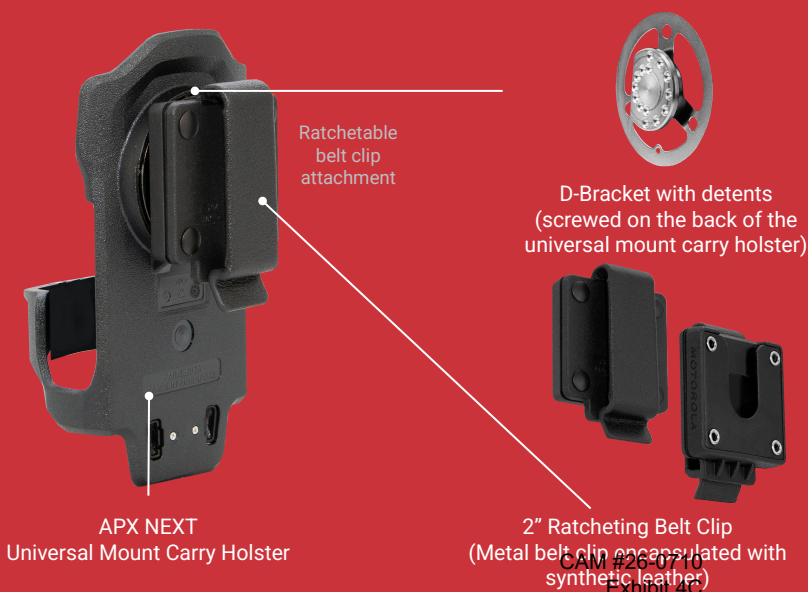


APX N portable radio accessories

COMPATIBILITY		CARRY SOLUTION		FEATURES				
CARRY SOLUTIONS Carry cases and holders are available in sizes designed to fit your radio and battery and permit audio to be heard clearly. Our carry accessories keep your hands-free, so you can concentrate on the task at hand.								
PORTABLE RADIOS	DESCRIPTION		PART NUMBER	MATERIAL	D-RINGS	ATTACHMENTS/REPLACEMENT KIT (SOLD SEPERATELY)	USE WITH BATTERIES	
APX NEXT XN		APX NEXT XN Boston Leather Carry Case	PMLN8328	Leather	●	AY000223A01 AY000229A01	RLN6487A RLN6488A RLN6486A	PMNN4812
		APX NEXT XN Classic Holster (Belt clip sold separately)	PMLN8601	Thermoplastic	●	2.5" - PMLN8602 3" - PMLN8603 AY000223A01 AY000229A01	RLN6487A RLN6488A RLN6486A	PMNN4812
APX NEXT XE		APX NEXT XE Classic Holster (Belt clip sold separately)	PMLN8208	Plastic	●	2.5" - NTN8266 3" - PMLN7965 AY000223A01 AY000229A01	RLN6487A RLN6488A RLN6486A	NNTN9217
		APX NEXT XE Boston Leather Carry Case	PMLN8209	Leather	●	AY000223A01 AY000229A01	RLN6487A RLN6488A RLN6486A	NNTN9217
APX NEXT		APX NEXT Classic Holster (Belt clip sold separately)	PMLN7947	Plastic		2.5" NTN8266 3" PMLN7965		NNTN9216 NNTN9217
		APX NEXT Hybrid Leather Carry Case with Standard Battery	PMLN7948	Plastic/Leather		2.5" NTN8266 3" PMLN7965 2.5" PMLN5407	2.75" PMLN5408 3" PMLN5409	NNTN9216 NNTN9217
		APX NEXT Universal Mount Carry Holster with 2" Ratcheting Belt Clip	PMLN8557	Plastic				NNTN9216 NNTN9217
		APX NEXT Universal Mount Carry Holster (Carry attachment sold separately)	PMLN8606	Plastic		PMLN8607 PMLN8608		NNTN9216 NNTN9217
		D-Bracket with Detents	PMLN8607	Metal				
		2" Ratcheting Belt Clip	PMLN8608	Metal Encapsulated with Synthetic Leather				

Details

- APX NEXT Universal Mount Holster with 2" Ratcheting Belt Clip is a plastic holster carry case which enables users to easy to insert and remove the radio from the holster.
- The Ratcheting belt clip allow user to ratcheting in different angles while in sitting position.
- The swivel belt clip is made with metal encapsulation with synthetic leather
- The APX NEXT Universal Mount Carry holster has Flexibility to interchange with different type of Carry attachments.
- Replacement Parts
 - PMLN8606 APX NEXT Universal Mount Carry Holster
 - PMLN8607 D-Bracket with Detents
 - PMLN8608 2" Ratcheting Belt Clip
- Video User Guide



APX N portable radio accessories

COMPATIBILITY		CARRY SOLUTION		FEATURES			
CARRY SOLUTIONS Carry cases and holders are available in sizes designed to fit your radio and battery and permit audio to be heard clearly. Our carry accessories keep your hands-free, so you can concentrate on the task at hand.							
PORTABLE RADIOS	DESCRIPTION		PART NUMBER	MATERIAL	D-RINGS	ATTACHMENTS/REPLACEMENT KIT (SOLD SEPERATELY)	USE WITH BATTERIES
APX N70		APX N70 Classic Holster (Belt clip sold separately)	PMLN8371	Plastic		2.5" PMLN8507 3" PMLN8508	PMNN4816 PMNN4817 PMNN4818
		APX N70 hybrid leather holster, PMNN4816 battery	PMLN8372	Plastic/leather		2.5" PMLN5407 2.75" PMLN5408 3" PMLN5409 2.5" PMLN8507 3" PMLN8508	PMNN4816
		APX N70 hybrid leather holster, PMNN4817 battery	PMLN8373	Plastic/leather		2.5" PMLN5407 2.75" PMLN5408 3" PMLN5409 2.5" PMLN8507 3" PMLN8508	PMNN4817
		APX N70 hybrid leather holster, PMNN4818 battery	PMLN8374	Plastic/leather		2.5" PMLN5407 2.75" PMLN5408 3" PMLN5409 2.5" PMLN8507 3" PMLN8508	PMNN4818
APX N70 XE		APX N70 XE classic holster	PMLN8689	Plastic		2.5" - PMLN8507 3" - PMLN8508 AY000223A01 AY000229A01 RLN6487 RLN6488 RLN6486	PMNN4816 PMNN4817 PMNN4818
		APX N70 XE Boston leather carry case	PMLN8690	Leather		AY000223A01 AY000229A01 RLN6487 RLN6488 RLN6486	PMNN4818 (TIA battery ONLY)
APX N50 APX N30		APX N30/APX N50 hard leather carry case with 2.75 inch swivel belt loop	PMLN8609	Leather		2.5" PMLN5407 2.75" PMLN5408 3" PMLN5409	PMNN4813
		APX N30/APX N50 hard leather carry case with 2.75 inch swivel belt loop	PMLN8668	Leather		2.5" PMLN5407 2.75" PMLN5408 3" PMLN5409	PMNN4815



APX N portable radio accessories

COMPATIBILITY	CARRY SOLUTION			FEATURES		
CARRY SOLUTIONS						
PORTABLE RADIOS	DESCRIPTION		PART NUMBER	MATERIAL	BELT LOOP/ BELT CLIP (INCHES)	SWIVEL/ FIXED
APX NEXT XN APX NEXT XE APX N70 XE		Boston leather fireman's radio strap with button back holder	AY000223A01	Leather	Up to 51"	
		Boston leather fireman's radio strap with button back holder - XL	AY000229A01	Leather	Up to 54"	
		Boston leather fireman's radio strap - XL	RLN6487	Leather	Up to 70"	
		Boston leather anti-sway strap for boston leather fireman's radio strap	RLN6488	Leather	Up to 9"	
		Boston leather fireman's radio strap	RLN6486	Leather	Up to 62"	
APX NEXT XE APX NEXT		2.5" hard plastic belt clip	NTN8266	Plastic	2.5"	Fixed
		3" hard plastic belt clip	PMLN7965	Plastic	3"	Fixed
APX NEXT XN		2.5" hard plastic belt clip	PMLN8602	Thermoplastic	2.5"	Fixed
		3" hard plastic belt clip	PMLN8603	Thermoplastic	3"	Fixed
APX NEXT APX N70 APX N50 APX N30		2.5" leather swivel belt loop	PMLN5407	Leather	2.5"	Swivel
		2.75" leather swivel belt loop	PMLN5408	Leather	2.75"	Swivel
		3" leather swivel belt loop	PMLN5409	Leather	3"	Swivel
APX N70 XE APX N70		APX N70 2.5" belt clip	PMLN8507	Plastic	2.5"	Fixed
		APX N70 3" belt clip	PMLN8508	Plastic	3.0"	Fixed
APX N50 APX N30		APX N30/APX N50 2.0" belt clip	PMLN8369	Plastic	2.0"	Fixed
		APX N30/APX N50 2.5" belt clip	PMLN8370	Plastic	2.5"	Fixed



Antennas

Designed for wearability

Details

Motorola Solutions' redesigned antennas provide convenience without compromising performance. Shorter and more flexible, these antennas conform to the users' mission critical environments.

- The 7/800 MHz and UHF Stubby Antennas deliver great coverage but will not snag on clothing or equipment.
- The Whip, Single and All-band Antennas are fabricated using a new polymer that delivers 40% better flexibility.

Antenna ID bands

Colored antenna ID bands are available for easy customization and come in packs of 10.

-  32012144001 Gray
-  32012144002 Yellow
-  32012144003 Green
-  32012144004 Blue
-  32012144005 Purple

Will APX NEXT antennas (stubby single-band and flexible all-band) work with other APX family radios such as the APX 8000 and APX 6000?

No. The current APX antennas have an embedded GPS antenna. The APX NEXT antennas do not have an internal GPS element because the hardware is located inside the radio itself. This means that APX NEXT antennas cannot be used with other models of APX radios.



Stubby

Single band

All-band



APX N portable radio accessories

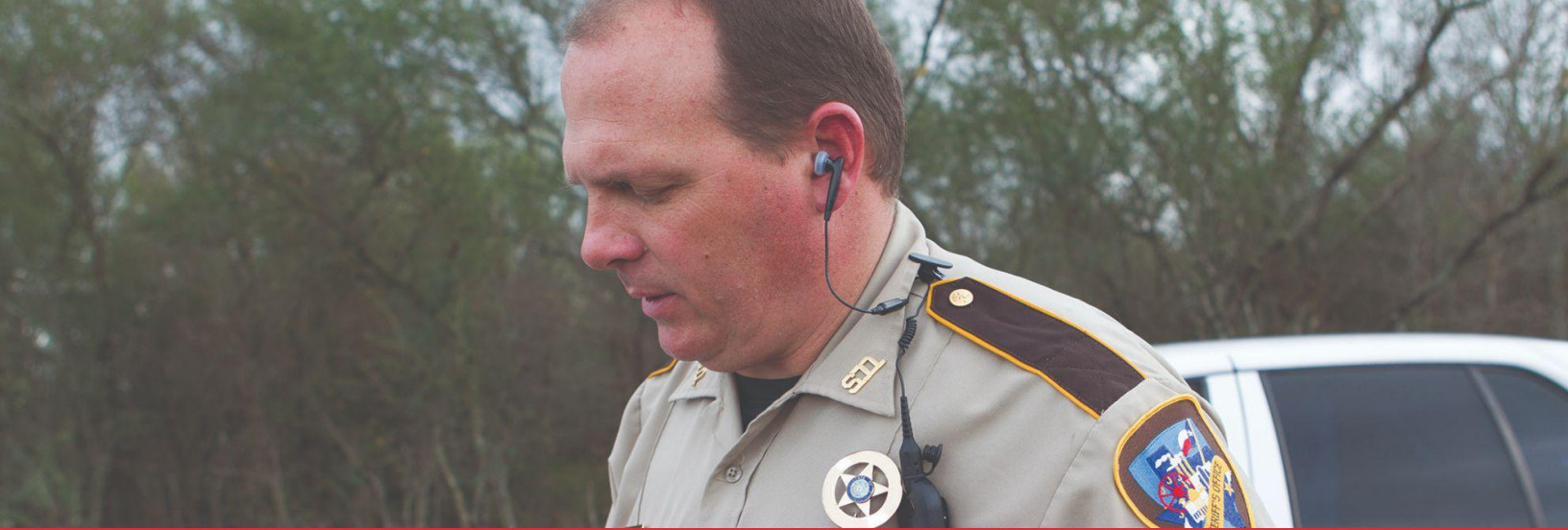
COMPATIBILITY	ACCESSORY		FEATURES					
ANTENNAS								
PORTABLE RADIOS	DESCRIPTION		PART NUMBER	UHF/VHF/ 700/800 MHz	FREQUENCY BAND (MHz)	LENGTH (CM)	TYPE	HAZLOC- CAPABLE†
APX NEXT XN		700/800 MHz, GPS Whip Antenna	AN000417A01	V, U, 700/800	764-870 MHz	20	Whip, All-Band	UL
APX NEXT XE APX NEXT		700/800 MHz, Stubby Antenna	AN000296A01	700/800	760-870 MHz	6.5	Stubby, Single Band	UL
		UHF, 380-470 MHz, Stubby Antenna	AN000369B01	UHF	380-470 MHz	9.0	Stubby, Single Band	UL
		UHF, 450-527 MHz Stubby Antenna	AN000369B02	UHF	450-527 MHz	9.0	Stubby, Single Band	UL
		700/800 MHz, Short Whip Antenna	AN000392A01	700/800	762-870 MHz	16.0	Short Whip, Single Band	UL
		UHF, 350-520 MHz, Short Whip Antenna	AN000393A01	UHF	350-520 MHz	14.0	Short Whip, Single Band	UL
		700/800 MHz, All-band Antenna	AN000297A01	All-band	136-174MHz, 380-520MHz, 760-870 MHz	20.0	Whip, All-Band	UL
APX N70 APX N50 APX N30		700/800 MHz Short Whip Antenna	AN000411A01	700/800	762-870MHz	15.0	Short Whip, Single Band	UL
		380/520 MHz Whip Antenna	AN000452A01	UHF	380-520MHz	12.0	Whip, Single Band	UL
		700/800 MHz Stubby Antenna	AN000418A01	700/800	762-870MHz	10.0	Stubby, Single Band	UL
APX N30 APX N50		136-174 MHz VHF Whip Antenna	AN000421A01	VHF	136-174MHz	18.0	Whip, Single Band	UL

COMPATIBILITY	ACCESSORY	
CABLES		
PORTABLE RADIOS	DESCRIPTION	PART NUMBER
APX N70 APX N50 APX N30	GCAI-mini programming cable	PMKN4265
	 GCAI-mini pProgramming & test cable	PMKN4231
	 Programming cable*	PMKN4012
	GCAI-mini cloning cable	PMKN4292
	GCAI-mini keyloading cable	PMKN4291

* Requires PMLN8334A GCAI to GCAI mini cable adapter

COMPATIBILITY	ACCESSORY	
ADAPTER CABLE		
PORTABLE RADIOS	DESCRIPTION	PART NUMBER
APX NEXT XN	 10-Pin RFDC Adapter Cable	PMKN4262





APX portable radio accessories



APX 8000HXE



APX 8000XE



APX 8000H



APX 8000



APX 6000XE



APX 6000



APX 4000
(2-knob)



APX 3000



APX 900



SRX 2200

Discontinued APX Portable radio models

APX 7000XE
APX 7000
APX 4000 1-knob
APX 1000



XVE500 RSM button configuration



Hear and be heard like never before

The XVE500 is the next generation mission-critical RSM designed for optimal use with APX NEXT™ XE radio. Equipped with four high dynamic range microphones, automatic audio leveling, noise reduction and a built in ViQi button, the XVE500 RSM delivers the clear, loud audio communications. Which allow easy access to radio controls and critical information. Whether you are in the heat of a fire or exposed to extreme weather conditions, the XVE500 will keep you connected to your team. This RSM was designed to withstand heat exposure of 500°F (260°C) for up to 5 minutes.

Key features

- Heat resistant housing and cable
- Loudest, clearest speaker
- Four High Dynamic Range (HDR) microphones
- Dedicated ViQi button
- Water and Wind Shielding
- New adaptive noise suppression
- Illuminated emergency button



APX portable radio accessories

COMPATIBILITY	ACCESSORY		FEATURES									
REMOTE SPEAKER MICROPHONES (RSM) Our robust portfolio includes Remote Speaker Microphones and secondary audio accessories engineered to give you clearer communications even in loud environments.												
PORTABLE RADIOS	DESCRIPTION		PART NUMBER	IMPRES AUDIO	MICROPHONE NOISE SUPPRESSION	VOLUME CONTROL	ORANGE PROGRAMMABLE BUTTON	CHANNEL CONTROL	PROGRAMMABLE BUTTON	IP RATING	HAZLOC-CAPABLE†	SIZE (WITHOUT CLIP) (MM)
APX NEXT XE* APX NEXT* APX 8000 APX 8000XE APX 8000H APX 8000HXE		XVE500 high impact green, channel knob, Xtreme temperature cable	PMMN4154	•	Multi-mic noise suppression	•	•	•	2	IP68	UL	75 x 98 x 34
		XVE500 black housing, channel knob, Xtreme temperature cable	PMMN4154_BLK	•	Multi-mic noise suppression	•	•	•	2	IP68	UL	75 x 98 x 34
		XVE500 high impact green, no channel knob, Xtreme temperature cable	PMMN4152	•	Multi-mic noise suppression	•	•		2	IP68	UL	75 x 98 x 34
		XVE500 black housing, no channel knob, Xtreme temperature cable	PMMN4152_BLK	•	Multi-mic noise suppression	•	•		2	IP68	UL	75 x 98 x 34
APX 8000 APX 8000XE APX 8000H APX 8000HXE APX 7000 APX 7000XE APX 6000 APX 6000XE		XE500 high impact green, channel knob, Xtreme temperature cable	PMMN4106	•	Multi-mic noise suppression	•	•	•	1	IP68	UL	75 x 98 x 33
		XE500 black housing, channel knob, Xtreme temperature cable	PMMN4106_BLK	•	Multi-mic noise suppression	•	•	•	1	IP68	UL	75 x 98 x 33
		XE500 high impact green, no channel knob, Xtreme temperature cable	PMMN4107	•	Multi-mic noise suppression	•	•		1	IP68	UL	75 x 98 x 33
		XE500 black housing, no channel knob, Xtreme temperature cable	PMMN4107_BLK	•	Multi-mic noise suppression	•	•		1	IP68	UL	75 x 98 x 33

† HazLoc Details: For more information on which accessories are approved by Underwriters' Laboratory (UL) with certain APX models, please consult the manual provided with each UL-approved APX portable.

*RSM Firmware:

1. Ensure the radio firmware is updated to the latest version
2. Radio will update the RSM firmware automatically once the RSM is connected to the radio.

Enhanced controls

The XVE500 RSM is an evolution of the XE500 RSM platform and like its predecessor was designed with the user's extreme environment in mind. From the exaggerated knobs and controls, that are easy to operate with bulky gloves to the asymmetrical shape that makes it easier to find the controls without looking.

Adaptive audio engine

XVE500 RSM utilizes 4 integrated microphones and an Adaptive Audio Engine. Similar to the radio, it automatically changes the level of noise suppression, microphone gain, Windporting and speaker equalization to produce clear and loud audio in any environment.

Flexible wearing

The strategic placement of the microphones and enhanced water drainage provide users with the flexibility to wear it straight, upside down and even sideways while still delivering loud and clear audio.

Extreme performance

Whether you are in the heat of a fire or exposed to extreme weather conditions the XVE500 will keep you connected to your team. This RSM was designed to withstand heat exposure of 500°F (260°C) for up to 5 minutes. Built as a system, the APX NEXT XE and APX 8000XE with the XVE500 have been tested to meet IP68 (2 meter, 4 hours) submersibility specifications.



APX portable radio accessories

COMPATIBILITY		ACCESSORY
REMOTE SPEAKER MICROPHONE ACCESSORIES AND REPLACEMENT PARTS		
RSM	DESCRIPTION	PART NUMBER
FIRE RSM REPLACEMENT PARTS		
XVE500	 Xtreme temperature replacement cable for XVE500 RSM	CB001138A01
	 XVE500 RSM clip assembly with brass insert designed to work with the boston leather straps (AY000223A01, AY000229A01) requires clip button NNTN8749	PMLN7633
	Replacement channel knob for XVE500 RSM (20pcs per pack)	PMLN7653
XE500	 Xtreme temperature replacement cable for XE500 RSM	30009402007
	 XE500 RSM clip assembly with brass insert designed to work with the boston leather straps (AY000223A01, AY000229A01) requires clip button NNTN8749	PMLN7633
XE	 Xtreme temperature replacement cable for XE RSM (NNTN8203 and NNTN8575 series)	30009402002
	 XE RSM clip assembly with brass insert designed to work with the boston leather straps (AY000223A01, AY000229A01) requires clip button NNTN8749	NNTN8271
XVE500 XE500 XE	 Clip Button	NNTN8749

Fire market solution

The XVE500, XE500 and XE RSM clip paired with a clip button allows easy and secure access to your RSM when used with a Boston Radio Strap with Button Back Holder.



Key features

- Multi-mic capability: four high dynamic range microphones
- Advanced windporting
- Adaptive noise suppression
- Intrinsically safe, Div 1 certified
- Enhanced ergonomic design



XVP Remote speaker microphone

Maximize your mission critical voice technology

The XVP RSM utilizes an enhanced end-to-end audio design for increased clarity that enables more intelligible communications in the loudest environments and speaking from any direction.

APX portable radio accessories

COMPATIBILITY			FEATURES										
REMOTE SPEAKER MICROPHONES (RSM) Our robust portfolio includes Remote Speaker Microphones and secondary audio accessories engineered to give you clearer communications even in loud environments.													
PORTABLE RADIOS	DESCRIPTION	PART NUMBER	IMPRES AUDIO	MICROPHONE NOISE SUPPRESSION	VOLUME CONTROL	ORANGE BUTTON	CHANNEL CONTROL	PROGRAMMABLE BUTTON	AUDIO JACK	IP RATING	HAZLOC-CAPABLE†	SIZE (WITHOUT CLIP) (MM)	
APX NEXT XE APX NEXT APX 8000XE APX 8000H APX 8000HXE APX 8000 APX 6000XE APX 6000 SRX2200		XVP850 RSM with channel knob	PMMN4135	•	Multi-Mic Noise Suppression	•	•	•	3	3.5 mm	IP68	UL	93 x 58 x 31
		XVP830 RSM without channel knob	PMMN4136	•	Multi-Mic Noise Suppression	•	•		3	3.5 mm	IP68	UL	93 x 58 x 31
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 2000 APX 1000 APX 900		IMPRES Windporting RSM with volume toggle switch, orange button, 3.5mm NON-threaded jack (IP68)	PMMN4099	•	Windporting	•	•		1	3.5 mm	IP68	UL	60 x 78 x 28
SRX 2200		Windporting RSM, coyote brown, (IP57)	NNTN8235		Windporting						IP57	UL	55 x 60 x 27
		Windporting RSM with NON-threaded 3.5mm audio Jack, coyote brown, (IP54)	NNTN8236		Windporting					3.5 mm	IP54	UL	55 x 60 x 27

† HazLoc Details: For more information on which accessories are approved by Underwriters' Laboratory (UL) with certain APX models, please consult the manual provided with each UL-approved APX portable.



Easy access to ViQi

ViQi is your virtual assistant, designed for public safety. the three-dot dedicated viqi button on your xvp rsm allows you to operate ViQi from your shoulder.

It's ViQi's job to quickly provide the information you need to stay safe and effective. Checking a driver's license? Just ask her. Need to run a plate? She's on it. She'll even discreetly warn you to move out of earshot if she has important information to share.

She understands natural language voice commands, from changing zone, channel and volume, to getting status checks. All while keeping your hands free and your focus on your surroundings.

Click [here](#) to learn more about ViQi.

APX portable radio accessories

COMPATIBILITY		ACCESSORY	
REMOTE SPEAKER MICROPHONE ACCESSORIES AND REPLACEMENT PARTS			
PORTABLE RADIOS	DESCRIPTION		PART NUMBER
RSM REPLACEMENT PARTS			
XVP850 XVP830		Low profile swivel clip with D-ring	PMLN8312
		Replacement coil cord	PMKN4260
		Swivel molle clip	PMLN8675
XVP850		Replacement channel knob	PMLN8313
XP		XP RSM replacement cable with audio jack	PMKN4222
		XP RSM replacement cable without audio jack	NKN6611
PMMN4062 PMMN4065 PMMN4069 PMMN4083 PMMN4099		Replacement coil cord	PMKN4234

Easy access to radio controls

State of Emergency

Activate or deactivate emergency mode from your XVP RSM.

Full Scale Volume Control

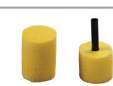
Hold the Up/Down lever in the (+) increment or (-) increment position and your APX NEXT radio will ramp the XVP RSM speaker loudness to the highest or lowest available volume setting.

Radio Function Buttons

Configure the one-dot, two-dot and three-dot buttons to access key radio functionality from your XVP RSM.



APX portable radio accessories

COMPATIBILITY	ACCESSORY		FEATURES			
REMOTE SPEAKER MICROPHONE ACCESSORIES AND REPLACEMENT PARTS						
PORTABLE RADIOS	DESCRIPTION		PART NUMBER	EARPIECE TYPE	CONNECTOR TYPE	HAZLOC-CAPABLE†
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 APX 2000 APX 1000 APX 900 SRX 2200		Receive-only earpiece with comfort eartube, UL approved	RLN4941**	Clear rubber eartip	3.5mm	UL
		Receive-only earpiece with comfort eartube. Extra loud audio output	RLN4941_XL - NA MDRLN4941 - APAC	Clear rubber eartip	3.5mm	UL
		Receive-only earpiece with Comfort Eartube	PMLN7560	Clear rubber eartip	3.5mm	
		Receive-only earbud, UL approved	AARLN4885	Foam earbud	3.5mm	UL
		Receive-only earpiece, loud version. Required BDN6783 or NMN6274	RLN5313_XL	Clear rubber eartip	3.5mm	
		EP7 sonic defender, use with RLN4941	RLN6511 RLN6512 RLN6513	Compatible surveillance kits RLN5882, RLN5883, PMLN5111, PMLN5112, PMLN6123, PMLN6124, PMLN6125, PMLN6126, PMLN6127, PMLN6128, PMLN6129, PMLN6130, PMLN8120		
		Adjustable D-style earpiece	PMLN7396	Over-the-ear	3.5mm	
		D-shell Rx-only earpiece	PMLN4620**	Over-the-ear	3.5mm	UL
		Receive-only flexible earpiece	WADN4190	Over-the-ear	3.5mm	UL
		Replacement foam plugs for RLN5887 and RLN6242. Noise reduction = 25dB.* (Pack of 50 pairs)	5080384F72	Foam eartip		
		Replacement rubber eartip for RLN6424 (Pack of 25)	5080370E97			
		D-ring swivel clip (12 pack). compatible with all XP RSMs and wireless RSMs	NNTN4990			

* For High Noise Kit solution - combine RLN6242 Low Noise Kit with translucent tube and clear rubber eartip and RLN6281 Replacement Foam Plugs for RLN6242. Noise reduction = 25dB.

** Also compatible with APX8000H & APX8000HXE.

† HazLoc Details: For more information on which accessories are approved by Underwriters' Laboratory (UL) with certain APX models, please consult the manual provided with each UL-approved APX portable.





APX portable radio accessories

COMPATIBILITY		ACCESSORY		FEATURES									
PUBLIC SAFETY MICROPHONES Our robust portfolio includes Public Safety Microphones and secondary audio accessories engineered to give you clearer communications even in loud environments.													
PORTABLE RADIOS	DESCRIPTION		PART NUMBER	IMPRES AUDIO	MICROPHONE NOISE SUPPRESSION	VOLUME CONTROL	ORANGE BUTTON	PROGRAMMABLE BUTTON	AUDIO JACK	IP RATING	HAZLOC-CAPABLE*	SIZE (WITHOUT CLIP) (MM)	
APX8000 APX8000XE APX8000HXE APX6000XE APX6000 SRX2200		Public safety microphone (30 inch cable) PSM Antenna required. VHF not supported.	PMMN4061	•	Windporting	•	•	1	3.5 mm	IP55	UL	60 x 78 x 28	
		Public safety microphone (24 inch cable) PSM Antenna required. VHF not supported. Recommended for use with UHF radios.	PMMN4060	•	Windporting	•	•	1	3.5 mm	IP55	UL	60 x 78 x 28	
		Public safety microphone (24 inch cable) PSM Antenna required. VHF not supported. Recommended for use with 7/800MHz radios.	PMMN4060_SP01	•	Windporting	•	•	1	3.5 mm	IP55	UL	60 x 78 x 28	
		Public safety microphone (18 inch cable) PSM Antenna required. VHF not supported.	PMMN4059	•	Windporting	•	•	1	3.5 mm	IP55	UL	60 x 78 x 28	

† HazLoc Details: For more information on which accessories are approved by Underwriters' Laboratory (UL) with certain APX models, please consult the manual provided with each UL-approved APX portable.
 * The top image features the multi-mic XVP Remote Speaker Microphone





APX wireless RSM

Every feature on this RSM has been purposefully designed. Large, yet recessed push-to-talk and emergency buttons are easy to access and designed to prevent accidental activation. Additional features include a volume control, audio jack and task light that allows you to read items such as a driver's license in the dark. This RSM features all of the advanced capabilities of Mission Critical Wireless including enhanced security, fast push-to-talk and quick touch pairing with voice prompts that confirm pairing actions. This RSM also features a removable and rechargeable battery. Charge the RSM on the go with the vehicular charger or in the office with the dual-unit desk charger.

How do mission critical wireless accessories help me?

They free you from being physically connected to the radio and are ideal for surveillance operations. They look consumer, but are mission critical in performance and provide exceptional flexibility, high security, superior audio performance and a new dimension of freedom. Carry your radio in a backpack, bag or purse without being constrained by wires. YOUR RADIO, UNLEASHED.



APX portable radio accessories

COMPATIBILITY	ACCESSORY		FEATURES							
MISSION CRITICAL WIRELESS (MCW) REMOTE SPEAKER MICROPHONES (RSM) Our robust portfolio includes Remote Speaker Microphones and secondary audio accessories engineered to give you clearer communications even in loud environments.										
PORTABLE RADIOS	DESCRIPTION		PART NUMBER	IMPRES AUDIO	MICROPHONE NOISE SUPPRESSION	VOLUME CONTROL	ORANGE PROGRAMMABLE BUTTON	AUDIO JACK	IP RATING	SIZE (WITHOUT CLIP) (MM)
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 2000 APX 3000 SRX 2200		Wireless RSM with battery, Clip (RLN6544) and dual unit charger (PMLN7120)	RLN6554		Windporting	●	●	3.5mm	IP55	88 x 63 x 26
		Wireless RSM with battery and clip. No charger.	RLN6544		Windporting	●	●	3.5mm	IP55	88 x 63 x 26

COMPATIBILITY		ACCESSORY	
WIRELESS RSM ACCESSORIES AND REPLACEMENT PARTS			
PORTABLE RADIOS		DESCRIPTION	PART NUMBER
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 APX 2000 SRX 2200		Dual unit Ccharger, rapid rate charger, 120V (US Plug)	PMLN7120
		Vehicular charger	PMLN6716
		Wireless RSM with battery and clip, No charger	RLN6544
		Wireless RSM battery, 1750 mA Li-Ion	PMNN4461
		D-ring swivel clip (12 pack) Compatible with all XP RSMs and wireless RSMs	NNTN4990

COMPATIBILITY	ACCESSORY		FEATURES										
MISSION CRITICAL WIRELESS (MCW) ACCESSORIES This portfolio is a game changer, giving you the flexibility to remove the radio from your belt and stay connected within 30 feet.													
PORTABLE RADIOS	DESCRIPTION	PART NUMBER	EARPIECE TYPE	MICROPHONE	PTT	TALK TIME (HOURS) 5/5/90 DUTY CYCLE	CHARGE TIME (HOURS)	WEIGHT (GRAMS)	SIZE (MM)	RANGE (FEET LINE OF SIGHT)	IP RATING	HAZLOC-CAPABLE¹	
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 APX 2000 SRX 2200	 Mission critical wireless earpiece with 12" cable and push-to-talk pod	NTN2570	Over-the-ear (Comm-Port™)	Directional, above the earpiece	●	10	3	43	70 x 41 x 25	30	IP54		
	 Mission critical wireless push-to-talk pod	NTN2571			●	10	3	43	70 x 41 x 25	30	IP54		
	 Mission critical wireless remote control keyfob with programmable buttons	NNTN8442				●	10	3	26	67 x 32 x 16	30	IP54	

† HazLoc Details: For more information on which accessories are approved by Underwriters' Laboratory (UL) with certain APX models, please consult the manual provided with each UL-approved APX portable.

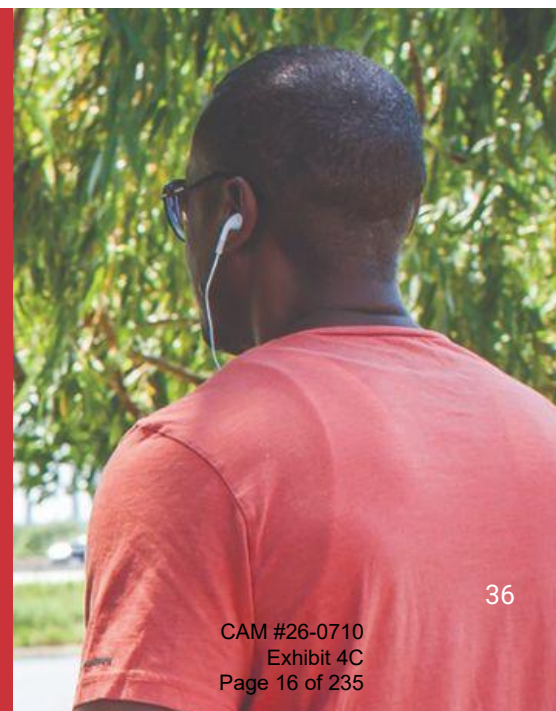


APX portable radio accessories

COMPATIBILITY	ACCESSORY		FEATURES			
MISSION CRITICAL WIRELESS (MCW) ACCESSORIES This portfolio is a game changer, giving you the flexibility to remove the radio from your belt and stay connected within 30 feet.						
PORTABLE RADIOS	DESCRIPTION	PART NUMBER	EARPIECE TYPE	MICROPHONE	PTT	
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 APX 2000 SRX 2200		Single-wire surveillance kit with quick disconnect translucent tube for wireless push-to-talk pod	PMLN7052	Clear rubber eartip	In-line	On pod, ordered separately
		Single-wire earbud with 11.5" cable for wireless push-to-talk pod, black	NNTN8294	Earbud	In-line	On pod, ordered separately
		Single-wire earbud with 45" cable for wireless push-to-talk pod, black	NNTN8295	Earbud	In-line	On pod, ordered separately
		Covert audio kit for mission critical wireless PTT pod	NNTN8296	1 earbud and 2 earbud headsets	In-line	On pod, ordered separately
		Y-adapter and retention hook for mission critical wireless push-to-talk pod	NNTN8385		Directional, on separate wire	On pod, ordered separately
		Neckloop for Discreet Earpiece Kit	RLN4920			
		Accessory kit for completely discreet wireless surveillance kit. includes: wireless neckloop, y-adapter and retention hook (NNTN8385), completely discreet earpiece kit (PMLN7696) and mission critical wireless push-to-talk pod (NTN2571)	NNTN8434			
		Commercial 3.5mm earbud headset adapter, 10 per pack	NNTN8737			
		Replacement wireless earpiece cable, 12 inch	NTN2572	Over-the-ear (CommPort™)	Directional above the ear commPort	On pod, ordered separately
		Mission critical wireless covert pack-n-go kit, basic. kit includes: NNTN8296 basic mission critical wireless covert kit, NTN2571 mission critical wireless push-to-talk (PTT) pod and NNTN8442 mission critical wireless remote control unit	RLN6489	Earbud and earbud headset	On Y-adapter or in-line on earbuds	On PTT and MCW keyfob
		Mission critical wireless covert pack-n-go kit, advanced. kit includes: all contents of covert pack-n-go kit plus PMLN7696 completely discreet earpiece kit and NNTN8385 wireless neckloop Y-adapter	RLN6501	Completely discreet earpiece, earbud and earbud headset	On y-adapter or in-line on earbuds	On PTT and MCW keyfob

What makes the covert pack-and-go kit a must-have?

Organize and stow all your APX wireless accessories on the go, all in one place. Keep this durable kit in a backpack or messenger bag and you'll always have the right accessories on hand. With a dozen secure straps and deep mesh pockets, you can access exactly what you need when an operation happens.





APX portable radio accessories

COMPATIBILITY		ACCESSORY	FEATURES		
MISSION CRITICAL WIRELESS (MCW) ACCESSORIES This portfolio is a game changer, giving you the flexibility to remove the radio from your belt and stay connected within 30 feet.					
PORTABLE RADIOS	DESCRIPTION	PART NUMBER	EARPIECE TYPE	MICROPHONE	PTT
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 APX 2000 SRX 2200	 Wireless earpiece maintenance kit with 10 silicone ear tubes, 10 microphone seal strips and 2 foam windscreens for NTN2572 over-the-ear earpiece	NTN8821	Over-the-ear (CommPort™)		
	 Ear strap for CommPort™ earpiece to secure earpiece to ear (10 per pack)	NTN8988	Over-the-ear (CommPort™)		
	 Replacement ear tips kit for wireless ear buds (20 small, 20 medium, 20 large and 10 clips)	NNTN8361	Earbud		
	 Replacement swivel clip for wireless PTT pod	PMLN6246			
	 Replacement or spare micro-USB plug-in charger (US)	PMPN4027			



APX portable radio accessories

COMPATIBILITY	ACCESSORY		FEATURES		
OPERATIONS CRITICAL WIRELESS (OCW) ACCESSORIES This portfolio is a game changer, giving you the flexibility to remove the radio from your belt and stay connected within 30 feet.					
PORTABLE RADIOS	DESCRIPTION	PART NUMBER	EARPIECE TYPE	MICROPHONE	PTT
APX 900	 Bluetooth accessory kit with flexible earpiece, bluetooth pod, and charging cradle with power supply	RLN6500	Over-the-ear (swivel)	Boom	On earpiece
	 Flexible earpiece with boom microphone for RLN6500	PMLN7203	Over-the-ear (Swivel)	Boom	On pod, ordered separately
APX 4000 APX 2000 APX 1000 APX 900	 Operations critical wireless earpiece with 12 inch cable	NNTN8125	Over-the-ear (CommPort™)	Directional, above the earpiece	On pod
	 Operations critical wireless push-to-talk pod with charger	NNTN8127			On pod
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 APX 2000 APX 900 SRX 2200	 Accessory kit for completely discreet wireless surveillance kit. includes: wireless neckloop, Y-adapter and retention hook (NNTN8385), completely discreet earpiece kit (PMLN7696) and mission critical wireless push-to-talk pod (NTN2571)	NNTN8434	-	-	-
	 Single-wire surveillance kit with quick disconnect translucent tube for wireless push-to-talk pod for pod	PMLN7052	Clear rubber eartip	In-line	On pod, NNTN8127 ordered separately
	 Single-wire earbud with 11.5" cable for wireless push-to-talk pod, black	NNTN8294	Earbud	In-line	On pod, NNTN8127 ordered separately
	 Single-wire earbud with 45" cable for wireless push-to-talk pod, black	NNTN8295	Earbud	In-line	On Pod, NNTN8127 ordered separately
	 Replacement wireless earpiece cable, 12 inch	NTN2572	Over-the-ear (CommPort™)	Directional above the ear commport	On pod, NNTN8127 ordered separately
	 Covert audio kit for operations critical wireless PTT pod	NNTN8296			





APX portable radio accessories

COMPATIBILITY	ACCESSORY		FEATURES		
OPERATIONS CRITICAL WIRELESS (OCW) ACCESSORIES					
PORTABLE RADIOS	DESCRIPTION	PART NUMBER	EARPIECE TYPE	MICROPHONE	PTT
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 APX 2000 APX 900 SRX 2200	 XBT operations critical wireless behind-the-neck headset	RLN6490	Headset	Boom	Headset or on pod NNTN8127 ordered separately
	 XBT operations critical wireless headband style Headset	RLN6491	Headset	Boom	Headset or on pod NNTN8127 ordered separately





How does CommPort™ work?

The miniature microphone and receiver connect to your APX radio and fasten securely and comfortably to your ear. Unlike bone conduction or boom mic technology, the CommPort System picks up sound waves as they cross the face so you hear and can be heard virtually in any environment.

APX portable radio accessories

COMPATIBILITY		ACCESSORY
COMMPORT™ Integrated microphone/receiver lets you talk discreetly and hear clearly and still be aware of everything around you, from traffic noise to other responders.		
PORTABLE RADIOS	DESCRIPTION	PART NUMBER
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 APX 2000 SRX 2200	 Replacement palm PTT for RLN6480	NKN6510
	Replacement cable for RLN6481	NKN6508
	 Replacement snap-on-side PTT for RLN6482	NKN6525
	 Replacement ring PTT for RLN6483	NKN6512
	 Replacement remote body PTT for RLN6484	NNTN4188
	 CommPort maintenance kit (includes 10 replacement ear tubes, 10 microphone seals and 2 windscreens)	NTN8821
	 Ear straps for secure attachment to ear (pack of 10)	NTN8988
	Replacement collar clip	4285838B01



APX portable radio accessories

COMPATIBILITY		ACCESSORY		FEATURES					
EAR MICROPHONE SYSTEM									
PORTABLE RADIOS	DESCRIPTION	PART NUMBER	IMPRES	EARPIECE TYPE	MICROPHONE	PTT	PROGRAMMABLE BUTTON	HAZLOC-CAPABLE†	
APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 APX 2000 APX 1000 APX 900 SRX 2200	 IMPRES ear microphone with bone conduction and programmable button, black	PMLN5653	•	In-ear mic	In-ear mic	Large, ring-guarded, recessed			
	 Earguard with adjustable loop	0180300E25	How does IMPRES improve audio performance? IMPRES enhances the clarity and audio quality of Motorola accessories by reducing ambient noise and improving voice intelligibility. If you speak quietly or normally, but not directly into a microphone, IMPRES Audio detects changes in your voice and automatically adjusts the transmitted volume so your listener won't have to adjust volume up and down.						
	Earholder, black, small	0180358B32							
	Earholder, clear, large	0180358B37							

COMPATIBILITY	ACCESSORY		FEATURES						
SURVEILLANCE KITS Transmit and receive discreetly with a variety of surveillance kits that feature a streamlined design and rugged cables that withstand tough conditions. A quick-disconnect, durable and comfortable translucent tube enables easy sharing between shifts.									
PORTABLE RADIOS	DESCRIPTION	PART NUMBER	IMPRES	EARPIECE TYPE	MICROPHONE	PTT	PROGRAMMABLE BUTTON	HAZLOC-CAPABLE†	
APX 8000 APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 APX 1000 SRX 2200	 1-wire receive-only earpiece, black	PMLN6125	•	Ear hanger				UL	
	 1-wire receive-only earpiece, beige	PMLN6126	•	Ear hanger				UL	
	 IMPRES 2-wire surveillance kit, programmable button, black	PMLN6127	•	Ear hanger				UL	
	 IMPRES 2-wire surveillance kit, programmable button, beige	PMLN6128	•	Ear hanger	Mic and PTT combined on a single wire	Mic and PTT combined on a single wire		UL	

† HazLoc Details: For more information on which accessories are approved by Underwriters' Laboratory (UL) with certain APX models, please consult the manual provided with each UL-approved APX portable.



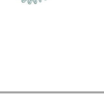
APX portable radio accessories

COMPATIBILITY	ACCESSORY		FEATURES						
SURVEILLANCE KITS									
PORTABLE RADIOS	DESCRIPTION	PART NUMBER	IMPRES	EARPIECE TYPE	MICROPHONE	PTT	PROGRAMMABLE BUTTON	HAZLOC-CAPABLE†	
APX 8000 APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 APX 2000 APX 1000 APX 900 SRX 2200		PMLN6129	•	Clear rubber eartip				UL	
		PMLN6130	•	Clear rubber eartip				UL	
APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 APX 2000 APX 1000 APX 900 SRX 2200		PMLN6123	•	Clear rubber eartip				UL	
		PMLN6124	•	Clear rubber eartip	Separate wire	Separate wire		UL	
		BDN6726			Ear hanger				UL
		BDN6727			Ear hanger				UL

† HazLoc Details: For more information on which accessories are approved by Underwriters' Laboratory (UL) with certain APX models, please consult the manual provided with each UL-approved APX portable. PMLN6129 is also compatible with APX8000.



APX portable radio accessories

COMPATIBILITY	ACCESSORY		FEATURES			
SURVEILLANCE KITS						
PORTABLE RADIOS	DESCRIPTION	PART NUMBER	EARPIECE TYPE	MICROPHONE	PTT	HAZLOC-CAPABLE†
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 APX 2000 APX 1000 APX 900 SRX 2200	 1-wire receive-only surveillance kit with translucent tube, black, 3.5mm threaded. requires BDN6783.	RLN5313*	Clear Rubber Eartip			UL
	 1-wire receive-only surveillance kit with translucent tube, black, loud version, 3.5mm threaded. Requires BDN6783 or NMN6274.	RLN5313_XL	Clear Rubber Eartip			
	 2-wire surveillance kit with translucent tube, black, 3.5mm threaded. Requires BDN6783.	RLN5312	Clear Rubber Eartip	Mic and PTT Combined on a Single Wire	Mic and PTT Combined on a Single Wire	
	 2-wire surveillance kit with earpiece, black, 3.5mm threaded. Requires BDN6783.	BDN6729*	Ear Hanger	Mic and PTT Combined on a Single Wire	Mic and PTT Combined on a Single Wire	UL
	 2-wire surveillance kit with extra-loud earpiece, beige, 3.5mm threaded. Requires BDN6783.	BDN6669	Ear Hanger	Mic and PTT Combined on a Single Wire	Mic and PTT Combined on a Single Wire	
	 2-wire surveillance kit with extra-loud earpiece, black, 3.5mm threaded. Requires BDN6783.	BDN6731*	Ear Hanger	Mic and PTT Combined on a Single Wire	Mic and PTT Combined on a Single Wire	UL
	 3-wire surveillance kit with earpiece, beige, 3.5mm threaded. Requires BDN6783.	BDN6668*	Ear Hanger	Separate Wire	Separate Wire	UL
	 3-wire surveillance kit with earpiece, black, 3.5mm threaded. Requires BDN6783.	BDN6730*	Ear Hanger	Separate Wire	Separate Wire	UL
	 3-wire surveillance kit with extra-loud earpiece, beige, 3.5mm threaded. Requires BDN6783.	BDN6670	Ear Hanger	Separate Wire	Separate Wire	

† HazLoc Details: For more information on which accessories are approved by Underwriters' Laboratory (UL) with certain APX models, please consult the manual provided with each UL-approved APX portable.

* Also compatible with AP8000H and APX8000HXE.



APX portable radio accessories

COMPATIBILITY		ACCESSORY		FEATURES		
SURVEILLANCE KIT ACCESSORIES AND REPLACEMENT PARTS						
PORTABLE RADIOS		DESCRIPTION		PART NUMBER	EARPIECE TYPE	COMPATIBLE SURVEILLANCE KITS
APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 APX 2000 APX 1000 APX 900 SRX 2200			Completely discreet earpiece kit with neckloop, beige, includes GMLN5261, RLN4920 and RNN4005	PMLN7696		
			Phonak nano ear receiver, beige (neckloop must be ordered separately)	GMLN5261		
			Phonak nano ear receiver, brown (neckloop must be ordered separately)	GMLN5262		
			Replacement Earwax Guards. 5 per pack. Compatible with PMLN7696	RLN4919		
			Optional Retention Hooks, Pack of 10	NNTN8457		
			Phonak inductive neckloop included in the PMLN7696	RLN4920		
			1.4 volt battery – pack of 6	RNN4005		
			Low noise kit with quick disconnect translucent tube and clear rubber eartip	RLN6242	Clear rubber eartip	PMLN6123, PMLN6124, PMLN6129, PMLN6130
			Replacement standard clear rubber eartip, pack of 50	RLN6282	Clear rubber eartip	PMLN6123, PMLN6124, PMLN6125, PMLN6126, PMLN6127, PMLN6128, PMLN6129, PMLN6130
			Replacement foam plugs for RLN5887 and RLN6242. Noise reduction = 25dB.* Pack of 50 pairs.	5080384F72	Foam eartip	PMLN6123, PMLN6124, PMLN6129, PMLN6130
			Low noise kit with 1 clear rubber eartip	RLN5886	Clear rubber eartip	RLN5882, RLN5883, PMLN5111, PMLN5112, PMLN6125, PMLN6126
			High noise kit* with 2 foam earplugs	RLN5887	Foam eartip	
			Clear EP7-small hearing protectors [sonic defenders] ultra earplugs noise reduction = 28dB	RLN6511	Comply™ Foam eartip	RLN5882, RLN5883, PMLN5111, PMLN5112, PMLN6123, PMLN6124, PMLN6125, PMLN6126, PMLN6127, PMLN6128, PMLN6129, PMLN6130, PMLN8120
			Clear EP7-medium hearing protectors [sonic defenders] ultra earplugs noise reduction = 28dB	RLN6512	Comply™ foam eartip	
			Clear EP7-large hearing protectors [sonic defenders] ultra earplugs noise reduction = 28dB	RLN6513	Comply™ foam eartip	

* For High Noise Kit solution - combine RLN6242 Low Noise Kit with translucent tube and clear rubber eartip and RLN6281 Replacement Foam Plugs for RLN6242. Noise reduction = 25dB.





APX portable radio accessories

COMPATIBILITY		ACCESSORY		FEATURES	
SURVEILLANCE KIT ACCESSORIES AND REPLACEMENT PARTS					
PORTABLE RADIOS		DESCRIPTION		PART NUMBER	EARPIECE TYPE
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 APX 2000 APX 1000 APX 900 SRX 2200		Small clear comfortable earpiece, right ear		RLN4760	Clear comfortable earpiece
		Medium clear comfortable earpiece, right ear		RLN4761	Clear comfortable earpiece
		Large clear comfortable earpiece, right ear		RLN4762	Clear comfortable earpiece
		Small clear comfortable earpiece, left ear		RLN4763	Clear comfortable earpiece
		Medium clear comfortable earpiece, left ear		RLN4764	Clear comfortable earpiece
		Large clear comfortable earpiece, left ear		RLN4765	Clear comfortable earpiece
SURVEILLANCE KIT AUDIO ADAPTERS					
APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 APX 2000 APX 1000 APX 900 SRX 2200	3.5mm threaded audio adapter		BDN6783†	UL Approved: BDN6667, BDN6668, BDN6669, BDN6728, BDN6729, BDN6730, BDN6731, BDN6670 Other: BDN6664, BDN6665, BDN6666, BDN6726, BDN6727, BDN6732	
		6 pin Hirose keyload and audio adapter		NNTN7869	ZMN6031, ZMN6032, ZMN6038, ZMN6039

† HazLoc Details: For more information on which accessories are approved by Underwriters' Laboratory (UL) with certain APX models, please consult the manual provided with each UL-approved APX portable.





APX portable radio accessories

COMPATIBILITY				ACCESSORY				FEATURES				
HEADSETS												
PORTABLE RADIOS	DESCRIPTION			PART NUMBER	IMPRES	HEADSET TYPE	SPEAKER	NOISE-CANCELLING / NOISE-REDUCTION	MICROPHONE	PTT	HAZLOC-CAPABLE¹	WEIGHT
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 APX 2000 APX 1000 APX 900 SRX 2200		IMPRES temple transducer with boom microphone and in-line push-to-talk replacement rubber temple cover (1 pair) 7580384M19		PMLN5101		Behind-the-head	Bone conduction		Boom	In-line	UL	Lightweight
		Earset D-shell		PMLN5096*		Over-the-ear	Single-ear		Boom	In-line	UL	Lightweight
		Ultra lite headset		PMLN5102		Over-the-head	Single-ear		Boom	In-line	UL	Lightweight
		Heavy-duty behind-the-head headset with noise-cancelling boom microphone, noise reduction = 24dB		PMLN6852		Behind-the-head	Dual-ear		Boom	On ear cup		Heavy-duty
		Heavy-duty behind-the-head headset with noise-cancelling boom microphone, noise reduction = 24dB		PMLN6853*		Behind-the-head	Dual-ear		Boom	On ear cup	UL	Heavy-duty
		Heavy-Duty over-the-head headset with noise-cancelling boom microphone, noise reduction = 24dB		PMLN7466		Over-the-head	Dual-ear		Boom	On ear cup		Heavy-duty
		Heavy-duty over-the-head headset with noise-cancelling boom microphone, noise reduction = 24dB		PMLN7467*		Over-the-head	Dual-ear		Boom	On ear cup	UL	Heavy-duty
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 2000 APX 1000 APX 900 SRX 2200		Lightweight over-the-head headset single muff with in-line push-to-talk & boom mic REX4648 - replacement foam earpad and microphone cover kit		RMN5058		Over-the-head	Single-ear		Boom	In-line	UL	Lightweight
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 APX 2000 APX 1000 APX 900 SRX 2200		XBT operations critical wireless behind-the-neck headset		RLN6490		Behind-the-neck	Dual-ear		Boom	Radio, headset or wireless PTT pod		Heavy-duty
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 APX 2000 APX 900 SRX 2200		XBT operations critical wireless headband style headset		RLN6491		Over-the-head	Dual-ear		Boom	Radio, headset or wireless PTT pod		Heavy-duty

† HazLoc Details: For more information on which accessories are approved by Underwriters' Laboratory (UL) with certain APX models, please consult the manual provided with each UL-approved APX portable.

* Also compatible with AP8000H and APX8000HXE.



APX portable radio accessories

COMPATIBILITY	ACCESSORY		FEATURES							
3M PELTOR HEAVY DUTY HEADSETS										
PORTABLE RADIOS	DESCRIPTION AND ADAPTER TYPE		PART NUMBER	HEADSET TYPE	CONNECTOR TYPE	SPEAKER	NOISE REDUCTION RATING (NRR)	NOISE - CANCELLING MICROPHONE	PTT (APX)	HAZLOC - CAPABLE†
DIRECT CONNECT										
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 SRX 2200		MT series over-the-head headset, direct radio connect	RMN5137	Over-the-head	Connects directly to Radio	Dual-ear	25dB	Boom	On ear cup	UL
		MT series neckband headset, direct radio connect	RMN5138	Neckband	Connects directly to Radio	Dual-ear	24dB	Boom	On ear cup	UL
		MT series hard hat attached headset, direct radio connect	RMN5139	Hard hat attached	Connects directly to Radio	Dual-ear	21dB	Boom	On ear cup	UL
PTT ADAPTER CONFIGURATIONS										
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 APX 2000 SRX 2200		MT series neckband headset with nexus connector	RLN6477 (limited availability)	Neckband	Nexus	Dual-ear	24dB	Boom	Requires PTT adapter PMLN6095	
		TacticalPro series neckband headset with nexus connector	RMN5135 (limited availability)	Neckband	Nexus	Dual-ear	25dB	Boom	Requires PTT adapter PMLN6095	
		PTT nexus adapter. requires one of the six headsets listed directly above	PMLN6095							
HEADSET REPLACEMENT PARTS										
APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 APX 2000 SRX 2200		Earmuff hygiene kit black ear seals	RLN4923							
		Boom microphone wind screen	RLN6543							

† HazLoc Details: For more information on which accessories are approved by Underwriters' Laboratory (UL) with certain APX models, please consult the manual provided with each UL-approved APX portable.



APX portable radio accessories

COMPATIBILITY		ACCESSORY		FEATURES			
HEARING PROTECTION							
PORTABLE RADIOS	DESCRIPTION	PART NUMBER	IMPRES	HEADSET TYPE	SPEAKER	NOISE-CANCELLING / NOISE-REDUCTION	
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 APX 2000 APX 1000 APX 900 SRX 2200		Clear EP7-Small Hearing Protectors [Sonic Defenders] Ultra Earplugs, noise reduction = 28dB	RLN6511		Comply™ Foam Ear tip	Noise-Reduction	
		Clear EP7-Medium Hearing Protectors [Sonic Defenders] Ultra Earplugs, noise reduction = 28dB	RLN6512		Comply™ Foam Ear tip	Noise-Reduction	
		Clear EP7-Large Hearing Protectors [Sonic Defenders] Ultra Earplugs, noise reduction = 28dB	RLN6513		Comply™ Foam Ear tip	Noise-Reduction	
TACTICAL SOLUTIONS							
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 APX 2000 SRX 2200		Tactical PTT/VOX Interface Module	PMLN6765				
		Tactical PTT Only Interface Module	PMLN6827				
		Tactical Boomless Temple Transducer Requires Interface Module PMLN6765 or PMLN6827.	PMLN6766		Over-the-Head	Bone Conduction	Noise-Cancelling
		Tactical Throat Microphone Requires Interface Module PMLN6765 or PMLN6827.	PMLN6828		Neckband	Earbud	Noise-Cancelling
		Tactical Ear Microphone Requires Interface Module PMLN6765 or PMLN6827.	PMLN6829		In-Ear	In-Ear	Noise-Cancelling
		Tactical Temple Transducer / Boom Mic Requires Interface Module PMLN6765 or PMLN6827.	PMLN6833		Over-the-Head	Bone Conduction	Noise-Cancelling
		Tactical Remote Body PTT For use with Interface Module PMLN6765 or PMLN6827.	PMLN6767				
		Tactical Remote Ring PTT For use with Interface Module PMLN6765 or PMLN6827.	PMLN6830				

What are the EP7 sonic defenders ultra earplugs?

RLN6511, RLN6512, RLN6513
The EP7 Sonic Defenders Ultra
 Earplugs provide extra comfort and/or noise protection for users wearing surveillance accessories or users wearing heavy duty headsets / helmets. With a foam-tipped stem design and soft memory-foam Comply™ Canal Tips, these comfortable earplugs protect your hearing without blocking your ability to hear routine sounds or conversations. Safe sounds are allowed to pass through into the ear canal, while potentially harmful noises (above 85dB) are reduced through a filter.

Filter caps are included and can be inserted for additional hearing protection or removed for use with surveillance kits.* With a patented EarLock® technology to hold them in place, all-day comfort, and a low-profile design, these earplugs can be worn while wearing a helmet or mask, or while using a phone or heavy duty headset. Lanyard is included in each earplug kit.

Motorola's Tactical Solution offers a high performance interface enhanced by high speed DSP (Digital Signal Processor) which only detects the human voice.

Providing steady and trouble free transmission without clipping your message even in the noisiest environments.

Combined with various headsets assures efficient and safer operation in a variety of work environments.





IMPRES 2 – A new generation. completely re-energized.

With IMPRES 2 chargers, you can charge IMPRES 2 batteries up to 40% faster. Customize your charging to extend the life of batteries in storage. And manage power more intelligently with enhanced diagnostics, so you get the most from each battery. IMPRES 2 batteries have been improved inside and out, so your team can tackle whatever the day brings. With higher capacity, you'll get more talk time. With better water resistance, you'll never think twice about submersion. And with the ability to charge up to 60% more times than standard Lithium Ion batteries, you'll reduce costs.



APX portable radio accessories

COMPATIBILITY	ACCESSORY		FEATURES								
MOTOROLA IMPRES 2 BATTERIES											
PORTABLE RADIOS	DESCRIPTION		PART NUMBER	IMPRES	CHEMISTRY	TYPICAL RATED CAPACITY (MAH)	DIMENSIONS (MILLIMETERS) (H X W X D)	WEIGHT (MAX.GRAMS)	HAZLOC-CAPABLE ¹	IP RATING	OPERATING TEMPERATURE
APX 8000 APX 7000 APX 7000XE APX 6000 APX 6000XE APX 2000 SRX 2200		IMPRES 2 Li-Ion 3400 mAh battery, IP68 rugged	PMNN4486	●	Li-Ion	3400	86 x 59 x 42	185		IP68 rugged	-20°C to +60°C
		IMPRES 2 Li-Ion 2550 mAh battery, IP68 rugged	PMNN4485	●	Li-Ion	2550	86 x 59 x 37	150		IP68 rugged	-20°C to +60°C
		IMPRES 2 Li-Ion 4850 mAh battery, IP68 rugged, -30°C rated	PMNN4487	●	Li-Ion	4850	130 x 59 x 42	320		IP68 rugged	-30°C to +60°C
		IMPRES 2 Li-Ion 5100 mAh battery, IP68 rugged	PMNN4494	●	Li-Ion	5100	130 x 59 x 42	320		IP68 rugged	-20°C to +60°C
APX 6000 APX 6000XE SRX 2200 APX 8000H APX 8000HXE		IMPRES 2 Li-Ion 3100 mAh battery, IP68 rugged	PMNN4547 ²	●	Li-Ion	3100	86 x 59 x 45	200	UL	IP68 rugged	-20°C to +60°C
		IMPRES 2 Li-Ion 4600 mAh battery, IP68 rugged	PMNN4573 ²	●	Li-Ion	4600	130 x 59 x 42	320	UL	IP68 rugged	-20°C to +60°C
APX 8000XE		IMPRES 2 Li-Ion 3400 mAh battery, IP68 rugged	PMNN4504	●	Li-Ion	3400	86 x 59 x 42	185	UL	IP68 rugged	-20°C to +60°C
		IMPRES 2 Li-Ion 4850 mAh Battery, IP68 rugged, -30°C rated	PMNN4505	●	Li-Ion	4850	130 x 59 x 42	320	UL	IP68 rugged	-30°C to +60°C

¹ HazLoc Details: For more information on which accessories are approved by Underwriters' Laboratory (UL) with certain APX models, please consult the manual provided with each UL-approved APX portable.

² Require radio firmware R25.01.00 or greater otherwise the radio fuel gauge will be inaccurate; MTN-0222-21-NA.





Increased capacity

Do more without the bulk.

First responders, public works employees, and other professionals know that shifts aren't getting any shorter. Thankfully, you can keep your people connected even longer. IMPRES 2 batteries deliver higher capacity without an increase in size.



Durable design

Tackle the toughest conditions.

Wherever the job takes you, be confident your battery will be up to the challenge. All IMPRES 2 batteries share the same IP68 rating as APX radios, which means they can be fully submersed in two meters of water for up to four hours. Designed with a rugged housing, they're as tough as the radios they charge. And in test after test, IMPRES 2 batteries continually withstand shocks, knocks, drops and shakes, outperforming the competition every time.



Extended battery life

Extended life. Built to last.

You face challenges every day. Battery life shouldn't be one of them. IMPRES 2 batteries, when combined with an IMPRES 2 charger, deliver up to 60% more charging cycles than traditional Lithium Ion batteries, so they're on the job longer. Which means you can stock fewer spares, and replace fewer batteries. We've also extended our capacity warranty from 18 to 24 months*, while backing all IMPRES batteries with a long 48 month workmanship warranty. IMPRES 2 batteries are compatible with all existing IMPRES chargers, so your upgrade will be a smooth one.

*IMPRES 2 batteries not charged exclusively in IMPRES 2 chargers receive a 6 month capacity warranty reduction to 18 months instead of 24 months.



APX portable radio accessories

COMPATIBILITY		ACCESSORY		FEATURES							
MOTOROLA IMPRES BATTERIES The only batteries developed, tested and certified for optimal performance with your APX radio. APX batteries are Proven Tough, in lab test after lab test, to withstand shocks, knocks, drops and shakes and outperform the other brands.											
PORTABLE RADIOS	DESCRIPTION		PART NUMBER	IMPRES	CHEMISTRY	TYPICAL RATED CAPACITY (MAH)	DIMENSIONS (MILLIMETERS) (H X W X D)	WEIGHT (MAX.GRAMS)	HAZLOC-CAPABLE†	IP RATING	OPERATING TEMPERATURE
APX 7000 APX 7000XE APX 6000 APX 6000XE SRX 2200		APX clamshell battery pack, IP57 requires 12 AA Alkaline batteries (not included).	PMNN4439		AA Alkaline/Li-Ion	Alkaline: 2700 Li-Ion: 6100	165 x 60 x 60	Alkaline: 476 Li-Ion: 380		IP57	
SRX 2200		Military, Li-Ion 3100 mAh, battery IP68 rugged, coyote brown	NNTN8182		Li-Ion	3100	86 x 59 x 42	185		IP68 Rugged	-20°C to +60° C
APX 4000 APX 3000 APX 2000 APX 1000 APX 900		IMPRES Li-Ion 2000 mAh slim battery, IP67	NNTN8128	●	Li-Ion	2000	115 x 52 x 18	160		IP67	-20°C to +60° C
		IMPRES Li-Ion 2350 mAh battery, IP67	PMNN4424	●	Li-Ion	2350	115 x 52 x 23	170		IP67	-10°C to +60° C
		IMPRES Li-Ion 2800 mAh battery, IP67	PMNN4448	●	Li-Ion	2800	115 x 52 x 23	170		IP67	-10°C to +60° C
 APX 900		IMPRES Li-Ion 2900 mAh battery, IP68	PMNN4489	●	Li-Ion	2900	115 x 52 x 23	170	UL	IP68	-10°C to +60° C
		IMPRES Li-Ion 2100 mAh battery, IP68	PMNN4491	●	Li-Ion	2100	115 x 52 x 18	160		IP68	-10°C to +60° C
		IMPRES Li-Ion 3000 mAh battery, IP68	PMNN4493	●	Li-Ion	3000	115 x 52 x 23	170		IP68	-10°C to +60° C
APX 4000 APX 3000 APX 2000 APX 1000		IMPRES Li-Ion 2500 mAh battery, IP57	NNTN8560	●	Li-Ion	2500	113 x 52 x 23	195	UL	IP57	-10°C to +60° C
 APX 3000		IMPRES Li-Ion 1300 mAh sim battery, IP67	NNTN8305	●	Li-Ion	1300	115 x 52 x 14	98		IP67	-10°C to +60° C

† HazLoc Details: For more information on which accessories are approved by Underwriters' Laboratory (UL) with certain APX models, please consult the manual provided with each UL-approved APX portable.



APX portable radio accessories

COMPATIBILITY	ACCESSORY		FEATURES								
CHARGER SOLUTIONS Choose from a variety of solutions including single-unit, unique dual-unit, multi-unit, travel and vehicular chargers and be confident your radio is charged and ready to go the moment you need it.											
PORTABLE RADIOS	DESCRIPTION		PART NUMBER	IMPRES	CHEMISTRY	POWER SOURCE	DIMENSIONS (MILLIMETERS) (H X W X D)	NUMBER OF POCKETS	RECONDITIONING CAPABLE	CHARGING CURRENT (MAX.)*	NUMBER OF DISPLAYS
SINGLE AND MULTI-UNIT CHARGERS											
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE SRX 2200		IMPRES 2 single-unit fast charger, US/NA 115V	NNTN8860	●	Li-Ion, NiMH	115VAC	75 x 100 x 125	1	●	Fast	
		IMPRES 2 single-unit fast charger, 115V, TAA compliant	NNTN8860 TAA	●	Li-Ion, NiMH	115VAC	75 x 100 x 125	1	●	Fast	
		IMPRES 2 single-unit fast charger	NNTN8863- US/NA PLUG, 100-240V NNTN8863- LACR, 100-240V NNTN8858 - EU, 240V NNTN8864 - EU PLUG, 120-240V NNTN8857 - BRZ, 100-240V NNTN8855A - ARG, 240V NNTN8856 - ANZ, 240V NNTN8865 - UK, 100-240V	●	Li-Ion, NiMH	100-240VAC	75 x 100 x 125	1	●	Fast	
APX 4000 APX 3000 APX 2000 APX 1000 APX 900		IMPRES single-unit charger, US/NA 115V	PMPN4576A PMPN4571 - ANZ, 240V PMPN4572 -UK, 240V PMPN4573 -ARG, 240V PMPN4575 -BRZ, 90 -260V PMPN4577 -EU, 240V	●	Li-Ion, NiMH	115VAC	51 x 88 x 94	1	●	Rapid rate	
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE SRX 2200		IMPRES 2 multi-unit fast charger with 6 displays and 6 integrated USB charging ports, US/NA 100-240V	NNTN8844A - US/NA NNTN8839 - ANZ NNTN8841 -BRZ	●	Li-Ion, NiMH	100-240VAC	153 x 445 x 292	6	●	Fast	6
APX 4000 APX 3000 APX 2000 APX 1000 APX 900		IMPRES multi-unit charger, 100-240V	PMPN4284 - US/NA PMPN4293 - ANZ PMPN4290 - UK PMPN4291 - ARG PMPN4292 - BRZ PMPN4289 - EU	●	Li-Ion, NiMH	115VAC	117 x 444 x 170	6	●	Rapid rate	1
		Pocket to use with IMPRES 2 multi-unit charger	AS000129A01								
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE SRX 2200		Wall mount bracket for IMPRES multi-unit chargers NNTN8844	NLN7967								
APX 4000 APX 3000 APX 2000 APX 1000 APX 900		Wall mount bracket for PMPN4284 charger	BR000272A01								

*Fast = up to 3.0A rapid rate = up to 1.5A



APX portable radio accessories

COMPATIBILITY	ACCESSORY	FEATURES						
CHARGER SOLUTIONS Choose from a variety of solutions including single-unit, unique dual-unit, multi-unit, travel and vehicular chargers and be confident your radio is charged and ready to go the moment you need it.								
PORTABLE RADIOS	DESCRIPTION	PART NUMBER	IMPRES	CHEMISTRY	POWER SOURCE	DIMENSIONS (MILLIMETERS) (H X W X D)	NUMBER OF POCKETS	CHARGING CURRENT (MAX.)
VEHICULAR, TRAVEL CHARGERS AND VEHICULAR ADAPTER								
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE SRX 2200	 IMPRES single-unit rapid rate vehicular charger	NNTN7624	•	Li-Ion, NiMH	12VDC hardwire	82 x 97 x 200	1	Rapid rate
APX 4000 APX 3000 APX 2000 APX 1000 APX 900	 IMPRES single-unit rapid rate vehicular charger	NNTN7616	•	Li-Ion, NiMH	12VDC hardwire	82 x 97 x 200	1	Rapid rate
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE SRX 2200	 Travel charger with voltage regulated vehicular charger adapter, custom charger base, mounting bracket, and coil cord	RLN6434		Li-Ion, NiMH	12VDC cigarette lighter adapter	67 x 67 x 70	1	
APX 4000 APX 3000 APX 2000 APX 1000 APX 900	 Travel charger with voltage regulated vehicular charger adapter, custom charger base, mounting bracket, and coil cord	NNTN8525		Li-Ion, NiMH	12VDC cigarette lighter adapter	64 x 67 x 57	1	
APX 8000 APX 8000XE APX 6000 APX 6000XE SRX 2200	 APX vehicular adapter includes fused power cable, 2 keys for the lock, screws for attaching vehicular adapter to the trunnion mounting bracket & quick start guide. Trunnion mounting bracket NTN8940 ordered separately.	NNTN8527		Li-Ion	12VDC hardwire	254 x 137 x 84	1	Rapid rate
	 Trunnion mounting bracket	NTN8940						



APX portable radio accessories

COMPATIBILITY		ACCESSORY
CHARGER SOLUTIONS		
PORTABLE RADIOS	DESCRIPTION	PART NUMBER
IMPRES BATTERY MANAGEMENT TOOLS		
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 APX 2000 APX 1000 APX 900 SRX 2200	 IMPRES Battery Fleet Management Software	https://www.motorolasolutions.com/en_us/products/two-way-radio-accessories/impres-battery-fleet-management.html
	 IMPRES Battery Fleet Management License Key (EID)	HKVN4036A (NA) HKVN4037A (EMEA) HKVN4038A (LACR) HKVN4039A (APAC)
	 IMPRES 2 single unit charger reprogramming and Battery Fleet Management interface cable*	NNTN8870

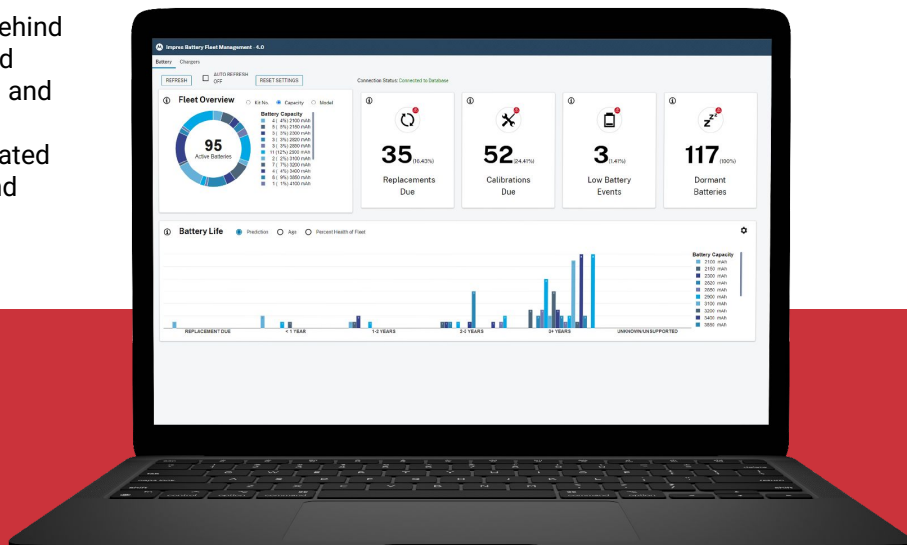
*Only supported by NNTN8860, NNTN8860_TAA, NNTN8863

Battery fleet management

Battery Fleet Management mitigates efforts behind the complexity and costs related to battery and charger management, making it easier for you and your employees to work safely and efficiently. Ensure optimal fleet performance with an updated user interface, meant to ease management and analytics capabilities.



Scan QR code to view the IMPRES Battery Fleet Management brochure.



When the IMPRES Battery Fleet Management software collects critical data, it allows you to analyze key aspects of the battery, such as battery age, capacity, recondition history and manufacturing and service dates. This information is then compiled into an accessible, user-friendly layout, so you are able to efficiently understand your devices' data. No other manufacturer delivers this patented technology and comprehensive capabilities.

For details on the 3 BFM on-premise configurations and how to order the Entitlement ID, view the [Ordering and Deployment Guide](#). The IMPRES Battery Fleet Management Software is available to download from Motorola Solutions' internal [MyView](#) portal.



Carry solutions

Motorola Carry Solutions were developed to meet the demands of public safety and other users who operate in the most rigorous of environments. A variety of carrying accessories are available for comfort and convenience.



APX portable radio accessories

COMPATIBILITY	ACCESSORY			FEATURES				
CARRY SOLUTIONS Carry cases and holders are available in sizes to fit your radio and battery and permit audio to be heard clearly. Our carry accessories keep your hands free, so you can concentrate on the task at hand.								
PORTABLE RADIOS	DESCRIPTION		PART NUMBER	MATERIAL	BELT LOOP/CLIP DIMENSION (INCHES)	SWIVEL / FIXED	D-RINGS	COMPATIBLE BATTERIES
APX 8000HXE	Carry holder for 2.5 and 3.5 model radios		PMLN7954	Plastic	2.5	Fixed		
	Leather carry case with D-ring		PMLN7955	Hard leather			●	
APX 7000		Carry holder for 1.5, 2.5 and 3.5 model radios	PMLN5331	Plastic	3	Fixed		
APX 7000XE		Carry holder for 1.5, 2.5 and 3.5 model radios	PMLN6102	Plastic	3	Fixed		
APX 8000 APX 6000		Carry Holder for 1.5, 2.5 and 3.5 Model Radios	PMLN7901	Plastic	2.5	Fixed		
APX 8000XE APX 6000XE		Carry holder for 1.5, 2.5 and 3.5 model radios	PMLN7902	Plastic	2.5	Fixed		
APX 3000		Covert carry holster	PMLN6327	Plastic	3	Fixed		
APX 7000		Leather carry case with 3" fixed belt loop	PMLN5323	Hard leather	3	Fixed	●	NNTN7038 NNTN8092 NNTN8930 PMNN4403 PMNN4485 PMNN4486
		Leather carry case with 3" fixed belt loop	PMLN5326	Hard leather	3	Fixed	●	NNTN7033 NNTN7034 NNTN8921 PMNN4487 PMNN4494
		Leather carry case with 3" fixed belt loop	PMLN5329	Hard leather	3	Fixed	●	NNTN7035 NNTN7036 NNTN7037 NNTN7573
APX 8000 APX 7000 APX 6000 SRX 2200		Universal carry holster	PMLN7732	Plastic	2.5	Fixed		PMNN4486, PMNN4485 PMNN4487, PMNN4494 NNTN8930, NNTN8921 PMNN4504, PMNN4505 NNTN8092, NNTN7033 NNTN7037, NNTN7573 NNTN7036, NNTN7035 PMNN4439



Leather carry cases

Motorola Leather Carry Cases constructed of top-grain leather are designed to withstand the harsh conditions of public safety users.

APX portable radio accessories

COMPATIBILITY	ACCESSORY		FEATURES					
CARRY SOLUTIONS								
PORTABLE RADIOS	DESCRIPTION		PART NUMBER	MATERIAL	BELT LOOP/CLIP DIMENSION (INCHES)	SWIVEL / FIXED	D-RINGS	COMPATIBLE BATTERIES
APX 7000		Leather carry case with D-rings and 2.75" swivel belt loop	PMLN5324	Hard leather	2.75	Swivel		NNTN7038 NNTN8092 NNTN8930 PMMN4403 PMNN4485 PMNN4486
		Leather carry case with D-rings and 2.75" swivel belt loop	PMLN5327	Hard leather	2.75	Swivel		NNTN7033 NNTN7034
		Leather carry case with D-rings and 2.75" swivel belt loop	PMLN5330	Hard leather	2.75	Swivel		NNTN7035 NNTN7036 NNTN7037 NNTN7573
		Dual display radio flip leather carry case with 2.75" swivel belt loop	PMLN5560	Hard leather	2.75	Swivel		NNTN7038 NNTN8092 PMMN4403
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE		Molded nylon carry case with quick disconnect swivel and adjustable lanyard	PMLN6802	Nylon		Swivel		
APX 7000XE		Leather carry case with 3" fixed belt loop	NNTN8112	Hard leather	3	Fixed		NNTN7038 NNTN8092 PMMN4403
		Leather carry case with 3" fixed belt loop	NNTN8114	Hard leather	3	Fixed		NNTN7033 NNTN7034
		Leather carry case with 3" fixed belt loop	NNTN8116	Hard leather	3	Fixed		NNTN7035 NNTN7036 NNTN7037 NNTN7573



APX portable radio accessories

COMPATIBILITY			ACCESSORY	FEATURES				
CARRY SOLUTIONS								
PORTABLE RADIOS	DESCRIPTION		PART NUMBER	MATERIAL	BELT LOOP/CLIP DIMENSION (INCHES)	SWIVEL/FIXED	D-RINGS	COMPATIBLE BATTERIES
APX 7000XE		Leather carry case with 2.75" swivel belt loop	NNTN8111	Hard leather	2.75	Swivel		NNTN7038 NNTN8092 PMMN4403
		Leather carry case with D-Rings and 2.75" Swivel Belt Loop	NNTN8113	Hard leather	2.75	Swivel	●	NNTN7033 NNTN7034 PMMN4487 PMMN4494 NNTN8921
		Leather carry case with d-rings and 2.75" swivel belt loop	NNTN8115	Hard leather	2.75	Swivel	●	NNTN7035 NNTN7036 NNTN7037 NNTN7573
		Boston leather carry case with D-rings – requires an audio accessory, radio strap holds down radio by strapping over the audio accessory connector, used with boston leather radio straps	AY000222A01	Hard leather			●	
APX 8000 APX 6000		Leather carry case with 3" fixed belt loop	PMLN7903	Hard leather	3	Fixed	●	NNTN7038 NNTN8092 PMMN4403 PMMN4485 PMMN4486 PMMN4547 NNTN8930 (for APX 6000)
		Leather carry case with 3" fixed belt loop	PMLN5660	Hard leather	3	Fixed	●	NNTN7033 NNTN7034 PMMN4487 PMMN4494 NNTN8921 (for APX 6000)
		Leather carry case with D-rings and 2.75" swivel belt loop	PMLN7904	Hard leather	2.75	Swivel	●	NNTN8092 PMMN4485 PMMN4486 PMMN4547 NNTN8930 (for APX 6000)
		Leather carry case with D-rings and 2.75" swivel belt loop	PMLN5659	Hard leather	2.75	Swivel	●	NNTN7033 NNTN7034 PMMN4487 PMMN4494 NNTN8921 (for APX 6000)
APX 8000XE APX 6000XE		Leather carry case with 3" fixed belt loop	PMLN7905	Hard leather	3	Fixed	●	NNTN7038 NNTN8092 PMMN4403 PMMN4547 PMMN4485 (for APX 6000XE) PMMN4486 (for APX 6000XE) NNTN8930 (for APX 6000XE) PMMN4504 (for APX 8000XE)



APX portable radio accessories

COMPATIBILITY	ACCESSORY			FEATURES				
CARRY SOLUTIONS								
PORTABLE RADIOS	DESCRIPTION		PART NUMBER	MATERIAL	BELT LOOP/CLIP DIMENSION (INCHES)	SWIVEL/FIXED	D-RINGS	COMPATIBLE BATTERIES
APX 8000XE APX 6000XE		Leather carry case with 3" fixed belt loop	PMLN5879	Hard leather	3	Fixed	●	NNTN7033 NNTN7034 PMNN4487 (for APX 6000XE) PMNN4494 (for APX 6000XE) NNTN8921 PMNN4573 (for APX 6000XE) PMNN4505 (for APX 8000XE)
		Leather carry case with D-Rings and 2.75" swivel belt loop	PMLN7906	Hard leather	2.75	Swivel	●	NNTN7038 NNTN8092 PMMN4403 PMNN4547 PMNN4485 (for APX 6000XE) PMNN4486 (for APX 6000XE) NNTN8930 (for APX 6000XE) PMNN4504 (for APX 8000XE)
		Leather carry case with D-Rings and 2.75" swivel belt loop	PMLN5877	Hard leather	2.75	Swivel	●	NNTN7033 NNTN7034 PMNN4487 PMNN4573 (for APX 6000XE) PMNN4494 (for APX 6000XE) NNTN8921 (for APX 6000XE) PMNN4505 (for APX 8000XE)
APX 4000 APX 2000 APX 1000		Leather carry case with 2.75" swivel belt loop, for one-knob radios* (D-stud is on carry case)	PMLN6085	Hard leather	2.75	Swivel	●	
		Leather carry case with 2.75" swivel belt loop, for two-knob radios (D-stud is on belt loop)	PMLN7182	Hard leather	2.75	Swivel	●	
		Replacement swivel belt loop for PMLN7182	PMLN7229	Hard leather	2.75	Swivel		
SRX 2200		Nylon, coyote brown carry pouch designed to fit elite special ops "molle" vest (sold separately)	NNTN8269	Nylon	Up to 5	Fixed		
		Coyote brown carry case	RLN6253	Nylon	Up to 5	Fixed		
APX 7000		Nylon carry case with 3" fixed belt loop	PMLN5322	Nylon	3	Fixed	●	NNTN7038 PMMN4403 NNTN8092
		Nylon carry case with 3" fixed belt loop	PMLN5325	Nylon	3	Fixed	●	NNTN7033 NNTN7034
		Nylon carry case with 3" fixed belt loop	PMLN5328	Nylon	3	Fixed	●	NNTN7035 NNTN7036 NNTN7037 NNTN7573

*For APX4000 One Knob Radios only



APX portable radio accessories

COMPATIBILITY	ACCESSORY			FEATURES				
CARRY SOLUTIONS								
PORTABLE RADIOS	DESCRIPTION		PART NUMBER	MATERIAL	BELT LOOP/CLIP DIMENSION (INCHES)	SWIVEL/FIXED	D-RINGS	COMPATIBLE BATTERIES
APX 900		Leather carry case with 3" fixed belt loop	PMLN5838	Hard Leather	3	Fixed		PMNN4424 PMNN4491 PMNN4493 PMNN4489 PMNN4448 NNTN8128
		Leather carry case with 2.5" swivel belt loop	PMLN5842	Hard Leather	2.5	Swivel		
		Leather carry case with 3" swivel belt loop	PMLN5840	Hard Leather	3	Swivel		
		Nylon carry case with 3" fixed belt loop	PMLN5844	Nylon	3	Fixed		
APX 7000 APX 7000XE APX 6000 APX 6000XE SRX 2200		Carry case for APX Radio with clamshell battery	PMLN6712	Nylon	Up to 5	Fixed		
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE		2.5" hard plastic belt clip (not compatible with APX 7000 UHF radios)	NTN8266	Plastic	2.5			
		3" hard plastic belt clip	HLN6875	Plastic	3			
		Universal chest pack with radio holder, pen holder and velcro secured pouch	HLN6602	Nylon				
		Break-a-way chest pack with radio holder pen holder and velcro secured pouch	RLN4570	Nylon				
		Replacement strap for HLN6602 and RLN4570	1505596Z02	Nylon				
		Accessory connector dust cover	1575250H01					
SRX 2200		Accessory connector dust cover	1575250H02					
APX 4000 APX 2000 APX 1000 APX 900		2" hard plastic belt clip	PMLN4651	Plastic				
		2.5" hard plastic belt clip	PMLN7008	Plastic				
		Accessory connector dust cover	15012157001					



APX portable radio accessories

COMPATIBILITY	ACCESSORY			FEATURES	
CARRY SOLUTIONS					
PORTABLE RADIOS	DESCRIPTION		PART NUMBER	BELT LOOP/BELT DIMENSION (INCHES)	MATERIAL
APX 900		Replacement 2.5" leather swivel belt loop	PMLN5610	2.5"	Hard leather
		Replacement 3" leather swivel belt loop	PMLN5611	3"	Hard leather
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE		Replacement 2.5" leather swivel belt loop	PMLN5407	2.5"	Hard leather
		Replacement 2.75" leather swivel belt loop	PMLN5408	2.75"	Hard leather
		Replacement 3" leather swivel belt loop	PMLN5409	3"	Hard leather
APX 7000XE	Replacement carry case strap with snaps, long. used with NNTN8111, NNTN8112, NNTN8113, NNTN8114, NNTN8115 and NNTN8116		PMLN5800	3"	Leather
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 2000 SRX 2200		1.75" wide leather belt	4200865599	Up to 41"	Leather
		Adjustable nylon carrying strap	NTN5243	Up to 36"	Nylon
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 APX 2000 SRX 2200		Boston leather fireman's radio strap	RLN6486	Up to 62"	Leather
		Boston leather fireman's radio strap - XL	RLN6487	Up to 70"	Leather
		Boston leather fireman's radio strap with button back holder	AY000223A01	Up to 51"	Leather
		Boston leather fireman's radio strap with button back holder - XL	AY000229A01	Up to 54"	Leather
		Boston leather anti-sway strap for boston leather fireman's radio strap	RLN6488	Up to 9"	Leather



APX portable radio accessories

COMPATIBILITY			ACCESSORY		FEATURES				
ANTENNAS									
PORTABLE RADIOS	DESCRIPTION		PART NUMBER	UHF/VHF/ 700/800 MHZ	FREQUENCY BAND (MHZ)	INTEGRATED GPS	LENGTH (CM)	TYPE	HAZLOC- CAPABLE†
APX 8000 APX 8000H APX 8000HXE APX 6000BN APX 4000 APX 2000		700/800 MHz, GPS whip antenna	PMAF4040	700/800	764-870	•	20.3	Whip	UL
APX 8000 APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE APX 4000 APX 3000 APX 2000 APX 1000 SRX 2200		700/800 MHz, GPS whip antenna	NAF5085	700/800	764-870	•	20.3	Whip	UL
		UHF, GPS whip antenna	PMAE4065	UHF	380-520	•	14.2	Whip	UL
APX 6000 APX 6000XE APX 4000 APX 2000 APX 3000 APX 1000 SRX 2200		VHF, GPS whip antenna	NAR6593	VHF	136-174	•	20	Whip	UL
APX 4000 APX 2000		900 MHz, GPS antenna	PMAF4008	800/900	896-941	•	18	Whip	
		800/900 MHz, GPS combination helical antenna	PMAF4003	800/900	806-941	•	18	Helical	UL
APX 8000 APX 8000XE APX 7000 APX 6000 APX 6000XE APX 4000 APX 2000 APX 1000		1/4 Wave, 700/800 MHz, GPS stubby antenna	NAR6595	700/800	764-870	•	9.8	Stubby	UL
APX 8000		VHF, 700/800, UHF Range 1, UHF range 2 GPS (radio only)	KT000026A01	VHF 700/800	136-174 764-870	•	20	Whip	UL
APX 8000 APX 8000XE APX 7000 APX 7000XE		VHF, 700/800 MHz dual band, GPS whip antenna	NAR6594	VHF 700/800	136-174 764-870	•	20	Whip	UL
		VHF, UHF Dual Band, GPS whip antenna	PMAT4001	VHF UHF	136-174 380-520	•	21.8	Whip	UL
		UHF 700/800 MHz dual band, GPS whip antenna	PMAS4001	UHF 700/800	380-520 764-870	•	19.7	Whip	UL

† HazLoc Details: For more information on which accessories are approved by Underwriters' Laboratory (UL) with certain APX models, please consult the manual provided with each UL-approved APX portable.



APX portable radio accessories

COMPATIBILITY	ACCESSORY		FEATURES						
ANTENNAS									
PORTABLE RADIOS	DESCRIPTION		PART NUMBER	UHF/VHF/ 700/800 MHZ	FREQUENCY BAND (MHZ)	INTEGRATED GPS	LENGTH (CM)	TYPE	HAZLOC- CAPABLE†
APX 900		UHF, flexible whip antenna	PMAE4022	UHF	403-470		16	Flexible whip	UL
		VHF, 136-147 MHz, stubby antenna	PMAD4093	VHF	136-147		11	Stubby	UL
		VHF, 147-160 MHz, Stubby antenna	PMAD4094	VHF	147-160		11	Stubby	UL
		VHF, 160-174 MHz, stubby antenna	PMAD4095	VHF	160-174		11	Stubby	UL
		700/800 MHz flexible whip antenna	NAF5080	700/800	764-870		6.5	Flexible whip	
		Coaxial flexible whip antenna, 896-941 MHz	NAF5088	900	896-941		7	Flexible whip	
		VHF, 136-174 MHz, flexible whip wideband antenna	PMAD4088	VHF	136-174		8.3	Flexible whip	UL
		700/800 MHz stubby antenna	PMAF4022	700/800	764-870		9	Stubby	
		UHF, 380-470 MHz, stubby antenna	PMAE4100	UHF	380-470		9	Stubby	UL
		UHF, 450-527 MHz, stubby antenna	PMAE4102	UHF	450-527		9	Stubby	UL
		UHF, 420-445Mhz, stubby antenna	PMAE4094	UHF	420-445		4.5	Stubby	

† HazLoc Details: For more information on which accessories are approved by Underwriters' Laboratory (UL) with certain APX models, please consult the manual provided with each UL-approved APX portable.



APX portable radio accessories

COMPATIBILITY	ACCESSORY			FEATURES					
ANTENNAS									
PORTABLE RADIOS	DESCRIPTION		PART NUMBER	UHF/VHF/ 700/800 MHZ	FREQUENCY BAND (MHZ)	INTEGRATED GPS	LENGTH (CM)	TYPE	HAZLOC- CAPABLE†
APX 6000 APX 6000XE APX 4000 APX 2000 APX 1000		UHF range 1, gps stubby antenna	FAF5259	UHF	380-470	●	9.3	Stubby	UL
		UHF range 2, gps stubby antenna	FAF5260	UHF	470-520	●	9.3	Stubby	UL
APX 7000 (700/800 MHz only) APX 6000 (700/800 MHz only)		GPS antenna (directly connected to radio when a public safety microphone is used)	NAG4000	700/800		●	7.9	Stubby	
		700/800 public safety microphone only stubby antenna	PMAF4002	700/800	764-870		9	Stubby	
APX 3000		Flexible antenna with one flexible antenna spacer, 700/800 MHz	PMAF4006	700/800	764-870	●	41	Flexible	
		Flexible antenna with three flexible antenna spacers, UHF	PMAE4080	UHF	308-470	●	77	Flexible	
		Flexible antenna with two flexible antenna spacers, VHF	PMAD4125	VHF	136-174	●	44	Flexible	
PROGRAMMING CABLES									
APX 8000XE APX 7000 APX 7000XE APX 6000 APX 6000XE (700/800 MHz only) APX 4000 APX 3000 APX 2000 APX 1000 APX 900 SRX 2200		Programming and test cable	PMKN4013						
		Programming cable (not compatible with APX 900)	PMKN4012						

† HazLoc Details: For more information on which accessories are approved by Underwriters' Laboratory (UL) with certain APX models, please consult the manual provided with each UL-approved APX portable.





APX mobile radio accessories

Communicate safely and easily wherever you go

You count on your mobile radio to function clearly and easily so you can concentrate on the mission and communicate safely. Get the most out of your APX radio by extending its power and reliability with APX accessories. Every mobile microphone, speaker, alarm and control station accessory is best-in-class technology, designed and optimized specifically for your APX mobile. There's simply no substitute for APX accessories.



APX 8500

NA
LACR
EMEA
Australia
APAC



APX 6500 Enhanced

NA
EMEA
Australia
APAC



APX 4500

NA only



APX 1500

NA
LACR
EMEA
APAC

For control head options, check with your Motorola Solutions representative. Not all APX radios are available in all regions.

Discontinued APX mobile radio models

APX 6500
AN
APX 7500

CAM #26-0710
Exhibit 4C
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Long range wireless remote speaker microphone (RSM)

The Long Range Wireless Remote Speaker Microphone (RSM) pairs instantly with touch pairing to the mobile microphone with Bluetooth gateway. The Long Range Wireless RSM works up to 100 meters away line-of-sight from the mobile radio, keeping you in communication where you never thought possible. Plug and play – Just attach the mobile gateway microphone to your radio, align the two devices where indicated by the blue dot and you are ready to go. Voice prompts will walk you through pairing quickly.



APX mobile radio accessories

COMPATIBILITY		ACCESSORY	
LONG RANGE WIRELESS get ready in seconds without having to worry about the wires getting in the way. No more getting tangled with your seatbelt. Work, safer, smarter and more comfortable in demanding environments.			
MOBILE RADIOS	DESCRIPTION		PART NUMBER
APX 8500 APX 7500 APX 6500 APX 4500 APX 1500		Long range wireless mobile accessory kit, includes wireless remote speaker microphone (RLN6544), mobile microphone bluetooth gateway (PMMN4097), vehicular charger (PMMN6716)	RLN6551
		Long range wireless mobile accessory kit (no power charger), includes wireless remote speaker microphone (RLN6544), mobile microphone bluetooth gateway (PMMN4097), Charger must be purchased separately	RLN6552
ACCESSORIES AND REPLACEMENT PARTS			
APX 8500 APX 7500 APX 6500 APX 4500 APX 1500		Dual Unit Charger, Rapid Rate Charger, 120V	PMLN7120
		Vehicular charger	PMLN6716
		Wireless RSM with battery and clip	RLN6544
		Mobile microphone with bluetooth gateway	PMMN4097
		Wireless RSM battery, 1750 mA Li-Ion	PMNN4461
		D-ring swivel clip (12 pack)	NNTN4990
		Receive-only earpiece with comfort eartube, UL approved†	RLN4941
		Receive-only earpiece with comfort eartube	PMLN7560
		Receive-only earbud, UL approved	AARLN4885
		EP7 sonic defender, use with RLN4941	RLN6511 RLN6512 RLN6513

† HazLoc Details: For more information on which accessories are approved by Underwriters' Laboratory (UL) with certain APX models, please consult the manual provided with each UL-approved APX portable.





IMPRES audio accessories

Mission critical voice transmissions have to be heard over engine, siren, road and wind noise. Fortunately, Motorola's exclusive IMPRES audio accessories are designed to optimize its output based on the accessory in use. IMPRES Visor Microphones are able to pick up and transmit the user's voice consistently to the receiving user regardless of how close they are speaking into the microphone.

APX mobile radio accessories

COMPATIBILITY	ACCESSORY		FEATURES	
MICROPHONES Access critical features directly on the Keypad microphone. Navigational buttons and a full keypad allow users to navigate radio menus, dial phone numbers and send text messages. Three programmable buttons are available for additional customization.				
MOBILE RADIOS	DESCRIPTION	PART NUMBER	MICROPHONE STYLE	IMPRES
APX 8500 APX 7500 APX 6500	 Water resistant palm microphone for motorcycle mounted mobiles	HMN1079	Standard	
APX 8500 APX 7500 APX 6500 APX 4500 APX 1500	 Keypad microphone	HMN4079	Keypad + Navigation	
	 Standard palm microphone	HMN1090	Standard	
	 Water resistant palm microphone	HMN1089	Standard	
	 Telephone keypad handset with hang-up cup	HMN4097	Telephone + Keypad	
	 IMPRES™ telephone-style handset	HMN4098	Telephone	
	 Desktop microphone	RMN5070	Desktop	
	 IMPRES visor microphone, requires PTT switch GLN7278 or RLN5926	RMN5054	Visor	



APX mobile radio accessories

COMPATIBILITY	ACCESSORY	
MOBILE MICROPHONE ACCESSORIES		
MOBILE RADIOS	DESCRIPTION	PART NUMBER
APX 8500 APX 7500 APX 6500 APX 4500 APX 1500		Microphone hang-up clip HLN5391
		Microphone extension cable, 2-Feet. Not compatible with HMN4097 handset or HMN4079 keypad PMKN4093
		Microphone extension cable, 10-Feet. Not compatible with HMN4097 handset or HMN4079 keypad PMKN4033
		Microphone extension cable, 20-Feet. Not compatible with HMN4097 handset or HMN4079 keypad PMKN4034
		Emergency push button, can be used with the visor microphone HLN5131
		Emergency footswitch, can be used with the visor microphone HLN5113
		Footswitch push-to-talk, can be used with the visor microphone GLN7278
		Push button push-to-talk, can be used with the visor microphone RLN5926
		Replacement cable for HMN4079 PMKN4309
		Rear KPM cable - Y junction cable (for 02/05/07) 30009487001
	Rear KPM cable - straight (for E5) 30009487002	
CONTROL STATION ACCESSORIES		
APX 8500 APX 6500 BN APX 4500 BN APX 1500 BN		Power supply for APX 8500 mid power mobile radio KT000254A02**
APX 7500 APX 6500 APX 4500 APX 1500		Power supply for APX mid power mobile radios (not compatible with enhanced _BN versions) HPN4007
		110V line cord, replacement cable for HPN4007 3060665A04
APX 8500 APX 7500 APX 6500		Desktop tray with speaker HLN6042**
APX 8500 APX 6500 APX 4500 APX 1500		Desktop tray with speaker with bracket HLN7042

* Not for use with mobile radios with model numbers ending in "AN"

**Item is discontinued but shall remain orderable while supplies last



APX mobile radio accessories

COMPATIBILITY	ACCESSORY	
INSTALLATION AND MOUNTING ACCESSORIES Mount your radio in your vehicle without compromising safety. Trunnion kits give you the flexibility to mount the radio under your dash, in your dash, between the seats or on the floor. Remote mount kits allow the radio to be mounted in the trunk when dash space is limited.		
MOBILE RADIOS	DESCRIPTION	PART NUMBER
APX 8500 APX 7500 APX 6500* APX 4500 APX 1500	 High power trunnion kit; quick release with lock	HLN7003
	 Remote mount control head trunnion compatible with O2, O5, E5 and O7 control heads	HKN6186
	Dual radio trunnion kit To be used with APX 8500 MP, APX 6500 and APX 6500 enhanced	HLN7045
	 Motorcycle enclosure, black	HLN7022
	Mid power trunnion kit; standard installation	HLN7002
APX 6500** APX 4500 APX 1500	Mid power trunnion kit	HLN6861

* Only original model mobile radios

** Only enhanced model mobile radios

COMPATIBILITY	ACCESSORY	
EXTERNAL ALARM ACCESSORIES External alarm accessories enable additional switching power when external accessories are attached.		
MOBILE RADIOS	DESCRIPTION	PART NUMBER
APX 8500 APX 7500 APX 6500 APX 4500 APX 1500	 External alarm relays	HLN6969

COMPATIBILITY	ACCESSORY	
UNIVERSAL RELAY CONTROLLER		
MOBILE RADIOS	DESCRIPTION	PART NUMBER
APX 8500 APX 7500 APX 6500 APX 4500 APX 1500	 Universal relay controller for o9 control head, 10 DC outputs, 15 amps per channel	PMUN1046
	Universal relay controller to transceiver cable	3064153H05



APX mobile radio accessories

COMPATIBILITY	ACCESSORY	
SPEAKERS Boost audio at your control station on your desk or in your vehicle with external speakers.		
MOBILE RADIOS	DESCRIPTION	PART NUMBER
APX 8500 APX 7500 APX 6500 APX 4500 APX 1500	 Remote mount, water resistant speaker, 7.5 watt rated audio	HSN4038
	 Remote mount, IPX4 speaker, 15 watt rated audio	HSN4040
	 7.5W external speaker	HSN4031
	 Non-water resistant speaker, 13 watt rated audio	HSN4032
	Covert 10 watt rated audio speaker	HSN4042
	 Siren speaker, under hood with grey finish	TDN6253*

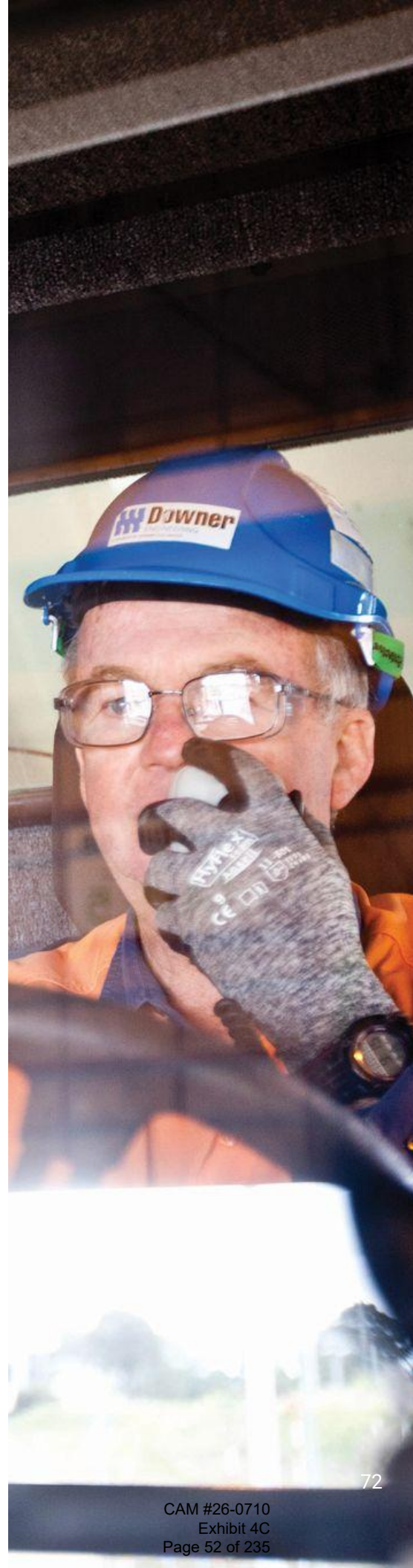
*Item is discontinued but shall remain orderable while supplies last

COMPATIBILITY		ACCESSORY	
SIREN ACCESSORIES			
MOBILE RADIOS		DESCRIPTION	PART NUMBER
APX 7500 APX 6500 APX 4500 APX 1500		Siren switchbox	HLN6819
		Siren cable, o5 siren to switchbox	HKH4363



APX mobile radio accessories

COMPATIBILITY		ACCESSORY	
CABLES			
MOBILE RADIOS	DESCRIPTION		PART NUMBER
CONTROL HEAD CABLES			
APX 8500 APX 7500 APX 6500 APX 1500		O3 handheld control head extension cable, 17-feet	PMLN4958
		O3 handheld control head accessory cable	PMLN4959
		Control head cable with connections for power, speaker and headset jack	HKN6187
		Control head cable with connections for power and speaker	HKN6188
REMOTE MOUNT CABLES			
APX 8500 APX 7500 APX 6500 APX 4500 APX 1500		Remote mount cable, 131-feet	HKN6164
		Remote mount cable, 115-feet	HKN6165
		Remote mount cable, 75-feet	HKN6166
		Remote mount cable, 50-feet	HKN6167
		Remote mount cable, 30-feet	HKN6168
		Remote mount cable, 17-feet	HKN6169
		Remote mount cable, 10-feet	HKN6170
		Cable, remote control head vehicular interface port connector for O5 control head	HKN6196
		Cable, remote control head mobile accessory port connector for O5 control head	HKN6961
APX 8500 APX 7500 APX 6500		Motorcycle remote cable for O5 control head	3075217A02
KEYLOAD CABLES			
APX 8500 APX 7500 APX 6500 APX 4500 APX 1500		Keyloader cable, KVL3000 and KVL4000	TKN8531
		Keyload adapter for mobile microphone port	HKN6182



APX mobile radio accessories

COMPATIBILITY	ACCESSORY		
CABLES			
MOBILE RADIOS	DESCRIPTION		PART NUMBER
POWER CABLES			
APX 8500 APX 7500 APX 6500 APX 4500 APX 1500		Mid power, dash mount power cable, 10-feet	HKN4191
		Mid power, remote mount power cable, 20-feet	HKN4192
		Mid power, rear ignition cable, dash mount	HLN6863
		High power, remote mount power cable 20-feet	HKN6110
		Motorcycle power cable	HKN6032
DATA CABLES			
APX 8500 APX 7500 APX 6500 APX 4500		Data tethering cable, required to connect to VML or certified data modem	KT000252A01
APX 7500 APX 6500 APX 4500 APX 1500		RS232 cable for rear accessory port, dash mount only, 6-feet	HKN6160
		RS232 cable for rear accessory port, remote mount only, 20-feet	HKN6161
		RS232 cable for mobile microphone port	HKN6183
		RS232 cable for j600 transceiver interconnect board, 22-feet	HKN6122
PROGRAMMING CABLES			
APX 8500 APX 7500 APX 6500 APX 4500 APX 1500		USB cable, rear accessory port, remote mount, 15-feet (for use with customer program software)	TKN8531
		USB cable, rear accessory port, dash mount, 6-feet (for use with customer program software)	HKN6184
APX 8500 APX 7500 APX 6500		Programming cable	HKN6184



Antennas

For optimum range and quality, it is important to match the mobile radio's frequency with the proper Motorola antenna. These are available as standard 1/4 wave models or can include 3dB, 3.5dB or 5dB signal gain.



APX mobile radio accessories

COMPATIBILITY		ACCESSORY		FEATURES		
ANTENNAS						
MOBILE RADIOS	DESCRIPTION	PART NUMBER	UHF / VHF / 800/900 MHz	FREQUENCY BAND (MHZ)	MOUNTING STYLE	
APX 8500 MOTORCYCLE ANTENNAS						
APX 8500	All band mobile antenna	AN000131A01*		2.75	Through-hole	
	Motorcycle mount, 1/4 wave whip antenna with QMA connector, 136-144 MHz, no tuning required	AN000197A01	VHF	136-144	Motorcycle	
	Motorcycle mount, 1/4 wave whip antenna with QMA connector, 144-150.8 MHz, no tuning required	AN000197A02	VHF	144-150.8	Motorcycle	
	Motorcycle mount, 1/4 wave whip antenna with QMA connector, 150.8-162 MHz, no tuning required	AN000197A03	VHF	150.8-162	Motorcycle	
	Motorcycle mount, 1/4 wave whip antenna with QMA connector, 162-174 MHz, no tuning required	AN000197A04	VHF	162-174	Motorcycle	
	Motorcycle mount, 1/4 wave whip antenna with QMA connector, 380-433 MHz, no tuning required	AN000197A05	UHF	380-433	Motorcycle	
	Motorcycle mount, 1/4 wave whip antenna with QMA connector, 425-470 MHz, no tuning required	AN000197A06	UHF	425-470	Motorcycle	
	Motorcycle mount, 1/4 wave whip antenna with QMA connector, 450-482 MHz, no tuning required	AN000197A07	UHF	450-482	Motorcycle	

*Item is discontinued but shall remain orderable while supplies last



APX mobile radio accessories

COMPATIBILITY	ACCESSORY		FEATURES		
ANTENNAS					
MOBILE RADIOS	DESCRIPTION	PART NUMBER	UHF / VHF / 800/900 MHz	FREQUENCY BAND (MHZ)	MOUNTING STYLE
APX 8500 MOTORCYCLE ANTENNAS					
APX 8500	Motorcycle mount, 1/4 wave whip antenna with QMA connector, 482-520 MHz, no tuning required	AN000197A08	UHF	482-520	Motorcycle
	Motorcycle mount, low profile, unity gain antenna with QMA connector, 450-512 MHz, no tuning required	AN000197A09	UHF	450-512	Motorcycle
	Motorcycle mount antenna with QMA connector, 3dB gain, 762-870 MHz	AN000197A10	800/900	762-870	Motorcycle
	Motorcycle mount, low profile antenna with QMA connector, 3dB gain, 762-870 MHz	AN000197A11	800/900	762-870	Motorcycle

COMPATIBILITY	ACCESSORY	
APX 8500 ANTENNA MULTIPLEXERS AND ADAPTERS		
MOBILE RADIOS	DESCRIPTION	PART NUMBER
APX 8500	Vehicle Multiplexer (supports HP)	EQ000103A02
	Motorcycle Multiplexer (low power)	EQ000103A01



APX mobile radio accessories

COMPATIBILITY		ACCESSORY		FEATURES		
ANTENNAS						
MOBILE RADIOS	DESCRIPTION	PART NUMBER	UHF / VHF / 800/900 MHz	FREQUENCY BAND (MHZ)	MOUNTING STYLE	
VHF ANTENNAS (RF ONLY)						
APX 8500* APX 7500 APX 6500 APX 4500 APX 1500		VHF 1/4 Wave Antenna, 136-144 MHz	HAD4006	VHF	136-144	Through-hole
		VHF 1/4 Wave Antenna, 144-150.8 MHz	HAD4007	VHF	144-150.8	Through-hole
		VHF 1/4 Wave Antenna, 150.8-162 MHz	HAD4008	VHF	150.8-162	Through-hole
		VHF 1/4 Wave Antenna, 162-174 MHz	HAD4009	VHF	162-174	Through-hole
		VHF 1/4 Wave Antenna, 146-174 MHz	HAD4017	VHF	146-174	Through-hole
		VHF Wideband Antenna, 136-174 MHz	HAD4021	VHF	136-174	Through-hole
		VHF Wideband Antenna 3.0 dB Gain, 136-174 MHz	HAD4022	VHF	136-174	Through-hole
UHF ANTENNAS (RF ONLY)						
APX 8500* APX 7500 APX 6500 APX 4500 APX 1500		UHF 1/4 Wave Antenna, 380-433 MHz	HAE6012	UHF	380-433	Through-hole
		UHF 1/4 Wave Antenna, 450-470 MHz	HAE4003	UHF	450-470	Through-hole
		UHF 1/4 Wave Antenna, 470-512 MHz	HAE4004	UHF	470-512	Through-hole

*CB000091A03 - Mini-U to QMA adapter required for APX 8500 to antenna connection.



APX mobile radio accessories

COMPATIBILITY		ACCESSORY		FEATURES		
ANTENNAS						
MOBILE RADIOS	DESCRIPTION		PART NUMBER	UHF / VHF / 800/900 MHz	FREQUENCY BAND (MHZ)	MOUNTING STYLE
VHF ANTENNAS (RF ONLY)						
APX 8500* APX 7500 APX 6500 APX 4500 APX 1500		UHF 3 dB gain antenna, 494-512 MHz	HAE4013†	UHF	494-512	Through-hole
		UHF 3.5 dB gain antenna, 380-420 MHz MAXRAD	HAE6010	UHF	380-420	Through-hole
		UHF 5 dB gain antenna, 380-420 MHz MAXRAD	HAE6011	UHF	380-420	Through-hole
		UHF 5 dB gain antenna, 455-470 MHz	RAE4014	UHF	455-470	Through-hole
		UHF 5 dB gain antenna, 494-512 MHz	RAE4016	UHF	494-512	Through-hole
		UHF 2 dB gain wideband antenna, 380-470 MHz, MAXRAD	HAE6013	UHF	380-470	Through-hole
		UHF 2 dB gain wideband antenna, 380-520 MHz	HAE6031	UHF	380-520	Through-hole
		UHF wideband low profile antenna, 450-512 MHz	HAE6016	UHF	450-512	Through-hole

*CB000091A03 - Mini-U to QMA adapter required for APX 8500 to antenna connection.
 †Item is discontinued but shall remain orderable while supplies last.



APX mobile radio accessories

COMPATIBILITY		ACCESSORY		FEATURES		
ANTENNAS						
MOBILE RADIOS	DESCRIPTION	PART NUMBER	UHF / VHF / 800/900 MHz	FREQUENCY BAND (MHZ)	MOUNTING STYLE	
700/800 MHZ ANTENNAS (RF ONLY)						
APX 8500* APX 7500 APX 6500 APX 4500 APX 1500		1/4 wave antenna, 762-870 MHz	HAF4016	700/800	762-870	Through-hole
		3 dB gain low profile antenna, 762-870 MHz	HAF4013	700/800	762-870	Through-hole
		3 dB gain elevated feed antenna, 762-870 MHz	HAF4014	700/800	762-870	Through-hole
		3 dB gain collinear antenna, 762-870 MHz	HAF4017	700/800	762-870	Through-hole
ALL BAND ANTENNAS (RF ONLY)						
APX 8500		Whip, all-band flexible antenna	AN000131A02	All band	136-174 380-520 760/870	(Through hole)
			AN000131A03	All band	136-174 380-520 760/870	(Replacement whip)

*CB000091A03 - Mini-U to QMA adapter required for APX 8500 to antenna connection.



APX mobile radio accessories

COMPATIBILITY		ACCESSORY	FEATURES		
ANTENNAS					
MOBILE RADIOS	DESCRIPTION	PART NUMBER	GPS / WiFi	FREQUENCY BAND (MHZ)	MOUNTING STYLE
VHF ANTENNAS (RF ONLY)					
APX 7500 APX 6500 APX 4500 APX 1500	 GPS roof mount antenna SMA male connector with RG-174 17ft cable	HAG4000	GPS only		Roof mount
	 GPS glass mount antenna SMA male connector with RG-174 17ft cable	PMAN4001	GPS only		Glass mount
APX 8500* APX 7500 APX 6500 APX 4500 APX 1500	Convert glass-mount motorcycle antenna with Wi-Fi 5GHz	PMAN5101	Wi-Fi BT (bluetooth)		Glass mount
	Convert glass-mount motorcycle antenna with GPS GNSS	PMAN4109	GPS only		Glass mount
	Wi-Fi/GPS combination vehicle antenna	AN000163A01	GPS Wi-Fi BT (bluetooth)		Through-hole
	Wi-Fi/GPS combination vehicle antenna	AN000163A02	GPS Wi-Fi BT (bluetooth)		Motorcycle

*CB000091A03 - Mini-U to QMA adapter required for APX 8500 to antenna connection.





Glossary

Hazloc-capable

For more information on which accessories are approved by Underwriters' Laboratory (UL) with certain APX models, please consult the manual provided with each UL-approved APX portable.

Motorola-approved accessories are a critical part of the overall radio system intrinsic safety certification. Non-Motorola approved accessories may not be certified for APX and if used, could result in equipment that is NOT approved and unsafe in a hazardous environment.

RADIOS	UL ACCESSORIES MANUAL
APX8000/8000XE	PMLN7769
APX900	PMLN7685
APX 2000/APX 4000/APX 1000/APX2000R/ APX 4000R	PMLN7812
SRX 2200/APX 6000/APX 6000XE/ APX 6000Li/APX 7000/APX 7000XE	PMLN7770
APX8000H / APX8000HXE	PMLN7894
APX NEXT, XE, and International	PMLN7985
APX NEXT XN	PMLN8382A



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<https://learning.motorolasolutions.com>

IP rating

Ingress Protection (IP) is a global standard for rating dust and water protection. The first digit IP5x or IP6x represents increased levels of dust protection. The second digit, IPx7 or IPx8 represents increased levels of water protection.

IPx7 represents withstanding submersion in 1 meter of fresh water for 30 minutes.

IPx8 represents heating accessory to 27°C higher than the water temperature for 2 hours then immediately immersing it to a depth of 1 meter for another 2 hours.

IPx8+Rugged represents exceeding industry specs by heating accessory to 27°C higher than the water temperature for 2 hours then immediately immersing it to a depth of 2 meters for another 4 hours.

Microphone noise suppression

Multi Mic Noise Suppression: Five integrated microphones and Adaptive Audio Engine automatically change the level of noise suppression, microphone gain, Windporting and speaker equalization to produce clear and loud audio in any environment.

Dual Mic Noise Suppression: Dual-microphone design tracks your voice so that you can keep your eye on what's in front of you while speaking. A digital signal processor (DSP) algorithm helps suppress background noise so you can be heard clearly regardless of the noise around you.

Windporting (Motorola Exclusive): Windporting reduces the effect of wind and other outdoor noises on your microphone performance and prevents water from clogging the microphone and distorting your transmission.

Noise-cancelling microphones negate crowd or machinery noise so your voice comes through loud and clear anytime you speak directly into the microphone.

Swivel or fixed loop

Secure to a belt loop and the case swings freely from side to side. The swivel latch system also allows the radio and case to be removed from the belt loop by simply inverting, lifting it up and out of the belt loop. Fixed loops provide a sturdy attachment to your belt.

Accessory software

To update your Mission Critical/Operation Critical Bluetooth® accessories, visit the [Accessory Software website](#).





For more information on Motorola Solutions mission-critical accessories,
Visit motorolasolutions.com/apx



Motorola Solutions, Inc. 500 West Monroe Street, Chicago, IL 60661 U.S.A. motorolasolutions.com

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MOTOROLA SOLUTIONS

City of Fort Lauderdale

Attachment 54 - Antenna Specifications

RFP # 549

December 18, 2025

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Section 1

RFP Section 3.42.5.2.E Antenna Specifications

Antenna Specifications are provided in the following pages.

VHLP4-11W-6WH/A



1.2 m | 4 ft ValuLine® High Performance Low Profile Antenna, single-polarized, 10.125–11.700 GHz, CPR90G, white antenna, flexible woven polymer gray radome without flash, standard pack—one-piece reflector

Product Classification

Product Type	Microwave antenna
Product Brand	ValuLine®

General Specifications

Antenna Type	VHLP - ValuLine® High Performance Low Profile Antenna, single-polarized
Polarization	Single
Antenna Input	CPR90G
Antenna Color	White
Reflector Construction	One-piece reflector
Radome Color	Gray
Radome Material	Polymer
Flash Included	No
Side Struts, Included	1 inboard
Side Struts, Optional	1 inboard

Dimensions

Diameter, nominal	1.2 m 4 ft
-------------------	--------------

Electrical Specifications

Operating Frequency Band	10.125 – 11.700 GHz
Gain, Low Band	40.2 dBi
Gain, Mid Band	40.7 dBi
Gain, Top Band	41 dBi
Boresite Cross Polarization Discrimination (XPD)	30 dB
Front-to-Back Ratio	66 dB
Beamwidth, Horizontal	1.6 °

VHLP4-11W-6WH/A

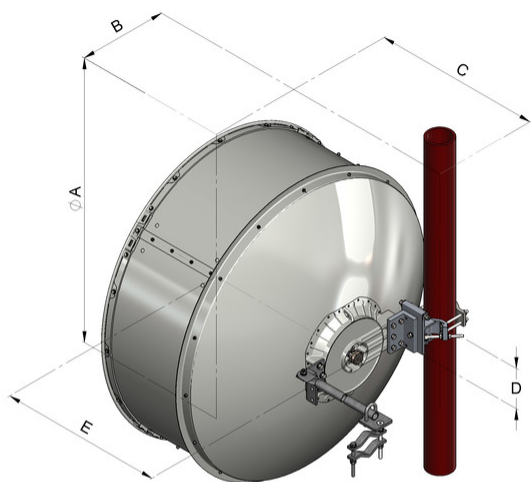
Beamwidth, Vertical	1.6 °
Return Loss	17.7 dB
VSWR	1.3
Radiation Pattern Envelope Reference (RPE)	7182A
Electrical Compliance	Brazil Anatel Class 2 Canada SRSP 310.5 Canada SRSP 310.7 Part A Canada SRSP 310.7 Part B ETSI 302 217 Class 3 US FCC Part 101A @ 10.55–10.7 GHz US FCC Part 101A @ 10.7–11.7 GHz US FCC Part 101B @ 10.125–11.7 GHz

Mechanical Specifications

Compatible Mounting Pipe Diameter	115 mm 4.5 in
Fine Azimuth Adjustment Range	±15°
Fine Elevation Adjustment Range	±15°
Wind Speed, operational	200 km/h 124.274 mph
Wind Speed, survival	250 km/h 155.343 mph

VHLP4-11W-6WH/A

Antenna Dimensions and Mounting Information



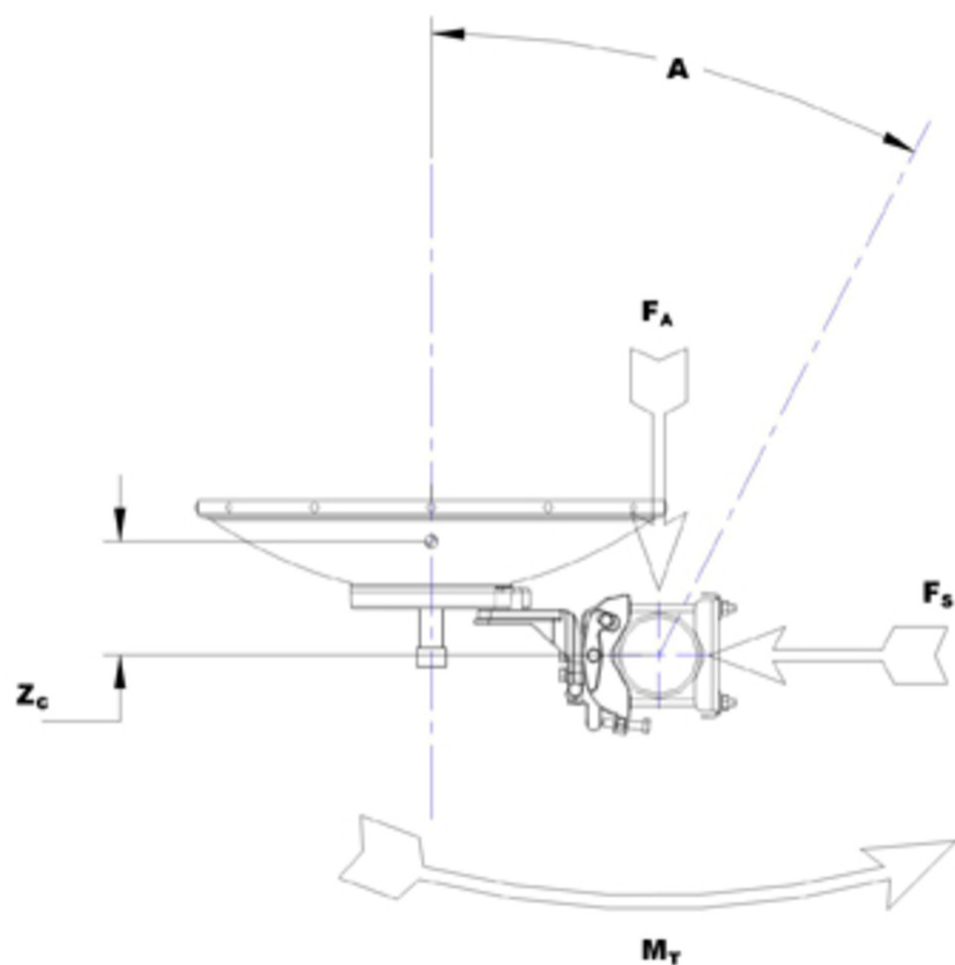
Dimensions in inches (mm)					
Antenna size, ft (m)	A	B	C	D	E
4 (1.2)	50.8 (1291)	16 (407)	30.2 (767)	7.2 (183)	29.5 (748)

Wind Forces at Wind Velocity Survival Rating

Axial Force (FA)	5326 N 1,197.333 lbf
Side Force (FS)	2638 N 593.046 lbf
Twisting Moment (MT)	2162 N-m 19,135.312 in lb
Force on Inboard Strut Side	2862 N 643.403 lbf
Zcg without Ice	43 mm 1.693 in
Zcg with 1/2 in (12 mm) Radial Ice	284 mm 11.181 in
Weight with 1/2 in (12 mm) Radial Ice	74 kg 163.142 lb

VHLP4-11W-6WH/A

Wind Forces at Wind Velocity Survival Rating Image



Packaging and Weights

Height, packed	1520 mm 59.843 in
Width, packed	380 mm 14.961 in
Length, packed	1360 mm 53.543 in
Packaging Type	Standard pack
Volume	0.8 m³ 28.252 ft³
Weight, gross	59 kg 130.073 lb
Weight, net	32 kg 70.548 lb

Regulatory Compliance/Certifications

VHLP4-11W-6WH/A

Agency	Classification
CHINA-ROHS	Below maximum concentration value
ISO 9001:2015	Designed, manufactured and/or distributed under this quality management system
REACH-SVHC	Compliant as per SVHC revision on www.andrew.com/ProductCompliance
ROHS	Compliant
UK-ROHS	Compliant



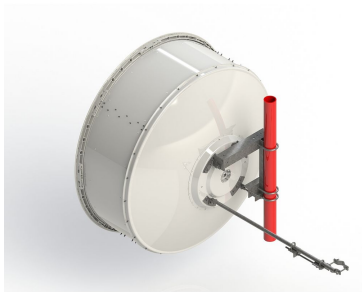
* Footnotes

Operating Frequency Band	Bands correspond with CCIR recommendations or common allocations used throughout the world. Other ranges can be accommodated on special order.
Gain, Mid Band	For a given frequency band, gain is primarily a function of antenna size. The gain of Andrew antennas is determined by either gain by comparison or by computer integration of the measured antenna patterns.
Boresite Cross Polarization Discrimination (XPD)	The difference between the peak of the co-polarized main beam and the maximum cross-polarized signal over an angle twice the 3 dB beamwidth of the co-polarized main beam.
Front-to-Back Ratio	Denotes highest radiation relative to the main beam, at 180° ±40°, across the band. Production antennas do not exceed rated values by more than 2 dB unless stated otherwise.
Return Loss	The figure that indicates the proportion of radio waves incident upon the antenna that are rejected as a ratio of those that are accepted.
VSWR	Maximum; is the guaranteed Peak Voltage-Standing-Wave-Ratio within the operating band.
Radiation Pattern Envelope Reference (RPE)	Radiation patterns define an antenna’s ability to discriminate against unwanted signals. Under still dry conditions, production antennas will not have any peak exceeding the current RPE by more than 3dB, maintaining an angular accuracy of +/-1° throughout
Wind Speed, operational	For VHLP(X), SHP(X), HX and USX antennas, the wind speed where the maximum antenna deflection is 0.3 x the 3 dB beam width of the antenna. For other antennas, it is defined as a deflection is equal to or less than 0.1 degrees.
Wind Speed, survival	The maximum wind speed the antenna, including mounts and radomes, where applicable, will withstand without permanent deformation. Realignment may be required. This wind speed is applicable to antenna with the specified amount of radial ice.

VHLP4-11W-6WH/A

Axial Force (FA)	Maximum forces exerted on a supporting structure as a result of wind from the most critical direction for this parameter. The individual maximums specified may not occur simultaneously. All forces are referenced to the mounting pipe.
Side Force (FS)	Maximum side force exerted on the mounting pipe as a result of wind from the most critical direction for this parameter. The individual maximums specified may not occur simultaneously. All forces are referenced to the mounting pipe.
Twisting Moment (MT)	Maximum forces exerted on a supporting structure as a result of wind from the most critical direction for this parameter. The individual maximums specified may not occur simultaneously. All forces are referenced to the mounting pipe.
Packaging Type	Andrew standard packing is suitable for export. Antennas are shipped as standard in totally recyclable cardboard or wire-bound crates (dependent on product). For your convenience, Andrew offers heavy duty export packing options.

VHLP6-6W/B



1.8 m | 6 ft ValuLine® High Performance Low Profile Antenna, single-polarized, 5.925–7.125 GHz

Product Classification

Product Type	Microwave antenna
Product Brand	ValuLine®

General Specifications

Antenna Type	VHLP - ValuLine® High Performance Low Profile Antenna, single-polarized
Polarization	Single
Side Struts, Included	1
Side Struts, Optional	1 inboard

Dimensions

Diameter, nominal	1.8 m 6 ft
-------------------	--------------

Electrical Specifications

Operating Frequency Band	5.925 – 7.125 GHz
Gain, Low Band	38.5 dBi
Gain, Mid Band	39.3 dBi
Gain, Top Band	40.1 dBi
Boresite Cross Polarization Discrimination (XPD)	30 dB
Front-to-Back Ratio	66 dB
Beamwidth, Horizontal	1.8 °
Beamwidth, Vertical	1.8 °
Return Loss	17.7 dB
VSWR	1.3
Radiation Pattern Envelope Reference (RPE)	7138B

VHLP6-6W/B

Electrical Compliance	Brazil Anatel Class 3 Canada SRSP 305.9 Part B Canada SRSP 306.4 Part A ETSI 302 217 Class 3 US FCC Part 101A
-----------------------	---

Electrical Specifications, Band 2

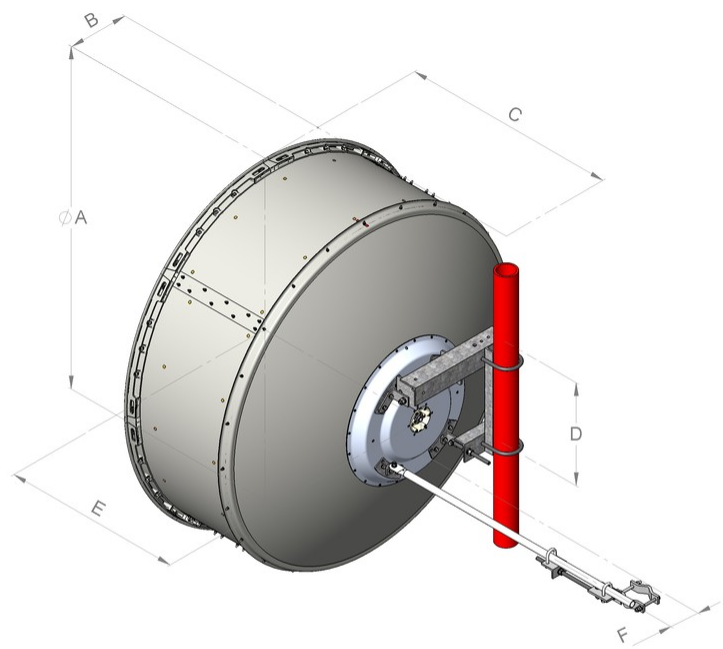
Operating Frequency Band	5.700 – 5.875 GHz
Gain, Mid Band	38.3 dBi
Beamwidth, Horizontal	2.2 °
Beamwidth, Vertical	2.2 °

Mechanical Specifications

Compatible Mounting Pipe Diameter	115 mm–120 mm 4.5 in–4.7 in
Fine Azimuth Adjustment Range	±15°
Fine Elevation Adjustment Range	±5°
Wind Speed, operational	201 km/h 124.896 mph
Wind Speed, survival	250 km/h 155.343 mph

VHLP6-6W/B

Antenna Dimensions and Mounting Information



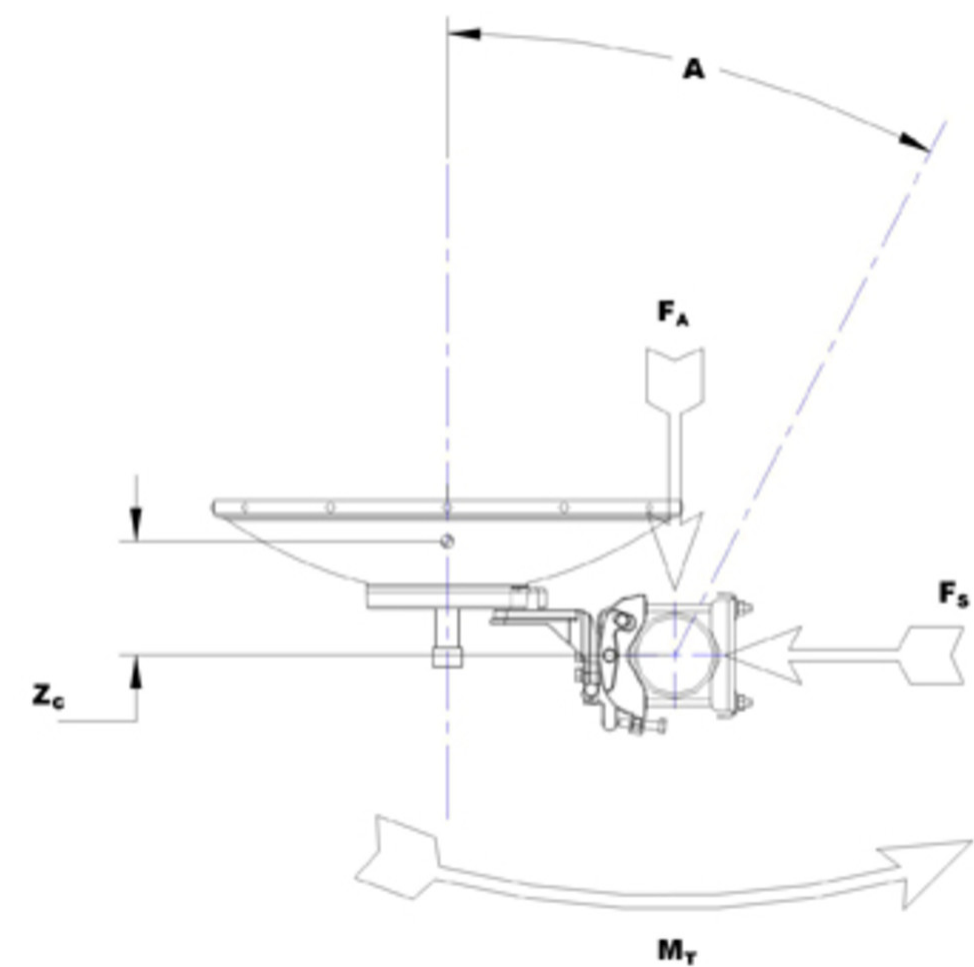
Dimensions in inches (mm)						
Antenna size, ft (m)	A	B	C	D	E	F
6 (1.8)	74.8 (1899)	13.4 (340)	47.5 (1206)	22.4 (570)	39.4 (1001)	6.9 (174)

Wind Forces at Wind Velocity Survival Rating

Axial Force (FA)	10670 N 2,398.712 lbf
Angle α for MT Max	-120 °
Side Force (FS)	5286 N 1,188.34 lbf
Twisting Moment (MT)	4752 N-m 42,058.742 in lb
Zcg without Ice	363 mm 14.291 in
Zcg with 1/2 in (12 mm) Radial Ice	543 mm 21.378 in
Weight with 1/2 in (12 mm) Radial Ice	234 kg 515.881 lb

VHLP6-6W/B

Wind Forces at Wind Velocity Survival Rating Image



Packaging and Weights

Weight, net

86 kg | 189.597 lb

Regulatory Compliance/Certifications

Agency

ISO 9001:2015

Classification

Designed, manufactured and/or distributed under this quality management system



* Footnotes

Operating Frequency Band

Bands correspond with CCIR recommendations or common allocations

VHLP6-6W/B

used throughout the world. Other ranges can be accommodated on special order.

Gain, Mid Band

For a given frequency band, gain is primarily a function of antenna size. The gain of Andrew antennas is determined by either gain by comparison or by computer integration of the measured antenna patterns.

Boresite Cross Polarization Discrimination (XPD)

The difference between the peak of the co-polarized main beam and the maximum cross-polarized signal over an angle twice the 3 dB beamwidth of the co-polarized main beam.

Front-to-Back Ratio

Denotes highest radiation relative to the main beam, at $180^\circ \pm 40^\circ$, across the band. Production antennas do not exceed rated values by more than 2 dB unless stated otherwise.

Return Loss

The figure that indicates the proportion of radio waves incident upon the antenna that are rejected as a ratio of those that are accepted.

VSWR

Maximum; is the guaranteed Peak Voltage-Standing-Wave-Ratio within the operating band.

Radiation Pattern Envelope Reference (RPE)

Radiation patterns define an antenna's ability to discriminate against unwanted signals. Under still dry conditions, production antennas will not have any peak exceeding the current RPE by more than 3dB, maintaining an angular accuracy of $\pm 1^\circ$ throughout

Wind Speed, operational

For VHLP(X), SHP(X), HX and USX antennas, the wind speed where the maximum antenna deflection is 0.3 x the 3 dB beam width of the antenna. For other antennas, it is defined as a deflection is equal to or less than 0.1 degrees.

Wind Speed, survival

The maximum wind speed the antenna, including mounts and radomes, where applicable, will withstand without permanent deformation. Realignment may be required. This wind speed is applicable to antenna with the specified amount of radial ice.

Axial Force (FA)

Maximum forces exerted on a supporting structure as a result of wind from the most critical direction for this parameter. The individual maximums specified may not occur simultaneously. All forces are referenced to the mounting pipe.

Side Force (FS)

Maximum side force exerted on the mounting pipe as a result of wind from the most critical direction for this parameter. The individual maximums specified may not occur simultaneously. All forces are referenced to the mounting pipe.

Twisting Moment (MT)

Maximum forces exerted on a supporting structure as a result of wind from the most critical direction for this parameter. The individual maximums specified may not occur simultaneously. All forces are referenced to the mounting pipe.



MOTOROLA SOLUTIONS

City of Fort Lauderdale

Attachment 56 - Mounting Options Documentation

RFP # 549

December 18, 2025

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Section 1

RFP Section 3.42.6.1 Mounting Options Documentation

Mounting Options Documentation is provided on the following pages.

APX™ P25 Mobile

Two-way Radio

Enhanced Single Band Mobile Radio Basic Service Manual

MARCH 2024

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MN005718A01-AH

CAM #26-0710

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Foreword

This manual includes all the information necessary to maintain peak product performance and maximum working time, using levels 1 and 2 maintenance procedures.



CAUTION: These servicing instructions are for the use of qualified personnel only. To reduce the risk of electric shock, do not service parts other than those contained in the Operating Instructions unless you are qualified to do so. Refer all servicing to qualified service personnel.

Product Safety and RF Exposure Compliance



CAUTION: This radio is restricted to occupational use only to satisfy FCC RF energy exposure requirements. Before using this product, read the Product Safety and RF Exposure booklet enclosed with your radio which contains important operating instructions for safe usage and RF energy awareness and control for compliance with applicable standards and regulations.

For a list of Motorola Solutions-approved antennas, batteries, and other accessories, visit <http://www.motorolasolutions.com>

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European Union (EU) and United Kingdom (UK) Waste of Electrical and Electronic Equipment (WEEE) Directive



The European Union's WEEE directive and the UK's WEEE regulation require that products sold into EU countries and the UK must have the crossed-out wheeled bin label on the product (or the package in some cases). As defined by the WEEE directive, this crossed-out wheeled bin label means that customers and end users in EU and UK countries should not dispose of electronic and electrical equipment or accessories in household waste.

Customers or end users in EU and UK countries should contact their local equipment supplier representative or service center for information about the waste collection system in their country.

Disclaimer

Please note that certain features, facilities, and capabilities described in this document may not be applicable to or licensed for use on a specific system, or may be dependent upon the characteristics of a specific mobile subscriber unit or configuration of certain parameters. Please refer to your Motorola Solutions contact for further information.

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Document History

The following major changes have been implemented in this manual since the previous edition:

Edition	Description	Date
MN005718A01-AA	Initial Release.	September 2019
MN005718A01-AB	- Added E5 Control Head information. - Added UHF1 and VHF information.	June 2020
MN005718A01-AC	Included the control head Exploded Views and Parts List.	July 2020
MN005718A01-AD	- Added Control Head Interface Board (CHIB) on page 62. - Updated O2 CHIB and CHUC Parts List. - Updated Table 76: O7 CHIB and CHUC Parts List on page 205. - Updated Table 77: E5 CHIB and CHUC Parts List on page 207.	May 2021
MN005718A01-AE	The following sections have been updated: O2 CHIB and CHUC Parts List. Table 76: O7 CHIB and CHUC Parts List on page 205. Table 77: E5 CHIB and CHUC Parts List on page 207. Model Charts on page 26. Mobile Radio Model Numbering Scheme on page 25.	October 2022
MN005718A01-AF	The following sections have been updated: Control Head Interface Board (CHIB) on page 62 O2 CHIB and CHUC Exploded View and Parts List on page 202 Table 75: O5 CHIB and CHUC Parts List on page 204 O7 CHIB and CHUC Exploded View and Parts List on page 205 Table 77: E5 CHIB and CHUC Parts List on page 207. O2 Control Head Test Mode on page 78 O7 Control Head Test Mode on page 82 E5 Control Head Test Mode on page 85	June 2023

Edition	Description	Date
	• O3 Radio Parts List on page 210 • TIB Radio Parts List on page 218 • APX Mobile Radio Transceiver Interface Board (TIB) Functional Block Diagram on page 185 • Power-Up Error Codes on page 174	
MN005718A01-AG	Amended the following sections: • I. What This Warranty Covers And For How Long on page 21 • Reassembling the O2 Control Head on page 149	September 2023
MN005718A01-AH	Added information regarding APX 1500 without Motorola Advanced Crypto Engine (MACE) IC in the following sections: • General Overview on page 48 • Controller Section on page 51 • Controller Functional Blocks on page 53 • Secure on page 56 • Transceiver Interface Board (TIB) on page 59 • Entering Test Mode on page 74 • Encryption on page 109	March 2024

Notations Used in This Manual

Throughout the text in this publication, you will notice the use of warning, caution, and notice notations. These notations are used to emphasize that safety hazards exist, and due care must be taken and observed.



WARNING: WARNING indicates a potentially hazardous situation, which, if not avoided, could result in death or injury.



CAUTION: CAUTION indicates a potentially hazardous situation, which, if not avoided, might result in equipment damage.



NOTE: NOTICE indicates an operational procedure, practice, or condition that is essential to emphasize.

Related Publications

The following list contains part numbers and titles of related publications.

- 68012006035, *ASTRO APX Mobile Radio O2 Control Head User Guide*
- 6875946M01, *ASTRO APX Mobile Radio O3 Control Head User Guide*
- 6875947M01, *ASTRO APX Mobile Radio O5 Control Head User Guide*
- 68012006034, *ASTRO APX Mobile Radio O7 Control Head User Guide*
- 68007024014, *ASTRO APX Mobile Radio O9 Control Head User Guide*
- MN006147A01, *ASTRO APX Mobile Radio E5 Control Head User Guide*
- MN003109A01, *ASTRO APX 8500 And O2, O3, O5, O7, O9 & E5 Control Head Installation Manual*
- PMLN6193, *ASTRO APX Mobile Radio O2 Quick Reference Card*
- PMLN5591, *ASTRO APX Mobile Radio O3 Quick Reference Card*
- PMLN5592, *ASTRO APX Mobile Radio O5 Quick Reference Card*
- PMLN6194, *ASTRO APX Mobile Radio O7 Quick Reference Card*
- PMLN5711, *ASTRO APX Mobile Radio O9 Quick Reference Card*
- PMLN8210, *ASTRO APX Mobile Radio E5 Quick Reference Card*
- 6881095C99/NNTN7851, *ASTRO APX Mobile Safety Manual*
- MN001435A01/PMLN7688, *ASTRO APX Wi-Fi Provisioning Leaflet*

Commercial Warranty

Limited Warranty

For information on warranty terms, see the Support page at <https://www.motorolasolutions.com>.

I. What This Warranty Covers And For How Long

Motorola Solutions Inc. ("Motorola Solutions") warrants the Motorola Solutions manufactured Communication Products listed below ("Product") against defects in material and workmanship under normal use and service for a period of time from the date of purchase as scheduled below:

Mobile Radios	One Year
Product Accessories	One Year

The radios additionally ship with a standard 1-year Repair Service Advantage (RSA) (for U.S. customers) or 1-year Extended Warranty (for Canada customers). However, at the time of order, you may choose to omit these warranties. For more RSA or Extended Warranty information, please refer to the price pages.

Motorola Solutions, at its option, will at no charge either repair the Product (with new or reconditioned parts), replace it (with a new or reconditioned Product), or refund the purchase price of the Product during the warranty period provided it is returned in accordance with the terms of this warranty. Replaced parts or boards are warranted for the balance of the original applicable warranty period. All replaced parts of Product shall become the property of Motorola Solutions.

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Motorola Solutions cannot be responsible in any way for any ancillary equipment not furnished by Motorola Solutions which is attached to or used in connection with the Product, or for operation of the Product with any ancillary equipment, and all such equipment is expressly excluded from this warranty. Because each system which may use the Product is unique, Motorola Solutions disclaims liability for range, coverage, or operation of the system as a whole under this warranty.

II. General Provisions

This warranty sets forth the full extent of Motorola Solutions responsibilities regarding the Product. Repair, replacement or refund of the purchase price, at Motorola Solutions option, is the exclusive remedy.

This warranty is given in lieu of all other express warranties, implied warranties, including without limitation, implied warranties of merchantability and fitness for a particular purpose, are limited to the duration of this limited warranty. In no event shall Motorola Solutions be liable for damages in excess of the purchase price of the product, for any loss of use, loss of time, inconvenience, commercial loss, lost profits or savings or other incidental, special or consequential damages arising out of the use or inability to use such product, to the full extent such may be disclaimed by law.

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Some states do not allow the exclusion or limitation of incidental or consequential damages or limitation on how long an implied warranty lasts, so the above limitation or exclusions may not apply.

This warranty gives specific legal rights, and there may be other rights which may vary from state to state.

IV. How To Get Warranty Service

You must provide proof of purchase (bearing the date of purchase and Product item serial number) in order to receive warranty service and, also, deliver or send the Product item, transportation, and insurance prepaid, to an authorized warranty service location.

Warranty service will be provided by Motorola Solutions through one of its authorized warranty service locations. If you first contact the company which sold you the Product, it can facilitate your obtaining warranty service.

You can also call Motorola Solutions at 1-800-927-2744 US/Canada.

V. What This Warranty Does Not Cover

This warranty does not cover the following conditions:

- Defects or damage resulting from use of the Product in other than its normal and customary manner.
- Defects or damage from misuse, accident, water, or neglect.
- Defects or damage from improper testing, operation, maintenance, installation, alteration, modification, or adjustment.
- Breakage or damage to antennas unless caused directly by defects in material workmanship.
- A Product subjected to unauthorized Product modifications, disassemblies or repairs (including, without limitation, the addition to the Product of non-Motorola Solutions supplied equipment) which adversely affect performance of the Product or interfere with Motorola Solutions normal warranty inspection and testing of the Product to verify any warranty claim.
- Product which has had the serial number removed or made illegible.
- Rechargeable batteries if:
 - Any of the seals on the battery enclosure of cells are broken or show evidence of tampering.
 - The damage or defect is caused by charging or using the battery in equipment or service other than the Product for which it is specified.
- Freight costs to the repair depot.
- A Product which, due to illegal or unauthorized alteration of the software/firmware in the Product, does not function in accordance with Motorola Solutions published specifications or the FCC type acceptance labeling in effect for the Product at the time the Product was initially distributed from Motorola Solutions.
- Scratches or other cosmetic damage to Product surfaces that does not affect the operation of the Product.
- Normal and customary wear and tear.



WARNING: The circuitry found on the control head and its associated interface boards is designed to function "as-is". Any attempt at modifying or altering the circuitry would void the warranty, and/or could result in radio malfunction or hazardous conditions for the radio and its associated vehicle.

VI. Patent And Software Provisions

Motorola Solutions will defend, at its own expense, any suit brought against the end user purchaser to the extent that it is based on a claim that the Product or parts infringe a United States patent, and Motorola Solutions will pay those costs and damages finally awarded against the end user purchaser in any such suit which are attributable to any such claim.

But such defense and payments are conditioned on the following:

- Motorola Solutions will be notified promptly in writing by such purchaser of any notice of such claim.
- Motorola Solutions will have sole control of the defense of such suit and all negotiations for its settlement or compromise.
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VII. Governing Law

This Warranty is governed by the laws of the State of Illinois, USA.

Chapter 1

Introduction

This radio is a Motorola Solutions newest two-way mobile radio designed to meet your most demanding needs. It is available in the following frequencies and power levels.

Table 1: Frequency Ranges and Power Level

Frequency Band	Bandwidth	Power Level
VHF	136–174 MHz	1– 50 W variable
UHF1	380-470 MHz	1-40 W variable
UHF2	450-485 MHz	1-45 W variable
	485-512 MHz	1-40 W variable
	512-520 MHz	1-25 W variable
700–800 MHz	762–806 MHz	2–30 W variable (2–3 W itinerant)
	806–870 MHz	3–35 W variable
800-900 MHz	806-870 MHz	3-35 W variable
	896-941 MHz (PCS band: 901-902, MHz 940-941 MHz)	1-30 W variable(1-3 W PCS band)

The radio is among the most sophisticated two-way radio available. It has a new robust design for radio users who need high performance, quality, and reliability in their daily communications. This new architecture supports a multitude of legacy and advanced features resulting in a more cost-effective two-way radio communications solution.

1.1

FLASHport®

All mobile radios are part of the FLASHport program and ship standard with a FLASH IC, which allows feature and system upgrades.

The FLASHport Aftermarket Software has the following features:

- Upgrade the System Enhancement Software Package to the latest version
- Upgrade to a different System Enhancement Software Package
- Order enhancements for existing mobile radios in the field

1.2

O2/O3/O5/E5/O7/O9 Control Head Description

The detailed function and operation of each Control Head is available in the User Guides.

See [Related Publications on page 20](#) for more information.

1.3

P25 Digital Vehicular Repeater System

Motorola Solutions offers an MSI Certified APX compatible, third party, P25 Digital Vehicular Repeater System (DVRS).

This system provides low-cost portable radio coverage in the following areas:

- Only mobile radio coverage is available.
- Portable radio coverage is intermittent or nonexistent.

1.4

Mobile Radio Model Numbering Scheme

Table 2: Sales Model Nomenclature

Position	1	2	3	4	5	6	7	8	9	10	11	12
Typical Model Number	M	2	5	T	S	S	9	P	W	1	A	N

Table 3: Sales Models Description

Position	Description	Value
1	Type of Unit	M = Mobile L = Table Top Station
2 and 3	Model Series	22 = APX 4500 24 = APX 2500 25 = APX 5500/APX 6500/ APX 6500Li 36 = APX 1500
4	Frequency Band	K = 136–174 MHz Q = 380–470 MHz S = 450–520 MHz T = Product Specific UHF Range U = 764–870 MHz V = 806–941 MHz Values given represent range only; they are not absolute.
5	Power Level	S = 10–50 W X = 1–110 W
6	Physical Packages	S = Transceiver with Selectable Control Head
7	Channel Spacing	9 = Variable/Programmable
8	Primary Operation	P = Programmable
9	Primary System Type	W = Programmable

Position	Description	Value
10	Feature Level	6 = Standard Plus 7 = Expanded Package
11	Version	Model Version - for example A, B, C (Major Change)
12	Unique Model Variations	N = Standard Package

1.4.1

Model Charts

Table 4: VHF Antenna Model Chart

M25KSS9PW1BN/M25KSS9PW1BN1/M22KSS9PW1BN/M24KSS9PW1BN/M36KSS9PW1BN									
Model/Item								Description	
G296AD								ADD: 1/4 Wave Whip Roof Top Antenna 136–144 MHz	
G297AD								ADD: 1/4 Wave Roof Top Antenna 144–150.8 MHz	
G299AE								ADD: 1/4 Wave Roof Top Antenna 150.8–162 MHz	
G300AE								ADD: 1/4 Wave Roof Top Antenna VHF	
G629AB								ADD: 1/4 Wave Broadband Antenna 146–174 MHz	
G792AB								ADD: VHF Antenna Wideband 136–174 MHz	
G301AD								ADD: 3BD Antenna 136–174 MHz	
G296AE								ADD: 1/4 Wave WP Antenna 136–144 MHz Motorcycle	
X								HAD4006_	Antenna, Roof Top, 1/4 Wave 136–144 MHz
	X							HAD4007_	Antenna, Roof Top, 1/4 Wave 144–152 MHz
		X						HAD4008_	Antenna, Roof Top, 1/4 Wave, 152–162 MHz
			X					HAD4009_	Antenna, Roof Top, 1/4 Wave, 162–174 MHz
				X				HAD4017_	Antenna Roof Mount Wideband VHF 146–174 MHz
					X			HAD4021_	VHF Antenna Wideband 136–174 MHz
						X		HAD4022_	VHF Antenna Wideband 136–174 MHz (3.0 dB Gain)
							X	RAD4002ARB	Antenna VHF 1/4 Wave 136–144 MHz Motorcycle

Table 5: VHF Antenna Model Chart (continued)

M25KSS9PW1BN/M25KSS9PW1BNI/M22KSS9PW1BN/M24KSS9PW1BN/M36KSS9PW1BN									
Model/Item								Description	
G297AE								ADD: 1/4 Wave VHF Antenna 144–150.8 MHz Motorcycle	
G299AD								ADD: 1/4 Wave VHF Antenna 150.8–162 MHz Motorcycle	
G300AB								ADD: 1/4 Wave VHF Antenna 162–174 MHz Motorcycle	
G301AC								ADD: 3BD Antenna 136–174 MHz	
GA00250AA								ADD: Bluetooth/Wi-Fi/GNSS Flexible Cable LMR240	
GA00250AB								ADD: Bluetooth/Wi-Fi/GNSS Flexible Cable LMR240 Motorcycle	
GA00226AA								ADD: GPS Antenna	
GA00269AA								ADD: GPS Antenna Motorcycle	
X								RAD4003ARB	Antenna VHF 1/4 Wave 144–150.8 MHz
	X							RAD4004ARB	Antenna VHF 1/4 Wave 150.8–162 MHz
		X						RAD4005ARB	Antenna VHF 1/4 Wave 162–174 MHz
			X					RAD4010ARB	Antenna 3 dB, Roof, Mount, 136–174 MHz
				X				AN000163A01	Antenna, Stubby, Bluetooth/Wi-Fi/GNSS Low Loss LMR240
					X			AN000163A02	Antenna, Stubby, Bluetooth/Wi-Fi/GNSS, Motorcycle, QMA, 6 ft., LMR195, Flexible, PVC Free
						X		HAG4000_	Mobile GPS Antenna
							X	HAG4001_	Mobile GPS Motorcycle Antenna

Table 6: VHF Antenna Model Chart (continued)

M25KSS9PW1BN/M25KSS9PW1BNI/M22KSS9PW1BN/M24KSS9PW1BN/M36KSS9PW1BN									
Model/Item								Description	
GA01580AA								ADD: Covert GNSS Glassmount LMR100	
GA01305AA								ADD: GPS/GNSS Mag Mount Antenna	
GA01579AB								ADD: Covert Bluetooth/Wi-Fi Glassmount 2.4/5 GHz	
GA00268AA								ADD: RFID Tag APX	
X								PMAN4109_	Antenna GPS/GLONASS on Glass with QMA LMR100
	X							PMAN4010_	Antenna GPS/GLONASS Mag Mount
		X						PMAN5101_	Antenna Covert Bluetooth/Wi-Fi on Glass with QMA Extension

M25KSS9PW1BN/M25KSS9PW1BNI/M22KSS9PW1BN/M24KSS9PW1BN/M36KSS9PW1BN					
Model/Item				Description	
GA01580AA				ADD: Covert GNSS Glassmount LMR100	
	GA01305AA			ADD: GPS/GNSS Mag Mount Antenna	
		GA01579AB		ADD: Covert Bluetooth/Wi-Fi Glassmount 2.4/5 GHz	
			GA00268AA		ADD: RFID Tag APX
			X	HLN7014_	RFID Assembly

Table 7: UHF1 Antenna Model Chart

M25QSS9PW1BN/M25QSS9PW1BNI/M22QSS9PW1BN/M24QSS9PW1BN/M36QSS9PW1BN									
Model/Item								Description	
G426AD								ADD: Antenna 1/4 Wave Whip 450–470 MHz	
	G427AB							ADD: Antenna 3.5 dB 380–433 MHz MAXRAD	
		G429AB						ADD: Antenna 5.0 dB 380–433 MHz MAXRAD	
			G425AC					ADD: Antenna 1/4 Wave Whip 380–433 MHz	
				G431AC				ADD: Antenna Wideband 2 dB 380–470 MHz	
					G210AB			ADD: Motorcycle Antenna 1/4 Wave 380–433 MHz	
						G510AB		ADD: Antenna Low Profile 450–512 MHz	
							GA00505AA		ADD: Antenna 2 dB Wideband 380–520 MHz
X								HAE4003_	Unity Gain Antenna UHF 450–470 MHz Quarter-wave - Roof Mount
	X							HAE6010_	Antenna 3.5 dB Gain 380–433 MHz
		X						HAE6011_	Antenna 5.0 dB Gain 380–433 MHz
			X					HAE6012_	Unity Gain Antenna UHF 380–433 MHz Quarter-wave - Roof Mount
				X				HAE6013_	Antenna Wideband 2.0 dB Gain 380–470 MHz
					X			HAE6014_	Antenna Motorcycle 1/4 Wave Whip 380–433 MHz
						X		HAE6016_	Antenna Low Profile 450–512 MHz
							X	HAE6031_	Antenna, 2 dB Wideband 380–520 MHz

Table 8: UHF1 Antenna Model Chart (continued)

M25QSS9PW1BN/M25QSS9PW1BNI/M22QSS9PW1BN/M24QSS9PW1BN/M36QSS9PW1BN									
Model/Item						Description			
GA00506AA						ADD: Antenna, Motorcycle 1/4 Wave Whip 425–470 MHz			
	GA00507AA					ADD: Antenna, Motorcycle 1/4 Wave Whip 450–482 MHz			
		GA00509AA				ADD: Antenna, Motorcycle Low Profile Unity 450–512 MHz			
			GA00226AA			ADD: GPS Antenna			
				GA00269AA		ADD: GPS Antenna Motorcycle			
				GA01580AA		ADD: Covert GNSS Glassmount LMR100			
X						HAE6032_	Antenna, Motorcycle 1/4 Wave Whip 425–470 MHz		
	X					HAE6033_	Antenna, Motorcycle 1/4 Wave Whip 450–482 MHz		
		X				HAE6035_	Antenna, Motorcycle Low Profile Unity 450–512 MHz		
			X			HAG4000_	Mobile GPS Antenna		
				X		HAG4001_	Mobile GPS Motorcycle Antenna		
					X	PMAN4109_	Antenna GPS/GLONASS on Glass with QMA		

Table 9: UHF1 Antenna Model Chart (continued)

M25QSS9PW1BN/M25QSS9PW1BNI/M22QSS9PW1BN/M24QSS9PW1BN/M36QSS9PW1BN									
Model/Item						Description			
GA01579AB						ADD: Covert Bluetooth/Wi-Fi Glassmount 2.4/5 GHz			
	G430AC					ADD: Antenna 5.0 dB 445–470 MHz			
		GA00250AA				ADD: Bluetooth/Wi-Fi/GNSS Flexible Cable LMR240			
			GA00250AB			ADD: Bluetooth/Wi-Fi/GNSS Flexible Cable LMR195 Motorcycle			
			G428AD			ADD: Antenna 3.5 dB 450-470 MHz			
						GA01305AA	ADD: GPS/GNSS Mag Mount Antenna		
						GA00268AA	ADD: RFID Tag APX		
X						PMAN5101_	Antenna Covert Bluetooth/Wi-Fi on Glass with QMA Extention		
	X					RAE4014AR_	Antenna 5.0 dB Gain 445–470 MHz		
		X				AN000163A01	Antenna, Stubby, Bluetooth/Wi-Fi/GNSS Low Loss LMR240		
			X			AN000163A02	Antenna, Stubby, Bluetooth/Wi-Fi/GNSS, Motorcycle, QMA, 6 ft., LMR195, Flexible, PVC Free		

M25QSS9PW1BN/M25QSS9PW1BNI/M22QSS9PW1BN/M24QSS9PW1BN/M36QSS9PW1BN									
Model/Item						Description			
GA01579AB						ADD: Covert Bluetooth/Wi-Fi Glassmount 2.4/5 GHz			
	G430AC					ADD: Antenna 5.0 dB 445–470 MHz			
		GA00250AA				ADD: Bluetooth/Wi-Fi/GNSS Flexible Cable LMR240			
		GA00250AB				ADD: Bluetooth/Wi-Fi/GNSS Flexible Cable LMR195 Motorcycle			
		G428AD				ADD: Antenna 3.5 dB 450–470 MHz			
					GA01305AA	ADD: GPS/GNSS Mag Mount Antenna			
					GA00268AA	ADD: RFID Tag APX			
				X		HAE4011_	Antenna Roof Top 3.5 dB UHF		
					X	PMAN4010_	Antenna GPS/GLONASS Mag Mount		
					X	HLN7014	RFID Assembly		

Table 10: UHF2 Antenna Model Chart

M25SSS9PW1BN/M25SSS9PW1BNI/M22SSS9PW1BN/M24SSS9PW1BN/M36SSS9PW1BN									
Model/Item						Description			
G426AD						ADD: Antenna 1/4 Wave Whip 450–470 MHz			
	G431AC					ADD: Antenna Wideband 2db 380–470 MHz			
		G510AB				ADD: Antenna Low Profile 450–512 MHz			
		GA00505AA				ADD: Antenna 2dB Wideband 380–520 MHz			
		GA00506AA				ADD: Antenna Motorcycle 1/4 Wave Whip 425–470 MHz			
					GA00507AA	ADD: Antenna Motorcycle 1/4 Wave Whip 450–482 MHz			
					GA00509AA	ADD: Antenna, Motorcycle Low Profile Unity 450–512 MHz			
					GA00226AA	ADD: GPS Antenna			
X						HAE4003_	Unity Gain Antenna UHF 450–470 Quarter-wave - Roof Mount		
	X					HAE6013_	Antenna Wideband 2.0 dB Gain 380–470 MHz		
		X				HAE6016_	Antenna Low Profile 450–512 MHz		
			X			HAE6031_	Antenna, 2dB Wideband 380–520 MHz		
				X		HAE6032_	Antenna, Motorcycle 1/4 Wave Whip 425–470 MHz		
					X	HAE6033_	Antenna, Motorcycle 1/4 Wave Whip 450–512 MHz		

M25SSS9PW1BN/M25SSS9PW1BNI/M22SSS9PW1BN/M24SSS9PW1BN/M36SSS9PW1BN									
Model/Item							Description		
G426AD							ADD: Antenna 1/4 Wave Whip 450–470 MHz		
	G431AC						ADD: Antenna Wideband 2db 380–470 MHz		
		G510AB					ADD: Antenna Low Profile 450–512 MHz		
		GA00505AA					ADD: Antenna 2dB Wideband 380–520 MHz		
		GA00506AA					ADD: Antenna Motorcycle 1/4 Wave Whip 425–470 MHz		
						GA00507AA	ADD: Antenna Motorcycle 1/4 Wave Whip 450–482 MHz		
						GA00509AA	ADD: Antenna, Motorcycle Low Profile Unity 450–512 MHz		
						GA00226AA	ADD: GPS Antenna		
					X	HAE6035_	Antenna, Motorcycle Low Profile Unity 450–512MHz		
					X	HAG4000_	Mobile GPS Antenna		

Table 11: UHF2 Antenna Model Chart (continued)

M25SSS9PW1BN/M25SSS9PW1BNI/M22SSS9PW1BN/M24SSS9PW1BN/M36SSS9PW1BN									
Model/Item							Description		
GA00269AA							ADD: GPS Antenna Motorcycle		
	GA01580AA						ADD: Covert GNSS Glassmount LMR100		
		GA01305AA					ADD: GPS/GNSS Mag Mount Antenna		
		GA01579AB					ADD: Covert Bluetooth/Wi-Fi Glassmount 2.4/5 GHz		
		G430AC					ADD: Antenna 5.0 dB 445–470 MHz		
						GA00250AA	ADD: BluetoothWi-Fi/GNSS Flexible Cable LMR195		
						GA00250AB	ADD: BluetoothWi-Fi/GNSS Flexible Cable LMR195 Motorcycle		
X						HAG4001_	Mobile GPS Motorcycle Antenna		
	X					PMAN4109_	Antenna GPS/GLONASS on Glass with QMA		
		X				PMAN4010_	Antenna GPS/GLONASS Mag Mount		
			X			PMAN5101_	Antenna Covert Bluetooth/Wi-Fi on Glass with QMA Extention		
				X		RAE4014AR_	Antenna 5.0 dB Gain 445–470 MHz		
					X	AN000163A01	Antenna, Stubby, Bluetooth/Wi-Fi/GNSS Low Loss LMR240		
					X	AN000163A02	Antenna, Stubby, Bluetooth/Wi-Fi/GNSS, Motorcycle, QMA, 6 ft., LMR195, Flexible, PVC Free		

Table 12: UHF2 Antenna Model Chart (continued)

M25SSS9PW1BN/M25SSS9PW1BNI/M22SSS9PW1BN/M24SSS9PW1BN/M36SSS9PW1BN				
Model/Item				Description
G486A_				ADD: 5 dB Gain Antenna 494–512 MHz
	G428AD			ADD: Antenna 3.5 dB 450–470 MHz
		GA00268AA		ADD: RFID Tag APX
X			RAE4016AR_	Antenna Roof Top 5 dB, 494–512 MHz
	X		HAE4011_	Antenna Roof Top 3.5 dB UHF
		X	HLN7014_	RFID Assembly

Table 13: 700–800 MHz Antenna Model Chart

M25URS9PW1BN/M25URS9PW1BNI/M22URS9PW1BN/M24URS9PW1BN/M36URS9PW1BN								
Model/Item							Description	
G174AD							ADD: Antenna 3 dB Low Profile 762–870 MHz	
	G175AD						ADD: Antenna 3 dB Elevated Feed 762–870 MHz	
		G335AW					ADD: Antenna 1/4 Wave 762–870 MHz	
			W484AF				ADD: Antenna 3 dB Collinear 762–870 MHz	
				G174AE			ADD: Antenna 3 dB Low Profile Motorcycle 762–870 MHz	
					G335 + G138		ADD: Antenna 3 dB Motorcycle 762–870 MHz	
						GA00268AA		ADD: RFID Tag APX
X						HAF4013_	Antenna 3 dB Low Profile 762–870 MHz	
	X					HAF4014_	Antenna 3 dB Elevated Feed 762–870 MHz	
		X				HAF4016_	Antenna 1/4 Wave 762–870 MHz	
			X			HAF4017_	Antenna 3 dB Collinear 762–870 MHz	
				X		HAF4018_	Antenna 3 dB Low Profile Motorcycle 762–870 MHz	
					X	HAF4015_	Antenna 3 dB Motorcycle 762–870 MHz	
						X	HLN7014_	RFID Assembly

Table 14: 700–800 MHz Antenna Model Chart (continued)

M25URS9PW1BN/M25URS9PW1BNI/M22URS9PW1BN/M24URS9PW1BN/M36URS9PW1BN												
Model/Item							Description					
GA01580AA							ADD: Covert GNSS Glassmount LMR100					
	GA01305AA						ADD: GPS/GNSS Mag Mount Antenna					
		GA00269AA						ADD: GPS Antenna Motorcycle				
			GA00226AA						ADD: GPS Antenna			
				GA00250AA						ADD: Bluetooth/Wi-Fi/GNSS Flexible Cable LMR240		
					GA01579AB						ADD: Covert Bluetooth/Wi-Fi Glassmount 2.4/5 GHz	
						GA00250AB						ADD: Bluetooth/Wi-Fi/GNSS Flexible Cable LMR195 Motorcycle
X							PMAN4109_	Antenna GPS/GLONASS on Glass with QMA				
	X						PMAN4010_	Antenna GPS/GLONASS Mag Mount				
		X					HAG4001_	Mobile GPS Motorcycle Antenna				
			X				HAG4000_	Mobile GPS Antenna				
				X			AN000163A01	Antenna, Stubby, Bluetooth/Wi-Fi/ GNSS Low Loss LMR240				
					X		PMAN5101_	Antenna Covert Bluetooth/Wi-Fi on Glass with QMA Extention				
						X	AN000163A02	Antenna, Stubby,Bluetooth/Wi-Fi/ GNSS, Motorcycle, QMA, 6 ft., LMR195, Flexible, PVC Free				

Table 15: 8/900 MHz Antenna Model Chart

M25VRS9PW1CN / M22VRS9PW1CN										
Model/Item						Description				
G174A_						ADD: Antenna 3 dB Low Profile 762–870 MHz				
	GA01777AA					ADD: 8/900 MHz Vehicle Mount Quarter Wave Antenna				
		GA01778AA					ADD: 8/900 MHz Vehicle Mount 3 dB Base Loaded Collinear Antenna			
			GA00226AA					ADD: GPS Antenna		
				GA01580AA					ADD: Covert GNSS Glassmount LMR100	
					GA01579AB					ADD: Covert Bluetooth/Wi-Fi Glassmount 2.4/5 GHz
X						HAF4013_	3 dB Low Profile Antenna Kit-Vehicle Mount			
	X					HAF4036_	Antenna, Stamped Metal, 8/900 MHz Vehicle Mount Quarter Wave Antenna Kit			
		X				HAF4037_	Antenna, Stamped Metal, 8/900 MHz Vehicle Mount 3 dB Base Loaded Collinear Antenna Kit			
			X			HAG4000_	Mobile GPS Antenna			
				X		PMAN4109_	Antenna GPS/GLONASS on Glass with QMA			
					X	PMAN5101_	Antenna Covert Bluetooth/Wi-Fi on Glass with QMA Extension			

Table 16: 8/900 MHz Antenna Model Chart (continued)

M25VRS9PW1CN / M22VRS9PW1CN						
Model/Item						Description
GA00250AA						ADD: Bluetooth/Wi-Fi/GNSS Flexible Cable LMR240
	GA01305AA					ADD: GPS/GNSS Mag Mount Antenna
		GA00268AA				ADD: RFID TAG APX
X					AN000163A01	Antenna, Stubby, Bluetooth/Wi-Fi/GNSS Low Loss LMR240
	X				PMAN4010_	Antenna GPS/GLONASS Mag Mount
		X			HLN7014_	RFID Assembly

Table 17: Emergency Model Chart

M25KSS9PW1BN/M25KSS9PW1BNI/M22KSS9PW1BN/M24KSS9PW1BN/M36KSS9PW1BN M25QSS9PW1BN/M25QSS9PW1BNI/M22QSS9PW1BN/M24QSS9PW1BN/M36QSS9PW1BN M25URS9PW1BN/M25URS9PW1BNI/M22URS9PW1BN/M24URS9PW1BN/M36URS9PW1BN M25SSS9PW1BN/M25SSS9PW1BNI/M22SSS9PW1BN/M24SSS9PW1BN/M36SSS9PW1BN M25VRS9PW1CN/M22VRS9PW1CN					
Model/Item			Description		
G235AC			ADD: PTT Footswitch APX		
	W470AT		ADD: External Emergency Pushbutton APX		
		W688AR	ADD: External Emergency Pushbutton APX		
		GA00304AA	ADD: Pushbutton PTT		
		G233AD	ADD: Gooseneck PTT APX		
X				GLN7278_	PTT Footswitch (XTL)
	X			HLN5113_	Emergency Footswitch
		X		HLN5131_	Emergency Pushbutton Switch
			X	RLN5926_	Pushbutton PTT
				X GLN7279_	Gooseneck PTT

Table 18: Cables Model Chart

M25KSS9PW1BN/M25KSS9PW1BNI/M22KSS9PW1BN/M24KSS9PW1BN/M36KSS9PW1BN M25QSS9PW1BN/M25QSS9PW1BNI/M22QSS9PW1BN/M24QSS9PW1BN/M36QSS9PW1BN M25URS9PW1BN/M25URS9PW1BNI/M22URS9PW1BN/M24URS9PW1BN/M36URS9PW1BN M25SSS9PW1BN/M25SSS9PW1BNI/M22SSS9PW1BN/M24SSS9PW1BN/M36SSS9PW1BN M25VRS9PW1CN/M22VRS9PW1CN					
Model/Item			Description		
GA00589AA			ADD: MMP Extension Cable 2 ft.		
	GA01114AA		INT: Dual Radio Cable Kit		
		GA01118AA	INT: Speaker Extension Cable MP		
		GA01516AA	INT: MMP to Micro USB Data Modem Tethering Cable		
		G303AB	ADD: RS232 Data Interface Cable Dash APX		
		G304AC	ADD: RS232 Data Interface Cable Trunking APX		
		G309AC	ADD: USB Data Interface Cable Trunking APX		
X				PMKN4093_	O9, MMP Extension Cable
	X			HKM6245_	Assembly, 1.5 ft. CAN Cable

M25KSS9PW1BN/M25KSS9PW1BNI/M22KSS9PW1BN/M24KSS9PW1BN/M36KSS9PW1BN M25QSS9PW1BN/M25QSS9PW1BNI/M22QSS9PW1BN/M24QSS9PW1BN/M36QSS9PW1BN M25URS9PW1BN/M25URS9PW1BNI/M22URS9PW1BN/M24URS9PW1BN/M36URS9PW1BN M25SSS9PW1BN/M25SSS9PW1BNI/M22SSS9PW1BN/M24SSS9PW1BN/M36SSS9PW1BN M25VRS9PW1CN/M22VRS9PW1CN							
Model/Item						Description	
GA00589AA						ADD: MMP Extension Cable 2 ft.	
	GA01114AA					INT: Dual Radio Cable Kit	
		GA01118AA				INT: Speaker Extension Cable MP	
			GA01516AA			INT: MMP to Micro USB Data Modem Tethering Cable	
				G303AB		ADD: RS232 Data Interface Cable Dash APX	
				G304AC		ADD: RS232 Data Interface Cable Trunking APX	
				G309AC		ADD: USB Data Interface Cable Trunking APX	
		X				HKN6246_	Assembly, 30 ft. Speaker Extension Cable
	X	X				54009321002	Label, Dual Radio Primary And Secondary Label
			X			KT000252A01	Cable, Programming, MMP to Micro USB Data Modem Tethering Cable
				X		HKN6160_	Cable 6 ft.. RS232 with Ignition 26 Pin
					X	HKN6161_	Cable Kit 20' Remote Mount Data
					X	HKN6172_	USB Data Cable, 4.5 m, 26 pin

Table 19: CAN Model Chart

M25KSS9PW1BN/M25KSS9PW1BNI/M22KSS9PW1BN/M24KSS9PW1BN/M36KSS9PW1BN M25QSS9PW1BN/M25QSS9PW1BNI/M22QSS9PW1BN/M24QSS9PW1BN/M36QSS9PW1BN M25URS9PW1BN/M25URS9PW1BNI/M22URS9PW1BN/M24URS9PW1BN/M36URS9PW1BN M25SSS9PW1BN/M25SSS9PW1BNI/M22SSS9PW1BN/M24SSS9PW1BN/M36SSS9PW1BN M25VRS9PW1CN/M22VRS9PW1CN									
Model/Item							Description		
G582AC							ADD: Remote Mount Cable 128 ft. APX		
X	G879AC						ADD: Remote Mount Cable 115 ft. APX		
	X	G607AC					ADD: Remote Mount Cable 75 ft. APX		
		X	G609AC				ADD: Remote Mount Cable 50 ft. APX		
			X	G610AC			ADD: Remote Mount Cable 30 ft. APX		
				G628AC			ADD: Remote Mount Cable 17 ft. APX		
				G618AC			ADD: Remote Mount Cable 10 ft. APX		
							HKN6164_	Cable, Remote Mount, 39.2 m	
	X						HKN6165_	Cable, Remote Mount, 35 m	
		X					HKN6166_	Cable, Remote Mount, 23 m	
			X				HKN6167_	Cable, Remote Mount, 15 m	
				X			HKN6168_	Cable, Remote Mount, 10 m	
					X		HKN6169_	Cable, Remote Mount, 5 m	
						X	HKN6170_	Cable, Remote Mount, 10 ft.	

Table 20: Direct Entry Keyboard Model Chart

M25KSS9PW1BN/M25KSS9PW1BNI/M22KSS9PW1BN/M24KSS9PW1BN/M36KSS9PW1BN																			
M25QSS9PW1BN/M25QSS9PW1BNI/M22QSS9PW1BN/M24QSS9PW1BN/M36QSS9PW1BN																			
M25URS9PW1BN/M25URS9PW1BNI/M22URS9PW1BN/M24URS9PW1BN/M36URS9PW1BN																			
M25SSS9PW1BN/M25SSS9PW1BNI/M22SSS9PW1BN/M24SSS9PW1BN/M36SSS9PW1BN																			
M25VRS9PW1CN/M22VRS9PW1CN																			
Model/Item										Description									
GA00260AA										ADD: Cable Lightbar Box to Transceiver									
	GA00259AA									ADD: Universal Relay Controller									
		W355AS									ADD: Status/Message 8 APX								
			W374AJ									ADD: Status/Message 16 APX							
				W591AQ									ADD: Auxiliary Switch Panel APX						
					W599BF									ADD: 8 Mode Direct Entry APX					
						W614AT									ADD: 16 Mode Direct Entry APX				
							W615AW									ADD: 24 Mode Direct Entry APX			
								GA00812AA									ADD: DEK for Whelen Siren with O3 Control Head Only		
									GA00814AA									ADD: DEK for Whelen Siren	
X										3064153H05	Cable, 2850 mm, Keypad Microphone with MMP								
	X									PMKN4109A	Wire, AWG 14								
	X									PMLN5436A	O9 Hub, Standard Tilting Mount								
	X									PMUN1046A	Hardware Kit, 09 Relay Control Box								
	X									40012006001	Circuit Breaker, 60 A								
		X								6880103W09	DEK Instruction Manual								
		X								HLN1228_	DEK Status SYS 9000								
		X	X		X	X	X	X	X	HLN6938_	Hardware DEK Mounting								
			X							6880103W09	DEK Instruction Manual								
			X							HLN1229_	DEK Status/Message SYS 9000								
				X						HLN1196_	Wildcard								

Table 21: Direct Entry Keyboard Model Chart (continued)

M25KSS9PW1BN/M25KSS9PW1BNI/M22KSS9PW1BN/M24KSS9PW1BN/M36KSS9PW1BN M25QSS9PW1BN/M25QSS9PW1BNI/M22QSS9PW1BN/M24QSS9PW1BN/M36QSS9PW1BN M25URS9PW1BN/M25URS9PW1BNI/M22URS9PW1BN/M24URS9PW1BN/M36URS9PW1BN M25SSS9PW1BN/M25SSS9PW1BNI/M22SSS9PW1BN/M24SSS9PW1BN/M36SSS9PW1BN M25VRS9PW1CN/M22VRS9PW1CN									
Model/Item							Description		
W355AS							ADD: Status/Message 8 APX		
W374AJ							ADD: Status/Message 16 APX		
W591AQ							ADD: Auxiliary Switch Panel APX		
W599BF							ADD: 8 Mode Direct Entry APX		
W614AT							ADD: 16 Mode Direct Entry APX		
W615AW							ADD: 24 Mode Direct Entry APX		
GA00812AA							ADD: DEK for Whelen Siren with O3 Control Head Only		
GA00814AA							ADD: DEK for Whelen Siren		
X	X		X	X	X	X	HK6189_	Cable, Control Head DEK	
			X	X	X		HLN1362_	DEK 8 Mode SYS 9000	
				X	X		HLN1363_	DEK 16 Mode SYS 9000	
					X		HLN1364_	DEK 24 Mode SYS 9000	
						X	6880103W09	Direct Entry Keyboard Instruction Manual	
						X	HBN6003_	Packing Box	
						X	HKN4265_	Fuse Cable	
						X	X	HLN1241_	DEK Housing Assembly SYS9000 Siren/PA
						X	X	HLN5331_	DEK 9000E Siren/PA Spare Button
						X	X	HLN6275_	DEK Mounting Hardware
							X	HKN4265_	Fuse Cable
							X	HLN5157_	DEK Mounting Hardware

Table 22: Housing Alarm PS Model Chart

M25KSS9PW1BN/M25KSS9PW1BNI/M22KSS9PW1BN/M24KSS9PW1BN/M36KSS9PW1BN M25QSS9PW1BN/M25QSS9PW1BNI/M22QSS9PW1BN/M24QSS9PW1BN/M36QSS9PW1BN M25URS9PW1BN/M25URS9PW1BNI/M22URS9PW1BN/M24URS9PW1BN/M36URS9PW1BN M25SSS9PW1BN/M25SSS9PW1BNI/M22SSS9PW1BN/M24SSS9PW1BN/M36SSS9PW1BN M25VRS9PW1CN/M22VRS9PW1CN					
Model/Item					Description
GA00187AB					INT: O5 Shield, Sun, Motorcycle
	W15AJ				ADD: Weather Proof Housing Enclosure Black APX
		W665BF			ADD: Base Station OP with PS APX
			B116BD		ADD: Buzzer 110 mA APX
			W116AQ		ADD: External Alarm Relay And Cable APX
X				NNTN7279B	Assembly, Accessory, Shield, Sun, Motorcycle
	X			HLN7022_	Black Motorcycle Enclosure with Hardware
		X		56012023001	Unit Box Spectra ST
		X		6880101W87	Spectra CTL STA Instruction Manual
		X		6880102W93	Spectra MAXTRAC Control Base Manual
		X		HLN6042_	Tray Base Spectra
		X		HLN7024_	Hardware Installation Base Tray
			X	HLN6953_	Buzzer Kit 110 mA
			X	HKN4258_	Cable Relay
			X	HLN6969_	XTL 5000, External Alarm Relay
			X	HKN6196_	Cable, VIP

Table 23: Microphone Model Chart

M25KSS9PW1BN/M25KSS9PW1BNI/M22KSS9PW1BN/M24KSS9PW1BN/M36KSS9PW1BN M25QSS9PW1BN/M25QSS9PW1BNI/M22QSS9PW1BN/M24QSS9PW1BN/M36QSS9PW1BN M25URS9PW1BN/M25URS9PW1BNI/M22URS9PW1BN/M24URS9PW1BN/M36URS9PW1BN M25SSS9PW1BN/M25SSS9PW1BNI/M22SSS9PW1BN/M24SSS9PW1BN/M36SSS9PW1BN M25VRS9PW1CN/M22VRS9PW1CN									
Model/Item								Description	
GA01354AA								ADD: Wireless Remote Speaker Microphone And Gateway	
GA01438AB								ADD: Gateway Remote Speaker Microphone	
GA01439AB								ADD: Gateway Remote Speaker Microphone And Wireless Remote Speaker Microphone	
G892AB								ENH: Hand Microphone, MMP Water Resist-ant APX	
G90AC								ADD: No Microphone Needed APX	
W20CA								ADD: Keypad Microphone MMP APX	
X							RLN6551B	Long Range Wireless Mobile Bluetooth with Ve-hicular Charger	
	X						PMMN4097C	Mobile Microphone with Bluetooth Gateway	
		X					RLN6552B	Long Range Wireless Mobile Bluetooth No PS	
				X			HMN1089_	Hand Microphone (GCAI) Water Resistant	
					X		(REFERENCE)_A381	No Microphone	
						X	HMN4079_	XTL5000 Keypad Microphone	

Table 24: Microphone Model Chart (continued)

M25KSS9PW1BN/M25KSS9PW1BNI/M22KSS9PW1BN/M24KSS9PW1BN/M36KSS9PW1BN M25QSS9PW1BN/M25QSS9PW1BNI/M22QSS9PW1BN/M24QSS9PW1BN/M36QSS9PW1BN M25URS9PW1BN/M25URS9PW1BNI/M22URS9PW1BN/M24URS9PW1BN/M36URS9PW1BN M25SSS9PW1BN/M25SSS9PW1BNI/M22SSS9PW1BN/M24SSS9PW1BN/M36SSS9PW1BN M25VRS9PW1CN/M22VRS9PW1CN							
Model/Item				Description			
W20CC				ADD: Keypad Microphone MMP (Cyrillic)			
	W20CD			ADD: Keypad Microphone MMP (Arabic)			
		W20CB		ADD: Keypad Microphone MMP (Hebrew)			
			W22BB	ADD: Hand Microphone (Motorcycle WP Microphone) APX			
			W22BA	ADD: Standard Palm Microphone APX			
			W382AM	ADD: Control Station Desk MMP Microphone			
			W872AB	ADD: Microphone Visor Standard APX			
X						HMN4109_	Keypad Assembly, Assembly, Keypad Microphone, Cyrillic
	X					HMN4110_	Keypad Assembly, Assembly, Keypad Microphone, Arabic
		X				HMN4108_	Keypad Assembly, Assembly, Keypad Microphone
			X			HMN1079_	Mod Motorcycle WP Microphone DB9 Pin Connection
				X		HMN1090_	Assembly, Microphone, Front, Grey, Standard Palm Microphone (GCA)
					X	RMN5070A	Desktop Microphone (MMP)
					X	RMN5054B	Smart Visor Microphone

Table 25: Speaker Model Chart

M25KSS9PW1BN/M25KSS9PW1BNI/M22KSS9PW1BN/M24KSS9PW1BN/M36KSS9PW1BN M25QSS9PW1BN/M25QSS9PW1BNI/M22QSS9PW1BN/M24QSS9PW1BN/M36QSS9PW1BN M25URS9PW1BN/M25URS9PW1BNI/M22URS9PW1BN/M24URS9PW1BN/M36URS9PW1BN M25SSS9PW1BN/M25SSS9PW1BNI/M22SSS9PW1BN/M24SSS9PW1BN/M36SSS9PW1BN M25VRS9PW1CN/M22VRS9PW1CN									
Model/Item							Description		
B18CR							ADD: Auxiliary Speaker 7.5 W APX		
B18CS							ADD: Auxiliary Speaker Specification Motorcycle APX		
G142AD							ADD: No Speaker Needed APX		
G831AD							ADD: Speaker 13 W Water Resistant		
G832AD							ADD: Speaker 7.5 W Water Resistant APX		
W432AG							ADD: Auxiliary Speaker 13 W (3.2 Ω)		
GA01116AA							ADD: Dual Radio Audio Combiner Kit		
X						HSN4031_	Speaker Module Assembly, External Speaker 7.5 W		
	X					HSN6003_	Motorcycle WP Speaker		
		X				(REFERENCE)_A383	No Speaker		
			X			HSN4040_	3.2 Ω External Speaker Assembly		
				X		HSN4038_	Speaker. 7.5 W Remote		
					X	HSN4032_	Speaker Module Assembly, MCS External Speaker 13 W		
					X	HKN6250_	Dual Radio Accessory Cable		
					X	YLN4713_	Audio Combiner Kit Assembly		

1.4.2

Radio Specifications

For radio specifications, visit the following links:

APX 6500

- Product Page:
https://www.motorolasolutions.com/en_us/products/two-way-radios/project-25-radios/mobile-radios/apx-6500.html
- Product Catalog Page:
https://www.motorolasolutions.com/en_us/products/two-way-radios/project-25-radios/mobile-radios/apx-6500.html#productcat

APX 4500

- Product Page:
https://www.motorolasolutions.com/en_us/products/two-way-radios/project-25-radios/mobile-radios/apx-4500.html
- Product Catalog Page:
https://www.motorolasolutions.com/en_us/products/two-way-radios/project-25-radios/mobile-radios/apx-4500.html#productcat

APX 1500

- Product Page:
https://www.motorolasolutions.com/en_us/products/two-way-radios/project-25-radios/mobile-radios/apx1500.html
- Product Catalog Page:
https://www.motorolasolutions.com/en_us/products/two-way-radios/project-25-radios/mobile-radios/apx1500.html#productcat

Chapter 2

Basic Maintenance

This chapter describes the preventive maintenance and handling precautions.

Each of these topics provides information vital to the successful operation and maintenance of the radio.

2.1

Preventive Maintenance

Radios are shipped from the factory with a worst-case frequency error of:

- ± 100 Hz for VHF
- ± 600 Hz for UHF1
- ± 600 Hz for UHF2
- ± 600 Hz for 700–800 MHz
- ± 600 Hz for 800–900 MHz

These specifications are tighter than the more stringent FCC requirements of:

- ± 2.5 ppm for VHF band
- ± 2.0 ppm for UHF1 band
- ± 2.0 ppm for UHF2 band
- ± 1.5 ppm for the 700–800 MHz bands
- ± 1.5 ppm for the 800–900 MHz bands

For radios that have been in storage for over 6 months from the factory ship date, check the reference oscillator before deploying the radios to the field. It is strongly recommended to check the reference oscillator once a year or every time the radio is serviced. The crystal contained in the reference oscillator naturally drifts over time due to its aging characteristic. Periodic (annual) adjustment of the reference oscillator is important for proper radio operation. Improper adjustment can result in both poor performance and interference with users on adjacent channels.

2.1.1

Inspection

Check that the external surfaces of the radio are clean and that all external controls and switches are functional. A detailed inspection of the interior electronic circuitry is not needed.



NOTE: Verify that all dust covers are in place.

2.1.2

Cleaning Procedures

The following procedures describe the recommended cleaning agents and the methods to be used when cleaning the external and internal surfaces of the radio.

External surfaces include the control head and radio chassis. These surfaces should be cleaned whenever a periodic visual inspection reveals the presence of smudges, grease, and/or grime. Internal surfaces should be cleaned only when the radio is disassembled for service or repair.



CAUTION:

Use all chemicals as prescribed by the manufacturer. Be sure to follow all safety precautions as defined on the label or material safety data sheet.

The effects of certain chemicals and their vapors can have harmful results on certain plastics. Aerosol sprays, tuner cleaners, circuit board cleaners, alcohols, and other chemicals should not make contact with plastic or metal radio housings.

The only recommended agent for cleaning the external radio surfaces is a 0.5% solution of a mild dishwashing detergent in water. The only factory recommended liquid for cleaning the printed circuit boards and their components is isopropyl alcohol (100% by volume).

Cleaning External Plastic Surfaces

Apply the 0.5% detergent-water solution sparingly with a stiff, non-metallic, short-bristled brush to work all loose dirt away from the radio. Use a soft, absorbent, lintless cloth or tissue to remove the solution and dry the radio. Make sure that no water remains entrapped near the connectors, cracks, or crevices.

Cleaning Internal Circuit Boards and Components

Isopropyl alcohol (100%) may be applied with a stiff, non-metallic, short-bristled brush to dislodge embedded or caked materials located in hard-to-reach areas. The brush stroke should direct the dislodged material out and away from the inside of the radio. Be careful not to break off electrical components.

Make sure that controls or tunable components are not soaked with alcohol. Do not use high-pressure air to hasten the drying process since this could cause the liquid to collect in unwanted places. After completing the cleaning process, use a soft, absorbent, lintless cloth to dry the area. Do not brush or apply any isopropyl alcohol to any plastic parts.



NOTE:

The cleaning can only be done after all the internal circuit boards and components are removed from the radio chassis.

Always use a fresh supply of alcohol and a clean container to prevent contamination by dissolved material (from previous usage).

2.1.3

General Radio Care and Handling Precautions

- Avoid physical abuse: do not pound, drop, or throw the radio. Exposed parts, such as controls and connectors, might be damaged.
- Operating the radio without an antenna cable attached may lead to radio failure and may void the warranty.
- Do not mount anything on the radio chassis fins, which are used for heat dissipation.

2.1.4

RF Power Amplifier (RF PA) Heatsinking

To avoid immediate failure of RF Power Amplifier (RF PA) or reduce the life of RF PA devices, install the following components in the chassis before transmitting:

- Printed-Circuit Board (PCB) DC

- RF connector clips
- Internal screws

If it is properly used, you can transmit for short period of time with the chassis eliminator.

2.2

Safe Handling of CMOS and LDMOS Devices

Complementary Metal Oxide Semiconductor (CMOS) and Laterally Diffused Metal Oxide Semiconductor (LDMOS) devices are used in this family of radios, and are susceptible to damage by electrostatic or high-voltage charges.

Damage can be latent, resulting in failures occurring weeks or months later. Therefore, special precautions must be taken to prevent device damage during disassembly, troubleshooting, and repair.

Handling precautions are mandatory for CMOS/LDMOS circuits and are especially important in low humidity conditions. Do not attempt to disassemble your radio without referring to the following caution statement.



CAUTION:

This radio contains static-sensitive devices. Do not open your radio unless you are properly grounded. Take the following precautions when working on this unit:

- Store and transport all CMOS/LDMOS devices in conductive material so that all exposed leads are shorted together. Do not insert CMOS/LDMOS devices into conventional plastic "snow" trays used for storage and transportation of other semiconductor devices.
- Ground the working surface of the service bench to protect the CMOS/LDMOS device. It is recommended that you use a wrist strap, two ground cords, a table mat, a floor mat, electrostatic discharge (ESD) shoes, and an ESD chair.
- Wear a conductive wrist strap in series with a 100k resistor to ground. Replacement wrist straps that connect to the bench top covering are Motorola Solutions part number 4280385A59.
- Do not wear nylon clothing while handling CMOS/LDMOS devices.
- Do not insert or remove CMOS/LDMOS devices with power applied. Check all power supplies used for testing CMOS/LDMOS devices to be certain that there are no voltage transients present.
- When straightening CMOS/LDMOS pins, provide ground straps for the apparatus used.
- When soldering, use a grounded soldering iron.
- Handle CMOS/LDMOS devices by the package and not by the leads. Before touching the unit, touch an electrical ground to remove any static charge that you may have accumulated. The package and substrate may be electrically common. If so, the reaction of a discharge to the case would cause the same damage as touching the leads.

Chapter 3

Basic Theory of Operation

The Enhanced Single Band Mobile Radio is a two-board assembly that consists of a controller board and a transceiver board. The controller board consists of the micro-controller, memory, and connectivity module. The transceiver board consists of transmitter, receiver, and frequency generation unit (FGU).

3.1

General Overview

The mobile radio is a synthesized and fixed-tuned radio.

The radio is a mid power model.

The radio is capable of the following operations:

- Analog operation at 12.5 kHz, 20 kHz, and 25 kHz bandwidths.
- ASTRO mode operation at 12.5 kHz bandwidth.



NOTE: Motorola Advanced Crypto Engine (MACE) or Secure related tests and information do not apply to APX 1500 radios and PMLN9050A Controller Boards.

Mobile Radio Assemblies Sections

Radio	Description
O2 Control Head Assembly	The control head assembly contains the following components: • LCD display • User Interface • OMAP 5912 microprocessor For the dash mount configuration, the control head assembly is attached to the controller using a flex and uses SSI to communicate. For the remote mount configuration, the control head assembly is attached to the Control Head Interface Board (CHIB). It uses a flex and a CAN cable to interface with the Remote Control Head to the Transceiver Interface Board (TIB). The TIB assembly plugs directly into the transceiver board at the back of the radio.
O3 Control Head Assembly	The control head assembly contains the following components: • LCD display • User Interface • OMAP microprocessor

Radio	Description
	The O3 plugs directly into the Transceiver Interface Board (TIB) assembly mounted at the back of the radio. The only difference between Dash mount and Remote Mount is the additional 17' Straight cable.
O5 Control Head Assembly	The control head assembly contains the following components: • LCD display • User Interface • OMAP microprocessor For the dash mount configuration, the control head assembly is attached directly to the controller using a flex and uses SSI to communicate. For the remote mount configuration, the control head assembly is attached to the Control Head Interface Board (CHIB). It uses a flex and a CAN cable to interface the Remote Control Head to the Transceiver Interface Board (TIB). The TIB assembly plugs directly into the transceiver board at the back of the radio.
E5 Control Head Assembly	The control head assembly contains the following components: • LCD display • User Interface • Kinetics K32H microprocessor For the dash mount configuration, the control head assembly is attached to the controller through a flex. It uses SSI to communicate. For the remote mount configuration, the control head assembly is attached to the Control Head Interface Board (CHIB). It uses a flex and a CAN cable to interface with the Remote Control Head to the Transceiver Interface Board (TIB). The TIB assembly plugs directly into the transceiver board at the back of the radio.
O7 Control Head Assembly	The control head assembly contains the following components: • LCD display • User Interface • OMAP 5912 microprocessor For the dash mount configuration, the control head assembly is attached to the controller using a flex. It uses SSI to communicate.

Radio	Description
	For the remote mount configuration, the control head assembly is attached to the Control Head Interface Board (CHIB). It uses a flex and a CAN cable to interface with the Remote Control Head to the Transceiver Interface Board (TIB). The TIB assembly plugs directly into the transceiver board at the back of the radio.
O9 Control Head Assembly	The control head assembly contains the following components: • LCD display • User Interface • OMAP microprocessor For the dash mount configuration, the control head assembly is attached directly to the controller using a flex. It uses SSI to communicate. For the remote mount configuration, the control head assembly is attached to the Control Head Interface Board (CHIB). It uses a flex and a CAN cable to interface with the Remote Control Head to the Transceiver Interface Board (TIB). The TIB assembly plugs directly into the transceiver board at the back of the radio.
Transceiver Board	The controller of this board contains the following digital hardware: • Microcontroller • Memory • Logic • Supporting peripherals The digital hardware performs the following functions: • Governs radio operation. • Service all radio inputs and outputs. • Process all voice and data. The digital hardware contains the following components: • A dual-core processor (MCU and DSP cores). • Processor memory devices. • Audio and power supply which support the Integrated Circuit (IC). • Audio CODEC and audio PA. • MACE (Type 3 Secure IC).¹

Radio	Description
	• GNSS (GPS/GLONASS) IC and supported circuitry. • Combination of WLAN/Bluetooth capable IC. • Supported circuitry. • Supported hardware for external accessory interfaces such as RS232, USB, SB9600, and logic signals.
CHIB	The CHIB contains the following components: • SSI-CAN FPGA • 16-bit CODEC for audio processing • Class D Audio PA • Controller Area Network (CAN) transceivers. Each CAN transceiver is used to communicate with the RF transceiver, audio, data, and system power-on commands.
Transceiver Interface Board	The TIB contains the following components: • CAN transceivers and audio • Digital routing for accessories The TIB is used with the O3 Control Head for Dash and Remote Mount configuration. The Remote Mount configuration is used with the O2, O5, O7, O9, and E5 Control Heads.
Radio Frequency Transceiver Board	Power Amplifier (PA) section Contains the antenna switch, directional coupler/detector, and amplifier. Front-End Receiver section Contains the preselector, low-noise amplifier (LNA), and mixer. IF section Contains the receiver intermediate-frequency (IF) amplifier/filter and the digital receiver back-end integrated circuit (IC). Frequency Generation section Contains the synthesizer, voltage-controlled oscillators (VCOs), reference oscillator, and receive and transmit buffers.

3.2

Controller Section

The Controller is a section of the radio that contains the following elements:

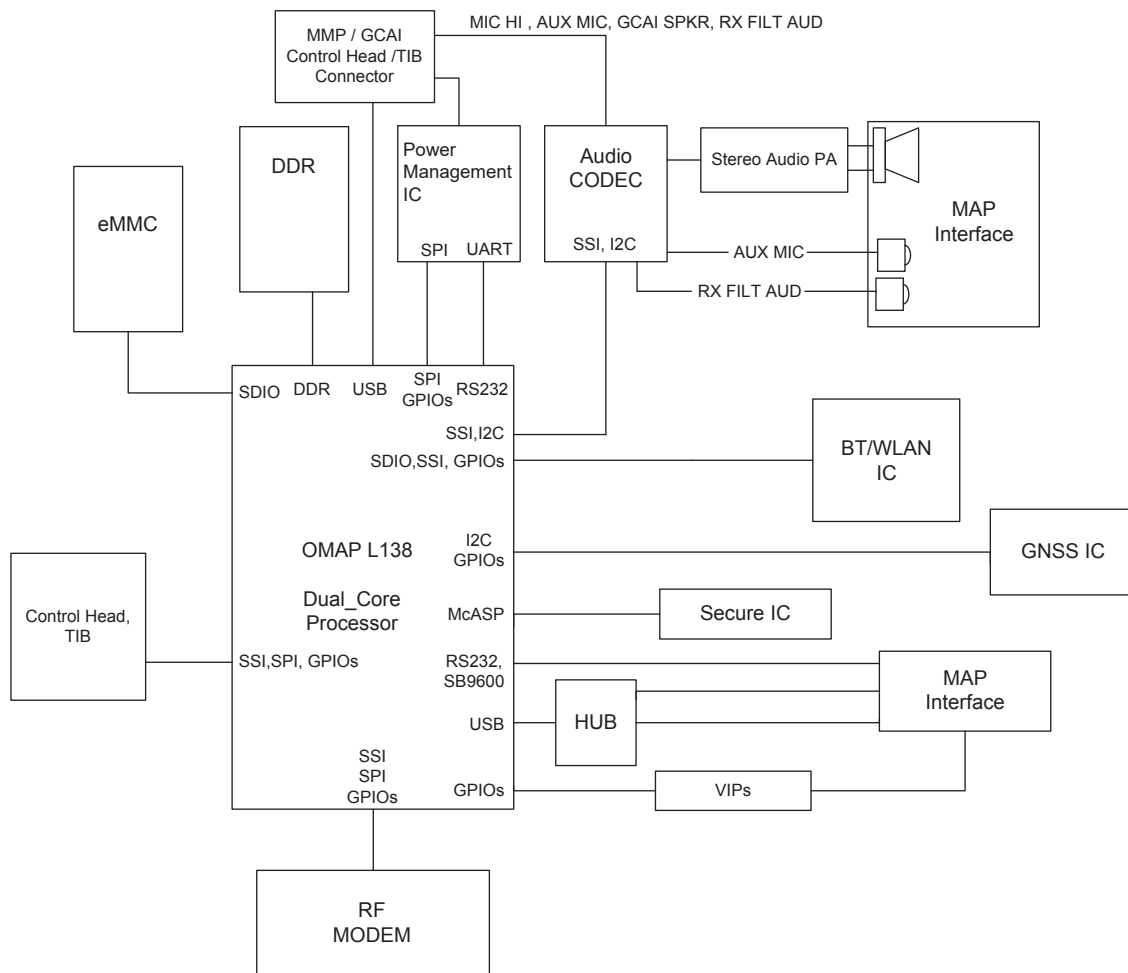
¹ Not applicable to APX 1500 radios.

- Voltage regulators and data communication circuitry (RS232, USB, and SB9600)
- Microcontroller, FLASH IC, SDRAM IC
- Transceiver Board interface connector
- CODEC and Audio circuitry
- Power Management and Voltage Regulator IC
- Emergency circuitry
- Secure IC
- Edge connector interface for control head or Transceiver Interface Board (TIB)
- Rear accessory connector for additional accessories
- GNSS circuitry
- WLAN/Bluetooth circuitry



NOTE: Motorola Advanced Crypto Engine (MACE) or Secure related tests and information do not apply to APX 1500 radios and PMLN9050A Controller Boards.

Figure 1: Mobile Controller Block Diagram



3.2.1

Controller Functional Blocks

The main functional blocks of the controller are a dual-core microprocessor. It consists of ARM-based controller and a DSP, Flash memory, and a Double-Data-Rate SDRAM memory.

The controller includes the following components:

- Type 3 encryption processor – Motorola Advanced Crypto Engine (MACE).
- Power Management IC.
- Various external switching and linear voltage regulators.



NOTE: Hardware MACE or Secure related tests and information do not apply to APX 1500 radios and PMLN9050A Controller Boards.

The primary clock sources (19.2 MHz and 32.768 kHz) to all other controller digital clocks.

The audio has a stereo CODEC and a class-D audio power amplifier that provides the radio with multiple internal microphone and speaker inputs or outputs. The external interfaces or connectors provide communication and control to the accessories, the control head, and the TIB.

The ARM controller core of the OMAP L138 processor handles the power-up sequence of all devices. This includes the following tasks:

- Firmware upgrades and operating system tasks with FLASH and SDRAM memories.
- User interface or control-head communication

The FLASH memory (4 GB eMMC) stores the firmware, tuning, codeplug settings, and gets read and stored into SDRAM (128 MB) for execution upon initialization. The ARM and DSP control and configure audio, wireless, and RF devices linked to the Serial Peripheral Interface (SPI) and Synchronous Serial Interface (SSI) buses. This is to enable the radio FM modulation, and optional wireless communication protocols. For encryption, a separate ARM processor (MACE) is used to encode and decode encrypted packets coming in from the main OMAP L138 processor through the SSI interface. Its firmware is flashed through the main processor to its internal FLASH memory.

The Power Management IC and the external switching and linear regulators on board provides power to the controller devices. The Power Management IC provides the 32.768 kHz clock to the OMAP L138 and to the WLAN or Bluetooth IC, and provides a 4.8 MHz clock to the MACE encryption IC. The OMAP L138 main reference clock (19.2 MHz), is supplied from the FGU section of the transceiver board.

The three external microphone input paths and an internal audio PA provide audio to an external loudspeaker. There are line level analog audio outputs for monitoring or recording. The external speaker is driven by a Class D audio amplifier that delivers a rated power of 15 W to a 3.2-Ohm speaker. The speaker path uses the CODEC for volume control, and to convert the audio signal from digital DSP samples to analog. All microphone input paths use the CODEC ADC to deliver digital audio samples to the DSP controller.

The control head and TIB contain a universal accessory connector (MMP). The connector provides audio, USB, and RS232 interfaces to the radio by using the Power Management IC and CODEC. In addition to other signals, many of these interfaces are available on the radio accessory interface connector (MAP).

A GNSS IC has the following components:

- Global Positioning System (GPS) and GLONASS receiver.
- IC that combines a WLAN transceiver (IEEE 802.11 b/g/n) and a Bluetooth 4.0 capable transceiver.
- 3-axis accelerometer.

The GNSS IC interfaces with the OMAP L138 processor through a shared I2C bus.

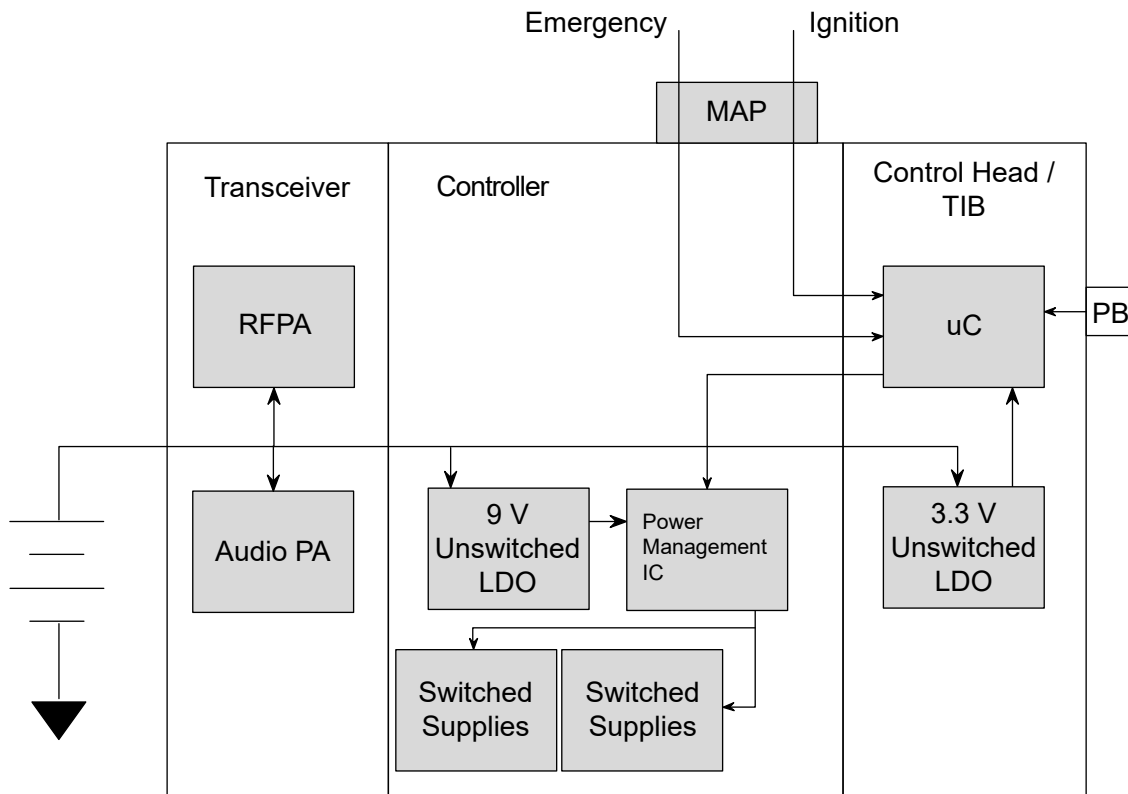
The WLAN or Bluetooth IC interfaces with the OMAP L138 processor from a 4-bit SDIO bus.

The radio can be connected to a wireless network access point using the WLAN or Bluetooth IC. The IC supports IEEE 802.11 b/g/n data rate standards and the 802.11i security standard. When this feature is enabled, the radio is updated with a new codeplug and software through Wi-Fi. The Wi-Fi AP name and password need to be set in the codeplug and the radio management software enabled to provide wireless updates. When the radio Wi-Fi is actively connected to an AP, a Receive Signal Strength Indicator (RSSI) is shown on the control head display.

3.2.2

Voltage Distribution/Power On/Off

Figure 2: Voltage Distribution/Power Diagram



3.2.2.1

Voltage Distribution for Controller and RF Board

The APX mobile radios are powered by a 12 V vehicle battery (negative ground), or a AC-to-DC desktop power adapter. The power enters at the rear of the radio at a dedicated 2-pin DC connector.

This raw voltage known as A+ is routed to the transmitter and transceiver board circuitry for post-regulation.

3.2.2.2

Power On/Off

There are three methods that can be used to turn the radio on and off (depending on the codeplug setting).

The radio can be turned on and off with the Power Button on the control head.

It can also be turned on and off with the Ignition sense (ACC) line and emergency by using the MAP accessory connector.

The transceiver regulators are controlled by the Power Management IC (ASIC). This IC has a Power Management Controller (PMC) state machine that turns on and off all radio supplies.

The PMC also resets the OMAP L138 microprocessor at power-up, in response to user inputs at the control head or MAP.

3.2.3

Audio Circuitry

This topic covers the RX audio path and TX audio path.

3.2.3.1

RX Audio Path

The receive audio path consists of the following main components:

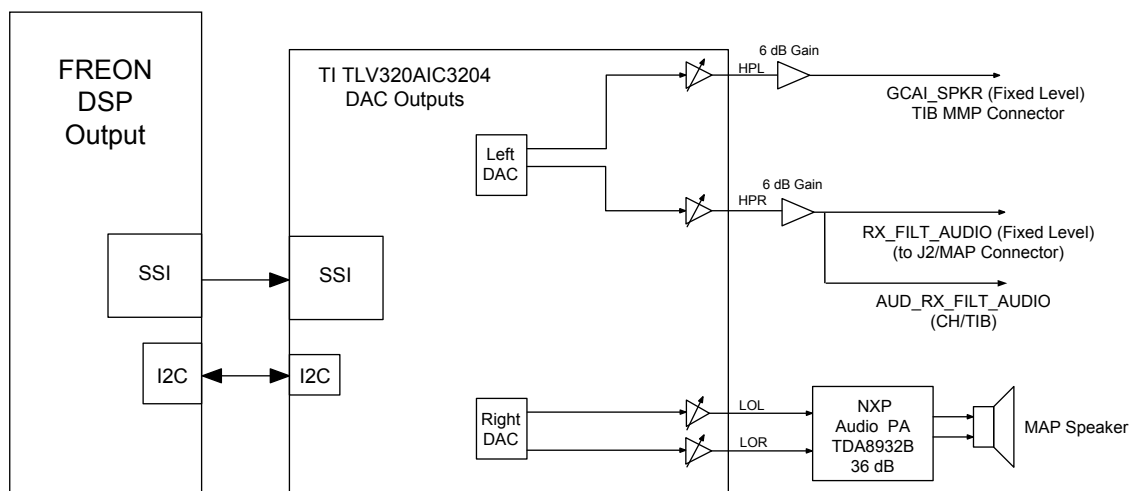
- Texas Instruments OMAP L138
- Texas Instruments Audio CODEC TLV320AIC3204
- TI Audio PA NXP TDA8932B

The Digital audio signal comes from the DSP processor using SSI protocol. The Audio SSI bus is routed to TI CODEC. The CODEC converts the SSI digital data to analog. This audio is routed to both the MAP and MMP accessory interfaces to supply line-level audio for monitoring/recording. It is also routed to the Audio PA, with volume control being programmed using the I2C bus by the OMAP L138.

The Audio PA converts the analog signal to a PWM output, it also adds 36 dB of gain. The output low pass filter (LC), filters out the Audio PA switching frequency before the audio is routed to the speaker output.

Figure 3: Receive Baseband Audio Path

RX Audio Lineup



3.2.3.2

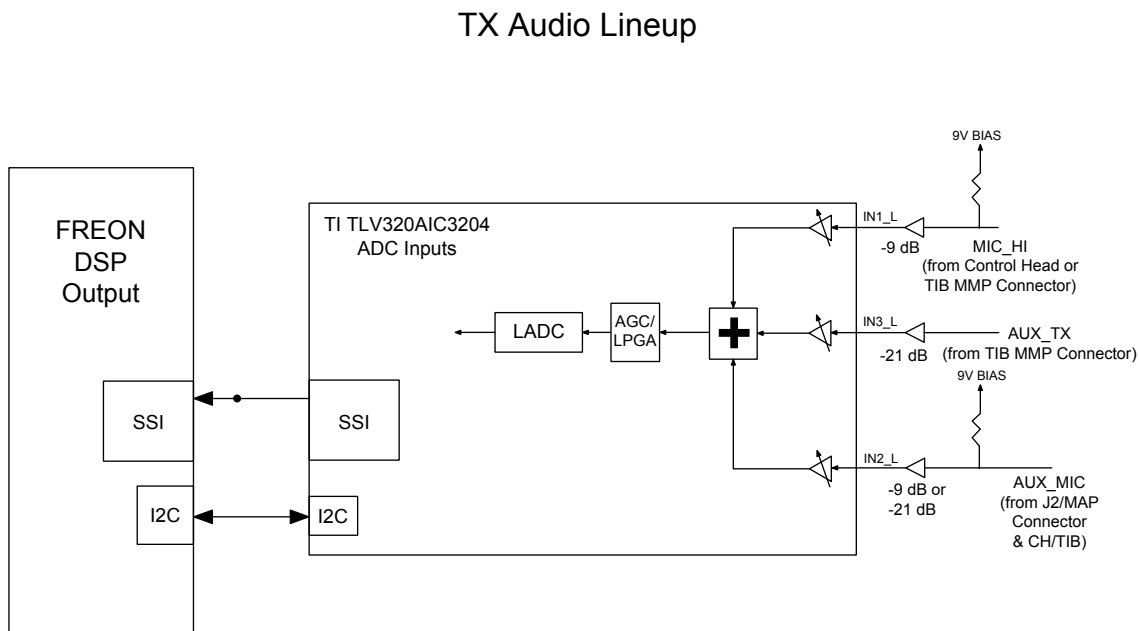
TX Audio Path

The analog audio comes from the external radio microphone that is attached through the control head's microphone port. It can also be attached through the MAP rear accessory connector J2 (Mic_Hi or Aux_Mic).

Analog audio is attenuated by 6 dB or 9 dB. It is routed to the Power Management IC, which converts the analog audio to digital. The converted audio is then sent it to the main processor using the Audio SSI bus.

OMAP L138 processes the audio that is then converted to Baseband audio and routed to the FGU. The audio is then sent to the transmitter board.

Figure 4: Transmit Baseband Audio Path



3.2.4

Secure

The controller board is able to perform secure encoding and decoding through the Motorola Advanced Crypto Engine (MACE) IC.



NOTE: Hardware MACE or Secure related tests and information do not apply to APX 1500 radios and PMLN9050A Controller Boards.

In TX mode, the CODEC supplies the OMAP L138 DSP with audio. When a secure signal has been selected, it is routed to the MACE through the SSI bus. The encrypted audio is then sent back to the OMAP L138 which routes it to the FGU for transmission. In RX mode, the encrypted digital audio sent to the OMAP L138 is first routed to the MACE through the SSI bus. The decrypted audio is then sent back to the OMAP L138 which routes it to the CODEC to be sent to the speaker.

Keyloading

See [Loading an Encryption Key on page 110](#). The KEYLOADER signal comes in on MMP pin 9 of the control head or TIB J700 connector. It routes to the MACE through the Power Management IC. There is an algorithm in the MACE which detects and stores the key as long as the radio is powered.

Tamper and key retention

The MACE has the option of infinite key retention. The key can be disabled by several means to avoid compromise. A tamper contact switch detects mechanical intrusion. A capacitor-backed supply maintains the static memory when all power to the radio is removed. This volatile key retention option holds the key for between 5 and 10 minutes on the discharge of this capacitor.

3.2.5

GPS Overview

The GNSS architecture employs a single chip GPS and GLONASS receiver which decodes signals at 1575.42 MHz.

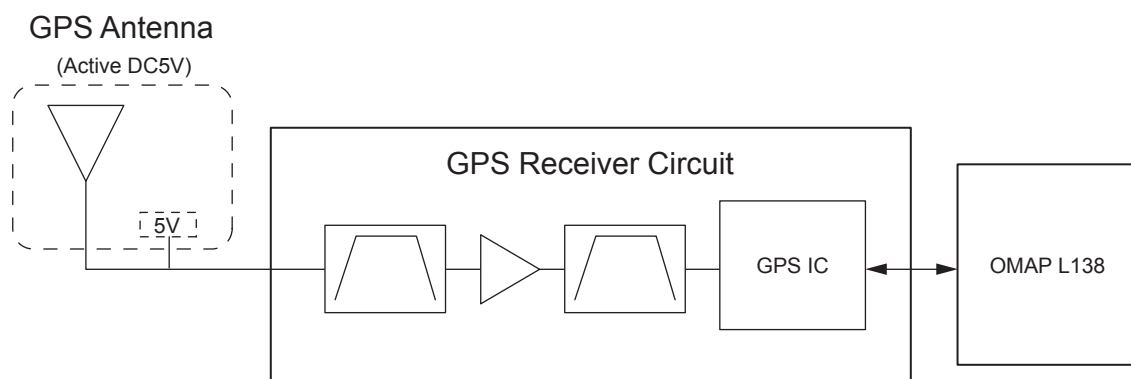
It is capable of producing a final position solution including full tracking and data decode capability. The receiver operates in the autonomous mode only.

The GNSS receiver is setup in an autonomous one track always (OTA) mode, also known as continuous navigation. The GNSS receiver continuously tracks satellites for as long as the radio is powered to ensure the best possible accuracy. In the event the radio loses visibility of the satellites due to terrain or environmental factors such as driving through a tunnel or in a parking garage, the receiver temporarily loses its position fix. It then begin to reacquire the signal and compute an updated position once the radio has moved back into an environment where GNSS signals are present.

The user is able to view the current latitude, longitude, and time/date stamp on the radio display. The radio can also be configured to send location to the system at predetermined intervals (LRRP). Depending on system options, the user may be able to enable/disable the GNSS receiver.

CAUTION: These custom connectors are optimized to meet voltage and current requirements for existing accessories and for the compatible flexes that are used with the radio. Inserting non-Motorola Solutions parts or pins into these connectors is not recommended. Failure to do so can result in equipment damage.

Figure 5: GPS Architecture



3.2.5.1

Acquiring a Position

Perform the following steps if the GNSS receiver is unable to acquire a position.

Procedure:

1. Make sure the radio is in an open sky environment to ensure the presence of GNSS signals (minimum 5 satellites in view at nominal power levels of -130 dBm).
2. Reset the radio. If a position fix does not occur within 2 minutes, proceed to [step 3](#).
3. Disconnect the GNSS antenna. Replace the GPS antenna if the center conductor on the antenna is shorted to ground.
4. Measure the voltage on the GNSS connector located on the radio and ensure that the result is 5 V. If the result is not 5 V, send the radio for repair.

 **NOTE:** Refer to the *Detailed Service Manual* for further instructions if GNSS does not obtain a position.

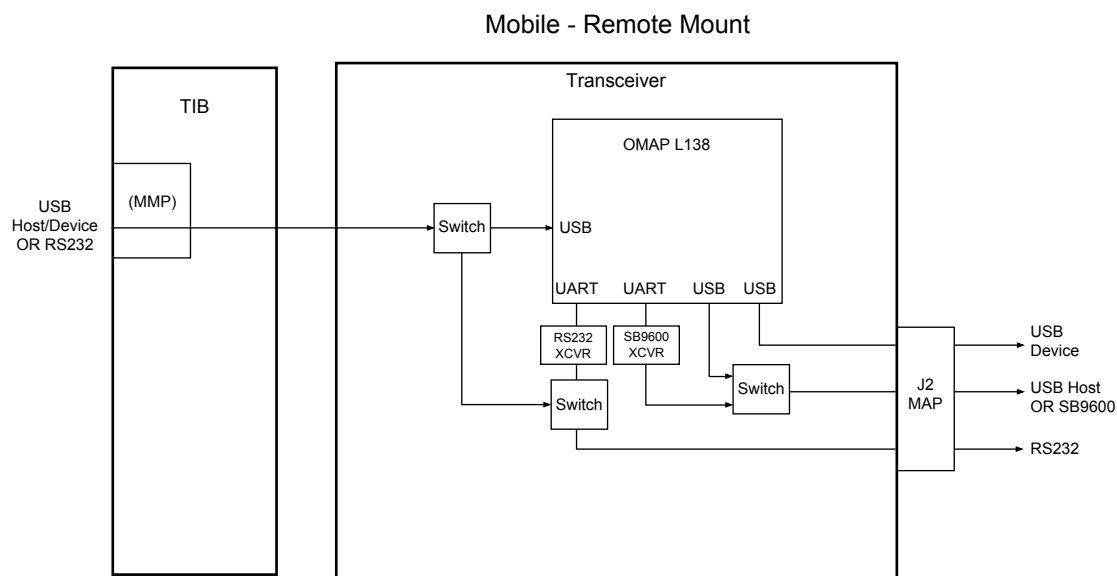
3.2.6

Serial Interfaces

RS232, USB Device, USB Host, and SB9600 are supported by the radio on the rear 26-pin J2 connection. While RS232 and USB Device/Host are supported on the TIB external connector J700.

Accessories that connect to the J700 and J2 connectors are identified through the 1-Wire[®] serial protocol. This information tells the controller which serial bus to configure for the accessory.

Figure 6: Remote-Mount Configuration



There are hardware design limitations that limit the number of serial interfaces that can be used simultaneously.

- **RS232** – This serial interface is available at either the MAP/J2 (rear) connectors, or at the J700 (TIB) connector. When no 1-Wire[®] accessory is added to the J700 connector, the MAP/J2 interface is the default choice. It is compatible with industry-standard 12 V RS232 logic. If a 1-Wire[®] compliant RS232 accessory is attached to the J700 connector, then the bus is no longer supported at MAP/J2. The J700 RS232 interface operates at 5 V logic. The voltage translation circuitry in the RS232 cable allows the bus to operate at 12 V.
- **SB9600** – This is a Motorola Solutions proprietary bus used to communicate with certain legacy accessories. The bus is available at the J2 connector by default.

- USB – USB Host and Device functionality are available at the J700 MMP connector on the TIB. The type of accessory or cable identified by the 1-Wire[®] interface determines the functionality once again. USB Device is also a dedicated interface at the MAP/J2 connector by default. In addition, USB Host can be optionally configured at the MAP/J2 connector through the SB9600 interface (the buses share common pins). The SB9600 bus is configured by default when MAP/J2 connector is connected with a 1-Wire[®] compliant USB Device accessory or cable. However, USB Host is configured when a 1-Wire[®] compliant USB Device accessory or cable is attached to the MAP/J2 connector.



NOTE: If a USB cable is attached to the TIB J700 connector, the RS232 link at the J2 can still be used. The J2 USB Host and Device interface can also be used if the J700 USB interface is for Host only.

3.3

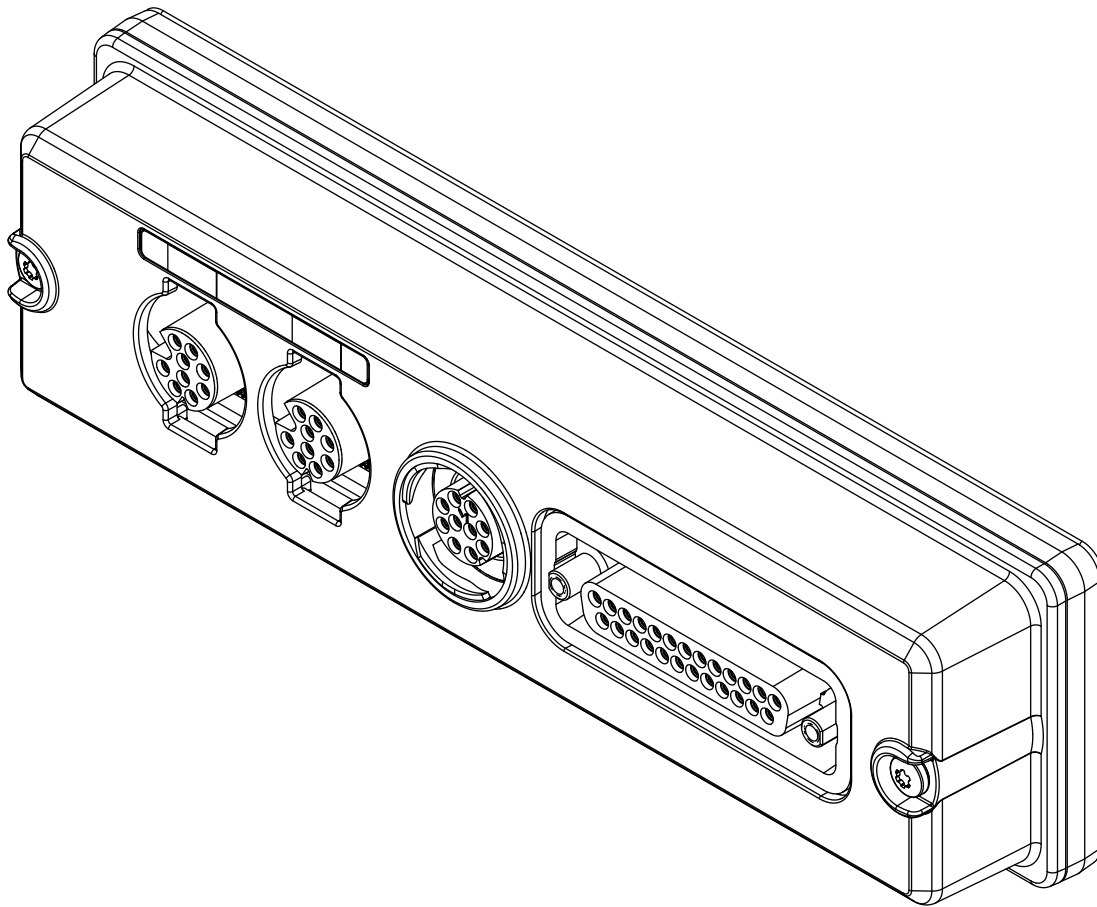
Transceiver Interface Board (TIB)

The Transceiver Interface Board (TIB) provides connectivity between the remote CAN cable and either the mid-power or high-power radio.

Opposite to that of the CHIB, the TIB must convert the CAN protocol back to Synchronous Serial Interface (SSI) through an FPGA, which is sent to the microprocessor. There also exists a legacy accessory interface J600, as well as the MMP J700 connection for data programming and hardware secure key-loading of the radio. The TIB universal connector attaches directly to the board, so all ESD protection to the TIB circuitry and to the radio front connector is located throughout the TIB. Power-ON, Power-OFF, and RESET of the radio is accomplished using an ATMEL AVR microcontroller to toggle SWB+ as determined by commands from the Transceiver or from a remote device, such as a control head, connected to the CAN bus.

The TIB contains an audio CODEC which interfaces to the FPGA to route audio to accessories attached to the TIB and a control line back to the radio. A charge pump boost circuit is designed to allow RS232 functionality at the MMP when A+ is below nominal value. During normal operation, the boost circuit is disabled. The TIB is capable of using either RS232 or USB at its MMP connector. The TIB contains an identical auto-termination circuit to that used on the CHIB. Finally, the TIB contains the circuitry to drive relays through VIP_OUT paths and detect levels through VIP_IN paths.

Figure 7: Transceiver Interface Board (TIB)



3.3.1

Quick Disconnect Circuit

Quick disconnect circuit which is located in the TIB provides immediate muting of all speaker audio by forcing the radio to reset when a control head CAN cable is disconnected from the TIB or from an extension cable that is attached to the TIB.

After the disconnection, if there are no other control heads attached through CAN to the TIB, the radio may be programmed to automatically turn itself off (approximately 20 seconds after the radio reset). This programming is done through the CPS by check marking the **Control Head(s) Required for Power Up** field. The **Control Head(s) Required for Power Up** field is typically 'check marked' in a configuration that has a single O3 control which is attached to an extension cable that is attached to the TIB. The radio immediately mute all speaker audio and ultimately power-off when the O3 control head is disconnected.



NOTE: If the **Control Head(s) Required for Power Up** field is NOT checked, the radio applies its normal power up rules such as ignition to determine whether to stay on or to power-off after the reset.

- If the field is 'check marked', then at least one control head must be present for the radio to remain powered-on after it resets. For example, if you only had one control head, and it is removed, the radio is powered-off after reset. If you had two control heads, and only one is removed, then after reset, the radio monitors the Ignition sense (ACC) line and compare to the ignition CPS setting to determine if it remains powered-on, or power-off. If you had two control heads, and you remove both, the radio is powered-off after reset.

- If the field is 'blank' (typical usage), then quick disconnect is not activated. For example, if you only had one control head, and it is removed, then after reset, the radio monitors the Ignition sense (ACC) line and compare to the ignition CPS setting to determine if it remains powered-on, or power-off. If you had two control heads, and only one is removed, the radio is powered-on after reset. If you had two control heads, and you remove both, the radio monitors the Ignition sense (ACC) line and compare to the ignition CPS setting to determine if it remains powered-on, or power-off.

3.3.2

Controller Area Network (CAN) Transceivers

There are a total of three CAN twisted pairs located between the control head and the radio transceiver.

CAN pair one is used for digital Audio, CAN pair two is used for digital Data and CAN pair three is for digital Power ON/OFF/RESET pulses. If an O5 control head is used, a TIB and CHIB must be present. If an O3 control head is used, only a TIB must be present, since the O3 control head has the CAN transceivers located on its PCB. The CAN bus provides a 1 MB/s data link. Only the list of approved Motorola Solutions CAN cables are to be used for any remote mount installations.

3.3.3

CAN Termination

The CAN architecture requires that a termination resistor is connected only at the two end-points of the CAN bus.

The CAN cable contains a jumper that grounds a “detect pin” at the CAN connectors. Logic within the auto-termination circuit determines how many cables are attached and enables or disables the termination resistors, for each of the three twisted pairs. The O3 control head has the termination resistors enabled at all times, since it is always an end-node. The remote mount cables are able to be connected to either the left CAN connector or to the right CAN connector. The letter L and R next to the connector indicates Left or Right CAN connector. It is not recommended to have CAN cables attached but dangling free at one end, during operation.



NOTE: Use Motorola Solutions fixed length CAN cables, as circuitry resides in each cable and the cable wiring impedance is unique to this remote cabling architecture as well.

3.4

Analog Mode of Operation

This topic covers Receive Operation and Transmit Operation.

Receive Operation

When the radio is receiving, the signal travels from the antenna through the RF PA output network. The output network is located in the power amplifier section to the front-end receiver assembly.

The signal is then filtered, amplified, and mixed with the first local oscillator signal generated by FGU. The resulting intermediate-frequency (IF) signal is fed to the IF circuitry where it is again filtered and amplified.

This amplified signal is passed to the back-end receiver IC where it is mixed with the second local oscillator to create the second IF.

The analog IF is processed by an analog-to-digital (A/D) converter. The converter is located within the digital back-end IC, where it is converted to a digital bit stream and decimated down to an I/Q digital sample.

This digital signal is then passed on to the DSP, where filtering and discrimination are performed in the software.

For voice signals, the DSP routes the digital voice data to the Codec. This is for volume gain control and conversion to an analog signal. The signal passes to the audio power amplifier, which drives the speaker. For signaling information, the DSP decodes the message and passes it to the microprocessor.

Transmit Operation

When the radio is transmitting, the microphone audio travels to a gain control circuit. The audio is then sent to the Codec where the signal is digitized.

The Codec passes digital data to the DSP, where pre-emphasis and low-pass (splatter) filtering is done. The DSP may also add signaling information. As a modulation signal for the transmitter voltage-controlled oscillator, the digital synthesizer IC receives the digitized signal including both voice and signaling data.

A modulated carrier is provided to the RF power amplifier, which transmits the signal under dynamic power control.

3.5

Control Head Interface Board (CHIB)

The Control Head Interface Board (CHIB) is used to provide functionality and connectivity between the Control Head Universal Connector (CHUC), the transceiver, and the Control Head.

For the remote-mount operation to function, the Synchronous Serial Interface (SSI) used to communicate between the control head and the transceiver in a Dash-mount configuration is converted on the CHIB to a Controller Area Network (CAN) protocol. The CHIB accomplishes this conversion using a Field-Programmable Gate Array (FPGA). This CAN data is then sent down the remote cable from the CHIB, through the CHUC, into the Transceiver Interface Board (TIB), and finally into the transceiver. The CHIB also provides an audio power amplifier for driving a speaker, a USB host, a USB device transceiver, and an auto-termination circuit to terminate the CAN bus.

Table 26: Control Head and CHIB Compatibility

CHIB Kit Numbers	Compatible with Control Head
PHCN4003A	E5 Control Head
PMUN1057_	O2 and O7 Control Heads
PHCN4003E or greater	E5, O2, and O7 Control Heads



NOTE: PMUN4003E and above are not a direct replacement for PHCN4003A and PMUN1057_. Only qualified service personnel can perform Control Head upgrade procedures to replace PHCN4003A or PMUN1057_ with PHCN4003E and above. Failure to perform Control Head upgrade procedures properly can cause incompatibility issues between the Control Head and CHIB. For more information, contact Motorola Solutions Service Center or Depot.

3.6

ASTRO Mode of Operation

In the ASTRO mode (digital mode) of operation, the transmitted or received signal is limited to a discrete set of deviation levels, instead of continuously varying.

The receiver handles an ASTRO-mode signal identically to an analog-mode signal up to the point where the DSP decodes the received data.

In the ASTRO receive mode, the DSP uses a specifically defined algorithm to recover information.

In the ASTRO transmit mode, microphone audio is processed the same way in analog mode. This is an exception for algorithm the DSP uses to encode the information. This algorithm results in deviation levels that are limited to discrete levels.

3.7

Radio Frequency Transceiver Board (RF Board)

Figure 8: VHF RF Transmitter Block Diagram

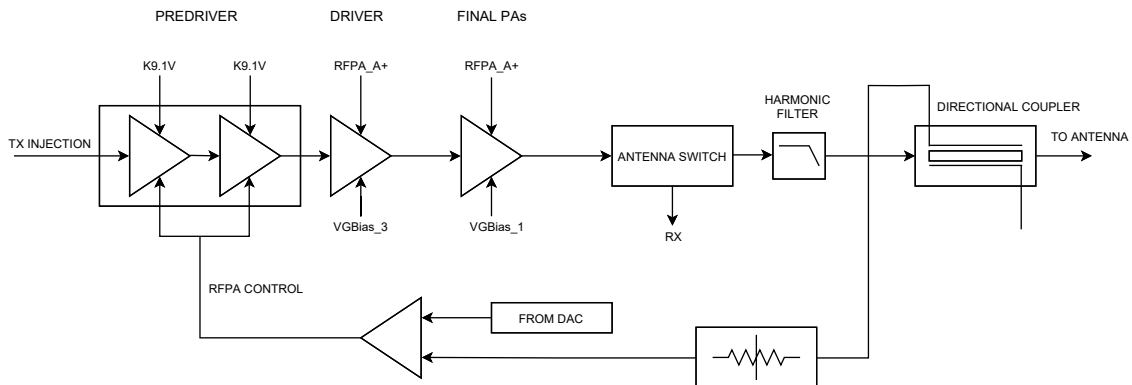
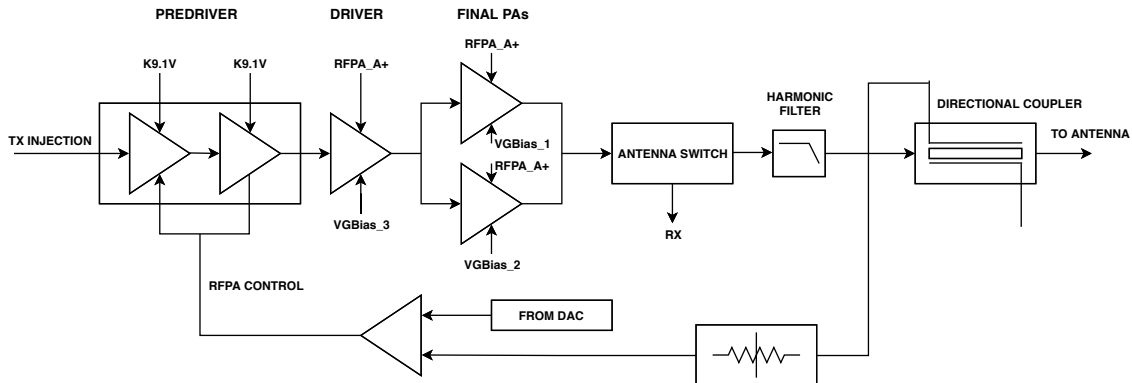


Figure 9: UHF1/UHF2/700-800 MHz/800-900 MHz RF Transmitter Block Diagram



3.7.1

Radio-Frequency Power Amplifier (RF PA) and Output Network (ON)

The RF PA is a three-stage power amplifier consisting of discrete LDMOS transistors.

The followings are the three stages:

- Controlled stage
- Driver stage
- Final stage

The RF PA is followed by the ON section, consisting of discrete circuitry with the following functions:

- Antenna switch
- Harmonic filter

- Power detector

3.7.2

Gain Stages

The controlled stage consists of two-stage, integrated amplifier with external matching, which amplifies the input signal from the VCO buffer and provides drive to the driver stage.

Power is controlled through gate bias to both internal stages of the controlled stage, and drain bias is supplied through K9.1 V. The driver stage has a fixed gate bias. The driver drain bias is supplied by the A+ (battery) voltage. For UHF1, UHF2, 700-800 MHz and 800-900MHz Band, driver stage drives the final stage, which consists of two transistors operating simultaneously. Both final devices have separate, fixed gate biases and their final drain biases are supplied by the A+ voltage. For VHF band, driver stage drives the final stage, which consists of a transistor. The final stage has a fixed gate bias and the final drain bias is supplied by the A+ voltage. The output of the final stage feeds the antenna switch, which routes the RF PA to the harmonic filter/power detector/antenna and isolates the RX front-end in transmit mode. Antenna switch routes antenna/power detector/harmonic filter to RX, and isolates TX in RX mode. Mode is determined via K9.1 V. The harmonic filter is a low-pass filter that attenuates harmonics generated by the RF PA in-transmit mode and provides additional receive selectivity in receive mode.

3.7.3

Power Control

The power control section regulates the RFPA output power by an automatic level control (ALC) circuit.

The transmitter ALC consists of a digital attenuator, voltage variable attenuator, RF log amp, digital-to-analog converter (DAC), analog-to-digital converter (ADC), and buffer or amplifier. The power detector senses the incident power transferred to the antenna through a directional coupler in which the RF signal is fed to the digital attenuator, voltage variable attenuator and the RF log amp. The RF log amp compares the input RF power from the directional coupler with the voltage set from the DAC to generate a DC voltage. The DC voltage is then gained by the buffer or amplifier and fed to the RFPA stage. The radio carrier power level is set by adjusting the DAC voltage set while monitoring the output power, which is saved in the radio memory.

3.7.4

Circuit Protection

The RFPA driver and final stage drain current, RFPA final stage temperature, RFPA control voltage, and battery voltage are sensed by the power control circuitry.

If a fault condition is detected, the control voltage is reduced, which cuts back the output power to a level that is safe for the particular operation conditions.

3.7.5

DC Interconnect

The DC connector at the edge of the board carries the A+ supply for the entire board.

This supply is routed directly to the controller and transmitter circuitry for both direct supply and regulating additional supplies. The radio chassis is grounded through the PCB screws and also through direct contact to the board. The dash mount control head receives the A+ supply through the 50-pin flex connector.

3.8

VHF, UHF1, UHF2, 700-800 MHz, and 800-900 MHz Receiver Overview

The receiver circuits primary duties are to detect, filter, amplify, and demodulate RF signals in the presence of strong interfering noise and unintended signals.

The receiver is broken down into the following blocks:

- Front-end (preselector and LNA)
- Mixer
- IF
- Back-end

Figure 10: VHF, UHF1, and UHF2 Receiver Block Diagram

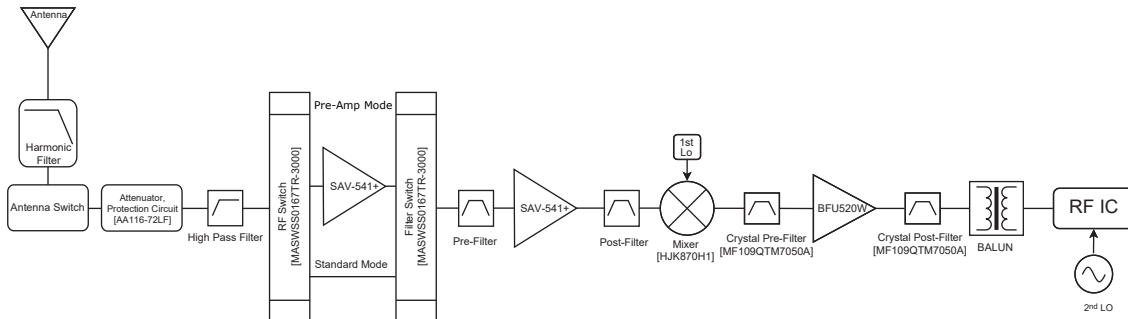


Figure 11: 700–800 MHz Block Diagram

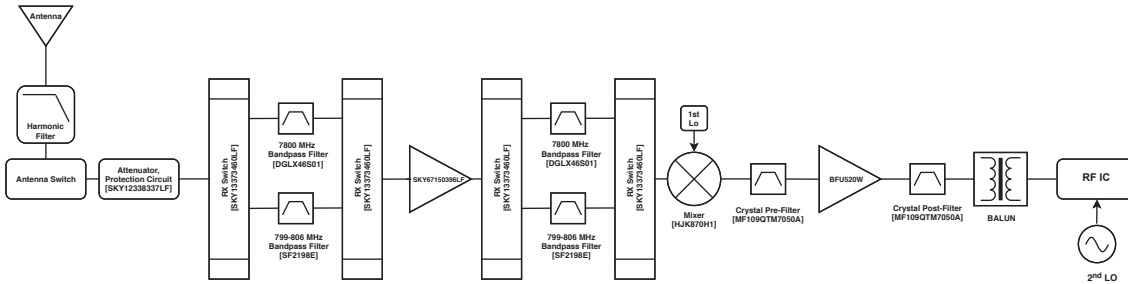
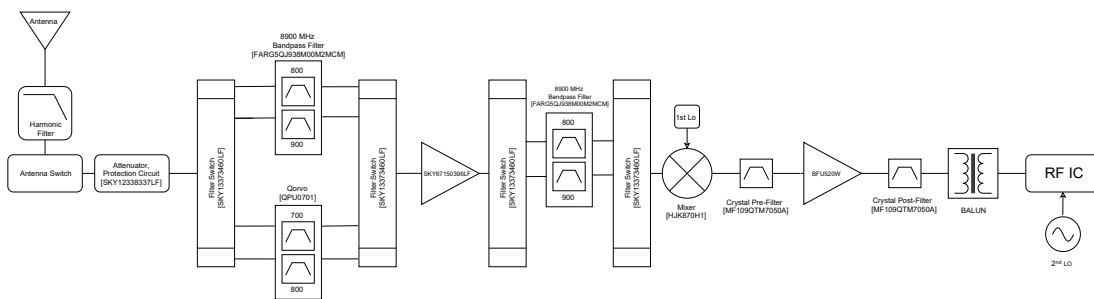


Figure 12: 800-900 MHz Block Diagram



3.8.1

VHF, UHF1 and UHF2 Receiver Front End

The receiver operating frequency are as follows; VHF (136MHz - 174MHz), UHF1 (380 MHz - 470MHz), UHF2 (450 MHz - 520 MHz).

The primary function of the receiver front-end is to optimize the rejection of the image frequency and other out-of-band frequencies while providing low-noise amplification of the received signal. The front-end uses discrete filters and LNAs.

The front-end has two possible configurations, standard mode and optional pre-amp mode. Standard mode provides the best intermodulation performance, and the optional pre-amp mode provides improved sensitivity at the cost of slightly reduced intermodulation performance.

The front-end line-up for standard mode includes a variable 15 dB attenuator for AGC purposes, a bandpass filter, a low-noise amplifier, and a fixed highpass filter. In pre-amp mode, an additional LNA is added between the attenuator and the first bandpass filter.

3.8.2

700–800 MHz and ISED Receiver Front-End

The 700–800 MHz and Innovation, Science, and Economic Development Canada (ISED) receiver operates in three bands; 700 (762MHz - 776MHz), IC (799 MHz - 806MHz), 800 (851 MHz- 870 MHz).

Receiver front end optimizes image rejection and selectivity while providing the first conversion.

The front-end uses a multipole switch to select between the three bands and the alternate path (700/800 ALT applicable to CN models only). The front-end use saw-filter technology and include a wideband, monolithic amplifier.

The 700ALT (769MHz-775MHz) and 800ALT (851MHz-860MHz) use TC-SAW filter technology (LTE Broadband Protection Filter) to improve the Strong Signal Intermodulation Rejection performance.

The first filter reduces the image frequency response and limits some out-of-band interference. The second filter following the monolithic Low Noise Amplifier (LNA) provides additional image rejection.

3.8.3

800-900 MHz Receiver Front End

The 800-900 MHz operates in two bands; 800 (851MHz - 870 MHz), 900 (935 MHz - 941MHz).

The primary function of the receiver front-end is to optimize image rejection and selectivity while providing the first conversion. The front-end uses saw-filter technology and includes a wideband, monolithic amplifier. The first filter is a dual-switched filter that reduces the image frequency response and limits some of the out-of-band interference.

The front end uses a multi-pole switch to select between the 2 bands and also the alternate path (TC-SAW filter) for 800MHz band (when the radio is programmed to use the frequency in between 851MHz to 860MHz) to improve Strong Signal Intermodulation Rejection performance. The second filter following the monolithic Low Noise Amplifier (LNA) provides additional image rejection.

3.8.4

Mixer

The receiver front-end signal is fed to the monolithic Mixer IC. It also down converted to an IF of 109.65 MHz.

The mixer is designed to provide low conversion loss and high intermodulation performance. The mixer is driven by the FGU receiver injection buffer. This efficiently drives the mixer over a wide temperature range

with minimum power variation. The injection buffer provides 17 dBm to the mixer. The design maintains temperature stability, low insertion loss, and high out-of-band rejection.

3.8.5

IF Circuitry

The crystal filters provide IF selectivity and out-of-band signal protection to the back-end IC.

Two crystal filters of two-pole with center frequency of 109.65 MHz enables:

- receiver to meet specifications for gain
- close-in intermodulation rejection
- adjacent channel selectivity



NOTE: Two crystal filters of two-poles also isolate from one another by a discrete IF amplifier.

3.8.6

Receiver Back-End

The output of the IF circuit is fed directly to the back-end receiver IC.

It is capable of down-converting analog and digital RF protocols into a baseband signal. It is then transmitted over the Synchronous Serial Interface (SSI) bus. It also converts the 109.65 MHz signal from the IF section. A second LO frequency is used to produce the second LO VCO. This VCO runs at low-side or high-side injection. The choice of frequency depends on known spurious interference related to the programmed received frequency.

3.9

Frequency Generation Unit

The Configuration of the Frequency Generation Unit (FGU) consist of the following:

- RF IC
- Discrete Voltage Controlled Oscillator (VCO)
- Buffer amplifiers and filter circuits
- 19.2 MHz reference oscillator
- Associated circuits

The 19.2 MHz Reference oscillator provides a frequency standard for the fractional-N synthesizer inside RF IC and the controller section. The GPO from the RF IC will select the VCO determined by mode and frequency of operation.

For the 700–800 MHz band, there are 3 VCOs implemented to cover the frequency bands of interest. For the VHF, UHF1, UHF2 , and 800-900MHz Band, there are four VCOs present. The VCOs are connected to a RF switch, followed by a prescaler buffer amplifier.

Figure 13: Configuration of the VHF/UHF1 Frequency Generation Unit

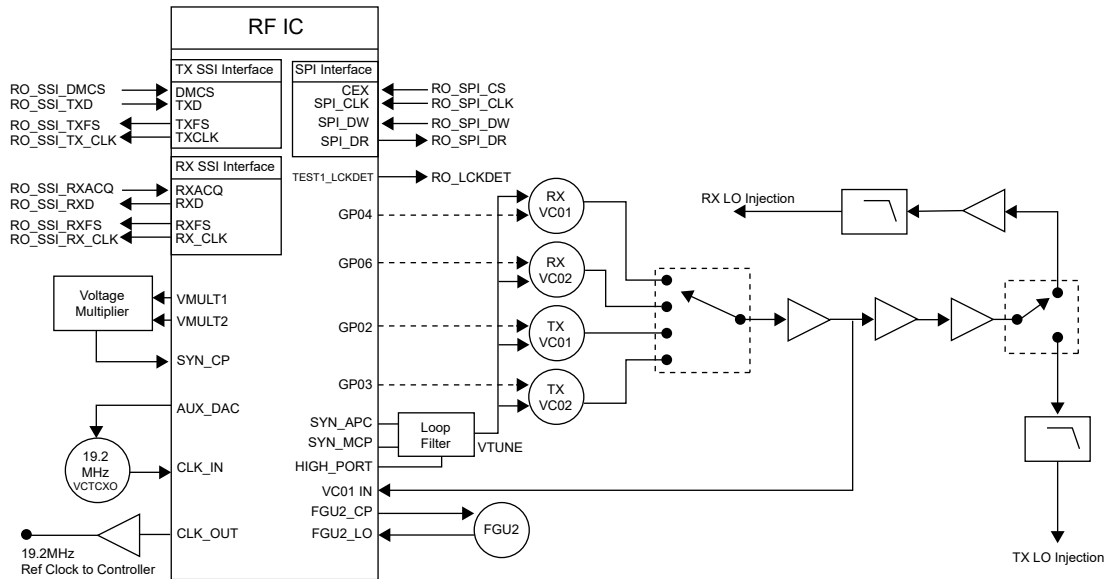


Figure 14: Configuration of UHF2 Frequency Generation Unit

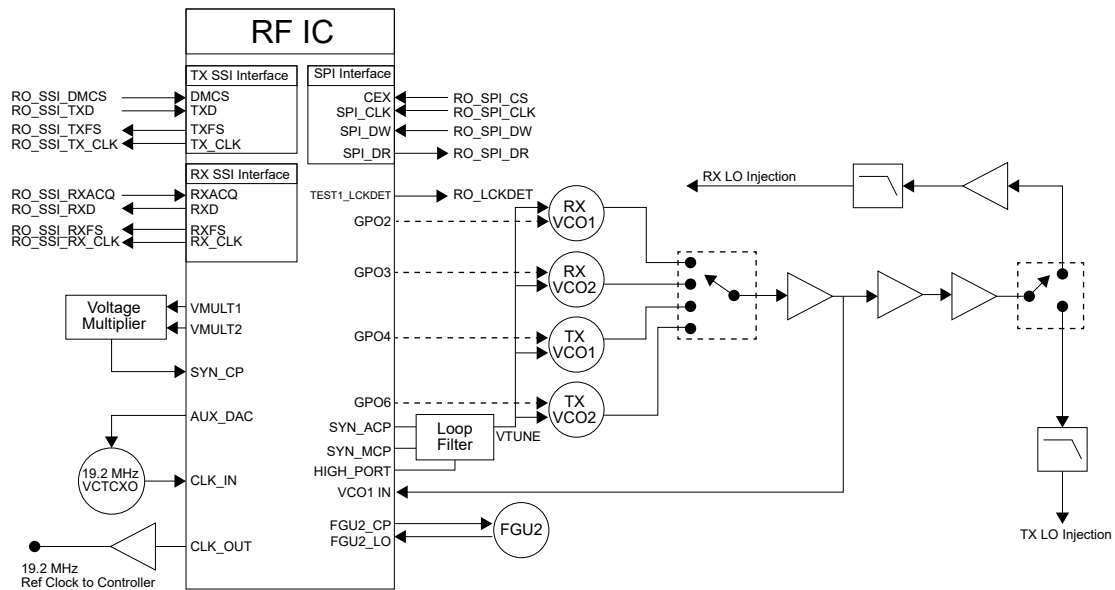


Figure 15: Configuration of the 700–800 MHz Frequency Generation Unit

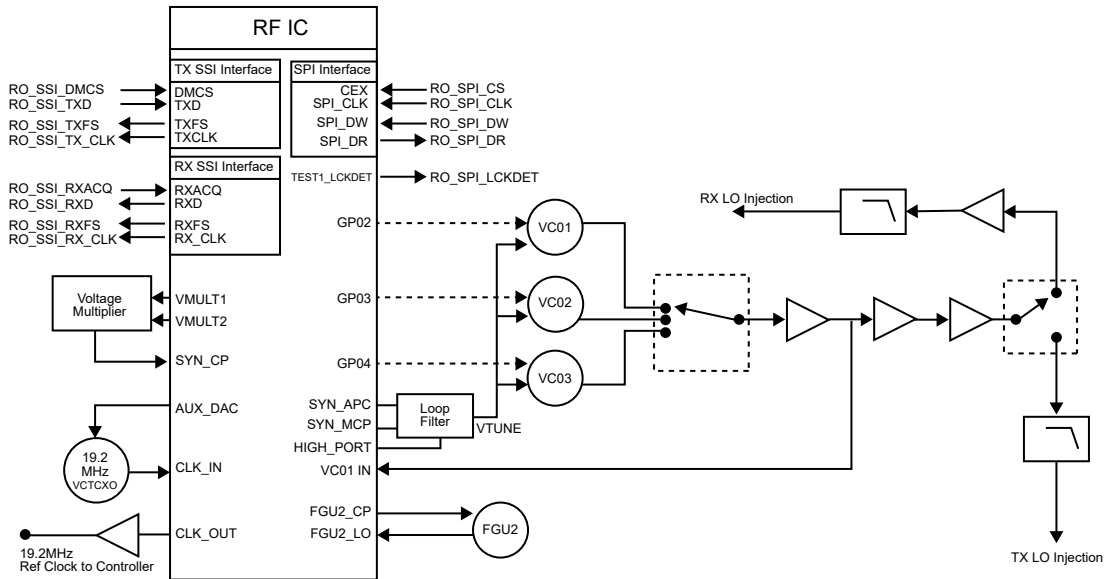
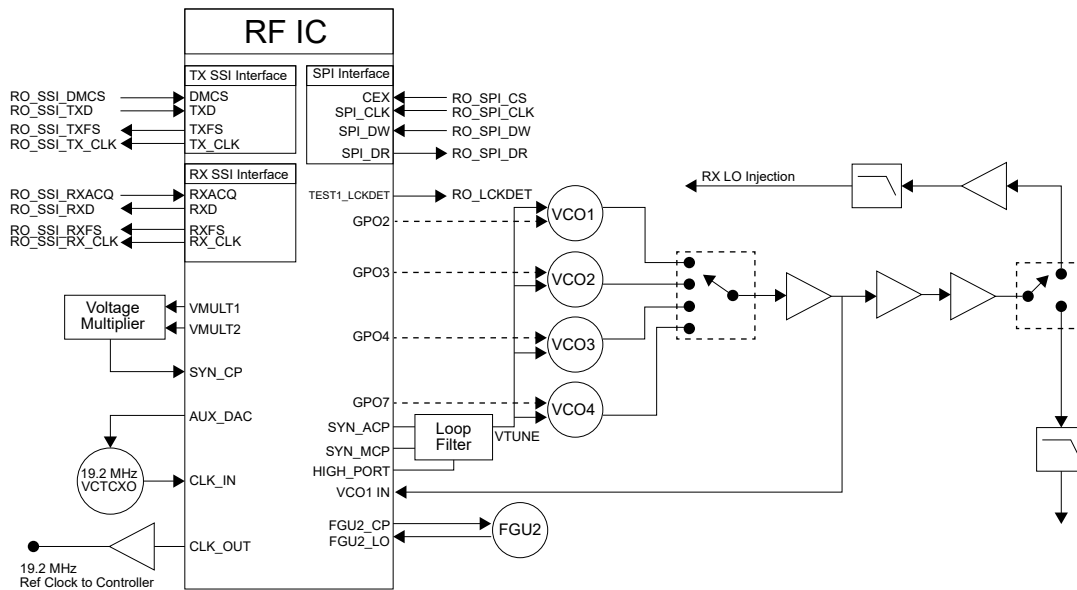


Figure 16: Configuration of 800-900MHz Frequency Generation Unit



The output is split into two paths. One of the output is fed back to RF IC to form a closed-loop synthesizer, and another output is connected to another two stages of injection buffer amplifiers. Then the output from injection buffer amplifiers is connected to the second RF switch to select either transmit or receive.

In TX mode, the output injection is switched to a transmit low pass filter followed by transmit power amplifier.

In RX mode, the output injection is switched to receiver mixer amplifier, followed by receive low pass filter before it is fed into the mixer.

Modulation is accomplished by direct digital programming of the Fractional-N synthesizer by the SSI (Serial Synchronous Interface) to the controller.

Chapter 4

Test Equipment, Service Aids, and Tools

This chapter provides lists of recommended test equipment, service aids, and tools. This also includes information that can be used in servicing and programming Motorola Solutions radios on the field.

4.1

Recommended Test Equipment

Equipments listed in this section are most of the standard test equipment required for servicing Motorola Solutions mobile radios. This list also includes several unique items designed specifically for servicing this family of radios.

Table 27: Recommended Non-Motorola Solutions Test Equipment

Model Number	Description	Application
N/A	1:1 Audio Transformer	Audio measurement (audio PA must NOT be grounded)
Agilent 6552	Power Supply (0–20 V, 0–25 A)	Mobile radio power supply and current measurements
Keysight N5765A	Power Supply (0–30 V, 0–50 A)	
Agilent 8901	Modulation Analyzer	Reference frequency measurements
AeroFlex 3920 or AeroFlex 8800SX	Digital Radio Test Set	Frequency, reference oscillator deviation digital tests and compensation measurements
Agilent U8903A and Rohde and Schwarz UPV	Audio Analyzer	Audio signal-level, SINAD, and distortion measurements
Keithly 2015-D	Audio Analyzing DMM	AC/DC voltage and distortion measurements
Fluke 187 or 189	Handheld Digital Multimeter (True RMS, AC, AC+DC, dB)	AC/DC voltage and current measurements
Fluke 190 Series	Handheld Oscilloscope (60–200 MHz Bandwidth, 2.5 GS/sec, Built-in 500-Count True RMS Multimeter)	Waveform measurements
Weinschel 49 30 43	30 dB RF Attenuator	For tests that require a modulation analyzer or wattmeter

4.2

Service Aids and Recommended Tools

This topic covers the listing and description of the service aids and tools designed specifically for servicing mobile radios, and the common tools required to disassemble and maintain the radio well. These kits and/or

parts are available from the Motorola Solutions parts division offices listed in Appendix A, B, C, and D accordingly.

Table 28: Service Aids for Mobile Radios

Motorola Solutions Part Number	Description	Application
DVN4236_	APX FLASHport Firmware CD	Kit with firmware to upgrade the radio, APX FLASHport CD.
DVN4237_	APX 7500 FLASHport Kit	Kit with firmware to upgrade the radio, APX FLASH port kit.
DVN4299_	APX 2500/APX 4500/APX 4500Li/APX 1500 FLASH-port Kit	
RVN5224_	APX Customer Programming Software (CPS) and Tuner Software	Programming and radio alignment software.
HKN6160_	1.8 m (6 ft) 4-wire RS232 data cable	1.8 m (6 ft) cable used for RS232 data applications through the 26 pin rear accessory connector. Also provides an Ignition sense (ACC) wire.
HKN6161_	6.1 m (20 ft) 4-wire RS232 data cable	6.1 m (20 ft) cable used for RS232 data applications through the 26 pin rear accessory connector (J2).
HKN6163_	1.8 m (6 ft) USB data cable	1.8 m (6 ft) cable used for USB programming and data applications through the 26 pin rear accessory connector (J2) or the J100 remote control head connector. Also provides Ignition sense (ACC) and speaker wires. An emergency jumper wire must be installed between pins 15 (emergency) and 1 (gnd) when used in dash mount applications.
HKN6172_	4.5 m (15 ft) USB data cable	4.5 m (15 ft) cable used for USB programming and data applications through the 26 pin rear accessory connector (J2) or the J100 remote control head connector. An emergency jumper wire must be installed between pins 15 (emergency) and 1 (gnd) when used in dash mount applications.
HKN6182_	MMP Cable Adapter for Keyloader	Use with TIB MMP or dash-mount control head MMP. Must be combined with KVL cable TKN8531_
HKN6183_	2-wire MMP RS232 Data Cable	Cable for RS232 data applications through the control head or TIB MMP.

4.3

Mobile Radios Field Programming and Equipment

The mobile radios can be aligned and programmed in the field. This requires specific equipment and special instructions. Refer to the online help in Customer Programming Software (CPS) and Tuner Software (RVN5224_).

The radios use a flash-memory device to store information about frequencies, squelch codes, signaling codes, time-out timer durations, and other parameters and can be programmed in the field for any number of times without removing the flash memory from the radio.

The mobile radios can only be programmed using a USB. To program the radio, connect the USB cable HKN6184_ to the control head Mobile Microphone Port (MMP) connector. This is the 10-pin connector to which the microphone is commonly attached. The MMP connector is below the volume knob and to the left of the LCD display. HKN6163_ and HKN6172_ USB cables can also be used for radio programming, and can be connected at the remote head control head J100 or radio rear J2 connectors. Refer to the *CPS Programming Installation Guide* (Motorola Solutions part number 6881095C44) for installation and setup procedures for the software.

Once the computer is connected to the radio, the prompts provided by the programming software can be followed. The following items, available through the Radio Products Services Division (except the computer), are required when programming mobile radios.

Table 29: Mobile Radios Field-Programming Items

Type or Part Number	Description
Customer Programming Software (CPS) and Tuner Software (RVN5224_)	This software enables you to program the radio features and align its parameters.
Personal Computer (PC)	Operating System - Windows® 7 with Service Pack 1, or above - Windows® 8 Minimum Hardware Requirements 1 GHz dual core or higher Pentium grade processor 8 GB RAM memory, excluding onboard graphics card memory usage 4 GB free hard disk space (for Standalone CPS) or 8 GB for CPS with Radio Management Suite. - DirectX 9-class graphics card - USB (Universal Serial Bus) Port radio communication - USB (Universal Serial Bus) Port for iButton dongle - DVD-ROM drive for software installation
USB Programming Cable	Used to connect radio directly to the computer, refer to Table 28: Service Aids for Mobile Radios on page 71 .

Chapter 5

Performance Checks

This chapter covers performance checks used to ensure that the radio meets published specifications.

The recommended test equipment listed in the previous section is almost accurate to the manufacturing equipment. Maintenance of the test equipment must be aligned with the manufacturer recommended calibration schedule. Checks should be performed if radio performance declines.

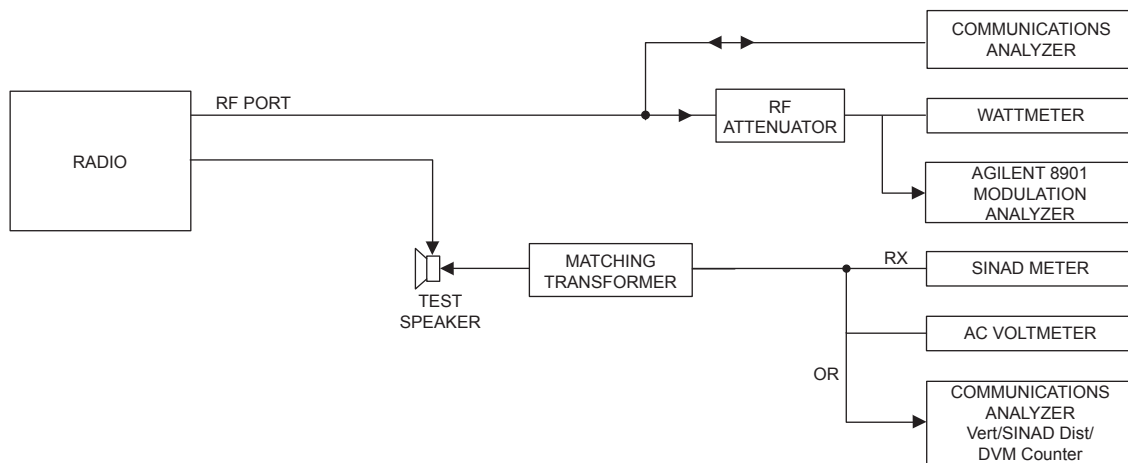
5.1

Test Setup

A personal computer (PC) and tuner software are required to align the radio. Refer to the applicable manual for installation and setup procedures for the software. To perform the alignment procedures, the radio must be connected to the PC and to a universal test set.

The radio alignment test setup is shown in the following figure.

Figure 17: Radio Alignment Test Setup



CAUTION: These radio alignment procedures must only be attempted by qualified service personnels. Failure to perform alignment procedures properly can result in seriously degraded radio or system performance.

5.2

Test Mode



CAUTION: Be sure to transmit into a series load when keying a radio under test such as 30 dB RF pad). Failure to do so can result in test equipment damage.

5.2.1

Entering Test Mode

Procedure:

1. Turn the radio on.
2. Within 10 seconds after Self Test is complete, press the **Home Button** five times in succession for O2/O5/O7/O9/E5 Control Head (see [O2 Control Head Test Mode on page 78](#) for O2, [O5 Control Head Test Mode on page 81](#) for O5, [O7 Control Head Test Mode on page 82](#) for O7 and [O9 Control Head Test Mode on page 83](#) for O9 Control Head, see [E5 Control Head Test Mode on page 85](#) for E5), or press the **Side Button 2** five times in succession for O3 Control Head (see [O3 Control Head Test Mode on page 79](#)).

The radio shows a series of displays that gives information regarding various version numbers and subscriber-specific information. The displays are described in [Table 30: Test-Mode Displays on page 74](#).

Table 30: Test-Mode Displays

Display Name	Description	Appears
SERVICE	Indicates radio has entered test mode	Always
HOST VERSION	Version of radio firmware	Always
DSP VERSION	Version of radio DSP firmware	Always
Secure Version	Firmware version for hardware encryption	When radio is secure-equipped
Encryption Mode	Type of hardware encryption being used	When radio is secure-equipped
CH VERSION	Version of Control Head firmware	Always
MCHB Version	Version of Control Head Board	Always
CHIB Version	Version of Control Head Interface Board	When auxiliary control head is present/radio is remote mount
Auxiliary Control Head	Firmware version for auxiliary control head	When auxiliary control head is present
Siren Version	Firmware version for siren	When siren is present
VRS Version Number	Firmware version for VRS	When VRS is present
MODEL NUMBER	Radio model number, as programmed in codeplug	Always
SERIAL NUMBER	Radio serial number, as programmed in codeplug	Always
ESN	Electronic Serial Number	Always
ROM Size	Memory capacity of flash part	Always
FLASHCODE	FLASHcodes, programmed as a part of radio codeplug	Always
RF BAND	Frequency band of radio	Always

Display Name	Description	Appears
TUNING VER	Version of Codeplug tuning	Always
PROCESSOR VER	Version of radio microprocessor	Always



NOTE:

All displays are temporary and expire without any user intervention. If the information is longer than the physical length of the control head display, it wraps around to the next display. After the last display, RF TEST is displayed.

Special attention: While information is scrolling in the test mode, if the **UP** button is pressed, the scrolling information pauses until the **DOWN** button is pressed again. Repeat with **UP** button to pause any other information. This makes recording radio version information easier.

- Turn the **Mode** Rotary Knob for O2/O5/O7/O9/E5 Control Head.
The display shows CH TEST.
- Press the **Home** button to enter the RF test mode.
The display shows 1 CSQ indicating test frequency 1, Carrier SQuelch mode.
- For the O3 Control Head, press the programmed **Monitor** button to enable toggling between RF TEST and CH TEST.
- Press the **Orange (EMERG)** button to select RF TEST.
The display shows 1 CSQ indicating test frequency 1, Carrier SQuelch mode.

5.2.2

RF Test Mode

A special routine called **RF TEST MODE** or air test has been incorporated into the radio.

Procedure:

- For the O2/O5/O7/O9/E5 Control Head, enter the RF test mode by pressing the **Home** button when the test mode menu RF TEST is displayed. If RF TEST is not displayed, use the **Mode** knob or the navigation button to scroll through the test mode menu until RF TEST is displayed.
- For the O3 Control Head, enter the RF test mode by pressing the **Orange (EMERG)** button when the test mode menu RF TEST is displayed. If RF TEST is not displayed, use the **Monitor** button to toggle between RF TEST and CH TEST.
- For the O2/O5/O7/O9/E5 Control Head, press the **Home** button to move the cursor back and forth between the frequency and signaling type. Use the **Mode** knob to scroll through the available selections.
- For the O3 Control Head, press the **Monitor** button to select Channel Spacing (12.5 kHz or 25 kHz), press the **Side Button 1** to change signaling type, and press **Side Button 2** to change frequency.

Table 31: VHF Rx and Tx Test Frequencies

Channel	Rx Frequency (MHz)	Tx Frequency (MHz)	Power (W)
F1	136.0625	136.0125	50
F2	140.8125	140.7625	50

Channel	Rx Frequency (MHz)	Tx Frequency (MHz)	Power (W)
F3	145.5625	145.5125	50
F4	150.3125	150.2625	50
F5	154.9375	154.9875	50
F6	155.0625	155.0125	50
F7	159.8125	159.7625	50
F8	164.5625	164.5125	50
F9	169.3125	169.2625	50
F10	173.9375	173.9875	50

Table 32: UHF1 Rx and Tx Test Frequencies

Channel	Rx Frequency (MHz)	Tx Frequency (MHz)	Power (W)
F1	380.0625	380.0125	40
F2	389.0625	389.0125	40
F3	405.0625	405.0125	40
F4	415.0625	415.0125	40
F5	424.9375	424.9875	40
F6	425.0625	425.0125	40
F7	440.0625	440.0125	40
F8	455.0625	455.0125	40
F9	465.0625	465.0125	40
F10	469.9375	469.9875	40

Table 33: UHF2 Rx and Tx Test Frequencies

Channel	Rx Frequency	Tx Frequency (Mhz)	Power (W)
F1	450.0625	450.0125	45
F2	455.0625	455.0125	45
F3	465.0625	465.0125	45
F4	470.0625	470.0125	45
F5	484.9375	484.9875	45
F6	485.0625	485.0125	40
F7	498.0625	498.0125	40
F8	511.9375	511.9875	40
F9	512.0625	512.0125	25
F10	519.9375	519.9875	25

Table 34: 700–800 MHz Rx and Tx Test Frequencies

Channel	Rx Frequency (MHz)	Tx Frequency (MHz)	Power (W)
F1	762.0625	762.0125	30
F2	769.0625	768.9875	30
F3	775.9375	776.0125	30
F4	799.0625	793.9875	30
F5	802.0625	805.9125	30
F6	805.9375	806.0125	35
F7	851.0625	823.9875	35
F8	855.0625	851.0125	35
F9	860.0625	860.0125	35
F10	869.9375	869.8875	35

Table 35: 800-900 MHz Rx and Tx Test Frequencies

Channel	Rx Frequency	Tx Frequency (Mhz)	Power (W)
F1	851.0625	806.0125	35
F2	855.0625	815.0125	35
F3	860.0625	823.9875	35
F4	865.0625	851.0125	35
F5	869.9375	860.0125	35
F6	935.0625	869.8875	35
F7	936.9375	896.0125	30
F8	937.0625	901.9875	3
F9	938.0625	935.0125	30
F10	940.9375	940.9875	3

Table 36: Signaling Types

Display	Modulation	Demodulation	Type
CSQ	None	None	Carrier Squelch
TPL	192 Hz	192 Hz	Private-Line
AST	1200 Hz	N/A	ASTRO (digital)
USQ	None	None	Open Squelch

When in the transmit test mode, DTMF modulation produces a sidetone in the speaker. All signaling types continually modulates the transmitted signal for detection or measurement by external instruments.

5.2.3
O2 Control Head Test Mode

The control head test mode is part of the diagnostics built into the radio. It is entered through the front-panel programming sequence. Test mode allows you to perform button and display tests to verify proper operation.

Procedure:

1. Enter the control head test mode by pressing the **Power** button. Press the **Menu Select** button **1** and **4** simultaneously to enter control head STANDALONE TEST.

CH firmware, CH FPGA, CH Flashzap version, and CH Board version are displayed before the unit enters the Control Head Test mode.

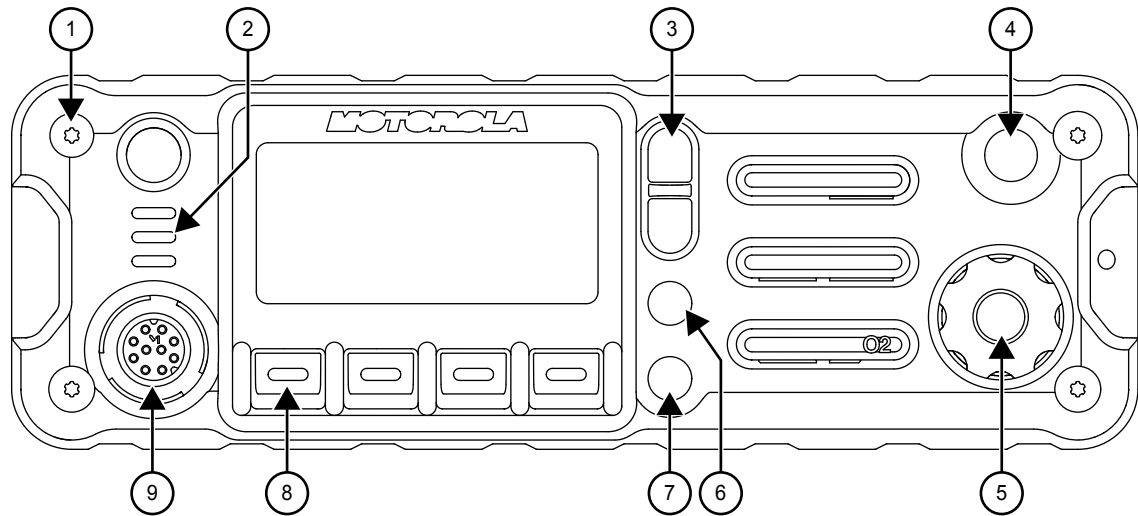
2. Press **Home** to enter sequential test.
3. In the **Factory Test** menu, pressing any button activates the following tests:
 - LED test (green, red, and yellow)
 - Backlight test (Off, Medium, and On)
 - LCD test (four borders test)
 - Keypad LED test (green, amber, red, and common white LED test)

4. Press any button to activate the keypad test.

All the ten buttons notations are displayed on the LCD. When the corresponding button is pressed, the notation disappears from the LCD.

5. Press any key to enter **Multifunction Knob** test after all ten buttons are pressed.
6. Turn the radio off and then turn the radio on to exit test mode and return to normal radio operation.

Figure 18: O2 Control Head



No.	Description
1	Power On/Off Button
2	LED Status Indicators
3	Up/Down Buttons

No.	Description
4	Emergency Button
5	Multi-Function Knob
6	Dim Button
7	Home Button
8	Menu Select Buttons
9	Accessory Port (Microphone)

5.2.4

O3 Control Head Test Mode

The control head test mode is part of the diagnostics built into the radio. It is entered through the front-panel programming sequence. Test mode allows you to perform button and display tests to verify proper operation.

Procedure:

1. Enter the control head test mode by pressing the **POWER ON/OFF** button while holding down the **1** and **3** button of the keypad. Release the **1** and **3** button when *Standalone Mode* is displayed.

The versions for CH Firmware, CH FPGA, CH Flashzap, and CH Board are displayed before the unit enters Factory Test.

2. In the **Factory Test** menu, pressing any button activates the following tests:

- LED test (green, red, and yellow)
- Backlight test (Off, Medium, and On)
- LCD test (4 borders test)

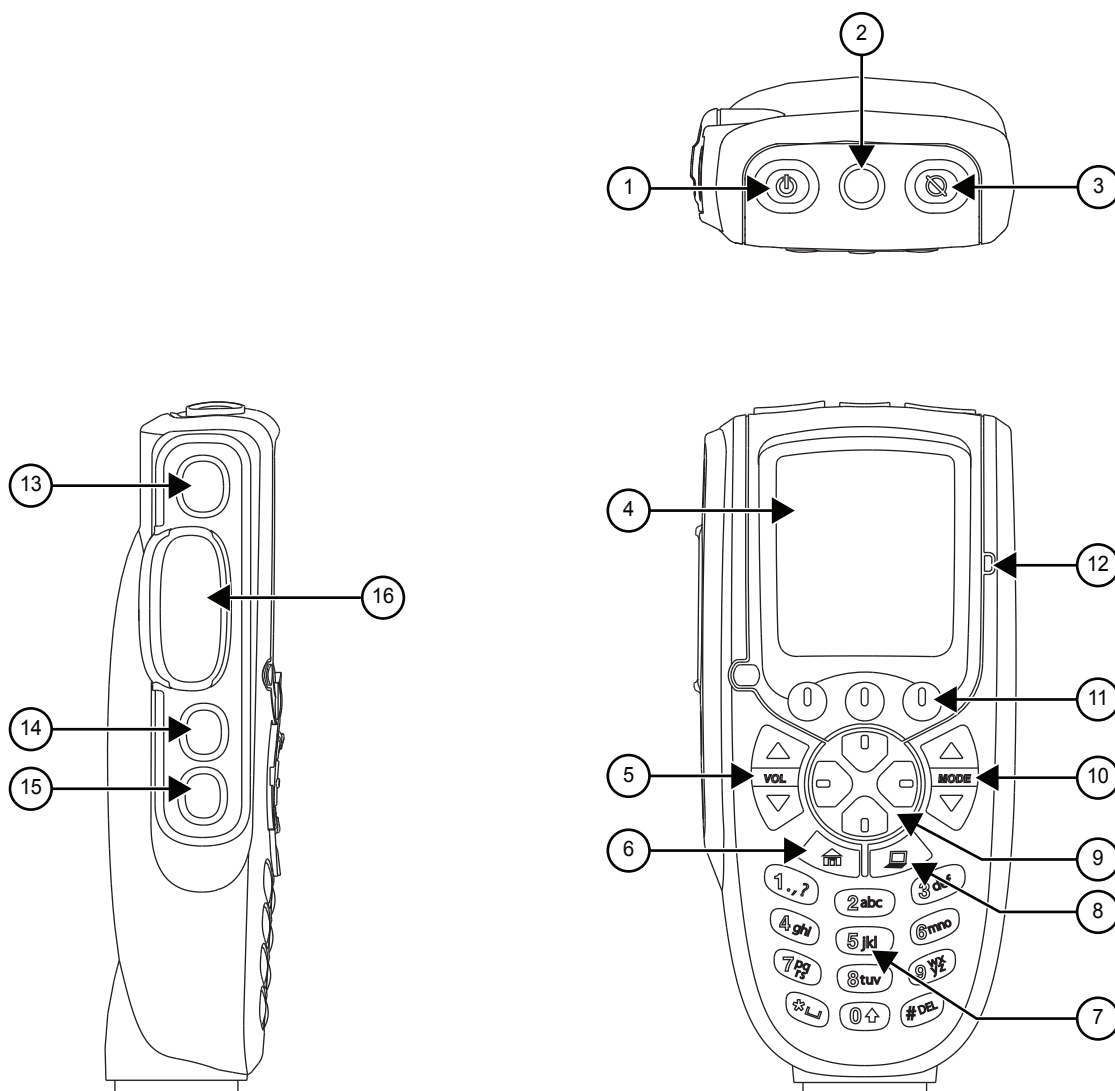
3. After the LCD test, place the Hook Up and remove the Hook Up until Hook Off is shown.

4. Press any button to activate the 32 buttons to test the Keypad Buttons, Side Buttons, and Top Buttons.

All the 32 Buttons notations are displayed on the LCD. When the corresponding button is pressed, the notation disappears from the LCD. Radio displays *Test Completed* after all 32 buttons are pressed.

5. Press the **POWER ON/OFF** to turn the control head off.
6. Turn the radio off and then turn the radio on to exit test mode and return to normal radio operation.

Figure 19: O3 Control Head



No.	Description
1	Power On/Off Button
2	Orange Button
3	Programmable Button
4	14-Character Display
5	Volume Rocker
6	Home Button
7	Keypad
8	Data Button
9	Navigation Keys
10	Mode Rocker

No.	Description
11	Programmable Soft Keys
12	LED Indicators
13	Programmable Button (Monitor)
14	Side Button 1 (Programmable)
15	Side Button 2 (Programmable)
16	Push-to-Talk Button

5.2.5

O5 Control Head Test Mode

The control head test mode is part of the diagnostics built into the radio. It is entered through the front-panel programming sequence. Test mode allows you to perform button and display tests to verify proper operation.

Procedure:

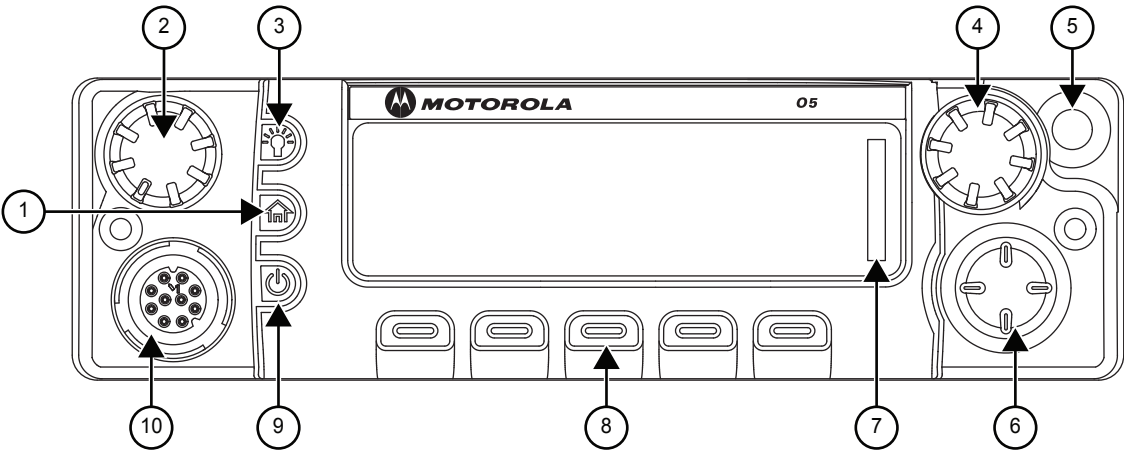
1.

After power up, press the **HOME** button five times to enter the **Test Mode** menu.
- NOTE:** Once **CH TEST** has been selected by pressing **Home**, turning the **Mode** knob does not change the control head test mode back to the RF test mode. You must turn the radio off and re-enter the RF test mode as described earlier.
2.

When the control head test mode has been selected, all the icons across the top of the LCD are displayed briefly. The indicator LED on the right side will also light up briefly. Press any of the control head buttons or turn the knobs to display the button or knob ID. The value of the button or knob is also displayed. The value of a button is 1 for a press and 0 for a release.
3.

Turn the radio off and then turn on the radio to exit test mode and return to normal radio operation.

Figure 20: O5 Control Head



No.	Description
1	Home
2	Volume Knob
3	Dim Button
4	Mode Knob

No.	Description
5	Emergency
6	Navigation Keys
7	Indicators
8	Soft Menu Keys
9	Power On/Off
10	MMP Connector

5.2.6

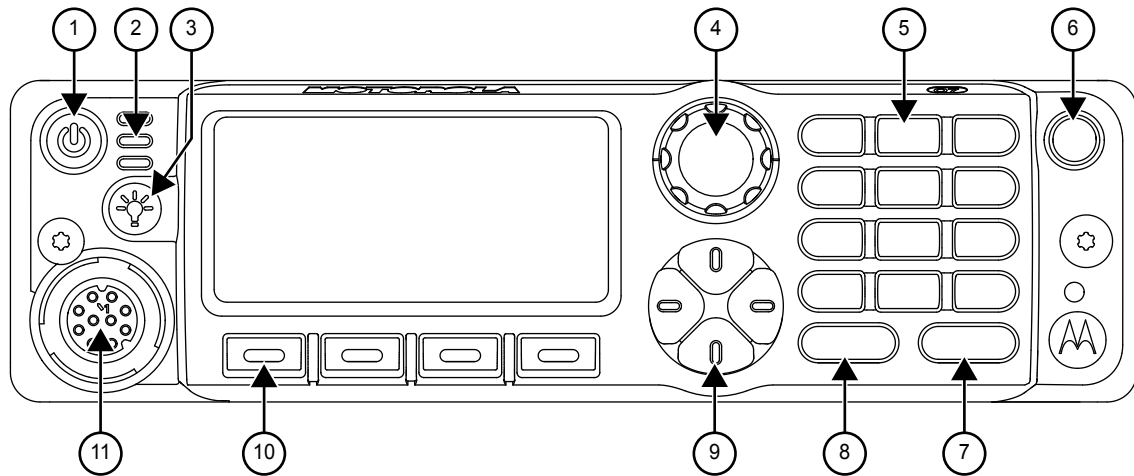
O7 Control Head Test Mode

The control head test mode is part of the diagnostics built into the radio. It is entered through the front-panel programming sequence. Test mode allows you to perform button and display tests to verify proper operation.

Procedure:

1. Power up the control head by pressing the **Power** button. Press the **Menu Select** button **1** and **4** simultaneously to enter control head **STANDALONE TEST**.
CH firmware, CH FPGA, CH Flashzap version, and CH Board version are displayed before the unit enters the Control Head Test mode.
2. Press **Home** to enter sequential test.
3. In the **Factory Test** menu, pressing any buttons activates the following tests:
 - LED test (green, red, and yellow)
 - Backlight test (Off, Medium, and On)
 - LCD test (four borders test)
 - Keypad LED test (green, amber, red, and common white LED test)
4. Press any button to activate the keypad test.
All the 24 buttons notations are displayed on the LCD. When the corresponding button is pressed, the notation disappears from the LCD.
5. Press any key to enter the **Multifunction Knob** test after all 24 buttons are pressed.
6. Turn the radio off and then turn the radio on to exit test mode and return to normal radio operation.

Figure 21: O7 Control Head



No.	Description
1	Power On/Off Button
2	LED Status Indicators
3	Dim Button
4	Multi-Function Knob
5	DTMF Keypad
6	Emergency Button
7	Data Button
8	Home Button
9	Navigational Keys
10	Menu Select Buttons
11	Accessory Port (Microphone)

5.2.7

O9 Control Head Test Mode

The control head test mode is part of the diagnostics built into the radio and is entered through the front-panel programming sequence. Test mode allows you to perform button and display tests to verify proper operation.

Procedure:

1. Power up the control head by pressing the **Power** Button. Press the **Soft Menu Keypad** buttons **2** and **5** simultaneously to enter control head **STANDALONE TEST**.
CH firmware, CH FPGA version, CH Flashzap version, and CH Board version are displayed before the unit enters the Factory Test.
2. Press **Home** to enter sequential test.
3. In **Factory Test** menu, pressing any button activates the following tests:
 - LED test (green, red, and yellow)

- Backlight test (Off, Medium, and On)
 - LCD test (4 borders test)
 - Keypad LED test (green, amber, red, and common white LED test)
4. Press any button to activate the keypad test.
- All the 48 buttons notations are displayed on the LCD and once the corresponding button is pressed, the notation disappears from the LCD.
5. Press any key to enter Rotary test after all 48 buttons are pressed. Response selector, Volume rotary, and Channel rotary functionality is tested by turning the knob.
6. Turn the radio off and then turn the radio on to exit test mode and return to normal radio operation.

Figure 22: O9 Control Head



No.	Description
1	Programmable Buttons (Top)
2	Power On/Off Button
3	LED Indicators

No.	Description
4	Status Icons
5	Display Backlight Control Buttons
6	Menu Select Buttons
7	Volume Knob
8	Programmable Buttons (Bottom)
9	Home Button
10	Mode Knob
11	Data Feature Button
12	4-Way Navigation Button
13	Keypad
14	Public Address Button
15	Orange Button
16	Directional Buttons
17	Response Selector
18	Siren Control Buttons

5.2.8

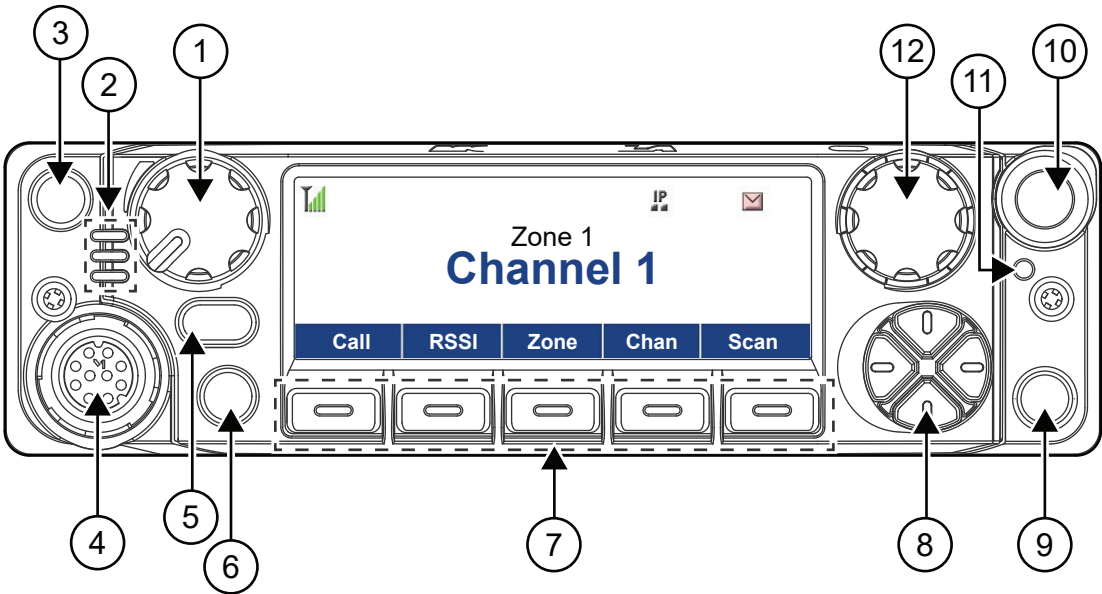
E5 Control Head Test Mode

The control head test mode is part of the diagnostics built into the radio. It is entered through the front-panel programming sequence. Test mode allows you to perform button and display tests to verify proper operation. For test mode, the control head must be standalone, not connected to brick.

Procedure:

1. Press and hold the **Menu Select Buttons 2** and **Menu Select Buttons 5** simultaneously, then press the **Power** button to enter control head Standalone Test.
The control head displays CH firmware, CH FPGA, CH Flashzap version, and CH Board version before entering the Control Head test mode.
2. Press **Home** button to enter sequential test.
3. In the **Factory Test** menu, pressing any buttons will activate the following tests:
 - LED test (green, red, and yellow)
 - Backlight test (0%, 3%, 8%, 15%, 22%, 44%, 70%, 94%)
 - LCD test (4 borders test)
 - Keypad LED test (green, amber, red, and common white LED test)
4. Hit any button after this to activate the keypad test. Pressing any of the control head buttons or turning the knobs will display the button or knob ID. The display also shows the value of the button or knob. The value of a button is 1 for a press and 0 for a release.
5. Then press next to enter volume and frequency knob test.
6. Turn the radio off and then turn on the radio to exit test mode and return to normal radio operation.

Figure 23: E5 Control Head



No.	Description
1	Volume Knob
2	Led Status Indicators
3	Power On/Off
4	MMP Connector
5	Dim Button
6	P Button
7	Menu Select Buttons
8	4-Way Navigation Button
9	Home Button
10	Emergency Button
11	Bluetooth Pairing Location Indicator
12	Mode Knob

5.3

Receiver Performance Checks

Table 37: Receiver Performance Checks

Test Name	System Analyzer	Radio	Test Condition	Comments
Reference Fre- quency	Mode: PWR MON channel test fre- quency (See RF Test Mode on page 75²)	TEST MODE, 1 CSQ output at antenna.	Press and hold PTT switch.	Maximum Fre- quency error is ± 2.0 PPM for VHF, UHF1 and UHF2

Test Name	System Analyzer	Radio	Test Condition	Comments
	Monitor: Frequency error Input at RF In/Out			± 1.5 PPM for 700/800 MHz and 800/900 MHz
Rated Audio	Mode: GEN Output level: 1.0 mV RF Channel test frequency (See RF Test Mode on page 75²) Monitor: DVM, AC Volts	TEST MODE, 1 CSQ. Use 12.5 kHz channel spacing	Release PTT switch.	Set volume control to 6.45 Vrms across the 3.2 Ω speaker or 7.75 Vrms across the 8 Ω speaker
Distortion	As above, except to distortion	As above	Release PTT switch.	Distortion $\leq 3.0\%$
Sensitivity (SINAD)	As above, except SINAD, lower the RF level for 12 dB SINAD	As above	Release PTT switch.	RF input to be $< 0.25 \mu\text{V}$ (700/800 MHz & 800/900 MHz) RF input to be $< 0.31 \mu\text{V}$ (UHF1, UHF2, VHF)
Noise Squelch Threshold (only radios with conventional system need to be tested)	RF level set to 1 mV RF As above, except change frequency to a conventional system. Raise RF level from zero until radio unsquelches.	As above Out of TEST MODE; select a conventional system	Release PTT switch. Release PTT switch.	Set volume control to 3.16 Vrms across the speaker. Unsquelch to occur at $< 0.25 \mu\text{V}$

5.4

Transmitter Performance Checks

Table 38: Transmitter Performance Checks

Test Name	System Analyzer	Radio	Test Condition	Comments
Reference Frequency	Mode: PWR MON channel test frequency (See RF Test Mode on page 75²)	TEST MODE, 1 CSQ.	Press and hold PTT switch.	Maximum Frequency error is ± 2.0 PPM for VHF, UHF1 and UHF2

² Test frequencies are listed in RF Test Mode

Test Name	System Analyzer	Radio	Test Condition	Comments
	Monitor: Frequency error Input at RF In/Out			± 1.5 PPM for 700/800 MHz and 800/900 MHz
Power RF	As above	As above	Press and hold PTT switch.	Refer to the Radio Specifications in the front of the manual.
Voice Modulation	Mode: PWR MON first channel test frequency (See RF Test Mode on page 75²) attenuation to -70, input to RF In/Out Monitor: DVM, AC Volts Set 1 kHz Mod Out level for 25 mVrms at test set, 80 mVrms at dummy microphone or load box input	As above	Press and hold PTT switch.	Deviation: VHF, UHF1, UHF2, 700/800 MHz, 800/900 MHz: ≥ 2.5 kHz but ≤ 3.5 kHz
Voice Modulation External Microphone	Mode: PWR MON first channel test frequency (See RF Test Mode on page 75²) attenuation to -70, input to RF In/Out	As above	Connect external microphone. Press and hold PTT .	Press PTT switch on microphone and say "four" loudly into the radio mic. Measure deviation: VHF, UHF1, UHF2, 700/800 MHz, 800/900 MHz: ≥ 2.5 kHz but ≤ 3.5 kHz
PL Modulation (radios with conventional, clear mode, coded squelch operation only)	Change frequency to channel test frequency (See RF Test Mode on page 75²) B/W to narrow	TEST MODE, 1 TPL	Remove modulation input from dummy microphone or load box. Press and hold PTT switch.	Deviation: VHF, UHF1, UHF2, 700/800 MHz, 800/900 MHz: ≥ 500 Hz but ≤ 1000 Hz
Talkaround Modulation (radios with conventional, clear mode, talk-around operation only)	Change frequency to conventional talkaround frequency.	Conventional talk-around personality (clear mode operation) 1 CSQ	Press and hold PTT switch.	Deviation: VHF, UHF1, UHF2, 700/800 MHz, 800/900 MHz:

Test Name	System Analyzer	Radio	Test Condition	Comments
	Mode: PWR MON deviation, attenuation to -70, input to RF In/Out Monitor: DVM, AC Volts Set 1 kHz Mod Out level for 80 mVrms at dummy microphone or load box.			≥ 2.5 kHz but ≤ 3.5 kHz
Talkaround Modulation (radios with conventional, secure mode, talk-around operation only) ³	Change frequency to conventional talkaround frequency. Mode: PWR MON deviation, attenuation to -70, input to RF In/Out Monitor: DVM, AC Volts Mod: 1 kHz out level for 80 mVrms at dummy microphone or load box.	Conventional talk-around personality (secure mode operation). Load key into radio 1 sec.	Press and hold PTT switch.	Deviation: VHF, UHF1, UHF2, 700/800 MHz, 800/900 MHz: ≥ 3.6 kHz but ≤ 4.4 kHz

³ The secure mode, talkaround modulation test is only required for radios that do not have clear mode talkaround capability.

Chapter 6

Radio Alignment Procedures

This section describes both receiver and transmitter radio alignment procedures. You are required to perform all the alignments in this section after replacing (or servicing) the transceiver boards.

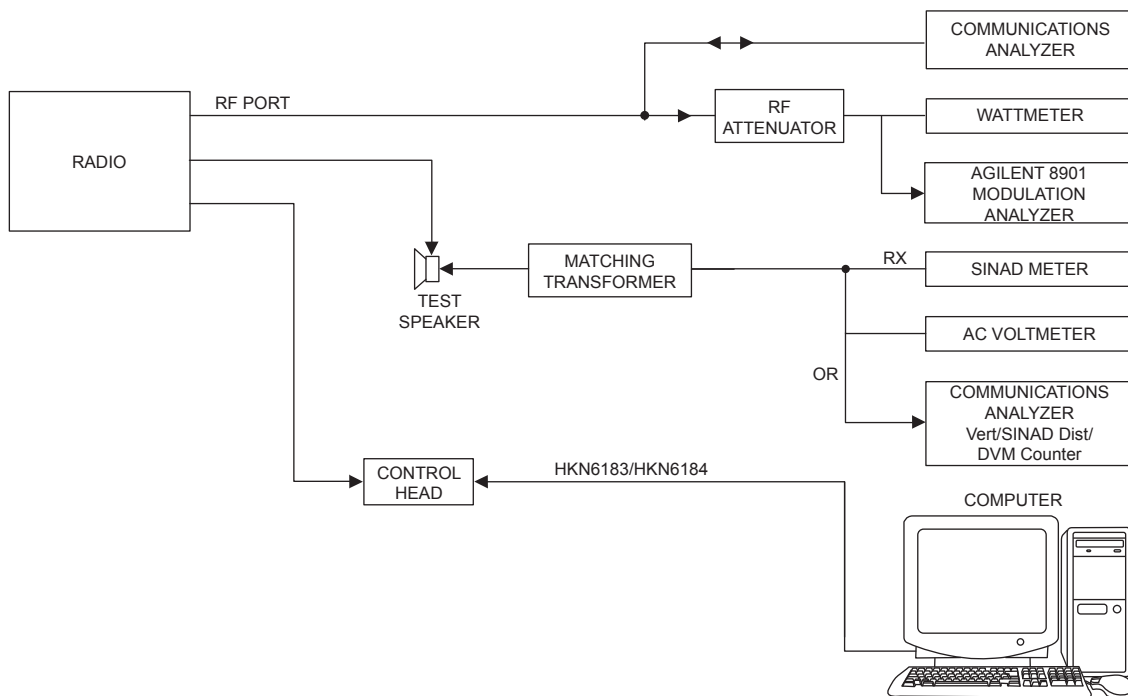
6.1

Navigating the Tuner Program

A personal computer (PC) and Tuner Software are required to align the radio. Refer to the CPS Programming Installation Guide (Motorola Solutions part number RVN5224_) for installation and setup procedures for the software.

Prerequisites: To perform the alignment procedures, the radio must be connected to the computer and to a universal test set, as shown in the following figure.

Figure 24: Radio Alignment Test Setup for Mobile Radios

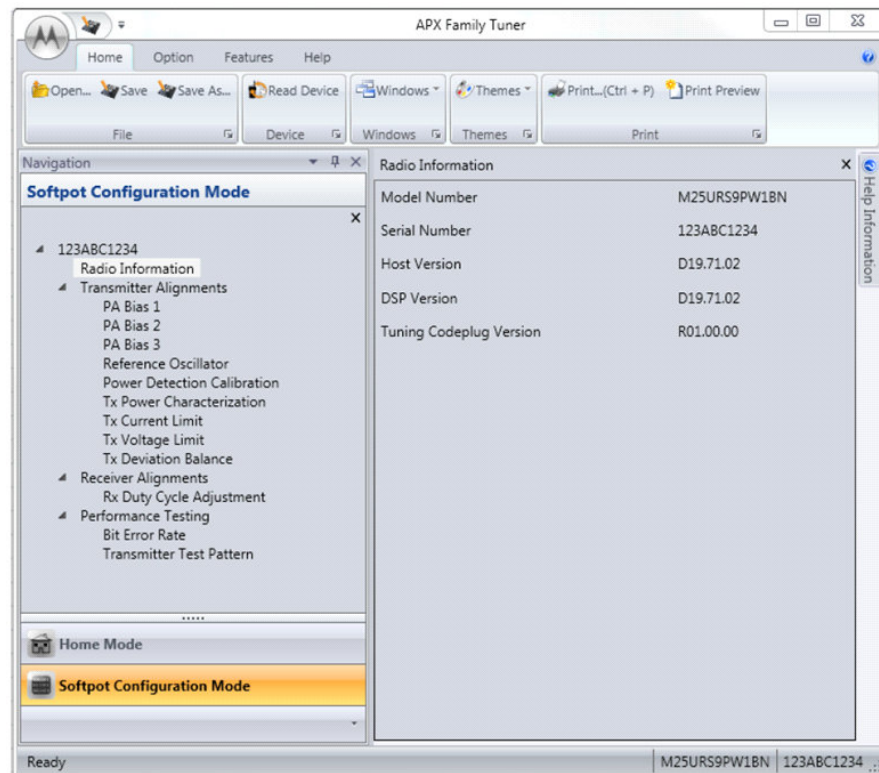


CAUTION: Only qualified service personnel who are operating as an FCC licensed technician or are overseen by an FCC licensed technician can perform the radio alignment procedures. Failure to perform alignment procedures properly may result in seriously degraded radio or system performance.

Procedure:

1. From the **Start** menu, select **Tuner**.
2. Click the **Read Device** icon to read the radio.
3. Click on the desired screen name in the **Tuner Main Menu** to access a screen.

Figure 25: Tuner Main Menu



CAUTION: Do not switch radios in the middle of any alignment procedure.

4. After completing the alignment procedures, close the **Alignment** window to return to the **Tuner Main Menu**.

Improper exits from the **Alignment** screens might leave the radio in an improperly configured state and result in seriously degraded radio or system performance.

The **Alignment** screens utilize the “softpot”, an analog **SOFTWARE**-controlled **POT**entiometer used for adjusting all radio alignment controls.

Use one of the following methods to increase or decrease the softpot value in each **Alignment** screen:

- Slider
- Spin buttons
- Manually enter a new value

A graphical scale on the display indicates the minimum, maximum, and proposed value of the softpot.

6.2

Transmitter Alignments

This section covers the transmitter alignment. The PA Bias 1, 2, and 3 alignment procedures adjust the drain bias current in one of the RF power amplifier devices.



NOTE: Screen captures are representative. Actual screen may change with software version.

6.2.1

Aligning PA Bias 1

Prerequisites:

Table 39: PA Bias 1 Alignment RF Power Amplifier Devices

Band/Power Level	Device
VHF 50 W	Final
UHF1 40 W	Final 1
UHF2 45 W	Final 1
700–800 MHz 35 W	Final 1
800-900 MHz 35 W	Final 1



NOTE: The appropriate antenna port should be terminated with a 50 Ω load while tuning.

Procedure:

1. Set the power supply voltage as indicated in the following table. Set the power supply current limit to 3.

Table 40: Power Supply Voltage Settings

Band/Power Level	Supply Voltage (V)	Supply Current Limit (A)
VHF 50 W	13.6	3
UHF1 40 W	13.6	3
UHF2 45 W	13.6	3
700–800 MHz 35 W	13.6	3
800-900 MHz 35 W	13.6	3

2. Select **PA Bias 1** from the **Tuner Main Menu**.

Figure 26: PA Bias 1 Alignment Screen

3. Click **Bias 0 Toggle** to enable bias mode.
4. Read the baseline current from the current meter on the power supply.

5. Click **Bias 0 Toggle** to disable bias mode.
6. Add baseline current to device bias current to calculate the target current.

Table 41: PA Bias 1 Alignment Device Bias Current

Band/Power Level	Device Bias Current (mA)
VHF 50 W	400
UHF1 40 W	28
UHF2 45 W	10
700–800 MHz 35 W	250
800-900 MHz 35 W	250

7. Click **Bias Toggle** to apply bias to gate of device.
8. Adjust the softpot value until the target current is achieved within $\pm 10\%$.
9. Click **Bias Toggle** to remove bias from gate of device.
10. Click **Program All** to save the tuned value.
11. Close the screen to return to the **Tuner Main Menu**.

6.2.2

Aligning PA Bias 2

Prerequisites:

Table 42: PA Bias 2 Alignment RF Power Amplifier Devices

Band/Power Level	Device
VHF 50 W	N/A
UHF1 40 W	Final 2
UHF2 45 W	Final 2
700–800 MHz 35 W	Final 2
800-900 MHz 35 W	Final 2



NOTE: The appropriate antenna port should be terminated with a 50 Ω load while tuning.

Procedure:

1. Set the power supply voltage as indicated in the following table. Set the power supply current limit to 3 A.

Table 43: Power Supply Voltage Settings

Band/Power Level	Supply Voltage (V)	Supply Current Limit (A)
VHF 50 W	13.6	3
UHF1 40 W	13.6	3
UHF2 45 W	13.6	3

Band/Power Level	Supply Voltage (V)	Supply Current Limit (A)
700–800 MHz 35 W	13.6	3
800-900 MHz 35 W	13.6	3

2. Select **PA Bias 2** from the **Tuner Main Menu**.

Figure 27: PA Bias 2 Alignment Screen

3. Click **Bias 0 Toggle** to enable bias mode.
4. Read the baseline current from the current meter on the power supply.
5. Click **Bias 0 Toggle** to disable bias mode.
6. Add baseline current to device bias current to calculate the target current.

Table 44: PA Bias 2 Alignment Device Bias Current

Band/Power Level	Device Bias Current (mA)
VHF 50 W	N/A
UHF1 40 W	28
UHF2 45 W	10
700–800 MHz 35 W	250
800-900 MHz 35 W	250

7. Click **Bias Toggle** to apply bias to gate of device.
8. Adjust the softpot value until the target current is achieved within $\pm 10\%$.
9. Click **Bias Toggle** to remove bias from gate of device.
10. Click **Program All** to save the tuned value.
11. Close the screen to return to the **Tuner Main Menu**.

6.2.3

Aligning PA Bias 3

Prerequisites:

Table 45: PA Bias 3 Alignment RF Power Amplifier Devices

Band/Power Level	Device
VHF 50 W	Driver
UHF1 40 W	Driver
UHF2 45 W	Driver
700–800 MHz 35 W	Driver
800-900 MHz 35 W	Driver



NOTE: The appropriate antenna port should be terminated with a 50 Ω load while tuning.

Procedure:

1. Set the power supply voltage as indicated in the following table. Set the power supply current limit to 3 A.

Table 46: Power Supply Voltage Settings

Band/Power Level	Supply Voltage (V)	Supply Current Limit (A)
VHF 50 W	13.6	3
UHF1 40 W	13.6	3
UHF2 45 W	13.6	3
700–800 MHz 35 W	13.6	3
800-900 MHz 35 W	13.6	3

2. Select **PA Bias 3** from the **Tuner Main Menu**.

Figure 28: PA Bias 3 Alignment Screen

3. Click **Bias 0 Toggle** to enable bias mode.
4. Read the baseline current from the current meter on the power supply.
5. Click **Bias 0 Toggle** to disable bias mode.
6. Add baseline current to device bias current to calculate the target current.

Table 47: PA Bias 3 Alignment Device Bias Current

Band/Power Level	Device Bias Current (mA)
VHF 50 W	150
UHF1 40 W	150
UHF2 45 W	100
700–800 MHz 35 W	100
800-900 MHz 35 W	100

7. Click **Bias Toggle** to apply bias to gate of device.
8. Adjust the softpot value until the target current is achieved within $\pm 10\%$.
9. Click **Bias Toggle** to remove bias from gate of device.
10. Click **Program All** to save the tuned value.
11. Close the screen to return to the **Tuner Main Menu**.

6.2.4

Aligning the Reference Oscillator

Radios are shipped from the factory with a worst-case frequency error of ± 50 Hz. These specifications are tighter than the more stringent FCC requirements of ± 1.5 ppm for the 700-800 MHz and 800-900 MHz bands and ± 2 ppm for the VHF, UHF1 and UHF2 bands.

Prerequisites:

Radios that have been in storage for over six months from the factory ship date requires the reference oscillator to be checked when the radio is deployed to the field. Check the reference oscillator every time the radio is serviced or at least once a year, whichever comes first.

The crystal contained in the reference oscillator naturally drifts over time due to its aging characteristic. Periodic (annual) adjustment of the reference oscillator is important for proper radio operation.

Improper adjustment can result in both poor performance and interference with other users operating on adjacent channels.

This procedure should be done with an Aeroflex 3920 service monitor or an acceptable substitute

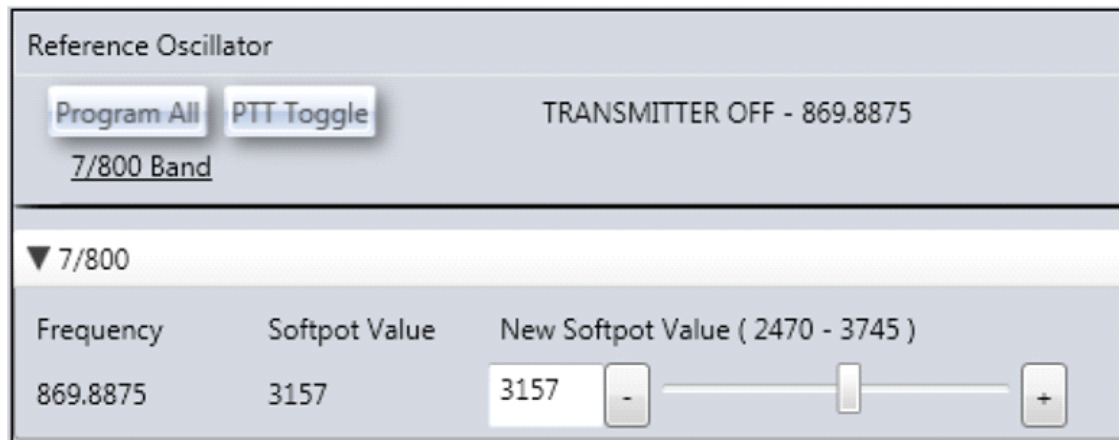
Procedure:

1. Initial setup using the Communication Analyzer:

Mode:	P25 Analog Mode 15 kHz LP filter enabled
RF Control:	P25 RX
Meter:	FM Deviation
Frequency:	Selected radio TX frequency

2. Connect a BNC cable between the “DEMOD OUT” port and the “Audio In 1” port on the service monitor.
3. Select **Reference Oscillator** from the **Tuner Main Menu**.

Figure 29: Reference Oscillator Window



4. Set the base frequency of the service monitor to the frequency displayed on the Tuner Main Menu.
5. Connect the antenna port to the test equipment (see [Figure 24: Radio Alignment Test Setup for Mobile Radios](#) on page 90).
6. Click **PTT Toggle** to make the radio transmit.
The screen indicates whether the radio is transmitting.
7. Wait five seconds until the analyzer reading stabilizes, then record the transmitter frequency.
8. Adjust the reference oscillator softpot value until the measured value is as close as possible to the frequency shown on the screen. Allow approximately five seconds for the analyzer frequency reading to stabilize after each change. The radio is capable of being tuned within 10 Hz of target frequency.
9. Click **Program All** to dekey the radio and save the tuned values.
10. Close the screen to return to the **Tuner Main Menu**.

6.2.4.1

Setting Up the Communication Analyzer for Reference Oscillator Alignment

Procedure:

Set up the Communication Analyzer with values for the following parameters:

Table 48: Communication Analyzer Set up

Parameter	Value
RF Control	Analyzer or RX
B/W	WB
Freq	CPS frequency under test
Attenuation	20 dB (optional)
Mon RF In	RF I/O
Meter	Frequency Counter or Offset
Mode	Analog or P25 STD

6.2.4.2

Setting Up the Agilent 8901 Modulation Analyzer for Reference Oscillator Alignment

Procedure:

1. Press the green **Automatic Operation** button on the analyzer.
2. Press the **FREQ** key.
3. Enter 7.1, then press the **SPCL** button to set the 8901 Modulation Analyzer for maximum accuracy.

6.2.5

Aligning the Power Detector Calibration

The power detector calibration alignment procedure adjusts the buffer gain for the forward power detector to minimize radio power variation from radio to radio.

Prerequisites: Terminate the appropriate antenna port with a calibrated power meter through a 30 db RF pad.

Procedure:

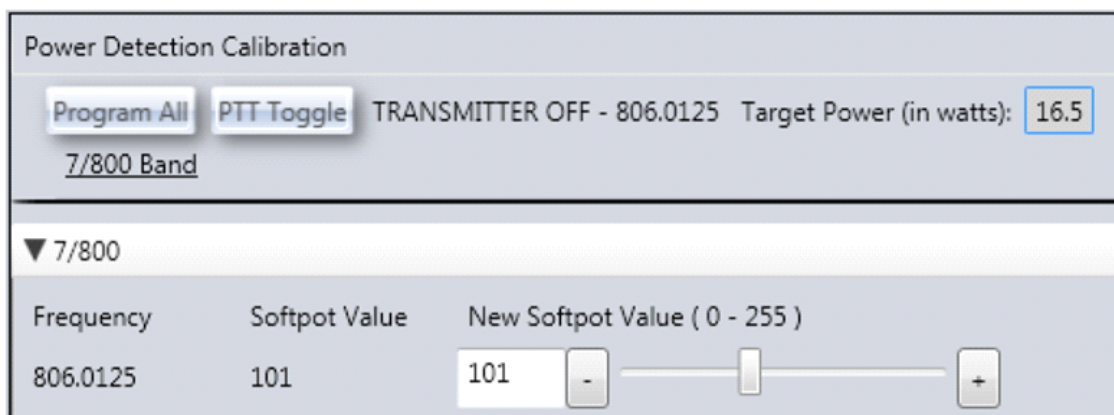
1. Set the power supply voltage and current limit as indicated in the following table.

Table 49: Power Supply Voltage Settings

Band/Power Level	Supply Voltage (V)	Supply Current Limit (A)
VHF 50 W	13.6	15
UHF1 40 W	13.6	15
UHF2 45 W	13.6	15
700–800 MHz 35 W	13.6	15
800-900 MHz 35 W	13.6	15

2. Select **Power Detection Calibration** from the **Tuner Main Menu**.

Figure 30: Power Detection Calibration Alignment Screen



3. Click **PTT Toggle** on the screen to make the radio transmit.
4. Adjust the softpot value until the target power is achieved.
5. Click **PTT Toggle** to disable transmit mode.
6. Click **Program All** to save the tuned value.
7. Close the screen to return to the **Tuner Main Menu**.

6.2.6

Aligning the Transmit Power Characterization

The Transmit (Tx) Power Characterization alignment procedure characterizes power tuning so that Tx power can be adjusted with the CPS software. The radio transmits at two power levels for each test frequency and you are required to record the measured power level with 0.1 W resolution.

Prerequisites: Terminate the appropriate antenna port with a calibrated power meter through a 30 db RF pad.

Procedure:

1. Set the power supply voltage and current limit as indicated in the following table.

Table 50: Power Supply Voltage Settings

Band/Power Level	Supply Voltage (V)	Supply Current Limit (A)
VHF 50 W	13.6	15
UHF1 40 W	13.6	15
UHF2 45 W	13.6	15
700–800 MHz 35 W	13.6	15
800-900 MHz 35 W	13.6	15

2. Select **Tx Power Characterization** from the **Tuner Main Menu**

Figure 31: Tx Power Characterization Alignment Screen

Tx Power Characterization		
Program All PTT Toggle TRANSMITTER OFF - 762.0125 7/800 Band		
▼ 7/800		
Frequency (MHz)	Measured Power 1	Measured Power 2
762.0125	2.671	30.489
768.9875	2.589	30.173
776.0125	2.677	31.189
793.9875	2.872	33.510
805.9125	2.797	32.258
806.0125	2.808	37.857
823.9875	2.590	34.434
851.0125	2.556	33.815
860.0125	2.517	33.415
869.8875	2.471	32.833

- Click the first box of the Measured Power 1 column.
The perimeter of the box turns green indicating active characterization point.
- Click **PTT Toggle** to transmit at the indicated frequency, then record the power measurement with 0.1 W resolution.
The perimeter of the box turns red, indicating that the radio is transmitting.
- Click the **PTT Toggle** button to disable transmit mode.
- Enter the power measurement with 0.1 W resolution, overwriting any value that may reside in the box from previous tuning.
- Repeat [step 3](#) through [step 6](#) for Measured Power 2.
- Repeat [step 3](#) through [step 7](#) for all frequencies.
- Click **Program All** to save the tuned value.
- Close the screen to return to the **Tuner Main Menu**.

6.2.7

Aligning the Transmit Current Limit

The Transmit (Tx) Current Limit alignment procedure tunes the Tx current-limiting protection.

Prerequisites: Terminate the appropriate antenna port with a calibrated power meter through a 30 db RF pad.

Procedure:

- Set the power supply voltage and current limit as per the following table.

Table 51: Power Supply Voltage Settings

Band/Power Level	Supply Voltage (V)	Supply Current Limit (A)
VHF 50 W	13.6	15
UHF1 40 W	13.6	15
UHF2 45 W	13.6	15
700–800 MHz 35 W	13.6	15
800-900 MHz 35 W	13.6	15

2. Select **Tx Current Limit** from the **Tuner Main Menu**.

Figure 32: Tx Current Limit Alignment Screen

Frequency	Softpot Value	New Softpot Value (0 - 255)
762.0125	60	60
768.9875	58	58
776.0125	56	56
793.9875	55	55
805.9125	55	55
806.0125	62	62
823.9875	65	65
851.0125	64	64
860.0125	62	62
869.8875	59	59

3. Select the first test frequency to tune.
4. Click **PTT Toggle** to transmit at the indicated frequency.
5. Click **Autotune**.
6. Repeat [step 3](#) through [step 5](#) for all test frequencies.
7. Click **Program All** to save the tuned values.
8. Close the screen to return to the **Tuner Main Menu**.

Table 52: Transmit Current Limit Devices

Band/Power Level	Devices	
VHF 50 W	Final	Driver

Band/Power Level	Devices	
UHF1 40 W	Final 1 and Final 2	Driver
UHF2 45 W	Final 1 and Final 2	Driver
700–800 MHz 35 W	Final 1 and Final 2	Driver
800-900 MHz 35 W	Final 1 and Final 2	Driver

6.2.7.1

Aligning the Transmit Voltage Limit

The Transmit (Tx) Voltage Limit alignment procedure tunes the Tx control voltage limiting protection.

Prerequisites: Terminate the appropriate antenna port with a calibrated power meter through a 30 db RF pad.

Procedure:

1. Set the power supply voltage and current limit as per the following table.
2. Select **Tx Voltage Limit** from the **Tuner Main Menu**.

Figure 33: Tx Voltage Limit Alignment Screen

Tx Voltage Limit

Program All PTT Toggle Autotune TRANSMITTER OFF - 762.0125

7/800 Band

▼ 7/800

Frequency	Softpot Value	New Softpot Value (0 - 255)
762.0125	175	175 - [Slider] +
768.9875	172	172 - [Slider] +
776.0125	170	170 - [Slider] +
793.9875	162	162 - [Slider] +
805.9125	164	164 - [Slider] +
806.0125	172	172 - [Slider] +
823.9875	179	179 - [Slider] +
851.0125	186	186 - [Slider] +
860.0125	187	187 - [Slider] +
869.8875	188	188 - [Slider] +

3. Select the first test frequency to tune.
4. Click **PTT Toggle** to transmit at the indicated frequency.
5. Click **Autotune**.
6. Repeat [step 3](#) through [step 5](#) for all test frequencies.
7. Click **Program All** to save the tuned values.
8. Close the screen to return to the **Tuner Main Menu**.

6.2.8

Aligning the Transmit Deviation Balance (Compensation)

The Transmit (Tx) Deviation Balance (Compensation) alignment procedure balances the modulation contributions of the low- and high-frequency portions of a baseband signal. Proper alignment is critical to the operation of signaling schemes that have low frequency components (for example, DPL). If improperly adjusted, it could result in distorted waveforms.

Prerequisites:

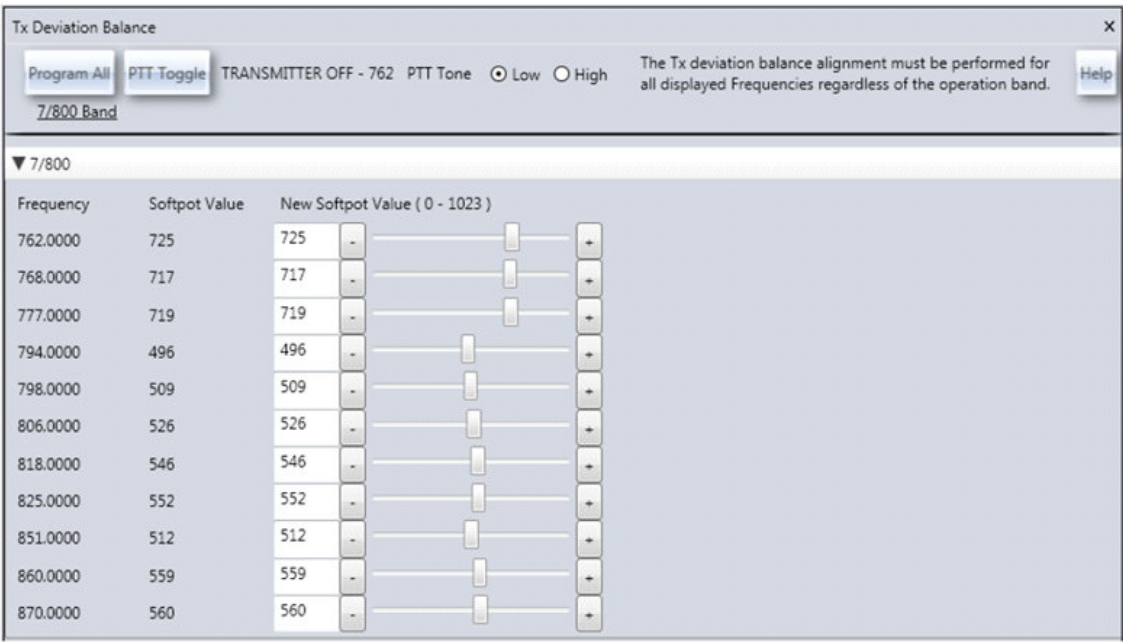
Perform this procedure at multiple frequencies to allow for proper alignment across the entire RF band. The RF band is divided into frequency zones with a calibration point (value) in each zone. When performing this tuning procedure, the PTT Tone Low generates a 300 Hz modulation frequency. The deviation level of this 300 Hz tone is used as the reference level for adjusting the deviation level of the PTT Tone High, which is a 3 kHz modulation frequency.

This procedure should be done with an Aeroflex 3920 service monitor or an acceptable substitute.

Procedure:

1. Select **Tx Deviation Balance (Compensation)** from the **Tuner Main Menu**.

Figure 34: Tx Deviation Balance (Compensation) Alignment Screen



The screen indicates the transmit frequencies to be used.

2. Connect the antenna port to the test equipment. See [Figure 24: Radio Alignment Test Setup for Mobile Radios on page 90](#).
3. Click the first frequency field.
4. Click **Low** for PTT Tone.

5. Click **PTT Toggle** to transmit.

The screen indicates whether the radio is transmitting. Wait approximately 5 seconds until the voltage or the deviation shown on the service monitor stabilizes.

6. Measure and record the AC voltage value or the deviation value from the service monitor.
7. Click **High** for PTT Tone.
8. Adjust the softpot value until the measured deviation/voltage when using high tone is within $\pm 0.2\%$ of the value observed when using low tone.
9. Repeat [step 4](#) through [step 8](#) for the remaining frequencies.
10. Click **Program All** to dekey the radio and save the tuned values.

6.2.8.1

Setting Up the R-2670 Communication Analyzer for Transmit Deviation Balance Alignment

Procedure:

1. Connect a BNC cable between the **DEMOD OUT** port and the **VERT/SINAD DIST/DMM COUNTER IN** port on the R-2670.
2. Press the **SPF** key on the R-2670 to display the **SPECIAL FUNCTIONS MENU**.
3. Move the cursor to High Pass, then select 5 Hz on the soft key menu. Select 20 kHz for the Low Pass setting.
4. In the RF Control section of the R-2670, enter the frequency displayed on the **Tuner Main Menu**.
5. Move the cursor to the B/W setting and select **WIDE ± 100 kHz** on the soft key menu.
6. Place the R-2670 cursor in the Display zone. Select **AC VOLTS** on the soft key menu.
7. Move the cursor to the **Range** setting and select **AUTO**.

6.2.8.2

Setting Up the Agilent 8901 Modulation Analyzer for Transmit Deviation Balance Alignment

Procedure:

1. Press the **FM MEASUREMENT** button.
The "Error 03-input level too low" indication is normal until an input signal is applied.
2. Simultaneously press the **Peak -** and **Peak +** buttons.
Both LEDs on the buttons light up.
3. Press the 15 kHz LP filter key.
4. Press the 50 Hz filter key.

6.3
Receiver Alignments

6.3.1
Front End Filter Alignment (UHF1 and UHF2 only)

This section covers the receiver alignment. The alignment procedure adjusts the front end receiver bandpass filters for the best receiver sensitivity and selectivity.

This procedure should be performed for all test frequencies to allow for proper software interpolation of frequencies between the test frequencies in the band. Refer to [Figure 35: Rx Front End Filter Alignment on page 105](#).

 **NOTE:** Rx Front End Filter Alignment is required after replacing (or servicing) the transceiver board.

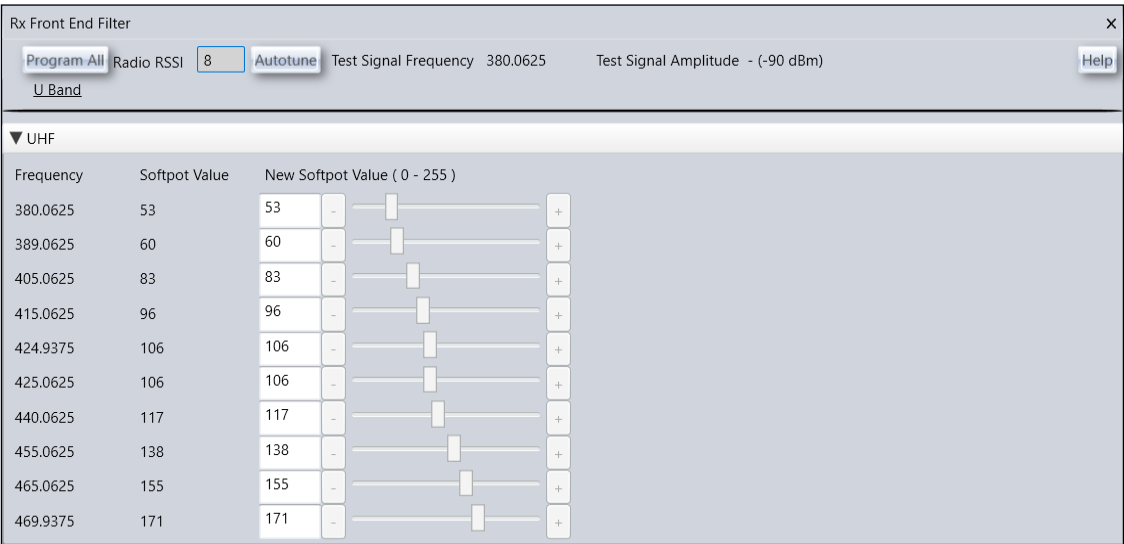
6.3.2
Tuning UHF1 and UHF2 Front End

Tuning of the radio is done through Rx Front End Filter tuning screen.

Procedure:

1. Select the Rx Front End Filter alignment screen.

Figure 35: Rx Front End Filter Alignment



2. Click the slider or the **New Softpot Value** text box to select which frequency to tune.
3. Apply RF test signal input with no modulation at -90 dBm on the Test Signal Frequency.
4. Click the **Autotune** button.
5. Repeat the steps 2–4 for all frequencies.
6. Click the **Program All** button on the screen to save the tuned values in the radio.

6.3.3
RX Duty Cycle Adjustment

Procedure:

1. Select the **Rx Duty Cycle Adjustment** screen.
2. Apply RF test signal input with no modulation at -60 dBm on the Test Signal Frequency displayed at the top of the screen.
3. Click **Autotune**.

Figure 36: RX Duty Cycle Adjustment AutoTune

Frequency	Softpot Value	New Softpot Value	Low/High Side Injection Amplitude Error	Low/High Side Injection Phase Error
869.9375	1038/1134	1038/1134	1.006378 / 1.007385	-0.001038 / -0.002930

4. Click **Program All** to save the tuned values in the radio.

6.4
Performance Testing

This section describes the performance test procedures for Bit Error Rate and Transmitter Test Pattern of the radio.

6.4.1
Bit Error Rate (BER) Test

This procedure tests the Bit Error Rate (BER) of the radio receiver at a desired frequency.

Figure 37: Bit Error Rate Screen

Table 53: Bit Error Rate Test Fields

Field	Description
Rx Frequency	Selects the Receive Frequency in MHz.
Test Pattern	Selects the Digital test pattern - TIA.
Modulation Type	Selects the digital modulation type of the incoming signal on which BER is to be calculated.

Field	Description
Continuous Operation	Allows the user to adjust the number of test repetitions. A selection of Yes causes the radio to calculate BER on a continuous basis indefinitely and update the results on this screen after each integration time. A selection of No causes the BER test to execute only one sample and then update the display.  NOTE: When Continuous Operation = Yes, all fields are dimmed while the test is in progress. They are enabled when the test is complete, or if the STOP button is pressed. When Continuous Operation = No, a wait cursor is displayed while the test is in progress and return to normal when the test is done.
Audio	Allows the user to select the audio output during a test. Selecting External routes the same signal to the radio accessory connector audio output. Selecting Internal is not supported. Selecting Mute disables the audio output.
BER Integration Time	Represents the amount of time during which the Bit Error Rate is to be calculated. Remember that integration over a longer time period results in a more precise measurement, at the expense of more time per measurement.  NOTE: This is especially useful in fading measurements. The range is from 0.360 to 91.8 seconds in increments of 0.360 seconds.

6.4.2

Transmitter Test Pattern

This procedure allows you to generate test patterns at selectable frequencies and channel spacing to check the transmitter.

The procedure contains the fields described in the following table.

Table 54: Transmitter Test Pattern Fields

Field	Description
Tx Frequency	This field selects the Transmit Frequency directly in MHz.
Channel Spacing	This field allows you to select the desired transmit deviation in kHz.
Test Pattern Type	This field represents the type of test pattern that is transmitted by the radio when PTT Toggle is clicked.

 **NOTE:** Test Pattern Type field is dimmed while the radio is transmitting.

Figure 38: Transmitter Test Pattern Screen

The screenshot displays the 'Transmitter Test Pattern' interface. At the top, there is a header bar with the title 'Transmitter Test Pattern'. Below this, a 'PTT Toggle' button is visible, followed by the text 'TRANSMITTER OFF - 762.000000 MHz'. The main area contains three settings: 'Frequency (MHz)' is set to '762.000000', 'Test Pattern Type' is set to 'Digital Voice', and 'Tx Power' is set to 'Low'. Each setting is represented by a label on the left and a corresponding input field or dropdown menu on the right.

Transmitter Test Pattern	
PTT Toggle TRANSMITTER OFF - 762.000000 MHz	
Frequency (MHz)	762.000000
Test Pattern Type	Digital Voice ▼
Tx Power	Low ▼

Chapter 7

Encryption

This chapter describes the encryption capability of your radio.

 **NOTE:** APX 1500 is software secure capable only. Hardware Motorola Advanced Crypto Engine (MACE), Secure, or Keyloading related tests and information do not apply to APX 1500 radios and PMLN9050A Controller Boards for the entire “Encryption” chapter.

7.1

Motorola Advanced Crypto Engine Secure Options

 **NOTE:** This information applies to both conventional and trunked systems.

The controller section contains the MACE (Motorola Advanced Crypto Engine) which encrypts and decrypts voice and data. MACE is a custom encryption IC and uses an encryption key variable to perform its encode or decode functions. The encryption key variable is loaded into the MACE using a key variable loader (KVL). Refer to the key-variable loader (KVL) manual for equipment connections and setup.

7.1.1

Secure Key Retention

The radio comes with a standard 10 minutes or infinite key retention (CPS setting).

Table 55: Controller Boards with Programmed Secure Algorithms

Kit Number	Description
NNTN9237A	ADP/AES/DVP-XL encryption
NNTN9238A	ADP/DVP-XL encryption
NNTN9239A	ADP/AES/DES/DES-XL/DES-OFB encryption
NNTN9240A	ADP/AES encryption
NNTN9241A	ADP/DES/DES-XL/DES-OFB encryption
NNTN9242A	ADP encryption
NNTN9243A	ADP/CFX - 256 configurable
NNTN9244A	ADP/DVP - XL/CFX - 256 configurable
NNTN9245A	ADP/AES/DES/DES - XL/DES-OFB/CFX - 256 configurable
NNTN9246A	ADP/DES/DES - XL/DES-OFB/CFX - 256 configurable
NNTN9247A	ADP/AES/CFX - 256 configurable
NNTN9248A	ADP/AES/DVP - XL/DES-OFB/CFX - 256 configurable
NNTN9249A	ADP/Localized enabled encryption
NNTN9250A	ADP/DVP - XL/Localized enabled encryption

Kit Number	Description
NNTN9251A	ADP/AES/DES/DES - XL/DES - OFB/Localized enabled encryption
NNTN9252A	ADP/DES/DES - XL/DES - OFB/Localized enabled encryption
NNTN9253A	ADP/AES/Localized enabled encryption
NNTN9254A	ADP/AES/DVP - XL/Localized enabled encryption
NNTN9255A	Localized Capable Encryption (RUS)

Refer to the PCAT (Product Catalog) for the various kit numbers required to program secure algorithms.

Refer to [Replacement Parts Ordering on page 222](#) for customer support in identifying kit numbers.

7.1.2

Secure Dispatch Operation

This feature is for personalities or talkgroups that are programmed to secure-selectable.

Press and release the Secure button to toggle between Secure and Clear.

- An illuminated secure status annunciator indicates that the transmitted signal is encrypted when the PTT button is pressed.
- The absence of the secure status annunciator indicates that the transmitted signal is not going to be encrypted.

The secure status annunciator displays the transmit operation as either secure (encrypted) or clear (nonencrypted).



NOTE: You cannot change from secure to clear while the PTT button is pressed. The radio generates an illegal tone and the transmission is terminated.

Secure-equipped radios automatically determine whether a secure or clear voice message is being received.

You receive either type of messages without having to reset the programmable secure button.

7.1.3

Secure Emergency Operation

Clear or Secure emergency-call operation is determined by the selected mode, talkgroup, or the default emergency mode.

The transmit operation is controlled by the setting of the secure programmable button.

During an emergency call, you are not able to change from Secure to Clear, or from Clear to Secure operation.

7.2

Loading an Encryption Key

To load an encryption key into an APX mobile radio:

Procedure:

1. Ensure proper encryption algorithm has been flashed into the radio. (DES_XL, DES-OFB, AES256, and others)

2. Load an encryption key into the radio memory from a key-variable loader (KVL) using the correct loader for the radio encryption type.
3. Attach the keyloader cable to the control head MMP connector in the dash mount configuration and to the TIB MMP connector in the remote mount configuration.

KEYLOADING is displayed on the radio display while the key transfer is in progress.

For single-key radios, a short tone sounds when a key is successfully loaded.

For multi-key radios, an alternating tone sounds for a few seconds after keys are successfully loaded.



NOTE: An invalid encryption key aborts a secure transmission. Radio displays **KEYFAIL** and a keyfail tone (consecutive medium-pitched beeps) sounds until you release the **PTT** button.

4. If a mode is not programmed for either secure or clear-only operation, use the secure programmable button to select secure or clear transmission.



NOTE: You cannot change from secure to clear, or from clear to secure, while pressing the **PTT** button.

7.3

Advanced Secure Operation



NOTE: The Advanced Secure feature is available only on radios that have been equipped by the factory to support it.

Advanced Secure incorporates the Multikey feature and a dual-encryption feature into the existing secure system. Multikey allows a radio to be equipped with multiple encryption keys. A default key is included and is associated with the current mode. The keys are strapped to a given mode or are operator-selectable and can be indexed into groups of keys called keysets. The keys are loaded using a manual keyloader.

In addition, your radio can support up to eight different encryption algorithms simultaneously.

7.3.1

Multikey Operation

Multikey applies for conventional and trunking.

Conventional

The encryption keys can be selectively strapped in each channel. Encryption keys are loaded into the radio through a KVL. The programmable radio features include operator-selectable keys, indices, and key erasure.

Trunking

Strap the encryption keys for trunking on a talkgroup or announcement group if the radio also uses conventional features. A different encryption key can be strapped to other features:

- Private Call
- Dynamic Regrouping
- Failsoft
- Interconnect
- System Wide
- Emergency talkgroup

7.4

Selecting Encryption Keys or Keysets



NOTE: The user navigation in this section might be different for every control head. Please refer to the respective control head user guide. See [Related Publications](#).

Procedure:

1. Press either menu button labeled **KEY** or **KSET** if available on the display menu. Alternatively, press and hold the menu button labeled **SEC** until a tone sounds.
2. Then press the menu button labeled **KEY** to select a single key or **KSET** to select a keyset on the second menu that is displayed. The display shows the last user-selected and properly stored encryption key available.
3. Use the **NAV** key to scroll through the encryption keys until the key or keyset desired is displayed. If the desired key is erased the display flashes **ERASED KEY** and the key name alternately.
4. If a good key then Press **Select**.

Result:

- If the selected key is erased, the display shows **KEY FAIL** and the radio sounds a momentary keyfail tone.
- If the selected key is not allowed, the display shows **ILLEGAL KEY** and the radio sounds a momentary illegal key tone.

7.5

Erasing Keys



NOTE: The user navigation in this section might be different for every control head. Please refer to the respective control head user guide. See [Related Publications](#).

Procedure:

1. Press the menu button labeled **ERAS**. Alternatively, press and hold the menu button labeled **SEC** until a tone sounds. Then press **ERAS** on the second menu that is displayed.
2. Use the **NAV** key to scroll through the encryption keys until the key to be erased is displayed. Alternatively, if a keypad microphone is used, press the numeric keys to jump to the desired encryption key.
3. Press the menu button labeled **SNGL** to erase the selected key.
4. Press the menu button labeled **YES**.

The selected key is set to zero.

ERASED is alternately displayed with the key name confirming the erasure.

5. To exit the menu without erasing a key, press the menu button labeled **ABRT**, the **PTT** button, or the **Home** button.

7.6

Erasing All Keys



NOTE: The user navigation in this section might be different for every control head. Please refer to the respective control head user guide. See [Related Publications](#).

Procedure:

1. Press the menu button labeled **ERAS**. Alternatively, press and hold the menu button labeled **SEC** until a tone sounds. Then press **ERAS** on the second menu that is displayed.
2. Press the menu button labeled **ALL**.

ERASE ALL KEYS is displayed.

3. Press the menu button labeled **YES**. All keys are erased.

ERASED KEY is alternately displayed with the displayed key name confirming the erasure.

4. To exit the menu without erasing a key, press the menu button labeled **ABRT**, the **PTT** button, or the **Home** button.

7.7

Over-the-Air Rekeying

The Over-the-Air Rekeying (OTAR) feature allows the dispatcher to reprogram the encryption keys in the radio remotely.



NOTE: For more information, refer to the respective Control Head User Guide. See [Related Publications](#).

Procedure:

1. Press the programmed **REKY** button.
2. Alternatively, press and hold the programmed **SEC** until a tone sounds.
3. Press the programmed **REKY** button.



NOTE: Use the **NAV** key to scroll through the menus.

REQUEST REKEY is displayed.

4. Press the **PTT** button to send the rekey request.

PLEASE WAIT is displayed.

Result:

If the operation is successful, your radio shows one of the following indications:

- The radio sounds five tones when the dispatcher has received the request.



NOTE: To exit the feature, perform one of the following actions:

- Any subsequent press of the **PTT** button.
- Press the **HOME** button.
- Press the **Emergency** button.

- The display momentarily shows **REKEYED**.

If the operation is unsuccessful, your radio shows one of the following indications:

- The display momentarily shows **REKEY FAIL** and the bad-key tone sounds. This is because the radio does not contain the Unique Shadow Key (USK) or Unique Key Encryption Key (UKEK). You have to load the USK into the radio using the KVL before the radio can be reprogrammed over the air.



NOTE: If you exit but stay on the current channel in the dispatch mode, your radio shows the following indications:

- A tone sounds indicating the status of the rekey request.
- The display shows **REKEYED** or **DENIED**.
- The display shows **NO ACK** and the bad-key tone sounds. Then, the dispatcher has not acknowledged your request after the radio has tried five times to send it. The radio returns to the display message in [step 1](#), allowing you to retry the request.
- The display momentarily shows **DENIED** and the bad-key tone sounds. This means that the request has been denied by the dispatcher, and the radio returns to the home display.

7.8

Hardware Encryption Temperature Detectors

As a requirement for FIPS 140-3 certification, the internal Motorola Advanced Crypto Engine (MACE) IC now has temperature detectors enabled **only** when operating in a Level 3 Approved Mode.

For details on the configuration requirements to operate in Level 3 Approved Mode, you can refer to the Security Policy for the MACE IC at <https://csrc.nist.gov/Projects/cryptographic-module-validation-program/validated-modules>

This policy is referenced by the National Institute of Standards and Technology (NIST).

The normal operation specification for temperature is -38 to +101 °C (-36 to +214 °F). If the internal MACE IC reaches temperatures below or above these temperature limits, all keys are deleted, and the MACE IC shuts down. This situation only happens in radio operations and not in device storage.

Customers operating in environments outside of these MACE temperature specs are recommended to turn on the Infinite Key Retention feature or change the FIPS operating mode to Level 2. These actions maintain operational parity with the previous releases. Toggling Infinite Key Retention or changing FIPS mode erases all keys in the device during that provisioning operation.

Chapter 8

Disassembly/Reassembly Procedures

This section details the procedures necessary to remove and replace the printed circuit boards in APX mobile radios. After troubleshooting and determining what needs to be replaced, disconnect the test equipment, the antenna cable, and the power cable.



WARNING: Disconnect the power cable from the radio before opening and removing the PCB. Failure to remove power can result in unit damage caused by transients or accidental shorts, as well as presenting a shock hazard.

Locate the exploded view of the radio in [Exploded Views and Parts Lists on page 191](#). Keep it handy for reference as you disassemble and reassemble the radio.

When installing a new circuit board, all mounting screws should be started before any are torqued. This will help ensure proper alignment.

After installing a new board, perform a complete alignment procedure as outlined in [Radio Alignment Procedures on page 90](#).

8.1

Replacement Procedures

After performing alignment procedures, always exit the SERVICE menu entirely (to the MAIN MENU) to properly save all changes. Failure to do so can result in an alignment or other failure.

8.1.1

Required Tools and Supplies

Table 56: Required Tools and Supplies

Tools and Supplies	Motorola Solutions Part Number	Supplier Part Number
8 mm, 10 mm, 15 mm, 25 mm, and 28 mm Hex Nut bits	—	—
Anti-static grounding kit	—	—
Flat-blade screwdriver	—	—
Long Nose Plier	—	—
Magnetic screwdriver set with bits	0180320B16	—
Mini-UHF to N-type adapter cable	3085651A01	—
Net Runner M8	—	—
Philips PH2 screw bit	—	—
Plastic scraping tool	6686119B01	—
Removal and insertion tool	6680163F01	—

Tools and Supplies	Motorola Solutions Part Number	Supplier Part Number
Roto-Torq adjustable driver	—	RSX4043
Small, flat-blade screwdriver	—	—
Solder aid (black stick), HEXA-CON	—	MA-800G
Tohnichi 6RTD-A Analog Torque Driver (1-6 in-lbs)	—	—
Torx® bits for T8 for TIB; T10 for PCB; and T20 for cover screws; 9 mm thin wall, deep socket for all antenna connector nuts.	—	—
9 mm Hex Nut Bit (for GPS and QMA connector)	—	—
Tweezers	—	—
Wire Stripper	—	—
O2/O7 Knob Removal Tool	66012035001	—
Electromagnetic Interference (EMI) metallic shielding tape, or equivalent	—	—
QMA to QMA	CB000091A02	—
QMA to Mini-UHF	CB000091A03	—
QMA to SMA	CB000091A04	—
QMA to N-Type	CB000091A05	—

8.1.2

Radio Disassembly

8.1.2.1

Disassembling the Radio

Use the following procedures to disassemble your radio:

Procedure:

1. Ensure that all accessories connections, power, antenna, and microphone are unplugged. If radio is in remote mount configuration, disconnect the remote-mount control cable (CAN cable) from the radio.
2. Remove the front control head or TIB screws using an appropriate bit by referring to the steps explained in 8.2.16.4 for O2 Control Head, 8.2.16.5 for O7 Control Head, and 8.2.16.6 for TIB. Do not discard the screws.
3. After removing the control head or TIB, the radio must be oriented as shown in the following figure with the bottom of the radio facing up. Remove the four (4) bottom cover screws using a T-20 torx bit. These screws have sealing washers, which should be kept with the screw. Do not discard the screws.

Figure 39: Removing the Bottom Cover Screws



4. Remove the bottom cover from the disengagement slot on the main chassis. Hold both sides of the bottom cover, and lift it gently. It may be necessary to gently pry the cover off using a plastic tool. Be sure to remove the bottom cover seal. Do not discard the seal.

Figure 40: Removing the Bottom Cover



5. Disconnect both GPS and Wi-Fi cable from the controller board by gently holding the controller board in place and pulling up the GPS and Wi-Fi cable's MMCX connector. Do not pull the cables, as damage may occur.

Figure 41: Disconnecting the GPS Cable

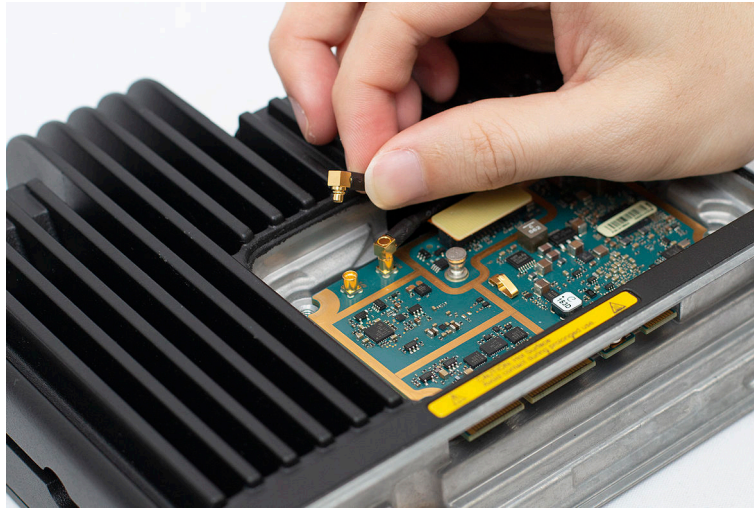
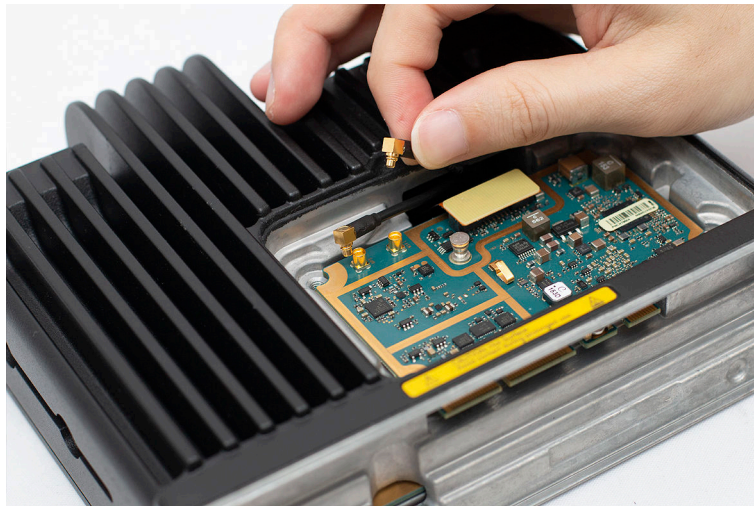
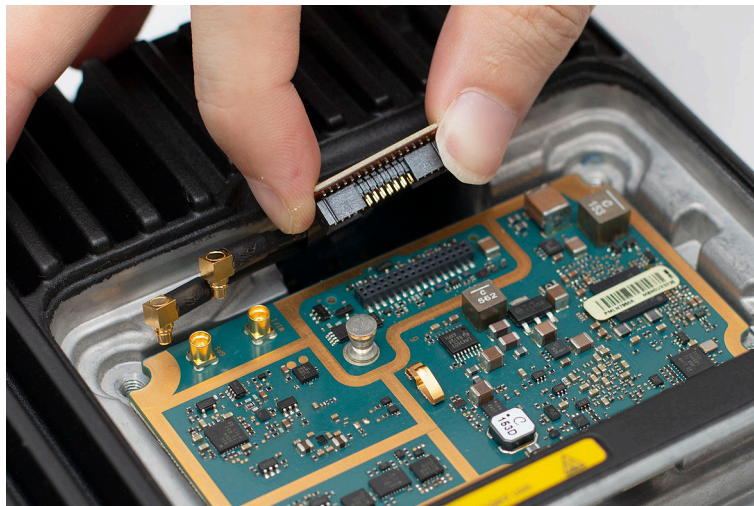


Figure 42: Disconnecting the Wi-Fi Cable



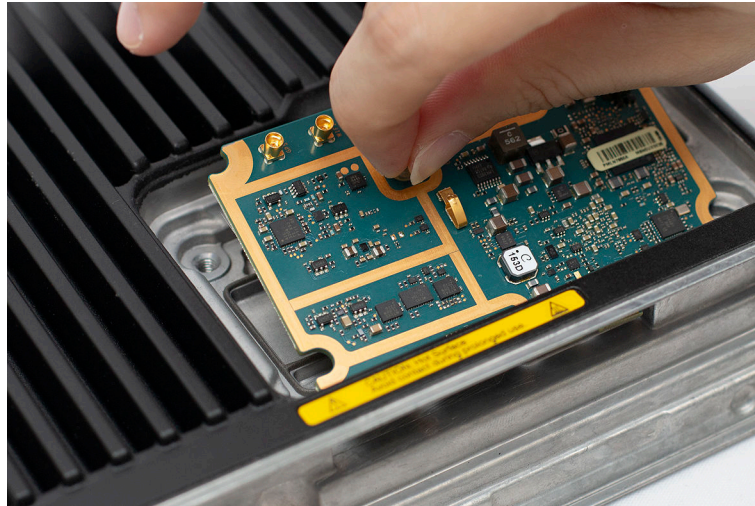
6. Disconnect the rear accessory flex from controller board.

Figure 43: Disconnecting the Rear Accessory Flex



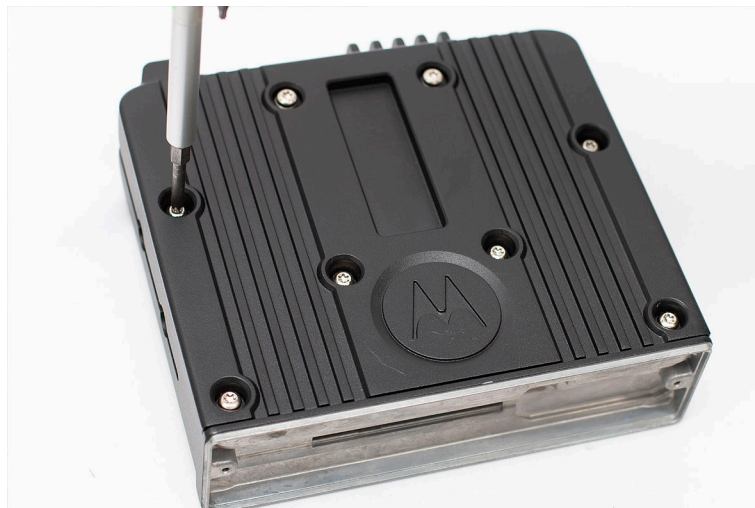
7. Disconnect the controller board from the RF board by tilting it upward from the core, out from the front chassis, and gently lift it with the handle.
8. Use the controller board handle to remove the controller board from the chassis. The controller board needs to be tilted forward, pulled back and out from the chassis, to avoid damage to the controller board edge card. Hold the controller board on the handle or edges only, and store it in an antistatic bag.

Figure 44: Removing the Controller Board



9. Flip the radio over.
10. Remove the eight (8) top cover screws using a T-20 torx bit. These screws have sealing washers that should be kept with the screws. Do not discard the screws.

Figure 45: Removing the Top Cover Screws



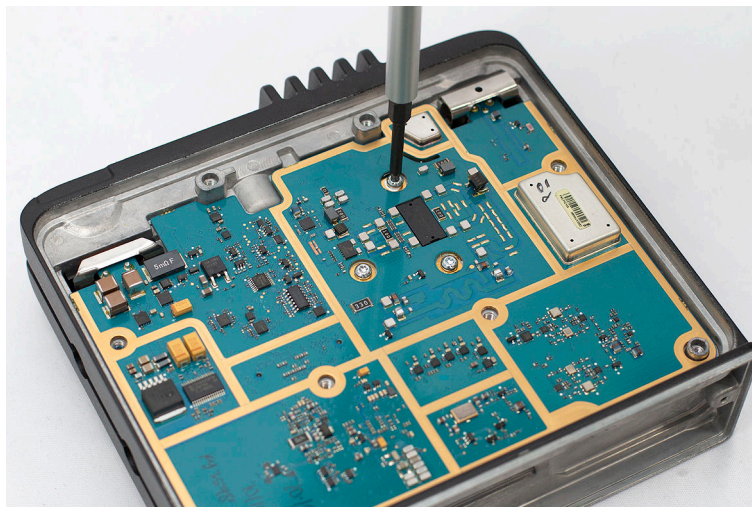
11. Remove the top cover with assistance of a plastic tool (6686119B01), and lift both side edges of the cover simultaneously. It may be necessary to gently pry off the cover using the plastic tool. Be sure to remove the top cover seal. Do not discard the seal.

Figure 46: Removing the RF Cover



12. Remove three (3) PA screws using a T-10 torx bit. Be careful while handling PA screws as there may be residual thermal grease on threads.

Figure 47: Removing the PA Screws



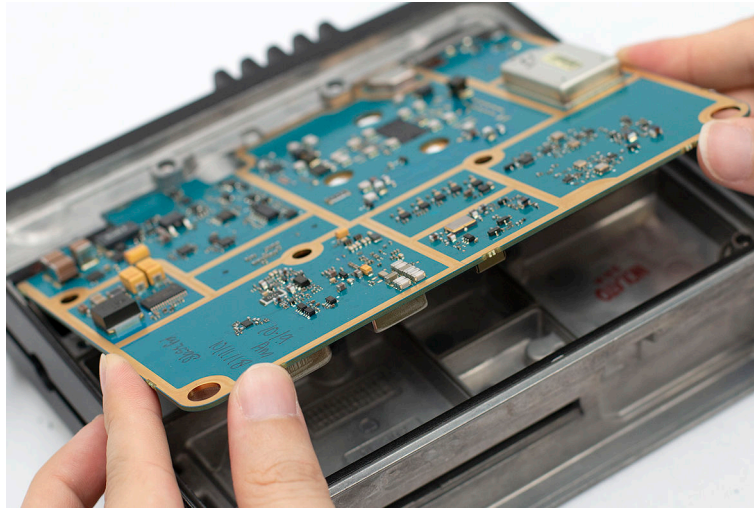
13. Remove the two (2) RF/DC retention clips by gently prying them out with a flat-blade screwdriver. For leverage, use only the chassis, do not use the PCB or any of its components.

Figure 48: Removing the RF/DC Retention Clips



14. Remove the RF board by gently pushing it upwards, and removing it from the front chassis. Then slide the RF board towards the front of the chassis, and swing the board up and out. Hold the RF board on the edges, and store it in an antistatic bag. Avoid contact with the exposed thermal grease on the RF board, and it may be removed with a dry lint-free cloth.

Figure 49: Removing the RF Board



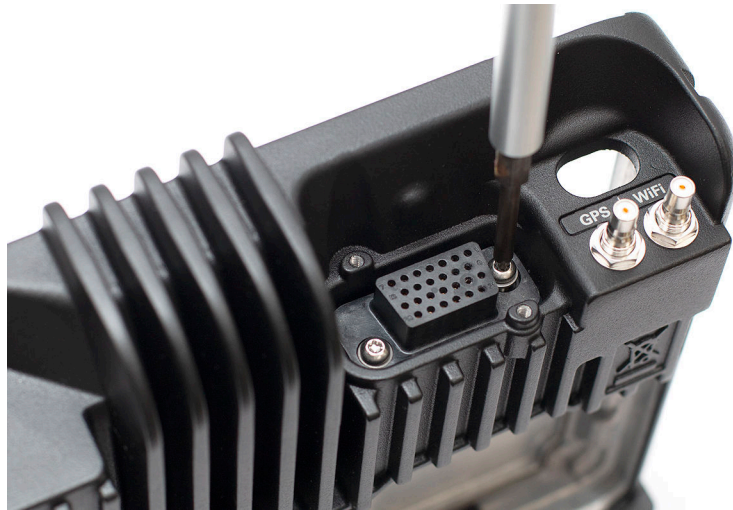
15. Remove the plastic retainer vertically.

Figure 50: Removing the plastic retainer



16. Remove the two (2) rear accessory connector screws using a T-10 torx bit. The rear accessory screws have a washer and seal, that needs to be remained assemble on the screw. Do not discard the screws.

Figure 51: Removing the Rear Accessory Connector screws



17. Gently remove the rear connector flex from the chassis, through the rear connector chassis opening.

Figure 52: Removing the Rear Connector Flex



18. Remove the GPS and Wi-Fi QMA connector nut using a deep 9 mm socket or deep nut driver. Remove the GPS and Wi-Fi QMA connector lock washer. Do not discard the nut or lock washer.

Figure 53: Removing the GPS QMA connector

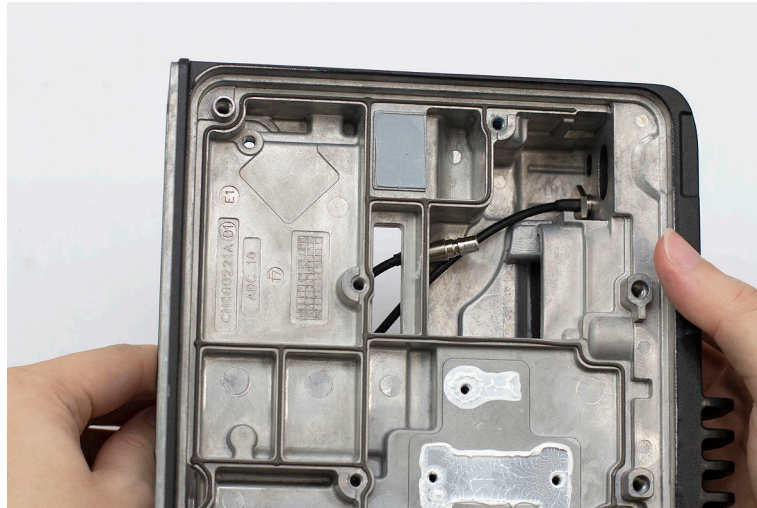


Figure 54: Removing the Wi-Fi QMA connector



19. Gently remove the GPS and Wi-Fi cable from the chassis retention channel, which is on the opposite side of the chassis, and pull the cable through the controller/RF chassis opening. The cable should now be entirely on top of the radio. Pull the GPS and Wi-Fi cable ferrule to the front of radio, and lift the cable out from the chassis.

Figure 55: Removing the GPS and Wi-Fi Cable



 **NOTE:** There is an o-ring on the internal threaded portion of GPS and Wi-Fi ferrule. Reassemble the lock washer and nut onto the GPS and Wi-Fi to hold the o-ring in place.

8.1.2.2

Disassembling the O2 Control Head

Procedure:

1. Ensure that the power, antenna, microphone and all accessory connections are unplugged. If the radio is a remote-mount radio, disconnect the remote-mount control cable from the front of the transceiver.
2. Remove the four front control head screws using a T20 torx bit and discard them.

Figure 56: Removing the Control Head Screws



3. Firmly grasp the front panel of the control head or the Transceiver Interface Board (TIB) for remote mount, and carefully remove the front housing assembly from the back housing assembly. Be careful not to pull the attached flex.

Figure 57: Removing the Control Head



4. Lay the control head or the TIB face down on a clean, flat surface, being careful not to scratch or mar the surface of the display.
5. Carefully disconnect the transceiver flex from the front housing assembly or TIB and set the front housing assembly or TIB aside.



NOTE: The O2/O7 knob removal tool can be used as a lever to simplify the task of disconnecting the transceiver flex and reduce the risk of damaging the connectors.

Figure 58: Disconnecting the Transceiver Flex from the Front Housing Assembly



6. Remove the two transceiver screws using a T10 torx bit and pull the back housing assembly away from the transceiver. Do not reuse the transceiver screws.



NOTE: Be careful to avoid pulling on the flex.

Figure 59: Removing the Back Housing Assembly



7. Carefully separate the I-seal, from the back housing assembly.
8. Carefully remove the transceiver flex from the transceiver by grasping the provided handle and separating it from the connector.

Figure 60: Removing the Transceiver Flex



8.1.2.3

Disassembling the O5 Control Head

Procedure:

1. Ensure that all accessory connections, power, antenna, and microphone are unplugged.

If the radio is in remote mount configuration, disconnect the remote-mount control cable (CAN cable) from the transceiver.

2. Remove the two (2) front control head/TIB screws using a T-10 torx bit, do not discard the screws.

Figure 61: Removing the Control Head Screws



3. Firmly grasp the control head/transceiver interface board (TIB) front housing and frame seal, and carefully remove it from the radio. Be careful not to pull the attached flex, during control head/TIB removal.

Figure 62: Removing the Control Head/TIB

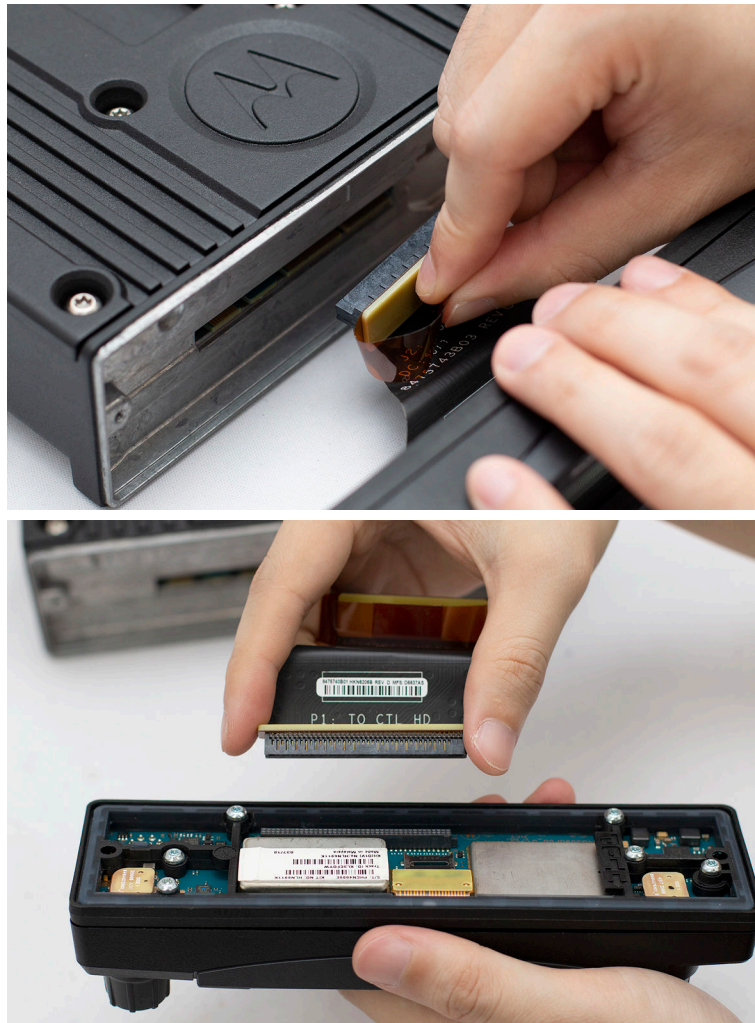


4. Lay the control head or TIB face down on a clean, flat surface, being careful not to scratch or mar the face of the display.
5. Carefully disconnect the control head/TIB flex from transceiver's edge card.



NOTE: "Carefully" means that the control head flex shall be disconnected from its mating control head connector by applying equal amounts of pressure on both ends of the mated pair until they fully disconnect. While disconnecting, make sure both mated pairs are pulled apart in a straight-forward or in-line direction parallel to the longitudinal axis of the connector pins.

Figure 63: Removing the Control Head Flex



8.1.2.4

Disassembling the O7 Control Head

Procedure:

1. Ensure that the power, antenna, microphone and all accessory connections are unplugged. If the radio is a remote-mount radio, disconnect the remote-mount control cable from the front of the transceiver.
2. Remove the two transceiver screws using a T10 torx bit and discard them.

Figure 64: Removing the Transceiver Screws



3. Firmly grasp the control head or the Transceiver Interface Board (TIB) for remote mount, and carefully remove the control head from the transceiver. Be careful not to pull on the attached flex.

Figure 65: Removing the Control Head



4. Lay the control head or TIB face down on a clean flat surface, and be careful not to scratch or mar the surface of the display.
5. Carefully remove the transceiver flex from the transceiver by grasping the provided handle and separating it from the connector. Set the transceiver aside.

Figure 66: Disconnecting the Transceiver Flex from the Transceiver



6. Carefully separate the I-seal from the control head or TIB.
 **NOTE:** Be careful not to damage the transceiver flex when separating the I-seal from the control head or TIB.
7. Carefully disconnect the transceiver flex from the control head or TIB.
 **NOTE:** The O2/O7 knob removal tool can be used as a lever to simplify the task of disconnecting the transceiver flex and reduce the risk of damaging the connectors.

Figure 67: Removing the Transceiver Flex



8.1.2.5

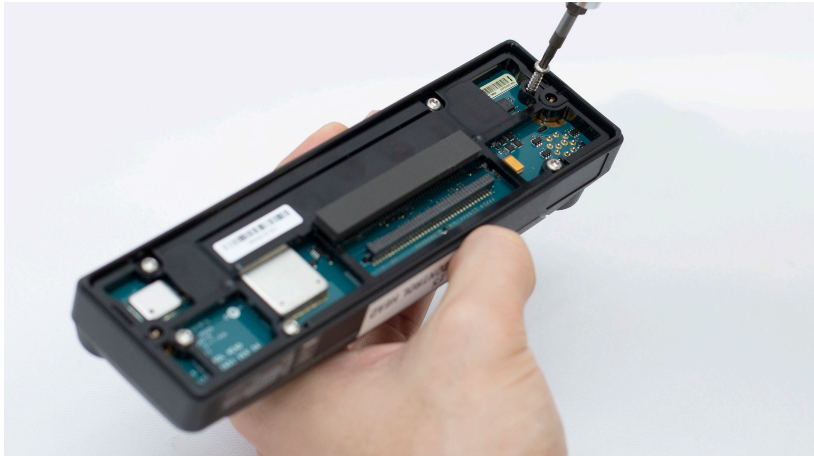
Disassembling the E5 Control Head

-  **NOTE:** Bracketed numbers are identical to item numbers shown in [E5 Control Head Exploded View and Parts List on page 200](#).

Procedure:

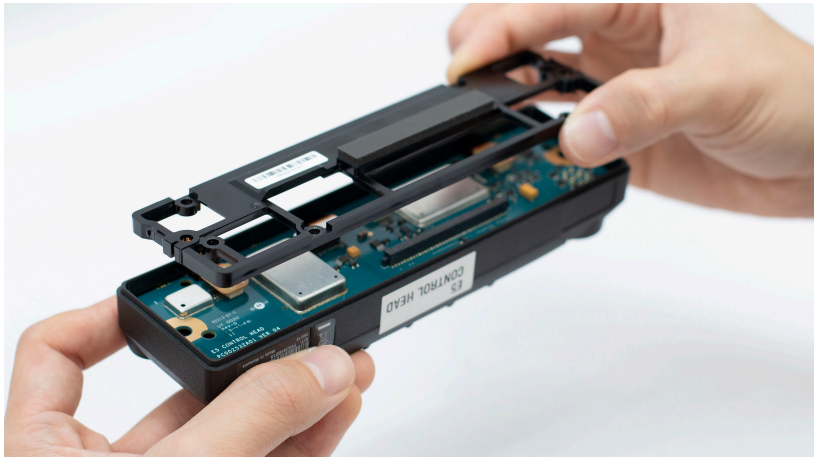
1. Lay the control head face down on a clean, flat surface being careful not to scratch or mar the display.
2. Using a Torx T10 screwdriver, remove the six main PCB retention screws [27] as shown in the following figure.

Figure 68: Main PCB Retainer Screws



3. Carefully separate the main PCB retainer [26] from the front housing assembly.

Figure 69: Main PCB Retainer

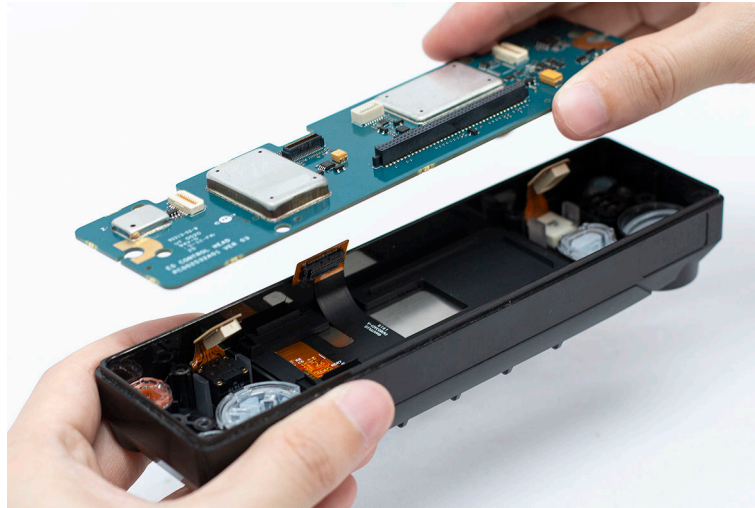


4. Carefully disconnect the frequency assembly, color display module encoder and the volume assembly flex assemblies.
5. After all the connectors have been unplugged, gently lift the main PCB up from the front housing assembly.



NOTE: Be careful not to damage the flex connectors when lifting up the main PCB.

Figure 70: Main PCB



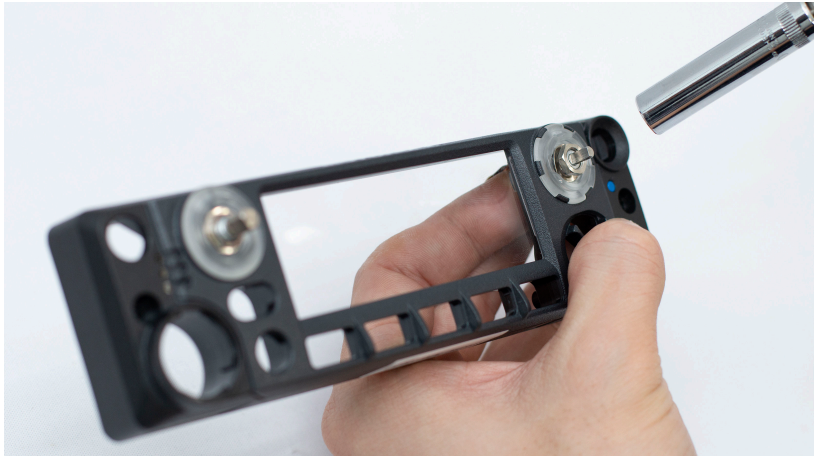
6. Remove the color display module from the front housing assembly.

Figure 71: Color Display Module



7. Using the knob removal tool, remove the encoder knob [1] from the front housing assembly.
8. Remove the torque washers and by using a hex nut driver, remove the encoder hex nut [4], followed by the 3 wave washers. Do not reuse the encoder hex nut.

Figure 72: Removing Hex Nut



9. Carefully remove the following parts from the front housing:

Figure 73: Emergency Button [20] and Emergency Button Retainer [21]



Figure 74: Home Button [14] and Home Button Retainer [15]



Figure 75: Navigation Button [16] and Navigation Button Retainer [17]

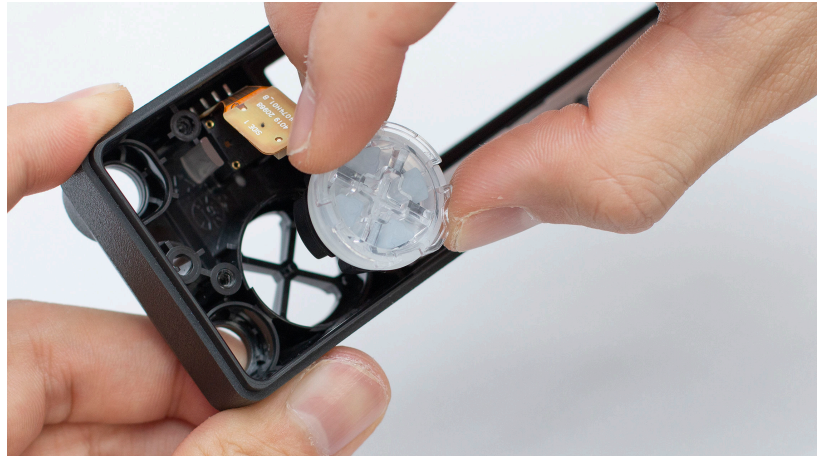


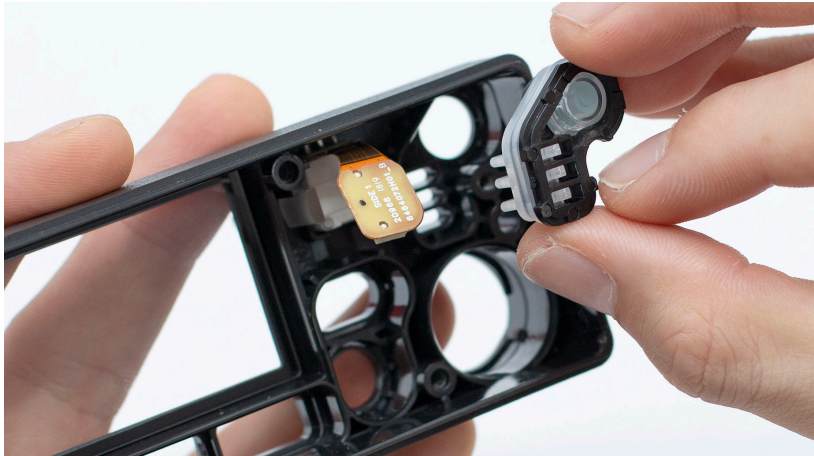
Figure 76: Menu Button [18] and Menu Button Retainer [19]



Figure 77: Programmable Button [12] and Programmable Button Retainer [13]



Figure 78: Power Button and Indicator Lights assembly [9][10][11]



10. Remove the volume assembly potentiometer and the frequency assembly switch from the front housing.

Figure 79: Volume Assembly Potentiometer



8.1.2.6

Disassembling the Transceiver Interface Board

Procedure:

1. Remove the Transceiver Interface Board (TIB) screws using a T-10 torx bit, do not discard the screws.

Figure 80: Removing the TIB Screws



2. Firmly grasp the TIB front housing and frame seal, and carefully remove it from the radio. To avoid option board damage during TIB removal, be careful not to pull the attached flex.

Figure 81: Removing the TIB



3. Lay the TIB face down on a clean, flat surface, being careful not to scratch or mar the face of the display.
4. Carefully disconnect the TIB flex from the transceiver's edge card.

 **NOTE:** “Carefully” means that the control head flex shall be disconnected from its mating control head connector by applying equal amounts of pressure on both ends of the mated pair until they fully disconnect. While disconnecting, make sure both mated pairs are pulled apart in a straight-forward [or “in-line”] direction parallel to the longitudinal axis of the connector pins.

Figure 82: Removing the Flex



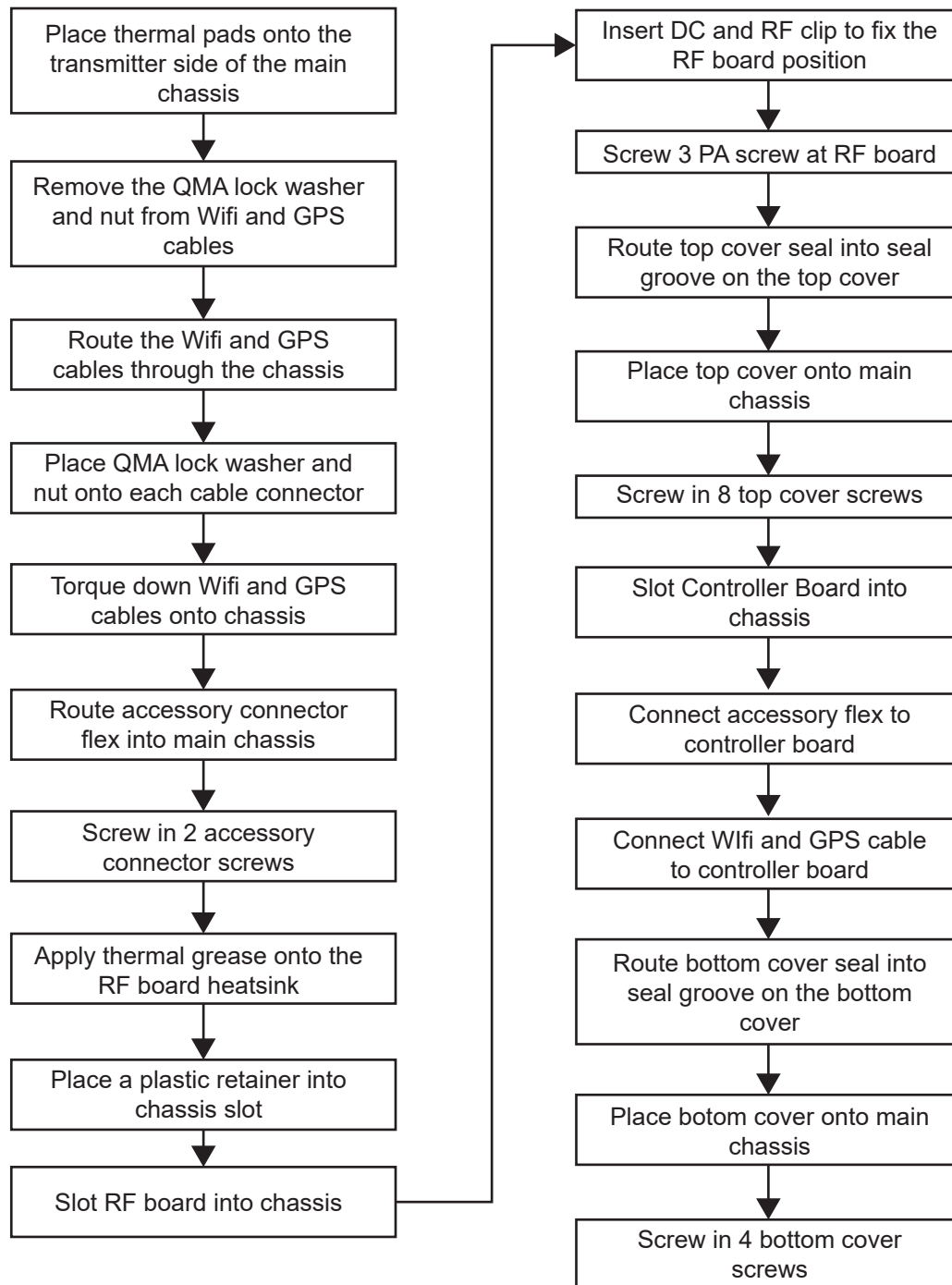
CAUTION: The following steps **MUST** be performed for option board equipped radios, prior to removal of the Controller or RF board from the chassis. Otherwise damage to Controller or RF boards could occur.

8.1.3

Radio Reassembly

The following figure is the radio reassembly summary flowchart. Use the procedures in sequence to reassemble your radio.

Figure 83: Radio Reassembly Summary



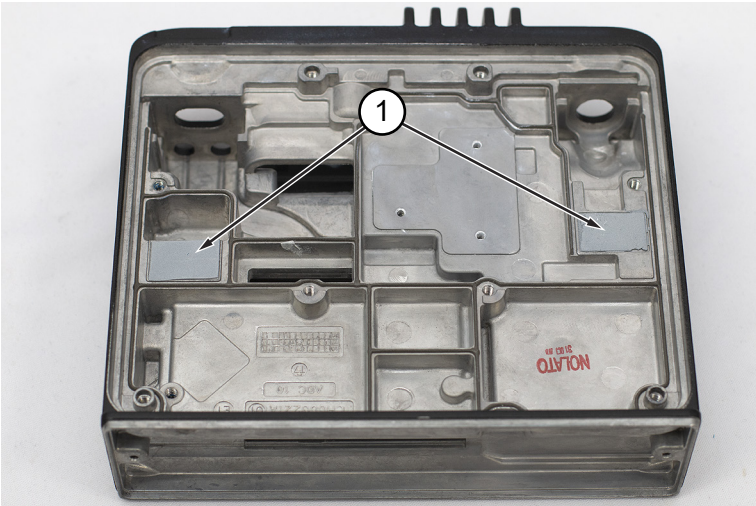
8.1.3.1
Enhanced Single Band Mobile Radio Models

Prerequisites: Prior to reassembling the radio, inspect all seals and sealing surfaces for damage (nicks, cuts, and so on) or dirt. Reseat all seals on their respective parts.

Procedure:

1. Begin with the chassis. Thoroughly inspect the chassis shield gasketing to ensure that there is no damage, and verify all chassis thermal pads are in place and free of damage. See [Chassis Thermal Pad Replacement Procedure](#) to replace damaged pads.

Figure 84: Inspecting the Chassis Shield Gasketing and Thermal Pads



No.	Description
1	Thermal Pad

2. After inspecting the GPS and Wi-Fi cable and placing seal on the QMA connector ferrule, insert the GPS and Wi-Fi QMA connector through the GPS and Wi-Fi cable chassis opening, while ensuring the notch on the GPS and Wi-Fi QMA connector is down and aligned with the protrusion chassis. Install the lock washer. Install the GPS and Wi-Fi nut using a 9 mm nutdriver and torque nut to 13 lbf-in.
3. Insert the free end of the GPS and Wi-Fi cable through the RF/controller board chassis opening. Retain the cable by pushing it into chassis pinch points.

Figure 85: Inserting the GPS and Wi-Fi Cable



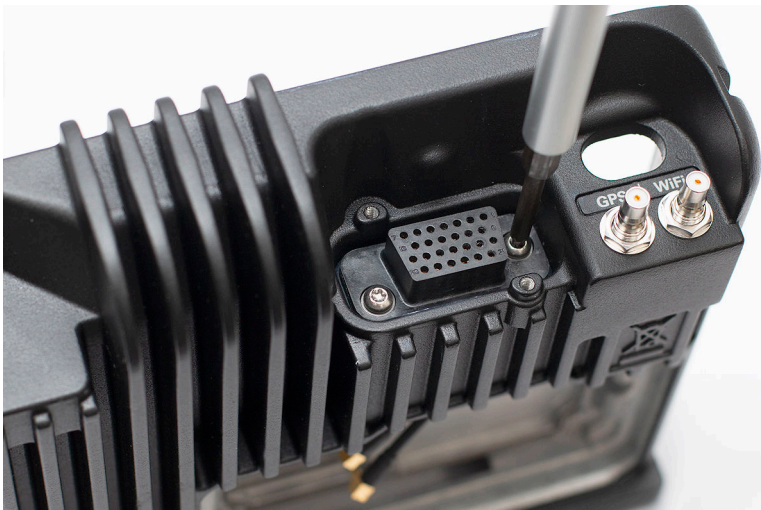
4. Insert the rear accessory flex through the rear chassis opening. Ensure that the flex is well-oriented. Insert the free end of the accessory flex through the RF/controller board chassis opening.

Figure 86: Inserting Rear Accessory Flex



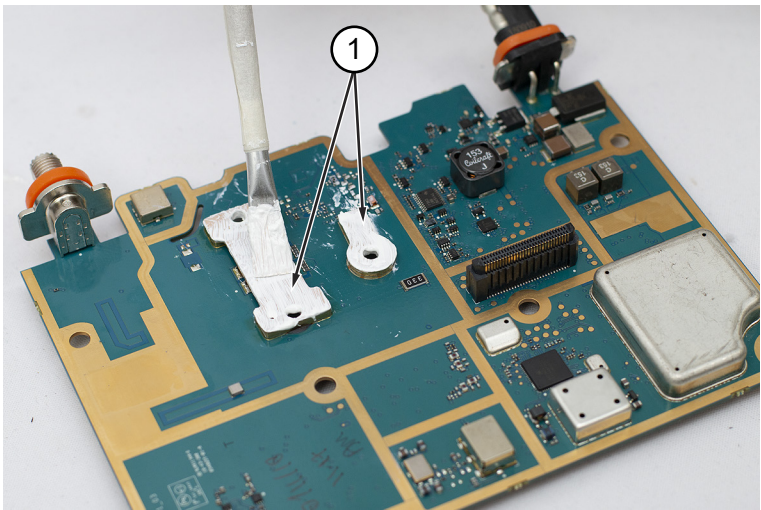
5. Install two (2) rear accessory connector screws using a T-10 Torx bit. Ensure that each rear accessory screw has one (1) washer and one (1) seal. Torque the rear accessory connector screws to 6-8 lbf-in.

Figure 87: Installing the Rear Accessory Connector Screws



6. Reapply thermal grease (1110022D23) to all RF board heat sinks. Cover all heat sinks with a smooth thin layer of thermal grease.

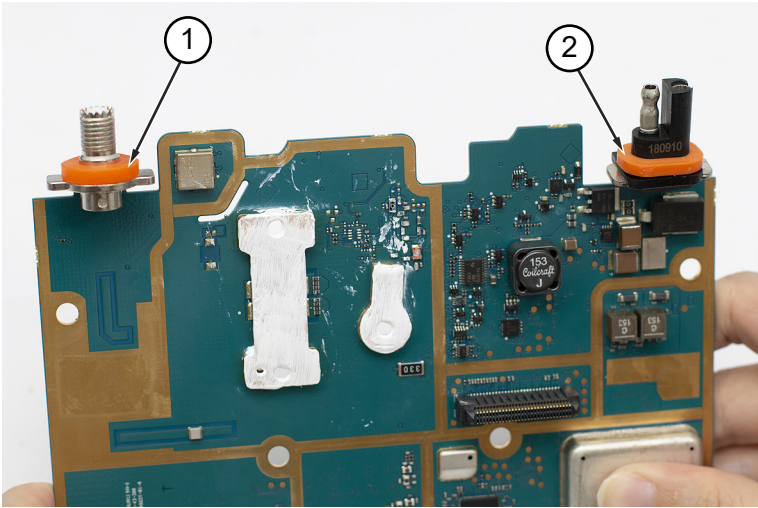
Figure 88: Applying the Thermal Grease to RF Board Heat Sinks



No.	Description
1	Thermal Grease

7. Ensure that the DC and RF connector seals on the RF board are properly seated.

Figure 89: Ensuring that the RF and DC Connector Seals are Properly Seated



1	RF Connector Seal
2	DC Connector Seal

8. Place the plastic retainer at the chassis opening.

Figure 90: Placing the Plastic Retainer

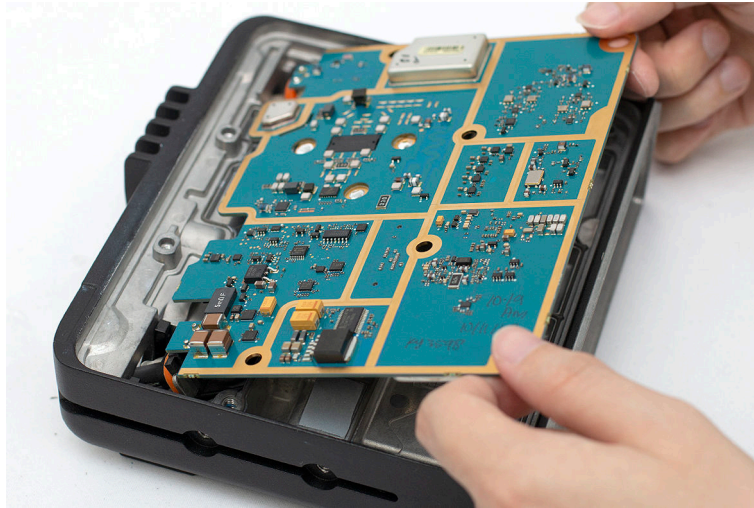


9. Install the RF board by tilting and sliding it into the chassis, and secure RF and DC connectors through the rear holes of the chassis. Push the RF board back and down to compress the RF and DC seals slightly, and ensure that it is properly seated. Ensure that the RF board alignment holes are positioned over the chassis alignment bosses, and the RF board is fully seated in the chassis.



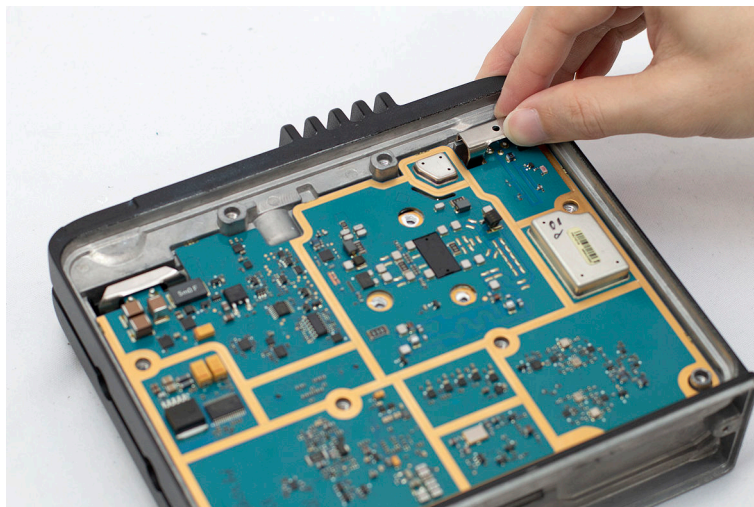
NOTE: It is important to assemble the RF Board, before placing the controller board and assembling the bottom cover.

Figure 91: Inserting RF Board into the Chassis



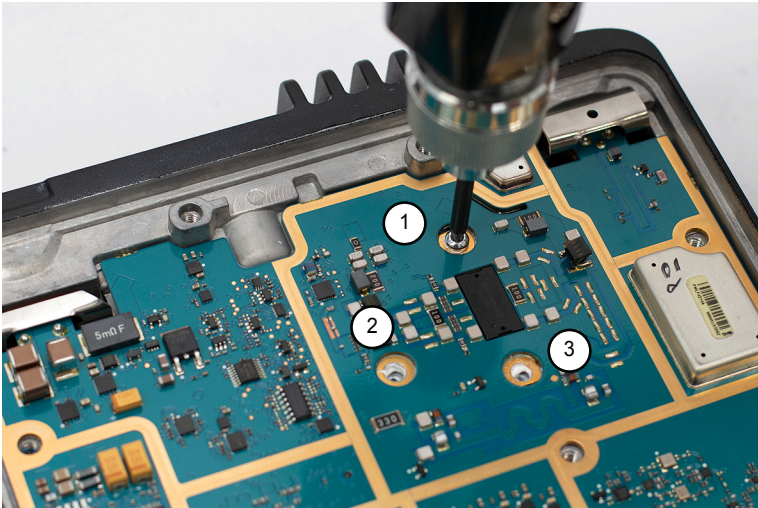
10. Insert the RF and DC retention clips, and ensure that they are fully seated. Insert all clips before board screws, to position the RF board properly.

Figure 92: Inserting the RF and DC Retention Clips



11. Install three (3) PA screws following the numbered sequence as shown in the following figure, using a T-10 Torx bit. Torque down the PA screws to 6-8 lbf-in.

Figure 93: Installing the PA Screws



12. Inspect and properly seat the top cover seal, and decently align its tab to the top cover.

Figure 94: Inspecting and Installing the RF Cover Seal



No.	Description
1	RF Cover Seal Tab

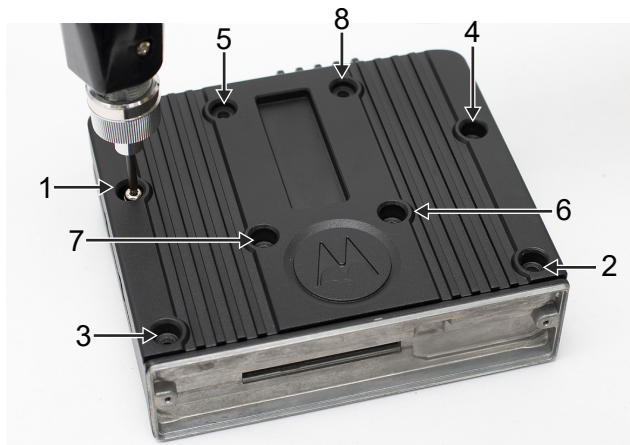
13. Place the top cover onto the chassis, and ensure that the top cover is properly aligned to the chassis. The top cover and chassis can be compressed together to squeeze seal into place.

Figure 95: Placing the RF Cover onto Chassis



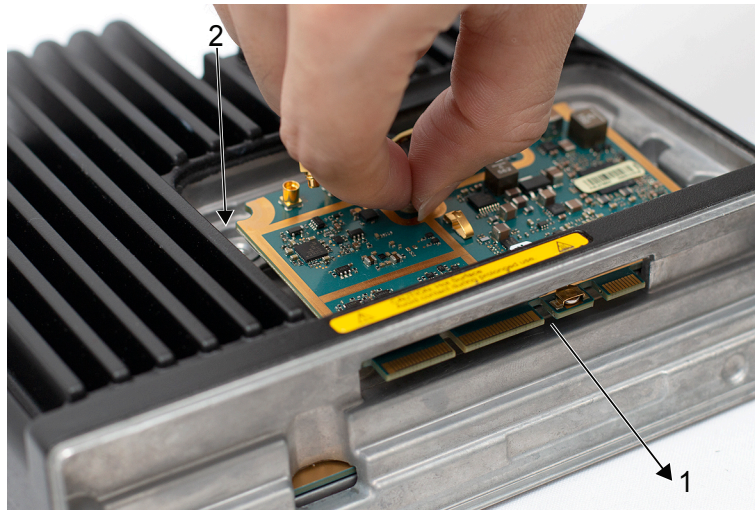
14. Inspect the sealing washers on the eight (8) top cover screws, and install the screws onto the top cover/chassis. Torque the top cover screws to 30 lbf-in, following the numbered sequence shown in the following figure, to ensure that top cover is seated properly. Repeat the torque order sequence at least twice.

Figure 96: Installing Screws onto the RF Cover/Chassis



15. Once the top cover is fully installed, check the interface between the top cover and the chassis to ensure that the top cover seal is not pinched.
16. Flip the radio over.
 - a. Install the controller board into the chassis by tilting the controller board edge card through the front opening using the controller board handle, and down into chassis. Ensure to hold the GPS and Wi-Fi cable and accessory flex out from the controller chassis pocket. Once the controller board is placed in the chassis, use the controller board handle to align the controller board-to-board (BTB) connector to the RF BTB connector.
 - b. Once aligned, press down the controller board as shown in the below numbers, to connect the controller/RF BTB connectors.

Figure 97: Installing Controller Board into Chassis



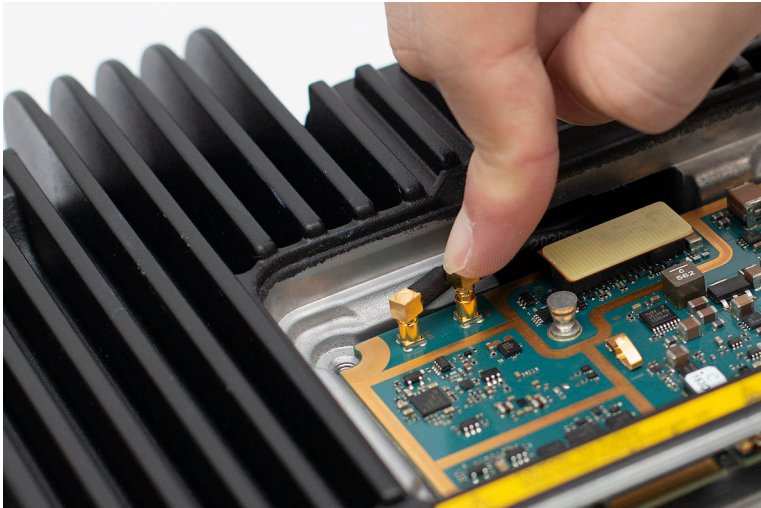
17. Install the accessory flex connector onto the controller board connector. Press down the flex backer to ensure proper connection.

Figure 98: Installing Accessory Flex Connector to the Controller Board



18. Install the GPS and Wi-Fi MMCX connector to the controller board. Ensure that the GPS and Wi-Fi cable is aligned in the GPS and Wi-Fi cable retention channel. Firmly press down the GPS and Wi-Fi MMCX connector to snap the connector into place. Press the cable down into the chassis pinch point. Do not press or pull the cable as damage may occur.

Figure 99: Installing GPS and Wi-Fi Connector to the Controller Board



19. Inspect and install the bottom cover seal onto the bottom cover. Ensure to correctly align the bottom cover seal tab to the bottom cover.

Figure 100: Inspecting and installing Bottom Cover Seal onto the Bottom Cover



No.	Description
1	Controller Cover Seal Tab

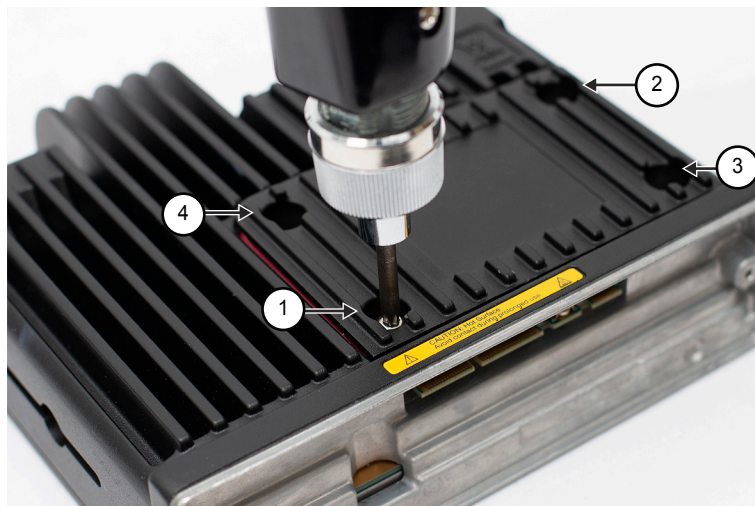
20. Place the bottom cover onto the chassis. Ensure that the bottom cover is properly aligned with the chassis. The bottom cover and chassis can be compressed together to squeeze seal into place.

Figure 101: Placing Controller Cover on the Chassis



21. Inspect the sealing washers on the four (4) bottom cover screws, and install the screws onto the bottom cover. Torque the bottom cover screws to 30 lbf-in, following the numbered sequence shown in the following figure, to ensure that the bottom cover is seated properly. Repeat the torque order sequence at least twice.

Figure 102: Placing the Controller Cover Screws



22. Once the bottom cover is fully installed, check the interface between the bottom cover and the chassis to ensure that the bottom cover seal is not pinched.
23. Attach the control head/TIB flex edge card connector to the edge card as described in [Reassembling the O2 Control Head on page 149](#) for O2 Control Head, [Reassembling the O7 Control Head on page 153](#) for O7 Control Head, and [TIB Reassembly](#) for TIB. Ensure to properly align the edge card connector to the exposed edge card.

8.1.3.2

Reassembling the O2 Control Head

Procedure:

1. Grasp the handle on the transceiver end of the transceiver flex and plug the flex into the 50-pin connector on the side of the main board.

2. Align the I-seal with the back housing assembly, and push the I-seal into place.
3. Align the back housing assembly with the transceiver, thread the flex through the back housing assembly, and push the back housing assembly into place.
4. Secure the back housing assembly to the transceiver with two new transceiver screws using the T10 torx bit. Apply 13 in. lbs. of torque for each screw. Simultaneously, firmly press down on the center of the back housing to provide sufficient compression to the I-seal during assembly.

Figure 103: Installing the Back Housing Assembly onto the Transceiver



5. Reinstall the transceiver flex onto the front housing assembly or TIB flex onto the TIB connector.

Figure 104: Installing the Transceiver Flex onto the Front Housing Assembly



6. Attach the front housing assembly to the back housing assembly.

Figure 105: Attaching the Front Housing Assembly to the Back Housing Assembly



7. Secure the front housing assembly to the back housing assembly with four new control head screws using the T20 torx bit. Apply 9 in. lbs. torque for each screw.

Figure 106: Attaching the Control Head Screws



8.1.3.3

Reassembling the O5 Control Head

Procedure:

1. Attach the control head/TIB flex edge card connector to the edge card. Be sure to properly align the edge card connector to the exposed edge card.

Figure 107: Installing Flex into the Controller PCB



2. Install the control head/TIB flex to the control head/TIB. Be sure to properly align the connectors.

Figure 108: Installing Control Head/TIB Flex to the Control Head/TIB



3. Align the control head/TIB to the front of the chassis using the frame seal. Install two (2) control head/TIB screws. Be sure the control head/TIB screws each have one (1) washer and one (1) seal installed. Torque down the control head/TIB screws to 8-10 in-lbf.

Figure 109: Aligning Control Head/TIB Front of Chassis, and Installing the Control Head/TIB Screws



8.1.3.4

Reassembling the O7 Control Head

Procedure:

1. Reinstall the transceiver flex onto the control head or TIB flex onto the TIB connector.

Figure 110: Installing the Transceiver Flex onto the Control Head



2. Align the I-seal with the control head and push the I-seal into place.



NOTE: Be careful not to damage the transceiver flex when pushing the I-seal into place.

Figure 111: Attaching the I-seal to the Control Head



3. Grasp the handle at the end of the transceiver flex and plug the flex into the 50-pin connector on the main board side.

Figure 112: Attaching the Control Head to the Transceiver



4. Align the control head with the transceiver and push the control head into place on the transceiver.
5. Secure the control head to the transceiver with two new transceiver screws using a T10 torx bit. Apply 9 in/lbs. torque for each screw.

Figure 113: Attaching the Transceiver Screws



8.1.3.5

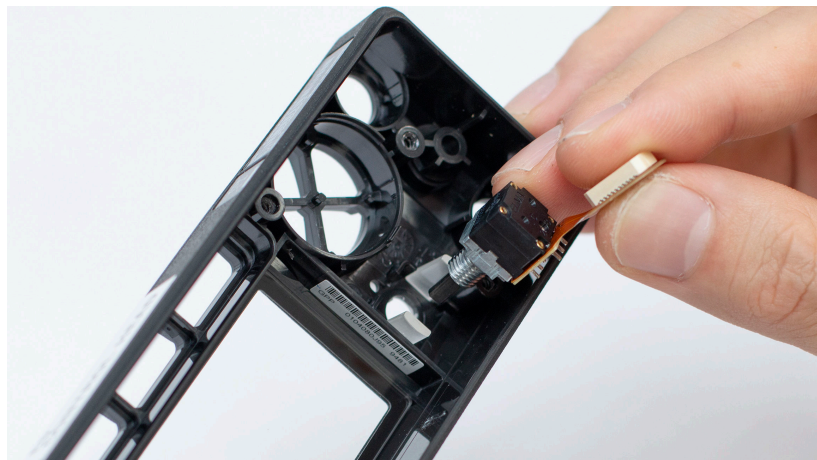
Reassembling the E5 Control Head

 **NOTE:** Bracketed numbers are identical to item numbers shown in [E5 Control Head Exploded View](#) and [Parts List](#) on page 200.

Procedure:

1. To reassemble, ensure that the front housing is clean from any dust or debris.
2. Insert the volume assembly potentiometer and the frequency assembly switch on the front housing.

Figure 114: Volume Assembly Potentiometer

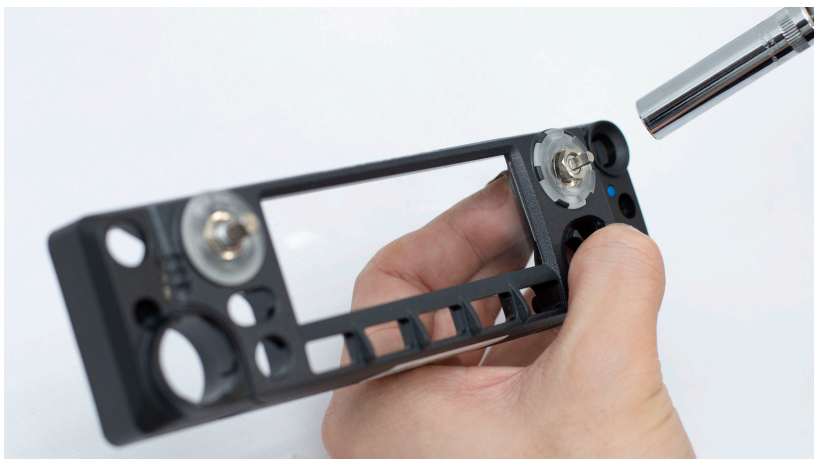


3. Place the 3 Wave washers and using a hex nut driver, fasten the new encoder hex nut [torque to 4.5 in. lbs.].

Figure 115: Installing 3 Wave Washers



Figure 116: Fastening Hex Nut



4. Slot in the torque washers and install both the volume and frequency knobs.

Figure 117: Torque Washer

