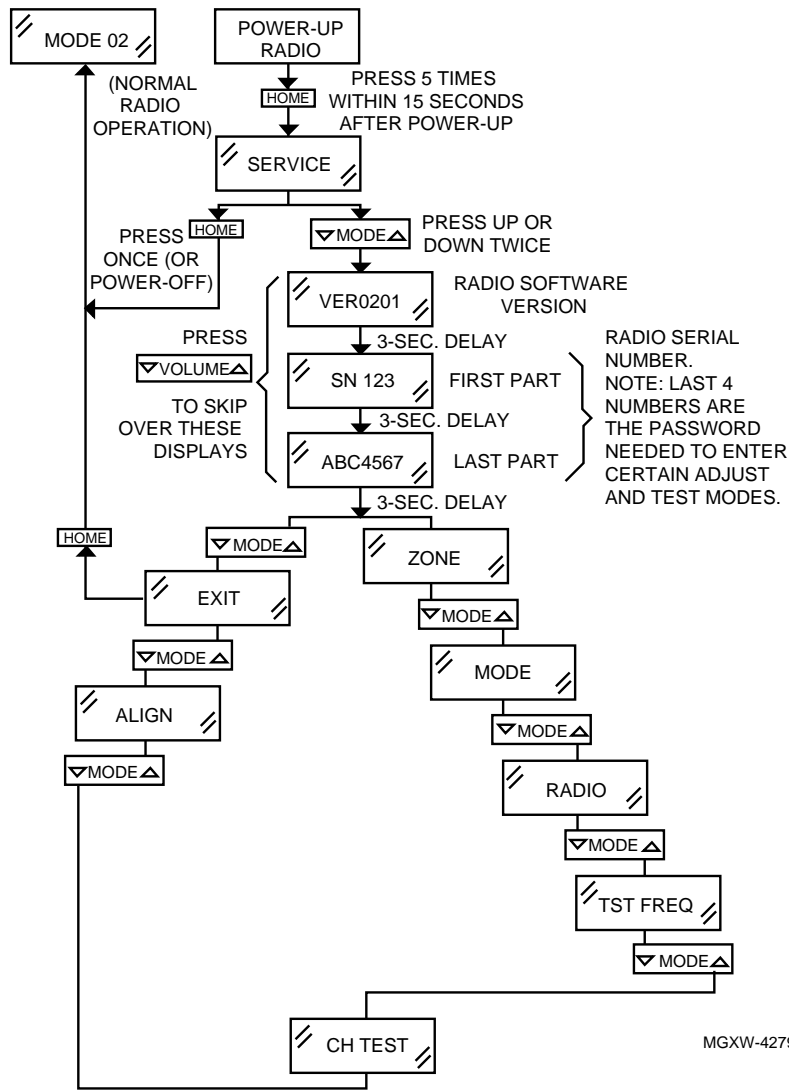
Zone/mode must be enabled to access this menu.

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



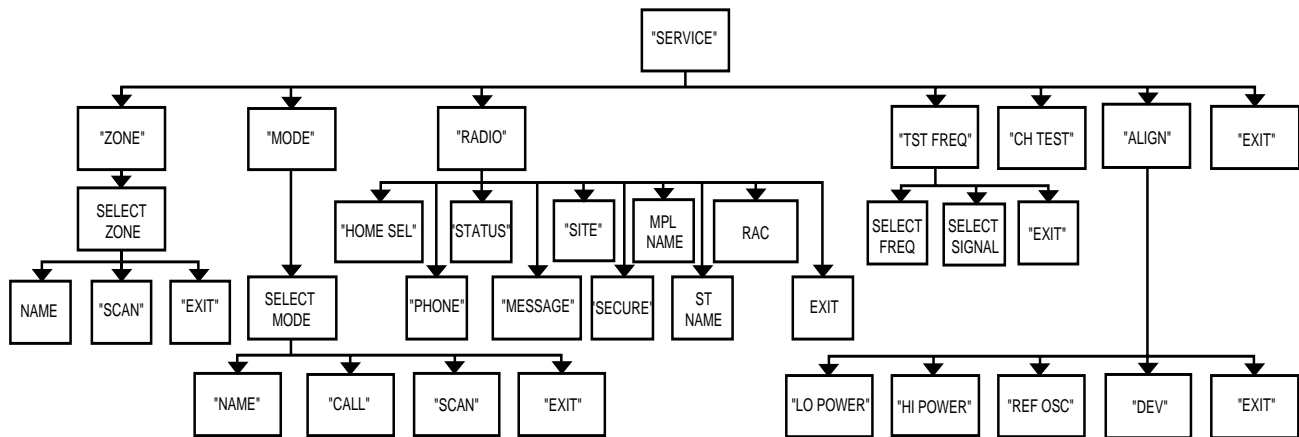
MAEPF-21456-A

Figure 5. Spectra 9000 Control and Programming Control Controls



MGXW-4279-B

Figure 6. Top-Level Menu



MGXW-5804-C

Figure 7. Lower-Level Menu Structure

Select "RADIO" to add or modify items which affect overall radio operations (including both trunked and conventional), 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.

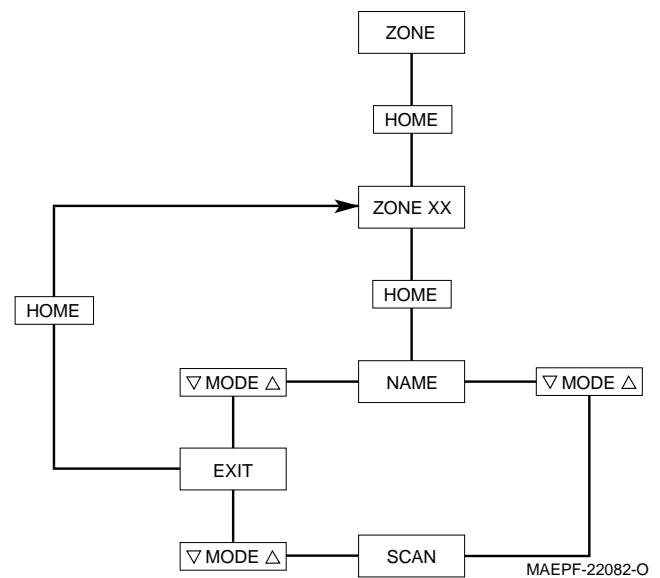
IV. CHANGE PARAMETERS ASSOCIATED WITH A ZONE (See Figure 8.)

1. After selecting "ZONE" from the top level menu; press **HOME**. The display changes to a zone number/name (for example, "ZONE 1"). The zone name will be flashing to indicate that a selection is expected. Press **Mode** up or down to scroll through all the zones 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 zones in reverse order.

2. Scroll through the zones until you find the one you wish to modify. When the zone is displayed, press **HOME** to select the zone for modifications. The display now changes to "NAME."



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Figure 8. Zone Parameters Menu

NOTE

By pressing **Mode**, you can cycle the display to "SCAN," "EXIT" and back to "NAME." Use this menu when you wish to edit the zone names or zone-slaved scan lists.

V. CHANGE ZONE NAMES

NOTE

Radio service software can be used to disable mode names. This will result in all zones being shown as "ZONE XX," where XX is the zone number. Attempting to change the zone name in the front panel will result in a bad-key tone.

1. With "NAME" displayed, press **HOME**. The zone selected is displayed with the first character flashing. Follow the instructions for editing the mode names to change the zone name.

- Press **HOME** to save the new zone name and return to the "NAME" display. If you wish to change other zone names, press **Mode** to scroll through the selections to "EXIT." Press **HOME** to go to the next zone selection. Repeat the procedures to edit the rest of the zone names.

VI. EDIT SCAN LISTS

The "SCAN" menu is used for zone-slaved scan lists. Radio service software can also be used to edit these lists. Operator-selectable zone scan lists can also be modified via the **Scan** button. Operation of this feature is covered in the operator's manual. Please refer to paragraph X. Edit Scan Lists for the Mode menu and instructions on modifying zone-slaved scan lists.

VII. CHANGE PARAMETERS ASSOCIATED WITH A MODE (See Figure 9.)

- After selecting "MODE" from the top level menu, press **HOME**. The display changes to a mode number/name (for example, "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.

- Scroll through the modes until you find the one you wish 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 mode-slaved scan lists.

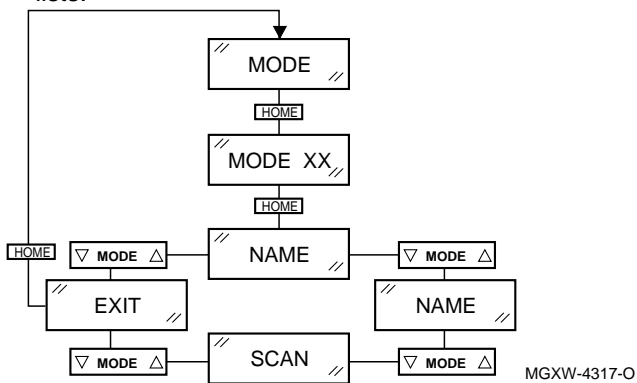
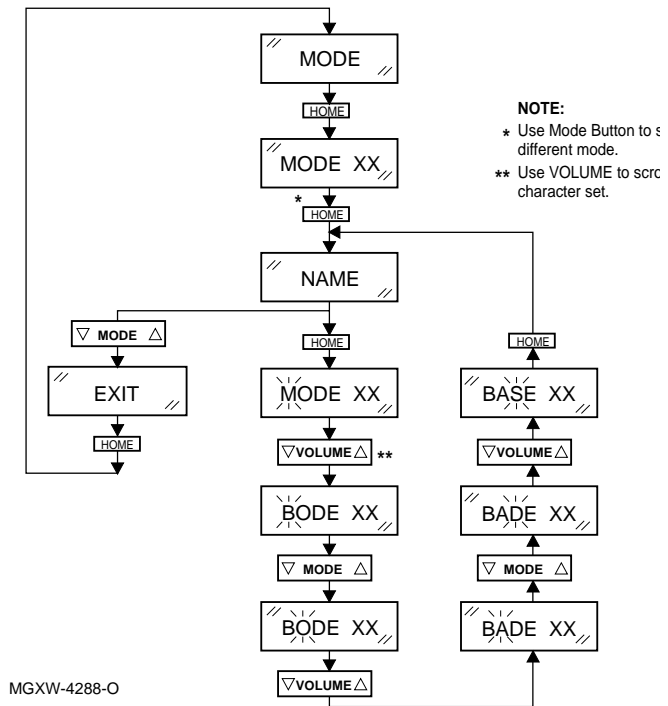


Figure 9. Mode Parameters Menu

VIII. CHANGE MODE NAMES (See Figure 10.)

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.



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Figure 10. Changing Mode Names

- With "NAME" displayed, press **HOME**. The mode selected is displayed with the first character flashing. If you wish to change the flashing character, press **VOL** up or down until the desired character is flashing in that position.

NOTE

When you press **VOL**, 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. Press 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. Press the radio keypad (if present) to enter numbers directly.

- Press **Mode** to advance the cursor to the next character, and press **VOL** to select the character desired.
- Repeat step (2) until the display shows the name desired.

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 reenter the "MODE" display. Repeat the above procedures (starting with paragraph VII) to change as many mode names as desired.

IX. EDIT SELECTIVE-CALL LIST

The "CALL" menu is much like the "MODE" menu. Use it to assign up to eight names and numbers to the radio's trunked mode selective-call lists. Each list location has two operator-programmable elements: the unit name and the unit ID number. The listed ID numbers are the six-digit numbers, always beginning with a leading 7, assigned to other trunked mobile units, and are used for making Private Conversation™ and Call Alert™ 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. If the radio has call list capability, but the selected mode has no call list, the "CALL" menu will appear in the display, but an invalid-key chirp will sound if you press **HOME**.

To enter the "CALL" menu, proceed as you would to enter the "NAME" menu (see paragraph VII). With "NAME" displayed, press **Mode** up to scroll to the "CALL" menu. Press **HOME**; the display changes to alternating displays; for example, "UNIT 1" displays for two seconds, then "ID7XXXXX" (X's represent an ID number) displays for two seconds. The default name, as shipped from the factory, is "UNIT XX" and "ID7_." 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 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 by pressing **VOL** and **Mode** (or keypad if present) just like you would change the mode name (see paragraph VIII). 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. An unprogrammed location's display will show "ID7_" with the "_" flashing. If a number has already been programmed, the leftmost number after the leading "7" flashes. You may edit the number by pressing **VOL** and **Mode** just like you would edit the mode name (see paragraph VIII).

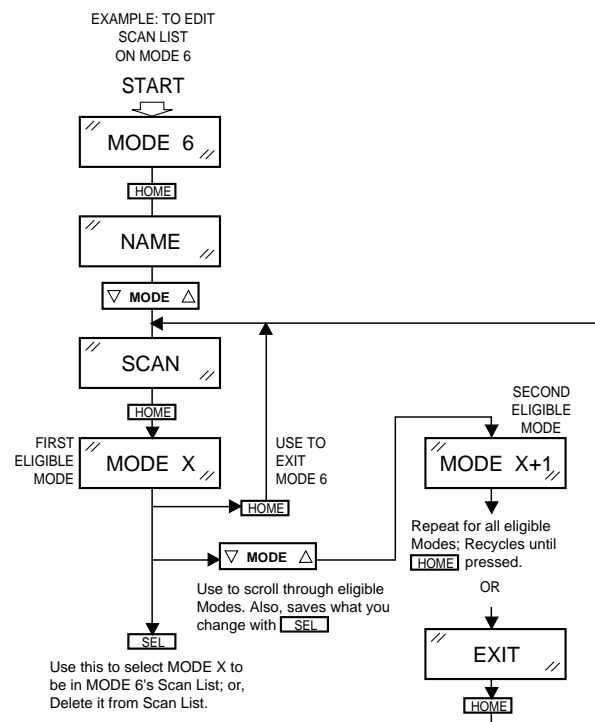
If your radio has a 12-button keypad, you can delete the existing numbers with the **Del** button. Then, enter the last five digits of the ID number with the keypad.

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 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.

X. EDIT SCAN LISTS (See Figure 11.)

The "SCAN" menu is used for mode-slaved or personality-slaved scan lists. Radio service software can also be used to edit mode-slaved or personality-slaved scan lists. Operator-selectable scan lists are modified using the **Scan** button. Operation of that feature is covered in the operator's manual. On SMARTNET™ models, operator-selectable lists can be edited using either front panel programming or the **Scan** button. On other models, operator-selectable scan lists can only be reviewed while in front panel programming; they cannot be modified. (An attempt to modify the operator-selectable list will result in an invalid-key chirp.)



NOTE:
You cannot delete MODE 6.
It must be a member of its
own list.

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Figure 11. Editing Scan Lists

Not all radios have mode-slaved or personality-slaved scan list capability, and some have the capability on only certain modes. A scan list-capable mode can have up to 16 modes listed. The "SCAN" display will not appear on models that have no scan list capability. 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**.

NOTE

If zone/mode operation is enabled in a radio, the "SCAN" selection under the "MODE" menu will sound a bad-key tone when **HOME** is pressed. For a zoned radio, scan lists may only be modified through the "ZONE" menu.

A. Conventional Mode-Slaved Scan

To enter the "SCAN" menu, select the desired conventional mode and proceed as you would to enter the "NAME" menu (see paragraph VII). 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, "N PRI" 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, press **Sel** as follows:

If Display Has	Press Sel	Indicator Changes To	Mode Status Is
No Indicators	Once	N PRI Lights	Non-priority
N PRI Lit	Once	PRI Lights	Second Priority
PRI Lit	Once	PRI Flashes	First Priority
PRI Flashing	Once	No Indicators	Non-listed

NOTE

Repeatedly pressing **Sel** 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 (on SMARTNET models, the selected mode 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 **Sel**. 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 **Mode** to save the status entered for that mode and to advance to the next mode. Press **Mode** to

scroll through all the eligible modes. As you scroll through the modes, the "PRI" and "N PRI" 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.

When the list has reached its maximum size, additional attempts to select modes will cause the invalid-key chirp and a "LIST FULL" display when **Sel** 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. Press **Sel** until the PRI and N PRI indicators are extinguished.

NOTE

On 12-button keypad radios, press **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.

B. Talkgroup Scan

1. Description

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," and "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 VII.) 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.

2. 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 **HOME** 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, "N PRI" will be lit. The **Sel** button toggles the "N PRI" 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.) Press **Mode** and **Sel** to scroll through the eligible modes and edit the list, as described in section X. A. Type II fleetwide announcement modes and dynamic regrouping modes cannot be entered into the list.

C. Priority Talkgroup Scan

1. Description

Trunked models designated as "C4," "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; 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 **HOME** 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 "N PRI" will be lit. Press **Sel** 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 X. A). Press **Mode** and **Sel** to scroll through the eligible modes and edit the list, as described in Section X.A.

XI. CHANGE RADIO-WIDE PARAMETERS

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

XII. 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."

Select "RADIO" from the top level menu. With "RADIO" displayed, press **HOME** to enter the "HOME SEL" menu. Press **HOME**; the display changes to a mode number/name (for example, "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 the radio's home mode, press **HOME** to select it. The new home mode is defined and the display changes back to "HOME SEL." Press **Mode** up or down to scroll to "EXIT"; press **HOME** to return to the top level menu.

NOTE

In a zone mode radio, the HOME SEL selection will sound a bad-key tone when **HOME** is pressed. For a zoned radio, the home mode can only be modified via the radio service software.

XIII. 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.

After selecting "RADIO" from the top level menu, press **HOME**. With "HOME SEL" displayed, press **Mode** up to scroll to the "PHONE" menu. Press **HOME**; the display changes to alternating displays; for example, "PHONE 1" displays for two seconds, then the number (if programmed) displays for two 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 by pressing **VOL** and **Mode** (or keypad if present), just like you would change a mode or call list (see paragraph VIII). 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 by pressing **VOL** and **Mode**, just like you would edit the mode name (see paragraph VIII).

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 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.

XIV. CHANGE STATUS, MESSAGE, SITE, MPL, OR SINGLE TONE 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. Some radios have operator-select multiple PL or operator-select Single Tone™. Front panel programming can be used to customize the list of statuses, messages, site, MPL, or Single Tone names to your preference. The process of editing these lists is identical to changing mode names (see paragraph VIII).

As shipped from the factory, there are eight names for the status and message lists, eight site names, 16 MPL names, and 16 Single Tone names; their default names are "STATUS 1" through "Status 8," "MESSAGE 1" through "MESSAGE 8," "SITE 1" through "SITE 8," "MPL 1" through "MPL 16," and "TONE 1" through "TONE 16," respectively.

To edit the names, enter the "RADIO" menu (see paragraph XI), press **Mode** up or down, to select the list type you wish to modify: STATUS, MESSAGE, SITE, MPL, or Single Tone name. With the desired list displayed, press **HOME**. The display changes to show one of the names in the list (for example, "STATUS 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. Press **VOL** and **Mode** to change one of these names just like you would change a mode name (see paragraph VIII).

After editing the name, press **HOME** to save the changes. Press **Mode** 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, press **Mode** and **HOME** to return to normal radio operation by exiting at the top level menu.

XV. EDIT MDC-1200 RAC (REPEATER ACCESS CONTROLLER) REPEATER LIST

The "RAC" menu is similar to the "CALL" menu. It is used to assign up to 63 repeater names and IDs to the radio's repertory RAC list. Each list location has two operator-programmable elements: the alias name and the ID.

To enter the "RAC" menu, proceed as you would to enter the "RADIO" menu (see paragraph XI. CHANGE RADIO-WIDE PARAMETERS). With "HOME SEL" displayed, press **Mode** down to scroll to the "RAC" menu. Press **HOME**; the display changes to alternating displays; for example, "RPTR 1" displays for two seconds, then "ID XXXX" displays for two seconds. The default name as shipped from the factory is "RPTR X." The alternating displays continue until you press **Mode** to go to another location or press **HOME** to select the displayed unit for editing.

1. Edit the Repeater Name

With the display alternating, press **HOME**. The display defaults to "RPTR X" (or previously edited name) and the first character location of the display flashes. Change the name by pressing the **Volume** and **Mode** buttons (or keypad if present) just like you would change a mode or call list (see paragraph VIII. CHANGE MODE NAMES). If you do not wish to change the name or, after you finishing editing it, press **HOME** to save the changes and/or advance to the repeater ID.

2. Edit the Repeater ID

Go through step (1) above to advance the editor to the repeater ID display. The display will show "ID - XXXX" and the first digit location will flash, indicating the current cursor location. Edit ID by pressing **VOL** and **Mode**, just like you would edit the mode name (see paragraph VIII. CHANGE MODE NAMES). If your radio has a 12-button keypad, enter the repeater ID number with the keypad. When you finish editing the number, press **HOME** to save the changes.

3. Exit the RAC Menu:

After editing the repeater names and IDs, scroll through the repeater list by pressing **Mode** until "EXIT" is shown on the display. Press **HOME** to return to the "RADIO" display. Press **Mode** again to return to normal radio operation.

XVI. 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 paragraph II). 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. Press **VOL** and **Mode** buttons (or keypad, if present) to enter the password.

NOTE

The password defaults to the last four digits of the radio's 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 reenter 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.

XVII. "ALIGN" MENU

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

NOTE

For trunked radios, place the microphone in the hangup clip (grounded) while in the "ALIGN" menu to unscquelch 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.

Press **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.

XVIII. LOW-POWER ADJUSTMENT

CAUTION

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 "LO POWER" displayed, press **HOME** to enter the adjustment mode. The display will show "LO 1 XXX," where the "1" represents the applicable test mode transmit frequency (see Table 9. Alignment Mode Frequencies) to be used, and "XXX" represents the current 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. Press **Mode** up to change to "L03XXX", which is the highest test frequency.

Table 9. Alignment Mode Frequencies

Test Frequency	Receive Frequency	Transmit Frequency
First	935.0125 MHz	896.0125 MHz
Second	938.0000 MHz	901.9875 MHz
Third	940.9625 MHz	940.9875 MHz

When setting or measuring RF power at 900 MHz, 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 25dB 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 **VOL** up or down until the power meter indicates one-half the rated power level. Then, dekey the radio. Press **HOME** to save the new value and exit back to the "LO POWER" menu.

Press **Mode** to scroll through the three test mode frequencies (LO 1 XXX, LO 2 XXX, and LO 3 XXX) and check each as described above. Always recheck for correct power level readings on all modes after power is readjusted.

XIX. HIGH-POWER ADJUSTMENT

CAUTION

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 **ALIGNMENT VIA IBM PERSONAL COMPUTER** paragraph II. 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 alignment mode transmit frequency (see Table 9) to be used, and "XXX" represents the 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. Press **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 \pm 0.2 V. Key the radio with the microphone PTT button, and adjust by pressing **VOL** 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.

Press **Mode** to scroll through the three test mode frequencies (HI 1 XXX, HI 2 XXX, and HI 3 XXX) and check each for power level of \pm 10% of initial power level set. Always recheck for correct power level readings on all modes after power is readjusted.

XX. REFERENCE OSCILLATOR ADJUSTMENT

NOTE

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 because of the narrow bandwidth in the 900 MHz frequency band. If adjustment is required, the radio's internal compartment must be stabilized at room temperature (25 \pm 3°C; 77 \pm 5°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 9. 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 NOTE above) and a 50-ohm load to the antenna connector. Press **Mode** to scroll to "REF3 XXX." Key the radio with the microphone PTT and monitor the frequency counter for a transmit frequency that is within \pm 230 Hz of the transmit frequency for that test mode. If adjustment is required, press **VOL** 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.

XXI. DEVIATION ADJUSTMENT

NOTE

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 operating in the narrow 900 MHz frequency bandwidth 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 9) 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 "DEV2 XX." Apply a 1-volt rms, 1 kHz tone to the microphone audio, and key the radio with the PTT button. Adjust by pressing **VOL** up or down to zero the deviation reading to less than or equal to +2.4 kHz; then dekey the radio. Press **HOME** to save the new value and exit back to the "DEV" menu.

Press **Mode** 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 ± 2.4 kHz peak deviation on all frequencies.)

NOTE

Single Tone deviation cannot be checked except by using an IBM PC as described in **ALIGNMENT VIA IBM PERSONAL COMPUTER** section VII.

ALIGNMENT VIA IBM PERSONAL COMPUTER

I. DESCRIPTION

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 FRONT PANEL PROGRAMMING AND ADJUSTMENTS.

Standard alignment procedures (power-set and current-limit adjust, reference oscillator adjustment, 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 12, Service Alignment Diagram.)

Table 10 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.

NOTE

After alignment, exit the "SERVICE" menu entirely (to the "MAIN MENU") to save all changes properly. Failure to do so can result in a "FAIL 01/82" or "FL 01/82" failure (see Table 11).

II. POWER SET AND CURRENT LIMIT ADJUSTMENT

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 preceded by an asterisk (*); perform all the following steps after PA board replacement.

For 12-watt units, no current set is required.

- 5a. At the High Power Set screen press the down arrow key to adjust the power-set relative value to 20. (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.

INSERT GXW-4294-A
PICKUP FROM PG. 25

Figure 12. Service Alignment Diagram

Table 10. 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	Second	N/A	N/A	First	N/A	N/A
COMMAND BOARD	Second	Fifth	Third	N/A	Fourth	Sixth	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

- *5c. Press **F3**, "SET TX I LIMIT," to enter the 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 of radio current.)
- *5e. Press **F8** to program value; then, press **F10** to return to the High Power Set screen.
- 6. Press **F4**, "HI TEST FREQ," to place the radio on the highest 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 this DOES cause the radio to transmit on the test mode, it also corrupts the alignment data.

NOTE

Set power to rated plus 10%; that is, set a 12-watt radio to 13.2 watts; set a 30-watt radio to 33.0 watts. Power can be set on any test frequency, but only one setting (the most recent) will be saved.

- *6a. Press **F6** to dekey; 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 the radio and measure the total radio current drain (computer will display "TRANSMITTER ON 896.0125 MHz"). Press **F6** again to dekey the radio.

- Press **F3**, "MID TEST FREQ," to change to the mid-range test frequency. Key the radio and measure the current drain (computer will display "TRANSMITTER ON 901.9875 MHz"). Dekey the radio.
- Press **F4**, "HI TEST FREQ," to change to the highest test frequency. Key the radio and measure the current drain (computer will display "TRANSMITTER ON 940.0125 MHz"). Dekey the radio. Press 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 two increments.
- 7. Press **F6** to dekey; then press **F8** to program this value.
- *7a. Press **F10** to exit the Current Limit screen.
- 8. Press **F10** to exit the High Power Set screen.
- 9. At the "ALIGNMENT" menu, press **F8** to select the TX Low Power screen. Adjust the relative value to 20 and press **F8** to program the value.
- 10. Press **F4** to place the radio on the highest test frequency. Key the radio with **F6**; adjust the relative value to achieve one-half rated power output. Press **F6** to dekey; then, 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.

- 11. This completes power set and current limit adjustment. Press **F10** as needed to return to the MAIN MENU or to other SERVICE screens.

III. REFERENCE OSCILLATOR ADJUSTMENT PROCEDURE

Adjustment of the reference oscillator is critical to radios operating in the 896 MHz band (which has much tighter channel spacing than the other land mobile bands). 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 \pm 3°C; 77 \pm 5°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 adjustment screen.
6. At the Reference Oscillator adjustment screen press **F6**, "TOGGLE PTT," to key the radio. Use the up or down arrow keys to adjust the reference oscillator frequency by selecting the relative value that yields the frequency closest to 896.0125 MHz.

NOTE

When you press **F6**, "PTT TOGGLE," you place the radio into test mode 1 and cause the radio to transmit on 896.0125 MHz. Do NOT use the microphone PTT during this procedure. While this does cause the radio to transmit on the test mode, it also corrupts the alignment data.

7. Press **F6** to dekey the radio; press **F8** to program the value.
8. This completes reference oscillator adjustment procedure. Press **F10** as needed to return to the MAIN MENU or to other SERVICE screens.

IV. TRANSMIT DEVIATION ALIGNMENT PROCEDURE

NOTE

Compensation should not require any adjustments; however, if for any reason such adjustments are needed, adjust compensation per paragraphs V. and VI. 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.

NOTE

This radio incorporates an interference-reducing feature that adaptively changes the deviation and power based on the strength of the last-received signal. Because of this, check the deviation in test modes, which turn the feature off, before setting.

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.) Press the up or down arrow keys to adjust the deviation to \pm 2.4 kHz, maximum. Press **F6** to dekey the radio.
7. Press **F3** to move to the next test mode. Press **F6** to key the radio.
8. Check the deviation and readjust as necessary. Press **F6** to dekey 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.

V. 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 (for example, DPL) and could result in distorted waveforms if improperly adjusted.

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

NOTE

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

A. Method 1

This method requires a modulation analyzer or meter with a frequency response to less than 10Hz 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 11Hz tone modulation.

NOTE

By pressing **F4**, "PTT 11Hz," you place the radio into test mode 1, causing it to transmit on 896.0125 MHz. 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 dekey the radio. (Use average deviation, if available, on the analyzer.)
8. Press **F6** to key the radio again. This generates a 67Hz 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).
10. Press **F6** to dekey; 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 IV.

B. 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 to be disassembled so that the RF board is exposed, and test point TP603 on that board can be accessed with an ac millivoltmeter. (J601 pin 2 may be used instead of TP603.)

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 67Hz tone modulation.

NOTE

By pressing **F6**, "PTT 67Hz," you place the radio into test mode 1, causing it to transmit on 896.0125 MHz. 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 dekey; 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 IV. TRANSMIT DEVIATION ALIGNMENT PROCEDURE.

VI. TX COMPENSATION CALIBRATION ALIGNMENT PROCEDURE

Alignment of compensation calibration points is 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 four frequency zones for compensation calibration points (two for transmit band; two for talkaround). Adjust these independently.

A. Method 1

This method requires a modulation analyzer or meter with a frequency response to less than 10Hz 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 **F4** to select the TX Compensation Calibration screen.

NOTE

There are four compensation calibration points to be set. Use the **F4** and **F6** keys 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. At the TX compensation Calibration screen, press **F4** to key the radio with an 11Hz tone modulation.
7. Note the level of deviation on the analyzer and press **F4** to dekey the radio. (Use average deviation, if available, on the analyzer.)
8. Press **F6** to key the radio again. This generates a 67Hz 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).
10. Press **F6** to dekey the radio.
11. Use the **TAB** key to select the next zone value; repeat steps (6) through (10) to check and adjust the value.

12. Repeat step (11) until all four zones have been adjusted.

13. Press **F8** to program the value.

14. This completes TX compensation calibration adjustment procedure. Press **F10** twice to return to the "SERVICE" menu and adjust deviation per paragraph IV.

B. Method 2

This method for setting TX compensation calibration can be used if a modulation analyzer or meter, as described in method 1, is not available. This method requires the radio to be disassembled so that the RF board is exposed, and test point TP603 on that board can be accessed with an ac millivoltmeter. (J601 pin 2 may be used instead of TP603.)

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 **F4** to select the TX Compensation Calibration screen.

NOTE

There are four compensation calibration points to be set. Press **F4** and **F6** 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.

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.

5. At the TX Compensation Calibration screen, press **F6** to key the radio with a 67Hz tone modulation.
6. Use the up and down arrow keys to adjust the compensation calibration value for a null ac voltage at TP603.
7. Press **F6** to dekey.
8. Press **TAB** to select the next zone value; repeat steps (5) through (7) to check and adjust the value.
9. Repeat step (8) until all four zones have been adjusted.
10. Press **F8** to program the value.

11. This completes TX compensation calibration procedure. Press **F10** twice to return to the "SERVICE" menu and adjust deviation per paragraph IV.

VII. 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
F5	Single Tone
F6	Trunking High-Speed Data

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.

NOTE

Single Tone will show "HS" on the display of the radio, since the modulation path is the same as trunking high-speed data.

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	1.50 kHz
MDC	1.75 kHz
Single Tone	1.50 kHz
Trunking HS	1.60 kHz

9. Press **F6** to dekey 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.

VIII. 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 IX. TROUBLESHOOTING AND REPAIR paragraph of this manual, and select the second test frequency (901.9875 MHz transmit) 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 1.87 MHz.

If adjustment is required, insert a long tuning tool (Motorola Part No. 66-84974L01) through the microphone's 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.

TROUBLESHOOTING AND REPAIR

I. POWER-UP SELF-CHECK DISPLAYS (Spectra and Spectra 9000 Control Head)

When the radio is powered up, the control head goes through a self-test routine to check for system failures. Table 11 lists the error messages that may appear in the display, followed by the possible causes and remedies.

Table 11. Power-Up Self-Check Display

ITEM	DISPLAY SHOWS		POSSIBLE CAUSE	REMEDY
	Spectra	Spectra 9000		
A	FL 01/81	FAIL 01/81	The pattern stored in the memory board ROM is incorrect.	Replace memory board.
B	FL 01/82	FAIL 01/82	The pattern stored in the memory board EEPROM is incorrect.	a. Reprogram EEPROM from ARCHIVE file if available. See paragraph VII. E., step 6a.
				b. Replace memory board.
C	FL 01/83	FAIL 01/83	Radio has conditions A and B.	
D	FL 01/84	FAIL 01/84	1. Memory board EEPROM is blank. 2. Microcomputer EEPROM is blank.	Replace memory board. Replace command board.
E	FL 01/85	FAIL 01/85	Radio has conditions A and D.	
F	FL 01/86	FAIL 01/86	Radio has conditions B and D.	
G	FL 01/87	FAIL 01/87	Radio has conditions A, B and D.	
H	FL 01/88	FAIL 01/88	Memory board RAM defective.	Replace memory board.
I	FL 01/89	FAIL 01/89	Radio has conditions A and H.	
J	FL 01/8A	FAIL 01/8A	Radio has conditions B and H.	
K	FL 01/8B	FAIL 01/8B	Radio has conditions A, B and H.	
L	FL 01/8C	FAIL 01/8C	Radio has conditions D and H.	
M	FL 01/8D	FAIL 01/8D	Radio has conditions A, D and H.	
N	FL 01/90	FAIL 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	FAIL 01/92	The pattern stored within the microcomputer EEPROM is incorrect.	Initialize EEPROM (see paragraph VII.E.).
P	FL 01/93	FAIL 01/93	Radio has conditions A and O.	
Q	FL 01/94	FAIL 01/94	Microcomputer EEPROM is blank.	Replace command board.
R	FL 01/95	FAIL 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 ROM is defective.	Replace control head board.
U	ER 01/82	ERROR 01/02	Radio has an error with its EEPROM; one or more modes in the radio have 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 VII. E., 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	FAIL 001	Synthesizer out-of-lock condition.	See synthesizer troubleshooting.
X	FAIL 002	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 VII. E., step 6a.)
				b. Replace memory board.
Y	FAIL 003	FAIL 003	Mismatch between radio programming and control head type.	a. Reprogram EEPROM.
				b. Replace control head with correct control head type.
Z	FAIL 999	FAIL 999	Serial number in the memory board and the microcomputer do not match; Radio will not function, but will allow test mode operation.	Replace memory board with the proper one.

Table 11A. Control Unit Troubleshooting Display Codes

ITEM	DISPLAY SHOWS		DESCRIPTION OF PROBLEM
	Spectra	Spectra 9000	
AA	FL 05/81		Control head ROM defective (replace control head board).
AB		FAIL 05/82	Control unit EEPROM corrupted. See control unit troubleshooting in this manual.
AC		FAIL 05/84	Control unit EEPROM blank. See control unit troubleshooting in this manual.
AD	FL 05/88		Control head RAM defective (replace control head board).
AE		FAIL 05/90	Control unit serial bus failure. See control unit troubleshooting in this manual.

Table 11B. SECURENET–Capable Radio Troubleshooting Display Codes

ITEM	DISPLAY SHOWS		DESCRIPTION OF PROBLEM
	Spectra	Spectra 9000	
BA		FAIL 09/90 ERROR 09/10	Option serial bus failure. See the appropriate SECURENET instruction manual.

Table 11C. Trunking System Troubleshooting Display Codes

ITEM	DISPLAY SHOWS		DESCRIPTION OF PROBLEM
	Spectra	Spectra 9000	
CA		FAIL 10/82 ERROR 10/02	Option EEPROM corrupted. See the trunking troubleshooting chart in this manual.
CB		FAIL 10/84	Option EEPROM blank. See the trunking troubleshooting chart in this manual.
CC		FAIL 10/10	Option serial bus failure. See the trunking troubleshooting chart in this manual.

Table 11D. Siren/PA Troubleshooting Display Codes

ITEM	DISPLAY SHOWS		DESCRIPTION OF PROBLEM
	Spectra	Spectra 9000	
DA		FAIL 08/10	Option serial bus failure. See the Spectra 9000 siren/PA option instruction manual.

II. SYSTEM SELF-CHECK

When the radio system is turned on it displays "SELF CHECK." During this time, each processor does a diagnostic check. This includes checking ROM, RAM, EEPROMs, and serial bus circuitry. If no errors are detected, the display shows the selected mode. If there are any errors, they are displayed for two seconds each, after the "SELF CHECK" display.

The error code is divided into two parts, separated by a "/." The first part indicates the location of the error. The second part indicates the type of error. While the problem is not necessarily located on the board indicated by the location code, the troubleshooting guide for that board should be used to initially locate the problem. See Table 11A for interpretation of these codes for a Spectra and Spectra 9000 control heads.

There are two types of errors. The first type does not stop the system from operating. This error occurs if an option board is not communicating on the serial bus.

In this case, the display indicates "ERROR_/_/_" This specifies the error. When this display appears, the operator is alerted by a beep. The system continues to operate without the option.

The second type of error inhibits the operation of the system. This occurs if the radio's EEPROM is corrupted. Since the data needed to operate the radio is stored in the EEPROM (frequencies and PL codes), the system cannot work if that data is invalid. This type of error is indicated by a display of "FAIL_/_/_" If there is a single error of this type, the display shows it indefinitely. If there are multiple errors, and one of this type, each error display is shown for two seconds and the display cycles through them.

A special case exists for error "ERROR 01/90." This error indicates that the control unit did not receive a message from the radio. If this error occurs, the control unit resets the system, after all the error displays are shown, in an effort to correct the failure.

A. 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.

B. Control Head Problems

The following symptoms are caused by a control head problem:

- Flickering "SELF CHK" but no failure message.
- Control head powers up; however, 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 X.). If this 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.

III. TRANSMITTER TROUBLESHOOTING

When setting or measuring RF power at 900 MHz, 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 13 shows the preferred test set-up using no cables.

Table 12 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.

INSERT GPW-4743-A
R.T. 60% PICKUP FROM PG. 33

*Figure 13.
Transmitter Troubleshooting Preferred Test Setup*

Table 12. Transmitting Troubleshooting Chart

Symptom	Possible Cause	Correction or Test (Measurements Taken at Room Temperature)
No RF power out	1. TX power level programming	Check TX power level programming (from front panel or programmer).
	2. No keyed 9.6V from command board	Check for keyed 9.6V on pin 15 of J500 w/transmitter keyed. If none, replace command board.
	3. No injection to power amplifier	a. Check the lock line (pin 14 of J500); if not less than 2 volts, go to synthesizer troubleshooting chart.
		b. Measure injection; should be > +19dBm; if low, replace VCO board.
	4. Power Amplifier	Measure PA control voltage (pin 2 of P503); if > 6 volts, replace PA board.
5. Power control circuit (on command board)	If PA control voltage above was < 6 volts, replace command board.	
No modulation	1. VCO board	a. All modulation testing should be done w/ the radio keyed & 1Vrms on the microphone high line of the microphone.
		b. Is there > 300mVrms @ pin 11 of J500? If so, replace VCO board.
	2. HearClear board.	Is there > 200mVrms @ pin 19 of P501? If not, replace HearClear board.
3. Command board	If there is the correct voltage @ 19 of P501 and not at pin 11 of J500, check deviation and compensation programming; if OK, replace command board.	
Distorted modulation	1. HearClear board	a. These measurements should be made w/ 1 kHz tone @ 80mVrms injected @ the microphone high line.
		b. Is the output of the HearClear board distorted (pin 19 of P501)? If so, replace the HearClear board.
	2. Command board	Is the output of the command board (pin 11 of J500) distorted? If so, replace command board.
	3. VCO board	Replace VCO board.
4. Compensation not set/working (DPL distorted)	Check compensation setting; if compensation won't adjust, go to "Can't Set Compensation" below.	
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, replace the microphone.
	3. HearClear board	W/80mVrms on the microphone high line, monitor the output of the HearClear board (pin 19 on P501); if less than 40mV, replace the HearClear board.
	4. Command board	W/80mVrms on the mic high line, monitor the VCO mod line (pin 11 on J500); voltage should be > 200mVrms; if not, replace command board.
	5. VCO board	If correct voltage was found on pin 11 of J500, replace the VCO board.
No/low signalling (PL,DPL, trunking, MDC)	1. Check programming	
	2. Command board	Check for proper modulation at pin 11 of J500; if not, replace command board.
Can't set compensation	1. Command board	a. All modulation testing should be down w/ the radio keyed & 1Vrms 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 > 3Vp-p; voltage @ in 11 of J500 should be > 3VP-P; if not, replace command board.
	2. RF board	If maximum deviation can be set to > 2.5 kHz, but compensation cannot be set, replace RF board; otherwise, replace VCO board.

IV. RECEIVER TROUBLESHOOTING

Table 13 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.

CAUTION

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

Table 13. 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+ at pin 31 of J0502 on the command board. If not there, check for SWB+ at pin 4 of P103 on the control head.
	3. Regulators (Command board)	Check for 9.6V on pin 10 of J500 and +5V on pin 1 of J500; if not there, check for A+ at pin 30 of J502; if OK, 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, go to synthesizer troubleshooting chart.
	3. Regulators (Command board)	Check for 9.6V on pin 10 of J500 and +5V on pin 1 of J500; if not there, check for A+ at pin 30 of J502 and SWB+ at pin 31 of J502; if OK, replace command board.
No receiver audio or receiver does not unscquelch	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 9.6V on pin 10 of J500 and +5V on pin 1 of J500; if not there, check for A+ at pin 30 of J502 and SWB+ at pin 31 of J502; if OK, 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 > 100mVrms on pin 5 of J500? If so, replace command board.
		c. Is the squelch output line (pin 8 of J500) > 3V (active)? If not, replace RF board.
4. HearClear board	Set volume to 13; is there signal on pin 11, but not pin 18 of P501? Or is there signal on pin 2, but not pin 7 of P501? If so, replace HearClear board.	
5. 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 250Hz, go to synthesizer troubleshooting chart.
	2. RF board	a. Run the remaining tests with a 1mV RF, 1 kHz tone @ 1.5 kHz deviation into the antenna connector.
		b. Is the voltage @ pin 4 of J500 > 75mVrms and < 9% distortion? If not, replace the RF board.
	3. HearClear board	Put the radio in one of the test modes from the front panel (this defeats the HearClear board); if the audio is corrected, replace the HearClear board.
4. Command board	Replace command board.	

Table 13. Receiver Troubleshooting Chart (continued)

Symptom	Possible Cause	Correction or Test (Measurements Taken at Room Temperature)
RF sensitivity poor	1. Synthesizer not on frequency/working	Check synthesizer frequency; if off by more than 250Hz, 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 1.5dB, 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; net conversion gain should be > 6dB.
		b. If conversion gain is < 6dB, 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 +2dBm, replace the VCO board; if injection is OK, replace Rx front-end assembly.
4. RF board	Check the sensitivity into the RF board @ 109.65 MHz. If greater than -118.5dBm, replace the RF board (CAUTION: there is 12.5Vdc on the center conductor of this coax; a dc blocking capacitor must be used here.)	
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 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+ at pin 31 of J0502 on the command board. If not there, check for SWB+ at 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.
Excessive noise in fading conditions	1. Check programming	Make sure HearClear is enabled.
	2. RF board	a. Is there > 3 Vp-p of noise on pin 4 of J500 with no signal applied? If not, replace RF board.
b. Apply a -100dBm signal to the antenna connector at the desired frequency; measure RSSI voltage (pin 9 of J500); increase the RF signal by 10dB; the RSSI voltage should increase by 180mVdc; if not, replace the RF board.		

V. SYNTHESIZER TROUBLESHOOTING

Table 14 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.

VI. 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 ICs 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 ICs do have internal protection, but it is effective only against over-voltages in the hundreds of volts, such as those that could occur during normal operations. Over-voltages from static discharge can be in the thousands of volts.

To avoid damaging CMOS ICs, 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.

Table 14. 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; unplug loop feedback coax from VCO board to RF board; measured level should be $-5\text{dBm} \pm 6\text{dB}$; frequency should be 407 to 411 MHz; if not, replace VCO board.
	2. Reference oscillator	Is there $> 1.5\text{V}$ p-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	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 unplug loop feedback coax from VCO board to RF board; measured level should be $-5\text{dBm} \pm 5\text{dB}$; frequency should be 407 to 411 MHz; if not, replace VCO board.
	3. RF board	Replace RF board.
Does not lock in Tx (or talkaround or receive)	1. RF board	Check the aux bit states (pin 9 & 11 of J601) Receive: pin 11 $> 8\text{V}$; pin 9 $> 8\text{V}$ Transmit: pin 11 $> 8\text{V}$; pin 9 $< 1\text{V}$ Talkaround; pin 11 $< 1\text{V}$; pin 9 $< 1\text{V}$ If wrong, replace RF board.
	2. VCO	Replace VCO board.
Synthesizer locks on wrong frequency	1. Synthesizer not locked	Check synthesizer lock line (pin 14 of J500); if $> 1\text{V}$, 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 $\pm 4\text{Hz}$; 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 $5\text{V} \pm 2\text{V}$? 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.	

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.

VII. 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.

CAUTION

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 Table 16 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 11).

A. Control Head Board (Spectra)

1. Unplug the microphone and remove the two front panel screws. Disconnect the control cable on remote models. Grasp the front panel firmly and carefully unplug the assembled control head from the radio or remote control head back housing.
2. Lay the control head face down on your work surface.
3. Remove seven screws (use a Torx T10 driver) or four screws for rotary models. Rotary models have, in addition to the screws, four snap features as shown in Figure 15. Carefully separate the printed circuit board, internal spacer, and elastomer keypad assembly from the front panel. On rotary models, care must be taken not to damage the flex circuitry when separating the printed circuit board from the front housing. Do not disturb the buttons in the front panel. On rotary models, the flex circuit must also be unplugged. If you have a rotary model, desolder the XMIT and Busy LED before removing the elastomer keypad. Remove the elastomer keypad from the printed circuit board.
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.

- Remove the PC board from the internal spacer. The PC board snaps into and out of the spacer.

IMPORTANT NOTE

Early model radios used a flex cable to interconnect between the command board and the control head. Your radio has the flex cable if it is one of the following model numbers:

- D27KGA5JB5AK
- D37KGA5JB5AK
- D37KGA5JB7AK
- D37KGA5JB9AK
- D37KMA7JA5AK
- D37KMA7JA7AK

If you elect to replace the control head with a new assembly that has the electronic on/off switch (board kit no. HLN6075), do so following these instructions:

Remove and discard the flex cable.

Install a new back housing (part number 15-80111L02) or modify the original back housing (15-80111L01) by removing the two tabs which hold the flex cable to the back housing, being sure that no tab material remains to interfere with the new control head assembly.

Install a rigid interconnect board (HLN6285A) in place of the flex cable.

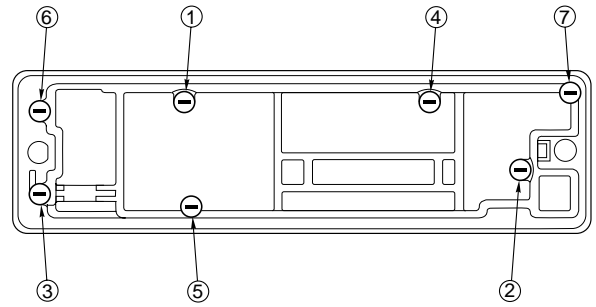
IF YOUR RADIO IS NOT ONE OF THE ABOVE MODELS, DISREGARD THIS NOTE.

NOTE

On rotary models, the flex circuit must be connected to the PC board prior to attaching the PC board to the spacer.

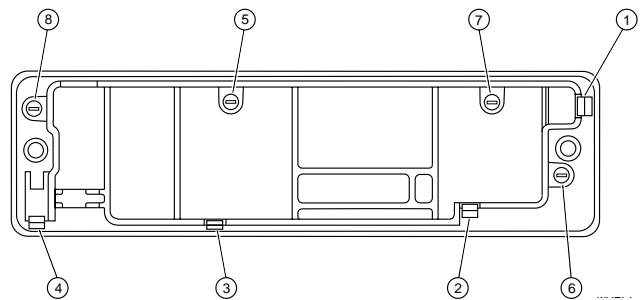
- If you have an rotary model, solder the XMIT Busy LEDs onto the PC board.
- Snap the new PC board into the internal spacer. Before you press the keypad into the board, make sure that the conductive pads in the board and the keypad are clean and free of any foreign material.
- Install the PC board internal spacer and elastomer keypad assembly to the front panel. Replace the screws and torque to 6-8 in.-lbs. in the sequence shown in Figures 14 and 15.
- For dash-mounted radios, plug the interconnect board into the radio, then plug in the control head assembly and fasten with the two front panel screws torqued to 4-6 in.-lbs. For remote mount control heads, replace the front panel into the remote control head back housing, ensuring the gasket is in place. Torque the screws to 4-6 in.-lbs. Replace any plugs and cables on the rear of the control head.

CAUTION
Take care to avoid misalignment of connector pins. Remove the radio top cover and command board cover (earlier models) to allow visual inspection during connector alignment.



MAEPF-22823-O

Figure 14. Control Head Assembly Screw Sequence



MAEPF-21438-O

Figure 15. Rotary Control Head Assembly Screw and Snap Sequence

B. Remote Control Head Interface Board Replacement

- Unplug the microphone. Disconnect the control cable from control head on remote models. Remove the two front panel screws (use a 2.5mm hex key driver). Grasp the front panel firmly and carefully unplug the control head assembly from the radio or remote control head back housing.
- Remove the two remote interface board attachment screws.
- Remove the remote control head interface board from the remote control head back housing.
- Attach the new interface PC board to the back housing with two screws torqued to 6-8 in.-lbs. Reassemble the back housing to the front housing with two screws torqued to 4-6 in.-lbs.

C. Power Amplifier Board

1. Back-End Removal

- a. Remove the radio's top and bottom covers.
- b. 4-watt and 30-watt - Remove four screws (use Torx T15 driver) from PA cover; remove cover and lift the PA shield and harmonic filter shield cover.
- c. Remove the two Allen-head screws (use metric 3.0 mm Allen wrench) from the heatsink.
- d. Carefully separate the PA assembly from the chassis.

NOTE

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

- e. 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 chassis.

2. PC Board Removal

NOTE

Before unfolding the RF cables, note how each is routed. This will facilitate assembly.

- a. 12-watt - Remove two plastic clips that hold the RF cables to the shield as follows: insert small, flat-blade screwdriver into the clip slot, deflect the snap holding one side of the clip to the shield, and pull the other side of the clip. Unfold the RF cables and remove the PA compartment shield.
- b. 4-watt and 30-watt - Remove two screws (use Torx T15 driver) and pull feed-thru plate from the side of the PA assembly. Remove RF cable clip. Unfold the RF cables and push them through the slots in the PA compartment.

12-WATT PA

- c. Desolder three leads for Pass Device Q9500.
- d. Remove two screws (use Torx T8 driver) from the power shield.
- e. 30-watt only - Remove two screws from the final device.
- f. Disconnect the red power lead.
- g. Use a Torx T15 driver to remove the larger screws. (Five screws are used on 12-watt, or six on 30-watt.) Carefully lift the PC board from the heatsink.

NOTE

Before desoldering the RF cables, note which cable is attached to each connector on the board. This will facilitate assembly since the cables differ in length.

- h. Desolder the antenna coax cable attached to the bottom of the board. Desolder and remove the power module shield. Desolder the RF cables from the board.

3. PC Board Installation

- a. Solder the RF cables to the board connectors.
- b. Clean any old thermal compound from the mounting surfaces of the power transistor, power module, and (on 30-watt models) the final device. (If the power transistor insulator was not disturbed, it is not necessary to clean beneath it.) Apply a new, uniform coat of thermal compound (for example, Motorola part no. 11-83166A01), which is thick enough to fill all small air voids, to the mounting surfaces.

NOTE

Do not use a thick coating of compound and do not allow any small bits of dirt or debris to get in the compound; such would degrade the thermal efficiency of the heatsink.

4-WATT & 30-WATT PA

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PICKUP FROM PG. 40

Figure 16. PA Board Screw Fastening Sequence

- c. Solder three leads of Q9500 pass device.
- d. Install the PC board and attach and tighten the screws in the sequence shown in Figure 16.
- e. 30-watt only - Install the final device with two screws. Figure 17 shows the properly oriented final device.
- f. Place the power module shield over the power module. Install power module and shield with two compression washers and screws.
- g. 30-watt only - Solder the final device leads and five capacitors. Capacitors must be soldered flat to the board and each capacitor surrounding the final device must be soldered as close to the device as possible.
- h. Solder power module leads, module shield, and transistor leads (30-watt only).
- i. Install the red power lead.

**INSERT GXW-4349-O
PICKUP FROM PAGE 40**

Figure 17. Installing the Final Device

- 4. Install Back End
 - a. 12-watt - Carefully position the RF cables through the slots in the PA shield and install the shield. Fold the RF cables under metal clips and install the two plastic clips.
 - b. 4-watt and 30-watt - Push the RF cables through the slots in the PA compartment. Install the feed-thru plate, making sure the RF cable is routed under the plate. Install the RF cable clip, making sure the cable is routed under the clip; fold cables.
 - c. 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 chassis.
 - d. 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. Tighten the mounting screws.
 - e. 4-watt and 30-watt only - Press PA compartment shield and install PA cover.

- f. Install radio's top and bottom covers.

5. Alignment

Perform the "Power Set and Current Limit Adjustment." See ALIGNMENT VIA IBM PERSONAL COMPUTER for procedures.

D. HearClear Board

- 1. Remove the radio covers. Lift off the command board cover (earlier models only).
- 2. Remove the original HearClear board and replace it with the new HearClear board at connector P0501 on the command board.
- 3. Reassemble the command board and radio covers.

E. 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 covers. Lift off the command board cover (earlier models only).

CAUTION

To remove the memory board, gently pry the board up at the center of the connector end of the board (see Figure 18). This will help prevent damage or bending the connector pins.

Figure 18. 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 command board and radio covers.

NOTE

Replacement memory boards are preprogrammed 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). Press **ENTER** 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 and dual-mode models, reenter conventional data via the CHANGE/VIEW menu; then use GET/SAVE and/or GET TCMS (for trunked and dual-mode models) to download a replacement codeplug image.

NOTE

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

F. Command Board

1. Remove the radio covers. Lift off the command board cover (earlier models only).
2. Remove the control head and the PA assembly.
3. Remove the shield 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 the six 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. Apply a thin coat of thermal compound (for example, 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.

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.

NOTE

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

11. Reconnect the two connectors.
12. Install the command board cover (on earlier models), the PA assembly, the control head, and the radio covers.

NOTE

Replacement command boards are preprogrammed 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 Table 16 and perform the other alignment procedures indicated.

G. Receiver Front End

1. Remove the radio covers. Remove the two mounting screws and unplug the control head. (For earlier models, also remove the two mounting screws and the control head rear housing.) Disconnect the coax cable that passes through the front of the chassis to 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. Reconnect both coax cables, then install the front-end cover and four mounting screws. Install the PA assembly and control head. (For earlier models, the control head rear housing must be installed before the control head is attached.)

NOTE

No alignment is required.

H. VCO Assembly

1. Remove the radio covers. 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.
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. 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

Ensure that 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).
6. Install the VCO cover and six mounting screws, and the RF board cover.
7. Install the PA assembly and the radio covers.
8. See Table 16 and perform the alignment procedures indicated.

I. RF Board

1. See the previous paragraph and remove the VCO board. Remove the control head. (For earlier models, also remove the control head rear housing.) 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 six 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, and 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. (For earlier models, the control head rear housing must be installed before the control head is attached.)
6. See Table 16 and perform the alignment procedures indicated.

VIII. SPECIAL REPAIR PROCEDURE

A. Minimum RF Performance Tests for Board Replacement (See Table 15).

B. Alignment via IBM PC

Table 16 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.

C. Power Amplifiers

Apply a thin coat of thermal compound (for example, Motorola part no. 11-83166A01) to the power module and voltage control pass device and final device (in 30-watt models) heatsink mounting surfaces.

NOTE

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

The voltage control pass device must be attached, with ceramic insulator and using the clip hardware, prior to securing the PC board mounting screws. This will ensure proper thermal conduction. Both surfaces of the insulator require thermal compound.

Tighten mounting screws on the power module and 30-watt final device before you attempt to transmit. This will ensure proper thermal conduction.

Tighten the antenna connector nut (refer to Table 17 for torque value) to ensure that the connector is well grounded. Failure to do so will cause improper operation in receive or transmit mode.

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

D. 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 reassembly, check every key or button to ensure that each works properly (see the Control Head Test).

E. Command Board

NOTE

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

1. Before reassembly, apply a thin coat of thermal compound (for example, 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. Tighten evenly to ensure you do not warp the board.
5. Reconnect the control head interconnect board (J103) to the control head connector (P103). Observe pin alignment on P502 while connecting to command board (J502). Secure the control head with two screws. Reconnect the memory board (via P505) and HearClear board prior to installing covers.

Table 15. Minimum RF Performance Tests for Board Replacement

TEST (Take Measurements at room temperature)	READING
12dB SINAD into antenna connector J9852F	-117.5dBm (maximum)
12dB SINAD into RX front end J9127	-119.0dBm (maximum)
12dB SINAD into RF board J350 (@ 109.65 MHz)	-118.5dBm (maximum)
VCO output TX injection J9641 (TX, TA mode)	+23dBm (maximum) +19dBm (minimum)
VCO output RX injection J9642 (RX mode)	+5dBm (maximum), +2dBm (minimum)
Synthesizer feedback P0602 (all modes)	+1dBm (maximum) -12dBm (minimum)
Recovered audio level (for 1.5 kHz Deviation @ 1 kHz, J500-4)	125mV rms (maximum), 75mV rms (minimum)
Power Amp Output:	
TX injection into PA J9641F	90 milliwatts
Power out (30W) at antenna connector (Note 1)	≥ 34 watts
Power at RX Connector (Note 1)	≤ 25 milliwatts
Power out (12W) at antenna connector (Note 1)	≥ 14 watts
Power out (4W) at antenna connector (Note 1)	≥ 5 watts
RX insertion loss (Note 2)	≤ 1.5dB

NOTES:

1. Measure with K9.4, V drive, 9.6V applied at 12-pin dc connector PA board and 13.8V applied. 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 16. Alignment Procedures

Procedure > ITEM	Reference Oscillator Tuning	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	Second	N/A	N/A	First	N/A	N/A
COMMAND BOARD	Second	Fifth	Third	N/A	Fourth	Sixth	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

Table 17. Minimum RF Performance Tests for Board Replacement

Part Number	Description	Repair Torque (in.-lbs.)	Where used
N/A	1/4-40 hex nut	10-12	Control head power switch (Earlier models only)
N/A	7/16 hex nut	6-8	Mini-UHF antenna connector
03-0007164	Screw, machine 6-32	4-6	PA board power tap (earlier models)
03-80114M02	Screw, machine M5X10	6-8	Radio mounting
03-10911A11	Screw, machine M3X8	6-8	PA boards device attachment
03-10911A12	Screw, machine	6-8	Pass device
03-10943J15	Screw, tapping M3.5X8	6-8	All PC board attachment (except for control head and remote dash board); back housing to chassis (earlier models)
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	Low power heatsink mounting
03-80077M03	Screw, hex M4X25	10-12	Mid power heatsink mounting
03-80077M04	Screw, hex M3X22	6-8	Remote cable mounting
03-80114M01	Screw, machine M3.5x44	6-8	Top and bottom cover (earlier models only)
03-84244C06	Wing screw M5X10	6-8	Radio mounting

6. Refer to paragraph VII., F. Troubleshooting and Repair to realign the radio.

F. Fastener Torque Chart

Table 17 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.

IX. 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 FRONT PANEL PROGRAMMING AND ADJUSTMENTS in this manual, and specifically, paragraph XVI. for password entry.)

After the password is successfully entered, the radio enters a test mode where basic radio and signalling measurements are made at three separate frequencies across the band. The first six characters of the display

show the six 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 935.0125 MHz and the signalling is carrier squelch. The display shows "350125CS". When transmitting, the display will change to the transmit frequency. The three test frequencies are:

Test Frequency	Receive Frequency	Transmit Frequency	Transmit Power Level
First	935.0125 MHz	896.0125 MHz	High (Rated)
Second	938.0000 MHz	901.9875 MHz	High (Rated)
Third	940.9625 MHz	940.9875 MHz	High (Rated)

The signalling types are shown in Table 18.

In test mode, press **Volume** 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. Press **HOME** 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. Press **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 types.

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 19. 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 ALIGNMENT VIA IBM PERSONAL COMPUTER paragraph VIII. 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.

X. 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 FRONT PANEL PROGRAMMING AND ADJUSTMENTS of this manual, and specifically, paragraph XVI. for password entry.)

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

Table 18. Signalling Types

	Display	Modulation	Demodulation	Type
1.	CS	None	None	Carrier Squelch, HearClear Disabled
2.	PL	100Hz	100Hz	PL
3.	PC	11Hz	None	PL (Compensation Adjust)
4.	PD	67Hz	None	PL (Deviation Adjust)
5.	DL	100Hz	100Hz	DPL
6.	LS	100Hz	100Hz	Trunked Low-Speed
7.	M6	1500Hz	1500Hz	MDC-600
8.	MC	1500Hz	1500Hz	MDC-1200
9.	HS	1500Hz	1500Hz	Trunked High-Speed
10.	DF	1477 & 941Hz	None	DTMF Digit #
11.	HC	None	None	Carrier Squelch, HearClear Enabled

NOTES:

- HearClear always disabled during test mode except on "HC" signalling type.
- Adaptive splatter feature always disabled.
- Sine waves used for trunked, MDC, and DPL signalling modulation/demodulation rather than actual data signalling.
- Volume level is 256 steps versus normal 16 to aid in setting rated audio level.
- Transmitter time-out timer is disabled.
- Microphone audio is disabled during MDC, DTMF, and trunked high-speed modulation.
- Synthesizer always in narrowband configuration during transmit.
- "Normal" radio operation is disabled (i.e., cannot initiate or receive calls, edit operator selectable scan list, etc.)
- For trunked radios, place the microphone in the hangup clip (grounded) while in the "TEST FREQUENCY" menu to unsquelch the radio and allow receiver measurements to be made.

Table 19. Checking Modulation Frequency and Deviation

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

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. Afterward, the self test proceeds through a 15-1/2 second self-check as shown in Figure 19 for Spectra control heads and Figure 20 for Spectra 9000 control heads.

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 21 shows the control head and the key number that should display for each key for the Spectra control head; Figure 22 shows the control head, accessories and key number that should display for each key for the Spectra 9000 control head.

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 **VOL** 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.

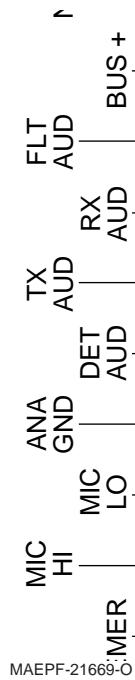
INSERT GXW-4318-O
PICKUP FROM PG. 46

Figure 19. Spectra Control Head Self-Test

T33 - T43 & T83
RADIO FRONT OPTIONS CONNECTOR
FOR A4 - A5 - A7 - A9 (Siren/PA Option or PA Option)

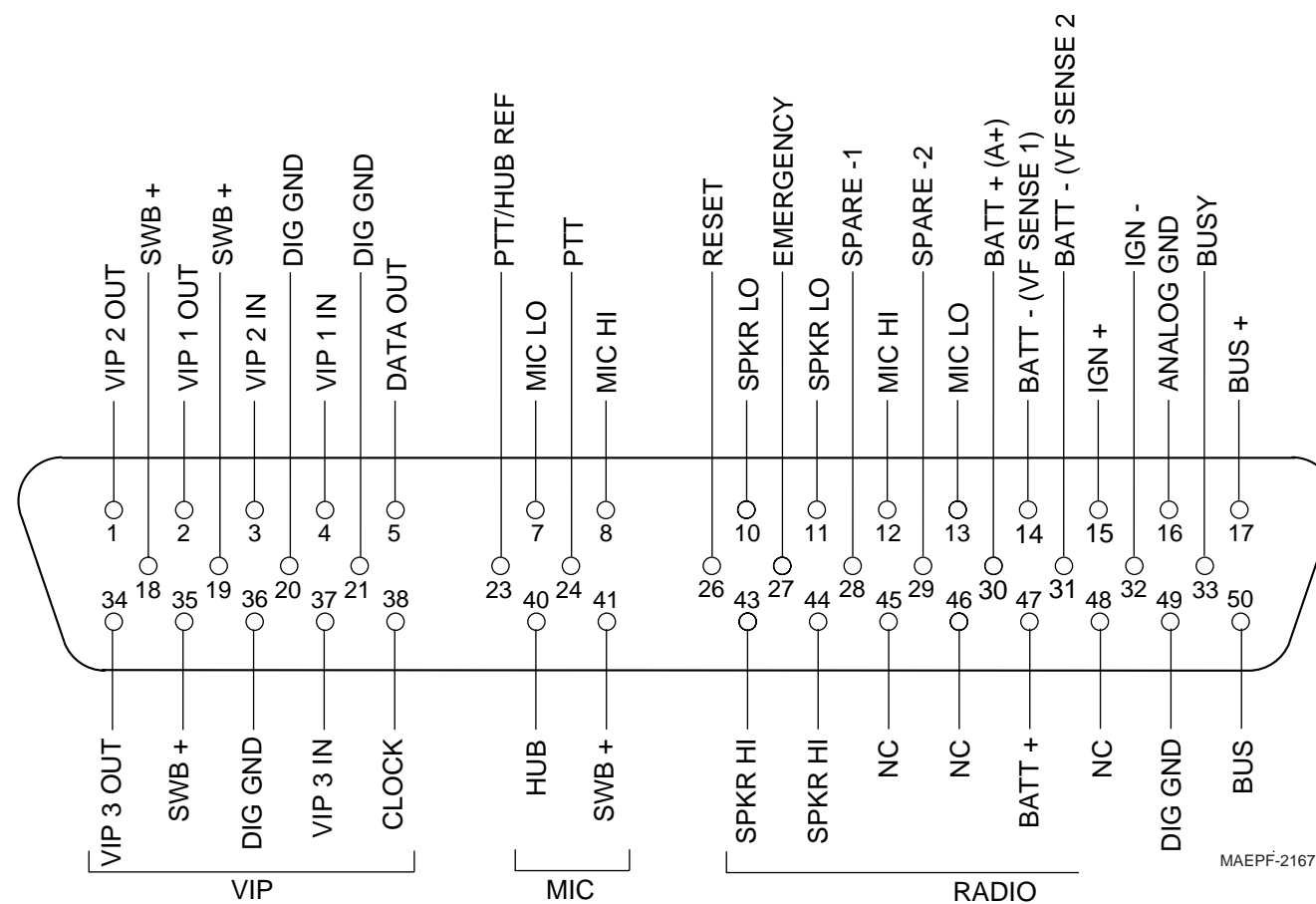
MOTOI	DESCRIPTION	Radio Front Options		
	ILLUSTRATOR	DATE	ENG	
	EH	5/24/91		
	EDITOR	DATE	CHK	
	JC	5/28/91		

LETTERING
REQUIRES:



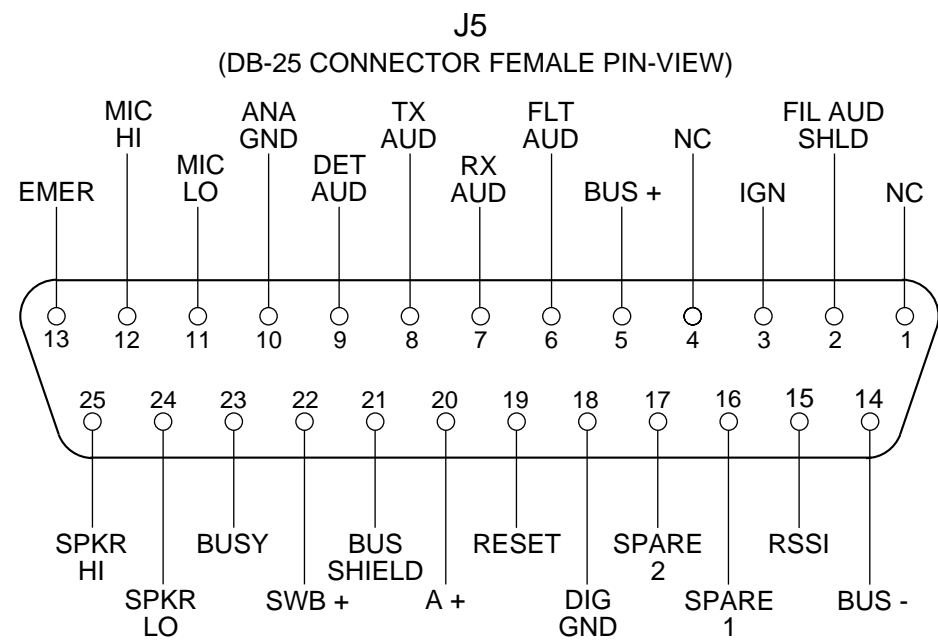
MAEPF-21669-O

FOR A4 - A5 - A7 - A9
CONTROL HEAD CONNECTOR



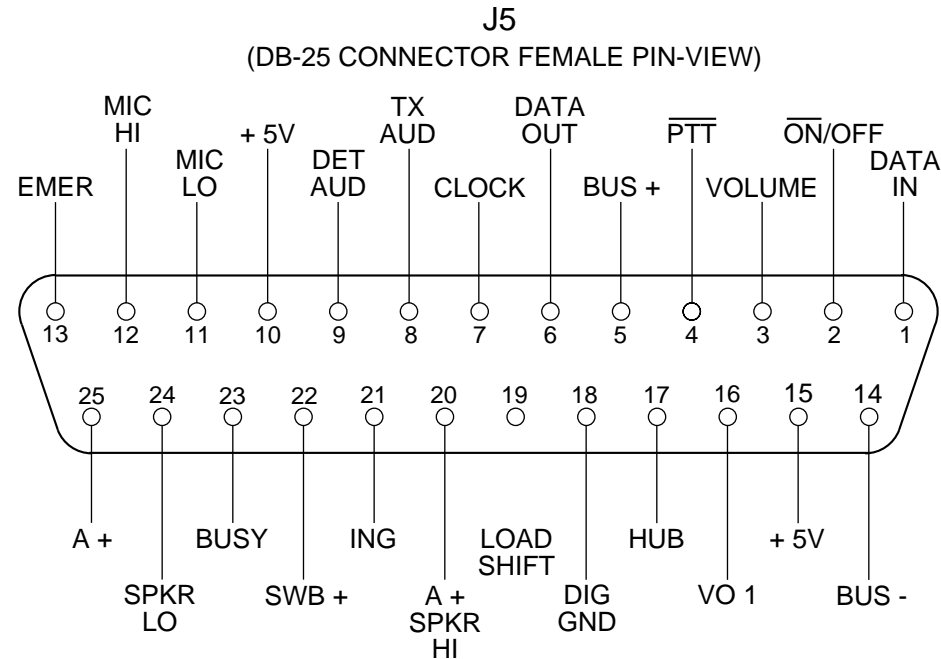
MAEPF-21670-O

T33 - T43 & T83
RADIO FRONT CONNECTOR
FOR A4 - A5 - A7 or A9 CONTROL HEAD REMOTE



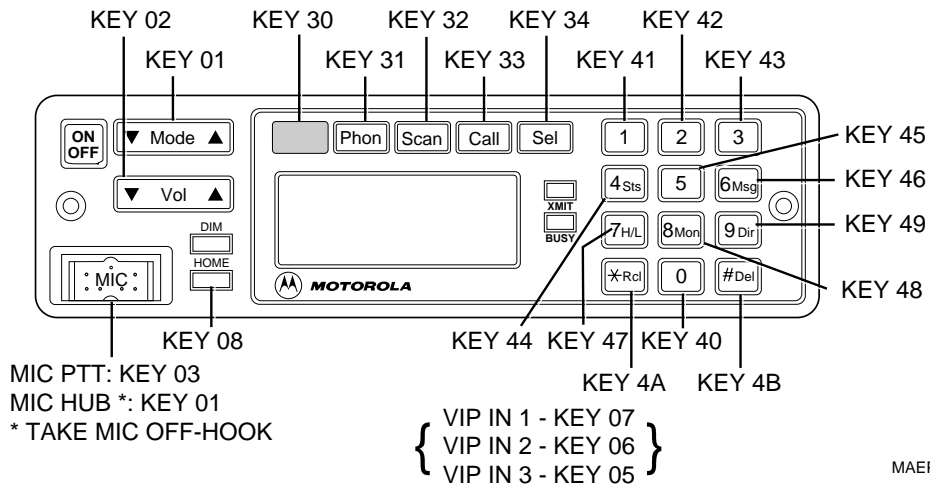
MAEPF-21671-O

T33 - T43 & T83
RADIO FRONT CONNECTOR
FOR A3 CONTROL HEAD REMOTE



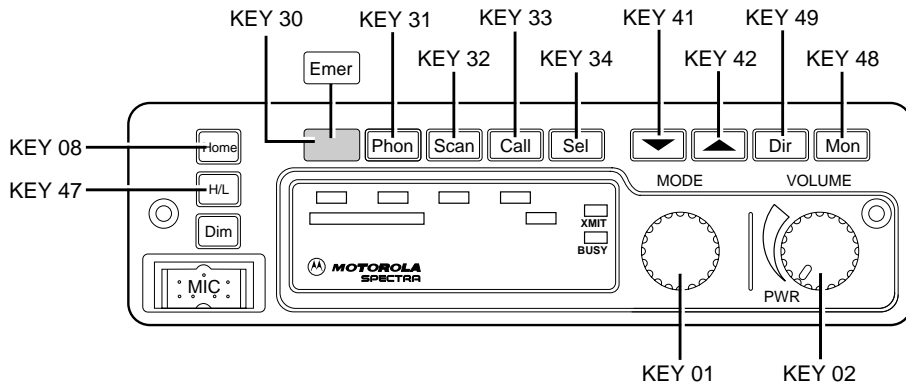
MAEPF-21672-O

Figure 23. Pin-Outs for Radio Chassis and Control Head



MAEPF-22781-A

Figure 21. Front Panel Diagnostics; Key Closure Displays



MAEPF-21703-A

Figure 21A. Front Panel Diagnostics; Rotary Key Closure Displays

INSERT GPW-7221-B

Figure 22. Front Panel Diagnostics; Key Closure Displays

CONTROL STATION OPERATION

I. 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

II. INSTALLATION PLANNING

A. 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.

B. Radio Location

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

III. INSTALLATION AND OPERATION

NOTE

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

1. The Control Station Wiring Diagram, 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.

INSERT GXW-4278-O
PICKUP FROM PW-4320-O

GXW-4323-A

FOLDING RIBBON CABLE FOR INSTALLATION

GXW-4324-B

INSTALLING RIBBON CABLE (12-WATT)

GXW-4325-B

FOLDING RIBBON CABLE (30-WATT)

PICKUP FROM GXW-4295-O & 4296-O

HORN/LIGHTS WIRING DIAGRAM
(Spectra Rear Accessory Connector)

EMERGENCY SWITCH WIRING DIAGRAM
(Spectra Rear Accessory Connector)

**WIRING DIAGRAM FOR HORN/LIGHTS AND EMERGENCY FEATURES
FOR SPECTRA DASH-MOUNT RADIOS**

**Spectra Mechanical Exploded View
Parts List**

MXW-6224-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	2680010M02	heatsink, mid-power
2	2680009M02	heatsink, low-power
3	2680105N01	shield, mid-power PA board
4	2680011M01	shield, low-power PA board
5	1580048N01	cover, mid-power PA
6	2680013M01	shield, power module
8	3280038N01	gasket, heatsink
10	1580264N01	cover, includes gasket
11	1580098L01	shield, receiver front-end
12	1580097L01	cover, VCO board
13	1580223N02	cover, VCO hybrid
14	3280247N01	gasket, VCO
15	1580099L01	shield, RF board
17	2880260M01	header, floating
18	4280007M01	clip, regulator
19	2780022N01	chassis, consolidated
22	3080239N02	cable, PA ribbon
23	HLN6285A	interconnect board
-	-----	control head hardware (includes following items through 36)
-	0180016R09	front housing assy (with keypad)
-	0180016R10	front housing assy (no keypad) (includes following items through 31)
25	1580020S01	housing, front cover (with keypad)
26	1580020S02	housing, front cover (no keypad)
27	3880009P01	pushbutton rocker, MODE
28	3880009P02	pushbutton rocker, VOLUME
29	3880092J05	pushbutton key, DIM
30	3880092J05	pushbutton key, HOME
31	6180017S01	lightpipe
32	4380019S01	spacer, internal frame
33	0310945A14	screw, tapping (6 used)
34	3280289L02	gasket, housing
35	3880227M04	cap, on/off switch
36	7580012S02	keypad
-		installation hardware (includes following items through 40)
-	3080091M01	speaker cable (not shown)
37	0384244C06	screw, wing 5 x 0.8 x 10 (4 used)
38	0780086N01	trunnion, mounting
39	0312002B14	screw, tapping, 10-16 x 5/8 (6 used)
40	0380114M02	screw, machine, 5 x 0.8 x 10 (8 used)
41	0310911A11	screw, machine, M3 x 0.5 x 8
42	0310943J15	screw, tapping, 3.5 x 0.6 x 8 (20 used)

43	0380102P01	screw, tapping, M3.5 x 0.60 x 10 (8 used)
44	0380043L01	screw, metric, M3.0 x 10 (4 used)
45	0380077M01	screw, front mount (2 used)
46	0380077M02	screw, hex socket (mid-power, 2 used)
47	0380077M03	screw, hex socket (low-power, 2 used)
49	0400131974	washer, flat (2 used)
51	7582200H01	pad
52	0480217E01	washer, compression
53	0484180C01	washer, shoulder
54	0780031P01	bracket, receiver front-end
55	0980272N02	connector, power
56	1480001M01	insulator, regulator
57	1480143M01	insulator, shield
58	1480179A01	insulator, alumina
59	2680118M02	shield, command board
60	2680186M01	shield, mid-power PA
61	3280015M01	gasket, power connector
62	3280088M01	gasket, accessory connector
63	3280089M02	gasket, antenna
64	2680119M03	shield, command board fence
65	4280016M03	clip, accessory connector
66	4280264M02	clip, coax, mid-power PA
67	4280265M02	clip, coax, low-power PA
68	4380104N01	spacer low-power PA shield
69	5584300B01	handle (2 used)
70	5584300B04	handle
71	4280274P01	clip, grounding
72	6480108R01	feedthru, mid-power PA
NONREFERENCED ITEMS		
	0310911A12	screw, machine, M3.5 x 0.6 x 10
	2680084N01	shield, harmonic filter
	2680090N01	shield, mid-power PA board fence
	2680286N01	shield, coax
	4380121M01	spacer, HearClear board
	6480262N01	feedthru, low-power PA
	7505295B01	pad, crystal, command board
	7580051P01	pad, crystal
	7580061P01	pad, foam
	7580094M05	pad, shock, VF display (3 used)

INSERT GXW-6225-B

BEPF-22525-O

**Exploded View (Rotary Dash Mount)
Control Head Parts List**

TPLF-3993-B

ITEM NO.	MOTOROLA PART NO.	DESCRIPTION
1	0380077M01	SCREW, Control Head Mounting (Qty 2)
2	3602113Z02	KNOB, Control Volume
3	3602113Z01	KNOB, Control Mode
4	0284218M01	NUT, Switch Volume
5	0284218M02	NUT, Switch Mode
6	0484219M01	LOCKWASHER, Switch Volume
7	0484219M02	LOCKWASHER, Switch Mode
8	1502117Z01	HOUSING, Front
9	6102110Z01	LIGHTPIPE
10	7502800V01	KEYPAD
11	AALN4009B	ASSEMBLY, Circuit Board
12	4302112Z01	SPACER, Internal
13	0310945A14	SCREW, Machine (Qty 4)
14	3280289L02	GASKET, Housing
15	HLN6285A	ASSEMBLY, Circuit Board
16	3202818V02	GASKET, Switch Mode
17	3202818V01	GASKET, Switch Volume
18	0102709J83	ASSEMBLY, Flex

INSERT CEPF-21434-A

**Exploded View (Rotary) Remote Mount
Control Head Parts List** TPLF-3998-B

ITEM NO.	MOTOROLA PART NO.	DESCRIPTION
1	0380077M01	SCREW, Control Head Mounting (Qty 2)
2	3602113Z02	KNOB, Control Volume
3	3602113Z01	KNOB, Control Mode
4	0284218M01	NUT, Switch Volume
5	0284218M02	NUT, Switch Mode
6	0484219M01	LOCKWASHER, Switch Volume
7	0484219M02	LOCKWASHER, Switch Mode
8	1502117Z01	HOUSING, Front
9	6102110Z01	LIGHTPIPE
10	7502800V01	KEYPAD
11	AALN4009B	ASSEMBLY, Board, Circuit
12	4302112Z01	SPACER, Internal
13	0310945A14	SCREW, Machine (Qty 4)
14	3280289L02	GASKET, Housing
15	AALN4007B	ASSEMBLY, Board Interface
16	1502116Z01	HOUSING, Back
17	3202818V02	GASKET, Switch Mode
18	3202818V01	GASKET, Switch Volume
19	0102709J83	ASSEMBLY, Flex
20	7502118Z01	COVER, Dust Rubber Microphone
21	7502118Z02	COVER, Dust Rubber VIP
22	4380128N01	SPACER, Trunnion (Qty 2)
23	0780127N01	TRUNNION, Mounting
24	0384244C06	SCREW, Machine Wing (Qty 2)
25	0300136756	SCREW, Tapping 10 -16 x 5/8 (Qty 4)
26	HKN4356B	CABLE, Radio
27	1580221J01	HOUSING, Connector VIP
28	3280275K01	GASKET, Connector VIP
29	0310945A11	SCREW, Tapping (2)

**Exploded View (Rotary)
Remote Mount Parts List** TPLF-3999-B

ITEM NO.	MOTOROLA PART NO.	DESCRIPTION
1	1580005G02	COVER, Dust
2	0380077M01	SCREW (Qty 2)
3	1580062P01	HOUSING, Remote Front CLEAR
	or 1580062P03	HOUSING, Remote Front SECURE
4	3280025R01	GASKET, Remote
5	HLN6161B	BOARD, Remote Interconnect
6	0400131974	WASHER, Flat (Qty 3)
7	0310945A11	SCREW, Tapping (Qty 3)
8	3280289L02	GASKET, Housing
9	1580005G01	COVER, Dust

INSERT DEPF-21435-A
100% BLK.
R.T.

**Exploded View Remote Mount
Control Head Parts List** TPLF-4000-B

ITEM NO.	MOTOROLA PART NO.	DESCRIPTION
1	AALN4007B	BOARD, Interconnect
2	1502116Z01 0180016R09	HOUSING, Back Remote ASSEMBLY, Front Housing, with Keypad (includes items through item 8)
	or 0180016R10	ASSEMBLY, Front Housing, without Keypad (includes items through item 8)
3	1580020S01	HOUSING, Front Cover with Keypad (A7 Models)
	or 1580020S02	HOUSING, Front Cover without Keypad (A5 Models)
4	3880009P01	PUSHBUTTON Rocker, Mode
5	3880009P02	PUSHBUTTON Rocker, Volume
6	3880092J05	PUSHBUTTON, Key DIM
7	3880092J05	PUSHBUTTON, Key HOME
8	6180017S01	LIGHTPIPE
9	4380019S01	SPACER, Internal Frame
10	0310945A14	SCREW, Tapping (Qty 6)
11	3280289L02	GASKET, Housing
12	3880227M04	CAP, Switch On/Off
13	7580012S02	KEYPAD
14	0384244C06	SCREW, Wing 5 x 0.8 x 10 (Qty 4)
15	0780127N01	TRUNNION, Remote Dash
16	0300136756	SCREW, Self-Drilling 10-16 x 1" (Qty 4)
17	7502118Z02	COVER, Dust Rubber (VIP)
18	7502118Z01	COVER, Dust Rubber (MIC)
19	1580221J01	HOUSING, Connector VIP (Optional)
20	3280275K01	GASKET, Connector VIP (Optional)
21	HKN4356B	CABLE, Radio
22	HLN6337A	BOARD, Control Head (A5 & A7)
23	0380077M01	SCREW (Qty 2)
24	0310945A11	SCREW, Tapping (2)

Exploded View Remote Mount Parts List TPLF-4001-B

ITEM NO.	MOTOROLA PART NO.	DESCRIPTION
1	1580005G02	COVER, Dust
2	0380077M01	SCREW (Qty 2)
3	1580062P01 or 1580062P03	HOUSING, Front Remote CLEAR HOUSING, Front Remote SECURE
4	3280025R01	GASKET, Remote
5	HLN6161B	BOARD, Remote Interconnect
6	0400131974	WASHER, Flat (Qty 3)
7	0310945A11	SCREW, Tapping (Qty 3)
8	3280289L02	GASKET, Housing
9	1580005G01	COVER, Dust

INSERT GXW-7032-B
100% BLK.
R.T. 95%

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	1380087J01	escutcheon
2	HLN5083A	button, EMER
2A	HLN5091A	button, DIR
2B	HLN5066A	button, SCAN
2C	HLN5256A	button, SRCH
2D	HLN5074A	button, CALL
2E	HLN5268A	button, PAGE
2F	HLN5259A	button, RPGM
2G	HLN5258A	button, SITE
2H	HLN5090A	button, PHON
2J	HLN5072A	button, H/L
2K	HLN5257A	button, LOCK
2L	HLN5076A	button, RCL
2M	HLN5085A	button, SQL
2N	HLN5078A	button, DEL
2P	HLN5087A	button, HOME
2Q	HLN5079A	button, SEL
2R	HLN5095A	button, blank
3	HLN5096A	plug
4	6180095J01	lens, VF display
5	3280057K02	gasket, lens
6	1580088J01	housing, front
8	3880195P03	pushbutton rocker, MODE
8A	3880195P02	pushbutton rocker, VOL
9	3880092J01	key, DIM
10	3280180J02	gasket, housing
11	6180185J02	lightpipe, keypad
12	7580098J01	keypad
13	(U102)	VF display (see electrical)
14	7580094M05	shock pad (3 used)
15	1480269K01	insulator
16	2680190P01	solder side shield
17	6180026R01	light guide, 8-position
18	6180026R02	light guide, 2-position
19	-----	display board (see model chart)
20	-----	command board (see model chart)
21	0310945A14	screw, tapping, P3.12 x 1.27 x 8 (2 used)
22	3080034K01	flex cable
23	0310945A11	screw, tapping, P3.12 x 1.27 x 16 (5 used)
25	3280178J01	gasket, ON/OFF switch
29	3280179J01	gasket, D-connector
30	3880128J01	key, ON/OFF
31	(J1)	connector, mini-D, 50 contact
32	1580089J01	housing, back
33	3280181J01	gasket, face connector
34	0310908A33	screw, machine, M3.5 x 0.6 x 30 (2 used)
35	0784323C01	bracket, strain relief
36	3380178M01	nameplate
37	0310908A18	screw, machine, M3 x 0.5 x 6
38	HKN4356B	radio cable
39	-----	microphone cable
40	1580221J01	housing, VIP connector
42	4380127J01	spacer, trunnion (4 used)
43	0780263L01	bracket, trunnion
44	0384244C06	wing screw, M5 x 8 x 10 (2 used)
45	0300138D21	screw, tapping 10-16 x 3/4 (4 used)
47	-----	siren cable (optional)
48	0380077M01	screw, front mount (2 used)
50	1580062P03	housing, remote front
51	3280025R01	gasket, remote
52	-----	interconnect board (see model chart)
53	0400131974	washer, flat (3 used)
54	0310945A11	screw, tapping P3.12 x 1.27 x 8 (3 used)
55	3280289L01	gasket, housing
56	1580005G01	cover, dust
57	3984257L02	contact, plug
58	1580005G02	cover, dust

MODEL CHART FOR SPECTRA 900 MHz CONVENTIONAL AND PRIVACY PLUS RADIOS “AK” SUFFIXED MODELS

MODEL						DESCRIPTION
					D27KGA5JBAK	12-Watt Standard, Privacy Plus
					D37KGA5JB5AK	30-Watt Standard, Privacy Plus
					D37KGA5JB7AK	30-Watt Expanded, Privacy Plus
					D37KGA5JB9AK	30-Watt Dual, Privacy Plus
					D37KMA7JA5AK	30-Watt Standard, Conventional
					D37KMA7JA7AK	30-Watt Expanded, Conventional
ITEM						DESCRIPTION
•	•	•	•	•	HBN6000A	Packing
•	•	•	•	•	HKN4121B	Ignition Switch Power Cable (See Note)
•	•	•	•	•	HKN4191A	Mobile Power Cable
•	•	•	•	•	HLF6002A	Board Carrier VCO/Doubler
•	•	•	•	•	HLF6022A	Harmonic Filter Board
•					HLF6052A	12-Watt PA Board
	•	•	•	•	HLF6062A	30-Watt PA Board
•	•	•	•	•	HLF6072A	VCO Hybrid Board 896/941 MHz
		•	•	•	HLN6001A	Control Head Hardware w/Keypad
•	•	•	•	•	HLN6004A	Internal Casting Hardware
	•	•	•	•	HLN6006A	30-Watt PA Hardware
•					HLN6007A	12-Watt PA Hardware
•					HLN6010B	12-Watt Transceiver Hardware
	•	•	•	•	HLN6011B	30-Watt Transceiver Hardware
•	•	•	•	•	HLN6015A	Installation Hardware
•	•	•	•	•	HLN6019A	HearClear Board
•	•	•	•	•	HLN6020A	Control Head Board
•	•	•	•	•	HLN6024A	Command Board
•	•		•		HLN6026A	Control Head Hardware w/o Keypad
			•		HLN6031A	Button Kit, Standard Conventional
			•		HLN6032A	Button Kit, Expanded Conventional
•	•				HLN6034A	Button Kit, Standard, Privacy Plus
		•			HLN6035A	Button Kit, Expanded, Privacy Plus
		•			HLN6036A	Button Kit, Dual, Privacy Plus
•	•	•	•		HLN6040A	Button Kit, Phone
•	•	•	•	•	HLN6058A	Control Head Interconnect Board
•	•	•	•	•	HMN1052A	Microphone
•	•	•	•	•	HRF6002A	Receiver Front End Hybrid Board
•	•	•	•	•	HRN6000A	RF Board
•	•	•	•	•	HSN4018A	Speaker
			•		HVN6002A	Software, Standard, Conventional
			•		HVN6003A	Software, Expanded, Conventional
•	•				HVN6005A	Software, Standard, Privacy Plus
		•			HVN6006A	Software, Expanded, Privacy Plus
		•			HVN6007A	Software, Dual, Privacy Plus
•	•	•	•	•	HXN6000A	Oscillator 16.8 MHz
•	•	•	•	•	RRA4935A	Roof Mount Antenna

CODE: • = ONE ITEM SUPPLIED

MAEPF-22093-O

NOTE: Part of 30-80091M01 Accessory Cable Assembly

MODEL CHART FOR SPECTRA 900 MHz CONVENTIONAL AND PRIVACY PLUS RADIOS “BK” SUFFIXED MODELS

MODEL						DESCRIPTION	
						D27KGA5JB5BK	12-Watt Standard Privacy Plus
						D37KGA5JB5BK	30-Watt Standard Privacy Plus
						D37KGA5JB7BK	30-Watt Expanded Privacy Plus
						D37KGA5JB9BK	30-Watt Dual Privacy Plus
						D37KMA7JA5BK	30-Watt Standard Conventional
						D37KMA7JA7BK	30-Watt Expanded Conventional
						ITEM	DESCRIPTION
•	•	•	•	•	•	HBN6000A	Packing
•	•	•	•	•	•	HKN4121B	Ignition Switch Power Cable (See Note)
•	•	•	•	•	•	HKN4191A	Mobile Power Cable
•	•	•	•	•	•	HLF6022A	Harmonic Filter Board
•						HLF6052A	12-Watt PA Board
	•	•	•	•	•	HLF6062A	30-Watt PA Board
•	•	•	•	•	•	HLF6072A	VCO Hybrid Board 896/941 MHz
•	•	•	•	•	•	HLF6073A	Board Carrier VCO/Doubler
		•	•	•	•	HLN6001A	Control Head Hardware w/Keypad
•	•	•	•	•	•	HLN6004A	Internal Casting Hardware
	•	•	•	•	•	HLN6006A	30-Watt PA Hardware
•						HLN6007A	12-Watt PA Hardware
•						HLN6010B	12-Watt Transceiver Hardware
	•	•	•	•	•	HLN6011B	30-Watt Transceiver Hardware
•	•	•	•	•	•	HLN6015A	Installation Hardware
•	•	•	•	•	•	HLN6019A	HearClear Board
•	•	•	•	•	•	HLN6020A/B	Control Head Board
•	•			•		HLN6026A	Control Head Hardware w/o Keypad
				•		HLN6031A	Button Kit, Standard, Conventional
				•		HLN6032A	Button Kit, Expanded, Conventional
•	•					HLN6034A	Button Kit, Standard, Privacy Plus
		•				HLN6035A	Button Kit, Expanded, Privacy Plus
		•				HLN6036A	Button Kit, Dual, Privacy Plus
•	•	•	•			HLN6040A	Button Kit, Phone
•	•	•	•	•	•	HLN6058A	Control Head Interconnect Board
•	•	•	•	•	•	HLN6062A *	Command Board
•	•	•	•	•	•	HLN6065A	Service Manual and Spare Fuse
•	•	•	•	•	•	HMN1067A	Microphone
•	•	•	•	•	•	HRF6002A	Receiver Front End Hybrid Board
•	•	•	•	•	•	HRN6002A	RF Board
•	•	•	•	•	•	HSN4018A	Speaker
				•		HVN6002A	Software, Standard, Conventional
				•		HVN6003A	Software, Expanded, Conventional
•	•					HVN6005A	Software, Standard, Privacy Plus
		•				HVN6006A	Software, Expanded, Privacy Plus
		•				HVN6007A	Software, Dual, Privacy Plus
•	•	•	•	•	•	HXN6000A	Oscillator 16.8 MHz
•	•	•	•	•	•	RRA4935A	Roof Mount Antenna

MAEPF-22094-O

CODE: • = ONE ITEM SUPPLIED * SOME UNITS WILL CONTAIN AN HLN6064A COMMAND BOARD

NOTE: Part of 30-80091M01 Accessory Cable Assembly

MODEL CHART FOR SPECTRA 900 MHz PRIVACY PLUS RADIOS “CK” SUFFIXED MODELS

MODEL				DESCRIPTION	
			D27KGA5JB5CK	12-Watt Standard Privacy Plus	
			D37KGA5JB5CK	30-Watt Standard Privacy Plus	
			D37KGA5JB7CK	30-Watt Expanded Privacy Plus	
			D37KGA5JB9CK	30-Watt Dual Privacy Plus	
ITEM				DESCRIPTION	
•	•	•	•	HBN6000A	Packing
•	•	•	•	HKN4121B	Ignition Switch Power Cable (See Note)
•	•	•	•	HKN4191A	Mobile Power Cable
•	•	•	•	HLF6022A	Harmonic Filter Board
•				HLF6052A	12-Watt PA Board (early version)
•				HLF6052B	12-Watt PA Board (later version)
	•	•	•	HLF6062A	30-Watt PA Board
•	•	•	•	HLF6072A	VCO Hybrid Board 896/941 MHz
•	•	•	•	HLF6073A	Board Carrier VCO/Doubler
		•	•	HLN6001B	Control Head Hardware, w/Keypad
•	•	•	•	HLN6004A	Internal Casting Hardware
	•	•	•	HLN6006A	30-Watt PA Hardware
•				HLN6007A	12-Watt PA Hardware
•				HLN6010B	12-Watt Transceiver Hardware
	•	•	•	HLN6011B	30-Watt Transceiver Hardware
•	•	•	•	HLN6015B	Installation Hardware
•	•	•	•	HLN6019A	HearClear Board
•	•	•	•	HLN6020B	Control Head Board
•	•			HLN6026B	Control Head Hardware, w/o Keypad
•	•			HLN6034B	Button Kit, Standard, Privacy Plus
•	•	•	•	HLN6036A	Button Kit, Dual, Privacy Plus
•	•	•	•	HLN6040A	Button Kit, Phone
•	•	•	•	HLN6058A	Control Head Interconnect Board
•	•	•	•	HLN6064B	Command Board
•	•	•	•	HLN6065A	Service Manual
•	•	•	•	HMN1052A	Microphone
•	•	•	•	HRF6002B	Receiver Front End Hybrid Board
•	•	•	•	HRN6002A	RF Board
•	•	•	•	HSN4018A	Speaker
•	•			HVN6005B	Software, Standard, Privacy Plus
		•		HVN6006B	Software, Expanded, Privacy Plus
		•		HVN6007B	Software, Dual, Privacy Plus
•	•	•	•	HXN6000A	Oscillator 16.8 MHz
•	•	•	•	RRA4935A	Roof Mount Antenna

CODE: • = ONE ITEM SUPPLIED

MAEPF-22095-O

NOTE: Part of 30-80091M01 Accessory Cable Assembly

MODEL CHART FOR SPECTRA 900 MHz CONVENTIONAL AND PRIVACY PLUS RADIOS “CK” AND “DK” SUFFIXED MODELS

MODEL	DESCRIPTION
D27KGA5JB2AK	12-Watt Limited Privacy Plus
D27KGA5JB5DK	12-Watt Standard Privacy Plus
D37KGA5JB5DK	30-Watt Standard Privacy Plus
D37KGA5JB7DK	30-Watt Expanded Privacy Plus
D37KGA5JB9DK	30-Watt Dual Privacy Plus
D37KMA7A7CK	30-Watt Expanded Conventional
D37KMA7JA5CK	30-Watt Standard Conventional
ITEM	DESCRIPTION
● ● ● ● ● ● ● HBN6000A	Packing
● ● ● ● ● ● ● HKN4121B	Ignition Switch Power Cable (See Note)
● ● ● ● ● ● ● HKN4191A	Mobile Power Cable
● ● ● ● ● ● ● HLF6022A	Harmonic Filter Board
● ● ● ● ● ● ● HLF6072A	VCO Hybrid Board 896/941 MHz
● ● ● ● ● ● ● HLF6073A	Board Carrier VCO/Doubler
● ● ● ● ● ● ● HLF6074A	12-Watt PA Board
● ● ● ● ● ● ● HLF6075A	30-Watt PA Board
● ● ● ● ● ● ● HLF6082A	30-Watt PA Board
● ● ● ● ● ● ● HLN6001B	Control Head Hardware w/Keypad
● ● ● ● ● ● ● HLN6015A	Installation Hardware
● ● ● ● ● ● ● HLN6026B	Control Head Hardware w/o Keypad
● ● ● ● ● ● ● HLN6031A	Button Kit, Standard Conventional
● ● ● ● ● ● ● HLN6032A	Button Kit, Expanded Conventional
● ● ● ● ● ● ● HLN6033A	Button Kit, Limited Privacy Plus
● ● ● ● ● ● ● HLN6034B	Button Kit, Standard Privacy Plus
● ● ● ● ● ● ● HLN6036A	Button Kit, Dual Privacy Plus
● ● ● ● ● ● ● HLN6040A	Button Kit, Phone
● ● ● ● ● ● ● HLN6063A	HearClear Board
● ● ● ● ● ● ● HLN6064B	Command Board (earlier models)
● ● ● ● ● ● ● HLN6065A	Service Manual
● ● ● ● ● ● ● HLN6066A	Control Head Interconnect Board
● ● ● ● ● ● ● HLN6068A	30-Watt PA Hardware
● ● ● ● ● ● ● HLN6069A	12-Watt PA Hardware
● ● ● ● ● ● ● HLN6070A	Internal Casting Hardware
● ● ● ● ● ● ● HLN6071A	30-Watt Transceiver Hardware
● ● ● ● ● ● ● HLN6072A	12-Watt Transceiver Hardware
● ● ● ● ● ● ● HLN6074A	Command Board (later models)
● ● ● ● ● ● ● HLN6078A	Control Head Board
● ● ● ● ● ● ● HMN1052A	Microphone
● ● ● ● ● ● ● HRF6002B	Receiver Front End Hybrid Board
● ● ● ● ● ● ● HRN6005A	RF Board
● ● ● ● ● ● ● HSN4018A	Speaker
● ● ● ● ● ● ● HVN6002A	Software, Standard Conventional
● ● ● ● ● ● ● HVN6003A	Software, Expanded Conventional
● ● ● ● ● ● ● HVN6004A	Software, Limited Privacy Plus
● ● ● ● ● ● ● HVN6005B	Software, Standard Privacy Plus
● ● ● ● ● ● ● HVN6006B	Software, Expanded Privacy Plus
● ● ● ● ● ● ● HVN6007B	Software, Dual Privacy Plus
● ● ● ● ● ● ● RRA4935A	Roof Mount Antenna

CODE: ● = ONE ITEM SUPPLIED

MAEPF-22096-O

**MODEL CHART FOR SPECTRA 900 MHz
PRIVACY PLUS RADIOS
“AK” SUFFIXED 4-WATT MODELS
“EK” SUFFIXED 12 & 30-WATTS MODELS**

MODEL		DESCRIPTION
D17KGA5JB7AK		4-Watt Expanded Privacy Plus
D27KGA5JB2BK		12-Watt Standard Privacy Plus
D27KGA5JB5EK		12-Watt Standard Privacy Plus
D27KGA5JB7AK		12-Watt Expanded Privacy Plus
D37KGA5JB5EK		30-Watt Standard Privacy Plus
D37KGA5JB7EK		30-Watt Expanded Privacy Plus
D37KGA5JB9EK		30-Watt Dual Privacy Plus
ITEM		DESCRIPTION
● ● ● ● ● ● ● ●	HBN6000A	Packing
● ● ● ● ● ● ● ●	HKN4121B	Ignition Switch Power Cable (See Note)
● ● ● ● ● ● ● ●	HKN4191A	Mobile Power Cable
● ● ● ● ● ● ● ●	HLF6022A	Harmonic Filter Board
	HLF6075A	30-Watt PA Board
	HLF6082A	30-Watt PA Board
● ● ● ●	HLN6074B	12-Watt PA Board
● ● ● ●	HLF6083A	4-Watt PA Board
● ● ● ● ● ● ● ●	HLF6072B	VCO Hybrid Board 896/941 MHz
● ● ● ● ● ● ● ●	HLN6111A	Internal Casting Hardware
	HLN6068A	30-Watt PA Hardware
● ● ● ●	HLN6069A	12-Watt PA Hardware
● ● ● ●	HLN6146B	4-Watt PA Hardware
● ● ● ● ● ● ● ●	HLN6071A	4-Watt and 30-Watt Transceiver Hardware
● ● ● ●	HLN6072A	12-Watt Transceiver Hardware
● ● ● ● ● ● ● ●	HLN6015A	Installation Hardware
● ● ● ● ● ● ● ●	HLN6100A	HearClear Board
● ● ● ● ● ● ● ●	HLN6075A/B	Control Head Board
● ● ● ● ● ● ● ●	HLN6094A/B	Command Board
● ● ● ● ●	HLN6101A	Control Head Hardware - No Keypad
● ● ● ● ● ● ● ●	HLN6102A	Control Head Hardware with Keypad
	HLN6081B	Button Kit, Std Conventional
	HLN6082A	Button Kit, Exp Conventional
● ● ● ●	HLN6033A	Button Kit, Ltd Privacy Plus
● ● ● ● ● ● ● ●	HLN6034B	Button Kit, Std Privacy Plus
● ● ● ● ● ● ● ●	HLN6036A	Button Kit, Dual, Privacy Plus
● ● ● ● ● ● ● ●	HLN6040B	Button Kit, Phone, Page, Emer (Field Option)
	HLN6105B	Button Kit (Field Option)
	HLN6061C	Button Kit, Emergency (Field Option)
● ● ● ● ● ● ● ●	HMN1067A	Microphone
● ● ● ● ● ● ● ●	HRF6003A	Receiver Front End Hybrid Board
● ● ● ● ● ● ● ●	HSN4018A	Speaker
● ● ● ● ● ● ● ●	HVN6013A	Spectra Software
● ● ● ● ● ● ● ●	RRA4935A	Roof Mount Antenna
● ● ● ● ● ● ● ●	HLN6066A/B	Control Head Interconnect Board
● ● ● ● ● ● ● ●	HLF6083A/B	Board Carrier VCO/Doubler
● ● ● ● ● ● ● ●	HRN6007A/B	RF Board

CODE: ● = ONE ITEM SUPPLIED

MAEPF-22097-0

Note: Part of 30-80091M01 Accessory Cable Assembly.

**MODEL CHART FOR SPECTRA 900 MHz
SMARTNET RADIOS
“AK” SUFFIXED 4-WATT MODELS
“CK” SUFFIXED 12 & 30-WATTS MODELS**

MODEL					DESCRIPTION	
				D17KGA5JC7AK	4-Watt Dual SMARTNET Expanded	
				D27KGA5JC2CK	12-Watt Dual SMARTNET Limited	
				D37KGA5JC5CK	30-Watt Dual SMARTNET Standard	
				D27KGA5JC5CK	12-Watt Dual SMARTNET Standard	
				D37KGA5JC7CK	30-Watt Dual SMARTNET Expanded	
ITEM					DESCRIPTION	
●	●	●	●	●	HBN6000A	Packing
●	●	●	●	●	HKN4121B	Ignition Switch Power Cable (See Note)
●	●	●	●	●	HKN4191A	Mobile Power Cable
●	●	●	●	●	HLF6022A	Harmonic Filter Board
		●		●	HLF6075A	30-Watt PA Board
	●		●		HLF6074B	12-Watt PA Board
●	●	●	●	●	HLF6072B	VCO Hybrid Board 896/941 MHz
●	●	●	●	●	HLN6111A	Internal Casting Hardware
		●		●	HLN6068A	30-Watt PA Hardware
	●		●		HLN6069A	12-Watt PA Hardware
●		●		●	HLN6071A	4-Watt and 30-Watt Transceiver Hardware
	●		●		HLN6072A	12-Watt Transceiver Hardware
●	●	●	●	●	HLN6015A	Installation Hardware
●	●	●	●	●	HLN6100A	HearClear Board
●	●	●	●	●	HLN6075A/B	Control Head Board
●	●	●	●	●	HLN6094A/B	Command Board
	●	●	●		HLN6101A	Control Head Hardware - No Keypad
●				●	HLN6102A	Control Head Hardware with Keypad
	●				HLN6037A	Button Kit, SMARTNET Limited
		●	●		HLN6038A	Button Kit, SMARTNET Standard
●				●	HLN6039A	Button Kit, SMARTNET Expanded
●	●	●	●	●	HLN6061C	Button Kit, Emergency (Field Option)
●	●	●	●	●	HMN1067A	Microphone
●	●	●	●	●	HRF6003A	Receiver Front End Hybrid Board
●	●	●	●	●	HSN4018A	Speaker
●	●	●	●	●	HVN6010A	Software, SMARTNET
●	●	●	●	●	RRA4935A	Roof Mount Antenna
●	●	●	●	●	HLN6066A/B	Control Head Interconnect Board
●	●	●	●	●	HLF6084A	Board Carrier VCO/Doubler
●	●	●	●	●	HRN6007A	RF Board
		●	●		HLN6040B	Button Kit, Phone, Page, Emer (Field Option)
●				●	HLN6137B	Button Kit, Keypad (Field Option)
●					HLN6146A	4-Watt PA Hardware
●					HLF6083A	4-Watt PA Board

CODE: ● = ONE ITEM SUPPLIED

MAEPF-22667-O

NOTE: Part of 30-80091M01 Accessory Cable Assembly

**MODEL CHART FOR SPECTRA 900 MHz
SMARTNET RADIOS
12 & 30-WATTS RF POWER
“BK” SUFFIXED MODELS**

MODEL				DESCRIPTION
			D27KGA5JC2BK	12-Watt Dual SMARTNET Limited
			D27KGA5JC5BK	12-Watt Dual SMARTNET Standard
			D27KGA5JC7BK	30-Watt Dual SMARTNET Expanded
			D37KGA5JC5BK	30-Watt Dual SMARTNET Limited
ITEM				DESCRIPTION
•	•	•	•	HBN6000A Packing
•	•	•	•	HKN4121B Ignition Switch Power Cable (See Note)
•	•	•	•	HKN4191A Mobile Power Cable
•	•	•	•	HLF6022A Harmonic Filter Board
•	•	•	•	HLF6072A VCO Hybrid Board 896/941 MHz
•	•	•	•	HLF6073A Board Carrier VCO/Doubler
•	•			HLF6074A 12-Watt PA Board
		•	•	HLF6075A 30-Watt PA Board
		•		HLN6001B Control Head Hardware, w/Keypad
•	•	•	•	HLN6015B Installation Hardware
•	•		•	HLN6026B Control Head Hardware, w/o Keypad
•				HLN6037A Button Kit, SMARTNET Limited
	•		•	HLN6038A Button Kit, SMARTNET Standard
		•		HLN6039A Button Kit, SMARTNET Expanded
•	•	•	•	HLN6061A Button Kit, EMER
•	•	•	•	HLN6063A HearClear Board
		•		HLN6064B Command Board
•	•	•	•	HLN6065A Service Manual and Spare Fuse
•	•	•	•	HLN6066A Control Head Interconnect Board
		•	•	HLN6068A 30-Watt PA Hardware
•	•			HLN6069A 12-Watt PA Hardware
•	•	•	•	HLN6070A Internal Casting Hardware
		•	•	HLN6071A 30-Watt Transceiver Hardware
•	•			HLN6072A 12-Watt Transceiver Hardware
•	•		•	HLN6074A Command Board
•	•	•	•	HLN6078A Control Head Board
•	•	•	•	HMN1052A Microphone
•	•	•	•	HRF6002B Receiver Front End Hybrid Board
•	•	•	•	HRN6005A RF Board
•	•	•	•	HSN4018A Speaker
•				HVN6008A Software, SMARTNET Limited
	•		•	HVN6009A Software, SMARTNET Standard
		•		HVN6010A Software, SMARTNET Expanded
•	•	•	•	RRA4935A Roof Mount Antenna

CODE: • = ONE ITEM SUPPLIED

MAEPF-22099-O

NOTE: Part of 30-80091M01 Accessory Cable Assembly

FEATURE MATRIX FOR SPECTRA 900 MHz CONVENTIONAL RADIOS “AK” , “BK” , “CK” SUFFIXED MODELS

MODEL	
A5 Package	
A7 Package	
STANDARD FEATURES: (●) OPTION: (○)	
● ●	8-Character Alphanumeric Display
● ●	Power-Up Self-Check
● ●	Full Mil 810D Specifications
● ●	60 Second Time-Out Timer
● ●	3dB Gain Antenna
● ●	External Speaker
● ●	Fast Lock Synthesizer
● ●	Volume Set Tone
● ●	Dimmer Control
● ●	HearClear Audio Enhancement
● ●	Ignition Sense
● ●	Monitor Button
●	Numeric DTMF Keypad
●	MDC PTT ID/Emergency
●	32 Conventional Channels
●	64 Conventional Channels
● ●	Talkaround
● ●	30-Watts Power
●	DTMF Encode List
●	Unlimited DTMF Encode
● ●	Mode-Slaved Channel Scan
●	Operator-Selectable Channel Scan
○ ○	Control Station Operation
○ ○	Remote Mount Capability
○ ○	DTMF Microphone
○ ○	Handset with Hangup
○ ○	Key-Lock Mount
○	External Footswitch
○	External Emergency Pushbutton
○ ○	10-Watt Audio
○ ○	Noise Cancelling Microphone

MAEPF-22668-O

FEATURE MATRIX FOR SPECTRA 900 MHz PRIVACY PLUS RADIOS “AK” AND “CK” SUFFIXED MODELS

MODEL				
B2 Package (“AK” Suffix Model Only)				
B5 Package				
B7 Package				
B9 Package				
STANDARD FEATURES: (●) OPTION: (○)				
●	●	●	●	8-Character Alphanumeric Display
●	●	●	●	Power-Up Self-Check
●	●	●	●	Full Mil 810D Specifications
●	●	●	●	60 Second Time-Out Timer
●	●	●	●	3dB Gain Antenna
●	●	●	●	External Speaker
●	●	●	●	Fast Lock Synthesizer
●	●	●	●	Volume Set Tone
●	●	●	●	Dimmer Control
●	●	●	●	HearClear Audio Enhancement
●	●	●	●	Ignition Sense
		●		Monitor Button
		●	●	Numeric DTMF Keypad
		●		MDC PTT ID/Emergency
		●		10 Conventional Channels
●				2 Systems/2 Subfleets
	●			3 Systems/8 Subfleets
		●	●	8 Systems/8 Subfleets
			●	Talkaround
●	●			12-Watts Power
	●	●	●	30-Watts Power
	●			Telephone Interconnect List
		●	●	Unlimited Telephone Interconnect
			●	Operator-Selectable Channel Scan
		●	●	Operator-Selectable System Scan
●	●	●		Fixed-List System Scan
			●	Dual Mode Operation
		●	●	Unlimited Private Conversation (PC) - with Call Alert (CA)
●				PC Response with CA Decode
	●	●	●	External Alarm Capability
○	○	○	○	Control Station Operation
○	○	○	○	Remote Mount Capability
		○	○	DTMF Microphone
○	○	○	○	Handset with Hangup
○	○	○	○	Key-Lock Mount
		○	○	External Alarm Relays
			○	External Footswitch
			○	External Emergency Pushbutton
○	○	○	○	10-Watt Audio
○	○	○	○	Noise Cancelling Microphone

MAEPF-22669-O

FEATURE MATRIX FOR SPECTRA 900 MHz PRIVACY PLUS RADIOS “CK” AND “DK” SUFFIXED MODELS

MODEL			
B5 Package			
B7 Package			
B9 Package			
STANDARD FEATURES: (●) OPTION: (○)			
●	●	●	8-Character Alphanumeric Display
●	●	●	Power-Up Self-Check
●	●	●	Full Mil810D Specifications
●	●	●	60 Second Time-Out Timer
●	●	●	3dB Gain Antenna
●	●	●	External Speaker
●	●	●	Fast Lock Synthesizer
●	●	●	Volume Set Tone
●	●	●	Dimmer Control
●	●	●	HearClear Audio Enhancement
●	●	●	Ignition Sense
●	●	●	Monitor Button
	●	●	Numeric DTMF Keypad
		●	MDC PTT ID/Emergency
●			1 Conventional Channel
	●	●	10 Conventional Channels
●			6 Systems/8 Subfleets
	●	●	8 Systems/8 Subfleets
●	●	●	Talkaround
●			12-Watts Power
●	●	●	30-Watts Power
●			Telephone Interconnect List
	●	●	Unlimited Telephone Interconnect
		●	Operator-Selectable Channel Scan
	●	●	Operator-Selectable System Scan
●	●	●	Fixed-List System Scan
●	●	●	Dual Mode Operation
	●	●	Unlimited Private Conversation (PC) - with Call Alert (CA)
●	●	●	PC Response with CA Decode
●	●	●	External Alarm Capability
○	○	○	Control Station Operation
○	○	○	Remote Mount Capability
○	○	○	DTMF Microphone
○	○	○	Handset with Hangup
○	○	○	Key-Lock Mount
○	○	○	External Alarm Relays
	○	○	External Footswitch
	○	○	External Emergency Pushbutton
○	○	○	Noise Cancelling Microphone

MAEPF-22670-O

FEATURE MATRIX FOR SPECTRA 900 MHz SMARTNET RADIOS “AK”, “BK”, “CK” SUFFIXED MODELS

MODEL			
C2 Package			
C5 Package			
C7 Package			
STANDARD FEATURES: (●) OPTION: (○)			
●	●	●	8-Character Alphanumeric Display
●	●	●	Power-Up Self-Check
●	●	●	Full Mii810D Specifications
●	●	●	60 Second Time-Out Timer
●	●	●	3dB Gain Antenna
●	●	●	External Speaker
●	●	●	Fast Lock Synthesizer
●	●	●	Volume Set Tone
●	●	●	Dimmer Control
●	●	●	HearClear Audio Enhancement
●	●	●	Ignition Sense
●	●	●	Monitor Button
		●	Numeric DTMF Keypad
●	●	●	MDC PTT ID/Emergency
●	●	●	10 Conventional Channels
●	●		8 Systems/8 Subfleets
		●	15 Systems/16 Subfleets
●	●	●	Talkaround
●	●		12-Watts Power
		●	30-Watts Power
		●	Telephone Interconnect List
		●	Unlimited Telephone Interconnect
●	●		Mode-Slaved Channel Scan
		●	Operator-Selectable Channel Scan
		●	Operator-Selectable System Scan
●			Fixed-List System Scan
●			Fixed-List Priority Monitor
		●	Operator-Selectable Priority Monitor
●	●	●	Dual Mode Operation
		●	Unlimited Private Conversation (PC) - with Call Alert (CA)
		●	Private Conversation List and Call Alert Decode
●			PC Response with 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
○	○	○	Control Station Operation
○	○	○	Remote Mount Capability
○	○	○	DTMF Microphone
○	○	○	Handset with Hangup
○	○	○	Key-Lock Mount
○	○	○	External Alarm Relays
○	○	○	External Emergency Pushbutton
○	○	○	Emergency Footswitch
○	○	○	10-Watt Audio
○	○	○	Noise Cancelling Microphone

MAEPF-22671-O

FEATURE MATRIX FOR SPECTRA 900 MHz PRIVACY PLUS RADIOS “EK” SUFFIXED MODELS

MODEL				
B2 Package (“BK” Suffix Model Only)				
B5 Package				
B7 Package				
B9 Package				
STANDARD FEATURES: (●) OPTION: (○)				
●	●	●	●	8-Character Alphanumeric Display
●	●	●	●	Power-Up Self-Check
●	●	●	●	Full Mil 810D Specifications
●	●	●	●	60 Second Time-Out Timer
●	●	●	●	3dB Gain Antenna
●	●	●	●	External Speaker
●	●	●	●	Fast Lock Synthesizer
●	●	●	●	Volume Set Tone
●	●	●	●	Dimmer Control
●	●	●	●	HearClear Audio Enhancement
●	●	●	●	Ignition Sense
	●	●	●	Monitor Button
	●	●		Numeric DTMF Keypad
	●	●	●	MDC PTT ID/Emergency
	●	●	●	10 Conventional Channels
	●			10 Systems/10 Subfleets
●				2 Systems/2 Subfleets
	●	●		15 Systems/10 Subfleets
	●	●	●	Talkaround
●	●			12-Watts Power
	●	●	●	30-Watts Power
	●	●	●	Telephone Interconnect List
	●	●		Unlimited Telephone Interconnect
	●	●		Operator-Selectable Channel Scan
	●	●		Operator-Selectable System Scan
●	●	●		Fixed-List System Scan
●	●	●		Dual Mode Operation
	●	●		Unlimited Private Conversation (PC) - with Call Alert (CA)
●	●	●		PC Response with CA Decode
●	●	●		External Alarm Capability
	●	●		MDC Auto Sel Call Decode
	●	●		MDC Call Alert Decode
○	○	○	○	Control Station Operation
○	○	○	○	Remote Mount Capability
	○	○	○	DTMF Microphone
○	○	○	○	Handset with Hangup
○	○	○	○	Key-Lock Mount
	○	○	○	External Alarm Relays
	○	○		External Footswitch
	○	○		External Emergency Pushbutton
○	○	○	○	10-Watt Audio
○	○	○	○	Noise Cancelling Microphone

MAEPF-22672-0

