URC-200 (V2) LOS TRANSCEIVER
OPERATION AND MAINTENANCE MANUAL

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CAUTION

To comply with RF exposure requirements, a minimum separation distance of 20 cm (7.9 inches) is required between the antenna and all persons while the transceiver is transmitting. ManPack (backpack) and hand-carry users should not exceed 50% duty cycle, as this approaches RF hazard limits and reduces battery life.

CAUTION

Several conditions must be observed when using the UVU-100 LOS antenna mounted on the transceiver's front panel, as serious damage to the transceiver may result if high RF power is allowed to leak into the interior of the transceiver directly from the antenna.

1. Transmit ONLY with the cover of the transceiver securely fastened in place.

2. Use ONLY vendor supplied power supplies, such as the RF shielded battery case (UBC-100) or power supply (UAC-100).

3. Use ONLY tempest approved shielded cables with the REMOTE connector.

CAUTION

When performing a self-calibration, the radio antenna port(s) must be attached directly to a good 50 ohm load(s). BNC type loads are acceptable. Use of a Type N to BNC adapter is recommended on the 30-90MHz antenna port (if present). The use of attenuators (instead of 50-ohm loads) or cables between load and antenna port can lead to calibration errors if there are strong RF signals present. Failure to follow the above procedure can result in severely degraded performance.

CAUTION

DO NOT attempt to change the operating frequency while the transmitter is keyed on. Although the radio set will not be damaged, the radiated frequency will be uncontrolled during tuning and can cause unnecessary interference to other radio systems.

CAUTION

DO NOT install the LOS antenna on the transceiver during testing in the transmit mode with (1) the cover removed or (2) the transceiver powered from an external power supply via test leads that are unshielded. RF from the antenna can radiate into the transceiver, circumvent the protection loops, and cause severe damage to the transmitter circuits.

WARNING

DO NOT THROW BATTERIES IN THE TRASH

Dispose of all used batteries in accordance with all manufacturer, Federal, State and local laws and regulations.

Improper handling, reverse-current operation or high environmental temperatures may cause internally generated heat, fire, or toxic materials and gasses to be released from the battery.

The following precautions must be strictly observed to prevent injury to personnel or damage to equipment:

- DO NOT heat, incinerate, crush, puncture, disassemble or mutilate the batteries.
- DO NOT recharge primary (Non- rechargeable) batteries.
- DO NOT store in equipment during periods of non-use for more than 30 days.
- DO follow all safety instructions that come with the batteries or printed on them.
- TURN OFF the equipment immediately if you (1) detect that the battery compartment is becoming unduly hot, (2) hear battery cells venting (hissing), or (3) smell irritating sulfur dioxide gas. Remove the battery only after it is cool (after 30 to 60 minutes), and dispose of it by following approved procedures.

1.0 INTRODUCTION

This manual provides operation and maintenance instructions for the URC-200 (V2) Radio Set, part number 01-P36744M003, shown in Figure 1. The radio set is a lightweight VHF/UHF transceiver providing AM/FM transmission and reception of non-secure voice or data in the frequency bands used in maritime, land, mobile and tactical line-of sight communications, as well as military and civilian air traffic control operations. Secure communications are achieved with an appropriate external encryption device and with the transceiver in the data (Cipher Text) mode.

NOTE

The URC-200 (V2) is FCC certified in the 115 – 149.995 (AM) and 115 – 173.995 (FM) bands.

1. The URC-200 (V2) transceiver is to be tuned only to those frequencies that the transceiver user, by law, is permitted to use.

2. Operation and tuning the transceiver should be restricted to those users who are knowledgeable about which frequencies are authorized for use.

3. Transceiver operation on unauthorized frequencies is a violation of the law.

4. The capabilities of this transceiver allow users the freedom for authorized personnel to easily tune the transceiver. This allows the transceiver to work with other communication systems within the band, if the transceiver's tuned frequencies are permitted by regulation.

1.1 Purpose and Functions

The URC-200 (V2) VHF/UHF Transceiver is a lightweight, tactical, Line-Of-Sight (LOS) transceiver that provides AM and FM communication of nonsecure voice or data. It is suitable for ManPack, vehicular, or fixed station applications. The transceiver is compatible with other AM or FM transceivers operating in the same VHF and UHF frequency ranges.

- In the AM mode the VHF frequency range is 115 to 149.9950 MHz
- In the FM mode the VHF frequency range is 115 to 173.9950 MHz
- In both the AM and FM modes the UHF frequency range is 225 to 399.9950 MHz

The transceiver has standard tuning increments of 25 kHz, 12.5 kHz and 5 kHz with a channel spacing as detailed in Table 1. The transceiver is capable of transmitting and receiving analog Plain Text (PT) voice and digital Cipher Text (CT) voice or data. Achieve secure communications with an appropriate external encryption device and the transceiver in the data (CT) mode. The URC-200 (V2) operates in most weather conditions and can be remote controlled.

Three options are available. Refer to Paragraph 4.7 for a full description of each option.

- A 30-90 MHz FM Low VHF option.
- An extended 400-420 MHz FM UHF option.
- An 8.33 kHz tuning increment and channel spacing option.

1.2 Features

The features offered by the transceiver include the following:

- Microprocessor controlled transceiver
- COMSEC compatibility. Achieve secure communications with an appropriate external encryption device and with the transceiver in the data [Cipher Text (CT)] mode
- Multi-band capability including civilian and military frequencies
- Easy access front panel controls
- Built-in speaker
- RS-232 remote control for all programmable functions
- Backlit display and keypad
- Ten preset memory channels with fully programmable frequencies, including transmit/receive offsets and AM/FM selection
- Self-calibrating varactor-tuned receiver front-end

1.3 Performance Characteristics

Table 1 identifies the URC-200 (V2) performance characteristics (without 30-90 or 400 MHz options).

Table 1 - Performance Characteristics

Standard Test Conditions: 28VDC Input, +25°C

Characteristics	Specifications
General	
Frequency Range	VHF - (FM) 115 to 173.995 MHz (AM) 115 to 149.995 MHz. UHF - (FM) 225 to 399.995 MHz (AM) 225 to 399.995 MHz.
Tuning Increments	25 kHz 12.5 kHz and 5 kHz (8.33 KHz Optional)
Channel Spacing	25 kHz (8.33 KHz Optional)
Stability	±1 ppm
Preset Channels	10 transmit and 10 receive preset channels.
Modulation	AM or FM
Power	
Operating Voltage	+22 to +34 VDC
Current	3.5 Amps Maximum

Table 1 – Performance Characteristics (Continued)

Standard Test Conditions: 28VDC Input, +25℃

Characteristics	Specifications
Estimated Battery Life (2 Batteries)	Hours, based on 9:1 ratio receive to transmit.
BA-5390/U	30
BA-5590B/U	23
BB-390A/U	11
BB-590/U	7
BB-2590/U	19
Operating Modes	
Plain Text (PT)	AM or FM
Cipher Text (CT)	AM or FM
T-R	Relay mode, each of 10 preset channels may have separate receive and transmit frequencies.
Beacon	Transmit an emergency audio sweep tone on any selected frequency.
Scan	Scan up to 10 channels.
Bandwidth	
IF Selectivity	PT - ±9.5 kHz, 6 dB down CT - ±15 kHz, 6 dB down
Audio Response	PT - 300 to 3000 Hz. (+2, -4 dB) CT - 30 Hz to 10.24 kHz. (+2, -4 dB)
Receiver Characteristics	
Sensitivity (10 dB SINAD)	
AM-CT	≤ -105 dBm (1.3μV), 16 kb/sec with 70% modulation
AM-PT	≤ -103.5 dBm (1.5μV), 1 kHz modulation at 30%
FM-CT	≤ -107 dBm (1.0μV), 16 kb/sec with ±5.6 kHz deviation
FM-PT	≤ -114 dBm (0.4μV), 1 kHz modulation with ±6.5 kHz deviation
Input Impedance	50Ω nominal
RF Signal Level at the Antenna Port	FM - No Signal to +25 dBm No signal to 315 mW (typical) AM - No Signal to 0 dBm No signal to 1.0 mW (typical) FM or AM - +27 dBm (500 mW) maximum for short durations without damage.
Image Response	80 dB (typical)
Spurious Response	80 dB (typical)
Squelch	Manual adjust, Carrier-to-noise ratio squelch, changing to carrier-level squelch at stronger signal levels.
Squelch Range	-110 dBm (0.7μV) to -80 dBm (22.3μV) nominal.
Distortion	AM - 10% Max., RF = -33dBm (5 mV), 1 kHz @ 85% AM Modulation FM - 10% Max., RF = -33dBm (5 mV), 1 kHz @ ±6.5 kHz Modulation
Adjacent Channel Rejection	25 kHz: 35dB typical 8.33 kHz: 45dB typical (ECS-8 option only.)

Transmitter Characteristics

High Power Output Mode	*Tolerance*	*Expressed in Watts Avg.*	*Expressed in dBm Avg.*	*Expressed in Watts CW*	*Expressed in dBm CW*
AM (at 80% AM PT ±5%)	Maximum (+2 dBm)	15.85 Watts	42 dBm	12.01 Watts	40.8 dBm
	Typical	10 Watts	40 dBm	7.58 Watts	38.8 dBm
	Minimum (-2 dBm)	6.31 Watts	38 dBm	4.78 Watts	36.8 dBm

Low Power Output Mode	*Tolerance*	*Expressed in Watts Avg.*	*Expressed in dBm Avg.*	*Expressed in Watts CW*	*Expressed in dBm CW*
AM (at 80% AM PT ±5%)	Maximum (+2 dBm)	7.94 Watts	39 dBm	6.02 Watts	37.8 dBm
	Typical	5 Watts	37 dBm	3.79 Watts	35.8 dBm
	Minimum (-2 dBm)	3.16 Watts	35 dBm	2.39 Watts	33.8 dBm

High Power Output Mode	*Tolerance*	*Expressed in Watts*	*Expressed in dBm*
FM	Maximum (+2 dBm)	15.85 Watts	42 dBm
	Typical	10 Watts	40 dBm
	Minimum (-2 dBm)	6.31 Watts	38 dBm
Medium Power Output Mode	*Tolerance*	*Expressed in Watts*	*Expressed in dBm*
FM	Maximum (+2 dBm)	7.94 Watts	39 dBm
	Typical	5 Watts	37 dBm
	Minimum (-2 dBm)	3.16 Watts	35 dBm
Low Power Output Mode	*Tolerance*	*Expressed in Watts*	*Expressed in dBm*
FM	Nominal	0.1 Watts or 100 mW	20 dBm

Modulation	
AM (PT)	60% to 90% at 1 kHz. : 15% Max. @ 80% AM
AM (CT)	70% nominal at 8 kHz. : Distortion 15% Max. @ 70% AM
FM (PT)	
VHF	±3.3 kHz at 1 kHz. : Distortion 10% Max.
UHF	±6.5 kHz at 1 kHz. : Distortion 10% Max.

Transmitter Characteristics (Cont.)

Modulation (Cont.)	
FM (CT)	
VHF	±5.0 kHz at 1 kHz.
UHF	±5.6 kHz at 1 kHz.
Spurious Outputs	>=70 dB below CW carrier (typical)
Harmonic Outputs	>=53 dB below CW carrier
Output Impedance	50Ω nominal
Protection	No damage from open or short circuits at the antenna port. Gradual transmit power reduction for high VSWR loads.
Transmit Duty Cycle when in the Hi Power Output Mode (10 W)	25 degrees C: continuous 55 degrees C: 9:1 receive to transmit duty cycle
Adjacent Channel Power	25 kHz: 50 dB typical 8.33 kHz 40 dB typical (ECS-8 option only.)

1.3.1 Options

Three options are available for purchase to extend the URC-200 (V2) frequency range or change the tuning increments or channel spacing. They are the 30-90 MHz, 400-420 MHz, and ECS-8, 8.33 kHz options. See Paragraph 4.7 for a detailed description of all options.

1.3.1.1 EBN-30, 30-90 MHz Option

Part Number 01-P37200N001. This option adds frequency range of 30-90 MHz to the URC-200 (V2). This option is for FM only in both receive and transmit modes. Plain or cipher text types of signals may be used. See Paragraph 4.7.1 for a detailed description of this option.

1.3.1.2 EBN-400, 400-420 MHz Option

Part Number 01-P39234N001. This option extends the UHF frequency range of the URC-200 (V2) to 420 MHz. In 400-420 MHz region this option is for FM only in both receive and transmit modes. Both plain text and cipher text signals may be used in 400 to 420 MHz frequency range. See Paragraph 4.7.2 for a detailed description of this option.

1.3.1.3 ECS-8, 8.33 kHz Option

Part Number 01-P42311K001. This option allows 8.33 kHz tuning in the VHF/UHF bands, and user selectable 8.33 kHz receive channel spacing in the 117.9750 to 136.9750 MHz band when in AM PT mode. See Paragraph 4.7.3 for a detailed description of this option.

It also allows the operator to place the radio into Aviation Mode, which restricts the operating frequency range from 117.9750 to 136.9750 MHz, with tuning increments of 25 and 8.33 kHz. A channel spacing of 25 or 8.33 kHz (receive only) is assigned automatically by channel entry. The URC-200 aviation mode channel entry is based on ICAO Annex 10 to the Convention on International Civil Aviation, Volume V. Refer to Table 18, Aviation Mode Frequency Chart.

Aviation Mode also restricts modulation to AM, and allows PT only, disabling the CT feature of the radio.

1.3.2 Description of the URC-200 (V2) Transceiver

The basic URC-200 (V2) Transceiver system consists of an antenna, battery box, transceiver and handset, as illustrated in Figure 1. See Table 5 for a list of items furnished.

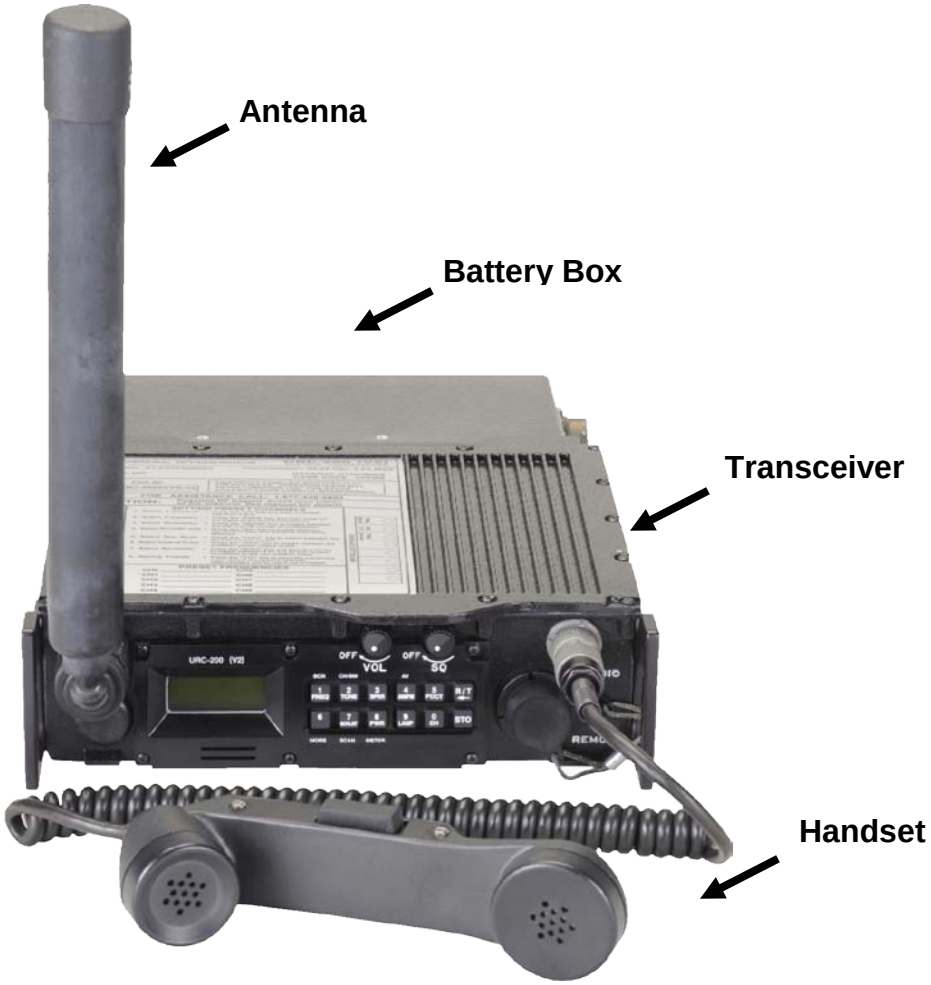


Figure 1 - URC-200 (V2) Transceiver Radio

1.3.2.1 Transceiver - URC-200 (V2)

The transceiver is contained in cast-aluminum housing with all operating controls and connectors located on the front panel. The battery connectors, for two batteries, are located on the rear panel. The front panel components are protected by handles on the sides, and an extension on the top cover protects the volume and squelch controls.

1.3.2.2 Antenna - UVU-100

CAUTION

To comply with RF exposure requirements, a minimum separation distance of 20 cm (7.9 inches) is required between the antenna and all persons while the transceiver is transmitting. ManPack (backpack) and hand-carry users should not exceed 50% duty cycle, as this approaches RF hazard limits and reduces battery life.

The antenna is a 12-inch long, broadband, VHF/UHF vertically polarized antenna that is attached to the front panel antenna connector. The antenna connector is a BNC type connector, surrounded by a threaded sleeve. The antenna is screwed onto this sleeve.

1.3.2.3 Battery Case - UBC-100

The battery case holds two batteries. When replacing batteries, always use two of the same part number. When replacing non-rechargeable batteries, always replace both. Refer to Table 2 for compatible battery types, part numbers, and reference documents.

Table 2 - Battery Types

Part Number	Composition	Type	Reference
BA-5390/U	Lithium Manganese Dioxide	Non-rechargeable	MIL-PRF-49471
BA-5590B/U	Lithium Sulfur Dioxide	Non-rechargeable	MIL-PRF-49471
BB-390A/U	Nickel Metal Hydride	Rechargeable	MIL-PRF-32052
BB-590/U	Nickel Cadmium	Rechargeable	MIL-PRF-32052
BB-2590/U	Lithium Ion	Rechargeable	MIL-PRF-32052

WARNING

DO NOT THROW BATTERIES IN THE TRASH

Dispose of all used batteries in accordance with all manufacturer, Federal, State and local laws and regulations.

Improper handling, reverse-current operation or high environmental temperatures may cause internally generated heat, fire, or toxic materials and gasses to be released from the battery.

The following precautions must be strictly observed to prevent injury to personnel or damage to equipment:

- DO NOT heat, incinerate, crush, puncture, disassemble or mutilate the batteries.
- DO NOT recharge primary (Non- rechargeable) batteries.
- DO NOT store in equipment during periods of non-use for more than 30 days.
- DO follow all safety instructions that come with the batteries or printed on them.
- TURN OFF the equipment immediately if you (1) detect that the battery compartment is becoming unduly hot, (2) hear battery cells venting (hissing), or (3) smell irritating sulfur dioxide gas. Remove the battery only after it is cool (after 30 to 60 minutes), and dispose of it by following approved procedures.

Quick release latches enable the battery case to be securely attached to the unit for operation. When the battery case is attached to the unit, the battery case is watertight. The case contains a vent to permit venting of battery gasses.

1.3.2.4 Handset - H-189/GR

The handset contains a microphone and receiver for transmitting and receiving audio signals. A retractable cord with a 5-pin connector attaches to the transceiver front panel. A push-to-talk switch is located in the handset handle.

The URC-200 (V2) outline dimensions are shown in Figure 2. The equipment weight and dimensions are shown in Table 3.

Table 3 - Equipment Weight and Dimensions

Characteristics	Specification		

Transceiver

Height	3.13 inches
Width	10.8 inches
Depth	9.75 inches (including handles)
Weight (approximate)	9.2 pounds (10.4 pounds with 30-90 MHz option)

Battery Case

Height	3.13 inches
Width	10.80 inches
Depth	5.20 inches
Weight (approximate)	1.1 pounds without batteries 6.9 lbs with two BA-5390/U batteries 5.5 lbs with two BA-5590B/U batteries 9.1 lbs with two BB-390A/U batteries 6.9 lbs with two BB-590/U batteries 7.4 lbs with two BB-2590/U batteries

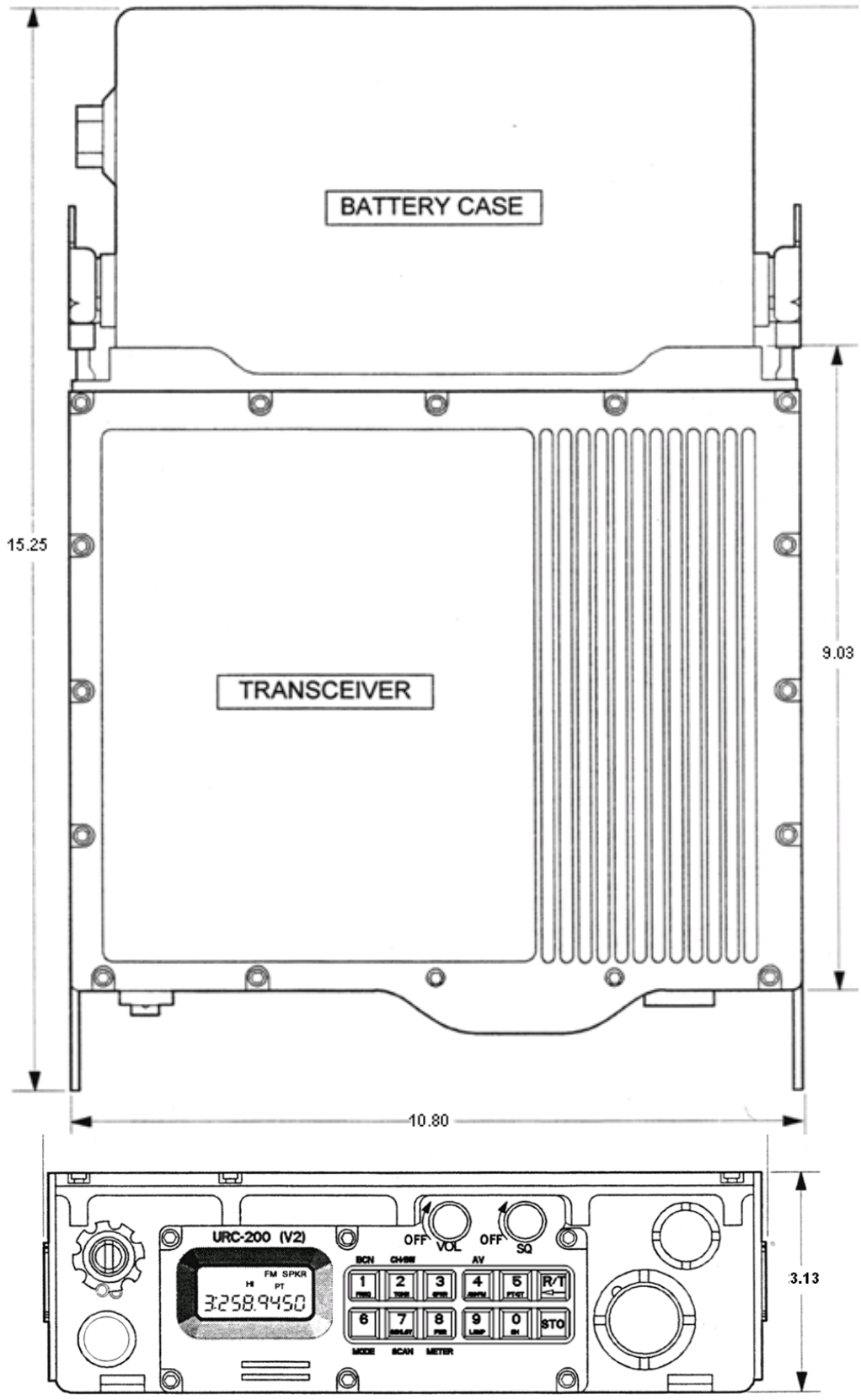


Figure 2 - Outline Dimensions

1.4 Power Requirements

The power required to operate the URC-200 (V2) is +28 VDC nominal applied to the DC Input port J1, with the following characteristics:

- Operating Voltage range - +22 to +34 VDC
- Current 3.5 Amps Maximum

1.5 Environmental Operation and Storage

Environmental characteristics of the URC-200 (V2) are shown in Table 4.

Table 4 - Environmental Characteristics

Characteristics	Specification
Temperature (Operating)	-20° C to +55° C
Altitude (Operating)	15,000 feet, MSL
Altitude (Storage)	50,000 feet, MSL
Humidity (Operating)	95% relative non-condensing
Temperature (Storage)	-50° C to +70° C
Humidity (Storage)	95% relative non-condensing

1.6 List of Items Furnished

Table 5 - List of Items Furnished

Quantity	Model	Description	Part Number
1	URC-200 (V2)	Receiver-Transmitter	01-P36744M003
1	UVU-100	Antenna VHF/UHF	85-P35988M001
1	PTSH-110	Handset	01-P04535L001
1	UBC-100	Battery Box	01-P36751M001

1.7 List of Items Not Furnished

A variety of equipment and accessories are compatible with the URC-200 (V2) transceiver but are not furnished with it. The following paragraphs describe various accessories that can be attached and/or used with the URC-200 (V2) transceiver. Unless otherwise noted, they may be selected and purchased as required from General Dynamics C4 Systems. Other accessories are also available. Please contact General Dynamics C4 Systems or refer to our website at http://www.gdc4s.com for more information.

NOTE

The list of accessories offered by General Dynamics C4 Systems (GDC4S) may change over time. Please contact GDC4S or refer to our website at **http://www.gdc4s.com** for the most up-to-date product information.

Power Supplies

- UAC-100 Power Supply, AC Input

  The UAC-100 power supply powers the URC-200 (V2) transceiver from a 110/220-VAC source.

- UDD-100A Power Supply, DC Input

  The UDD-100A power supply powers the URC-200 (V2) transceiver from a 12 VDC source.

- UAC-350 AC Power Supply

  The UAC-350 power supply powers the URC-200 (V2) transceiver and the UPA-50 or UPA-55/55H power amplifiers from a 110/220-VAC source.

- UAD-100A Uninterruptible Power Supply

  Intended for “jerk-and-run” applications, the UAD-100A power supply operates from a110/220-VAC source but includes two batteries that power the radio when disconnected from the source.

Battery Chargers

- UBS-110 Battery Charger

  The UBS-110 is a commercial grade battery charger. It charges one or two BB-390/U or BB-590/U batteries.

- LSBC-102(V)1 Battery Charger

  The LSBC-102(V)1 is a ruggedized, military grade battery charger. It charges one or two BB-390/U or BB-590/U batteries at once.

Interface Boxes

- UIB-100 Power Interface Box

  The UIB-100 is a power distribution box that attaches to the rear of the URC-200 (V2) transceiver. It provides the mechanical connections to distribute unfiltered 28VDC from a power supply or other source to the transceiver and the UPA-55H power amplifier.

- UFB-100 Filtered Power Interface Box

  The UFB-100 is a power distribution box with an internal filter. It attaches to the rear of the URC-200 (V2) transceiver. It provides the mechanical connections to distribute filtered 28VDC from a power supply or other source to the transceiver. It also provides unfiltered DC to the UPA-55 and the UPA-55H power amplifier.

- UBC-100 Battery Box

  The UBC-100 attaches batteries to the rear of the URC-200 (V2) Transceiver

Shock Trays and Mounts

- UST-100 Shock Tray

  The UST-100 is used to mount the URC-200 (V2) Transceiver and power interface/filter box in a vehicular or other setting where shock and vibration damping is required.

- UST-200 Shock Tray Mounts

  The UST-200 is used to mount the URC-200 (V2) Transceiver in a 10 watt or 30/50 watt system configuration in a vehicular or other setting where shock and vibration damping is required.

- URM-100 Rack Mount

  The URM-100 is used to mount the URC-200 (V2) Transceiver in a 10 watt or 30/50 watt system configuration in a 19” rack.

Cables

In addition to the cables shown below, other cables for data and audio connections, remote control, power, and RF/Antenna connections are available. Contact General Dynamics Customer Service for more information.

- LSCA-103A and LSCA-110 Cable Assemblies

  The LSCA-103A and LSCA-110 are used to connect to the remote PTSH-104 Amplified Speaker assembly.

- PTKY-103 CRYPTO Cable Assembly

  The PTKY-103 is a shielded, three-foot long water-tight cable assembly used to connect the transceiver to a COMSEC device for secure operation.

Remote Control Units

Two remote control units are available. The UEC-120 controls one transceiver, and the UEC-220 can control one or two transceivers.

RF Power Amplifier

Two versions of the RF power amplifier are available: the UPA-55 and UPA-55H.

The UPA-55 provides up to 50 Watts average power at 90% modulation (35.6 Watts CW) RF AM power and 50 Watts FM output power with harmonics ≤ -60 dBc AM or FM.

The UPA-55H provides up to 50 Watts RF FM and 30 Watts average power at 90% modulation (21.4 Watts CW) AM output power with harmonics ≤ -60 dBc FM. ≤ -80 dBc AM.

Both versions operate over the VHF frequency range of 115 to 174 MHz, and the UHF frequency range of 225 to 420 MHz (FM mode, AM mode up to 400MHz).

Antennas

In addition to the antennas shown in this manual, a variety of single, dual and tri-band antennas are available for operation with the URC-200 (V2) Transceiver. Applications include mobile, ManPack and base station installations. Mounting brackets are supplied in some cases. Contact General Dynamics Customer Service for more information.

- UVL-100 ManPack antenna.
  Antenna covers 30-110 MHz.

- UVL-150 HF rugged spring-loaded antenna for vehicular applications.
  Antenna covers 30-90MHz.

- UVU-115 15" Whip Antenna for vehicular applications.
  Antenna covers 115MHz - 420 MHz.

- UVU-130 VHF/UHF dual band high gain rugged whip antenna for base station applications.
  Antenna covers 115MHz - 420 MHz.

- UVU-200 VHF/UHF Antenna for base station applications.
  Antenna covers 115-420Mz.

- UVU-300 LVHF & VHF/UHF antenna for base station applications.
  Antenna covers 30-90MHz and 115 to 420 MHz.

Other Accessories

Other accessories include (but are not limited to) the following:

- **UCB-200, UCB-300, and UCB-500 Carrying Bag**

  The convenient canvas carrying case is available in woodland camouflage, black, and desert camouflage, respectively.

- **PTSH-104K Remote Speaker Kit**

  Used to provide remote loudspeaker audio.

1.8 Tools and Test Equipment

No special tools or test equipment are required for installation or operation of the URC-200 (V2) in a standalone mode. However, common hand tools may be required when installing the transceiver into a rack or mobile mount.

1.9 Shipping and Handling Precautions

Care should be taken not to touch the connector pins on the URC-200 (V2) connectors. Touching the connector pins may cause damage to the pins or ESD damage to the device.

Use the original shipping container and packing material to re-pack the hardware for shipping. To pack the hardware, re-use the protective packing material. If the original packing materials are not available, pack hardware in a cardboard container surrounded on all sides by rigid foam so it does not shift in the container. Tape the container closed with strapping or package tape.

2.0 PREPARATION FOR USE AND INSTALLATION

This section provides instructions and procedures for unpacking, inspection, assembly and installation of the URC-200 (V2).

2.1 Unpacking

To unpack, open the outer shipping container and remove the packing material. Inspect the hardware for damage. Verify contents of the shipping container with Paragraph 1.6 and the packing list to ensure all materials are included. Retain the packing material and the shipping container for possible future use.

2.2 Installation

This section contains information necessary for preparing the URC-200 (V2) Transceiver for use. Included is information on installation of the battery, handset and antenna.

Install the batteries into the battery pack. Either one or two batteries may be installed into the battery pack. If using two batteries, always use two batteries of the same part number.

The following batteries may be used in the transceiver:

BA-5390/U	Lithium Manganese Dioxide	Non-rechargeable
BA-5590B/U	Lithium Sulfur Dioxide	Non-rechargeable
BB-390A/U	Nickel Metal Hydride	Rechargeable
BB-490/U	Lead Acid	Rechargeable
BB-590/U	Nickel Cadmium	Rechargeable
BB-2590/U	Lithium Ion	Rechargeable

Orient the batteries as shown in Figure 3. The battery power connectors must be oriented as shown or the battery pack will not install onto the transceiver.

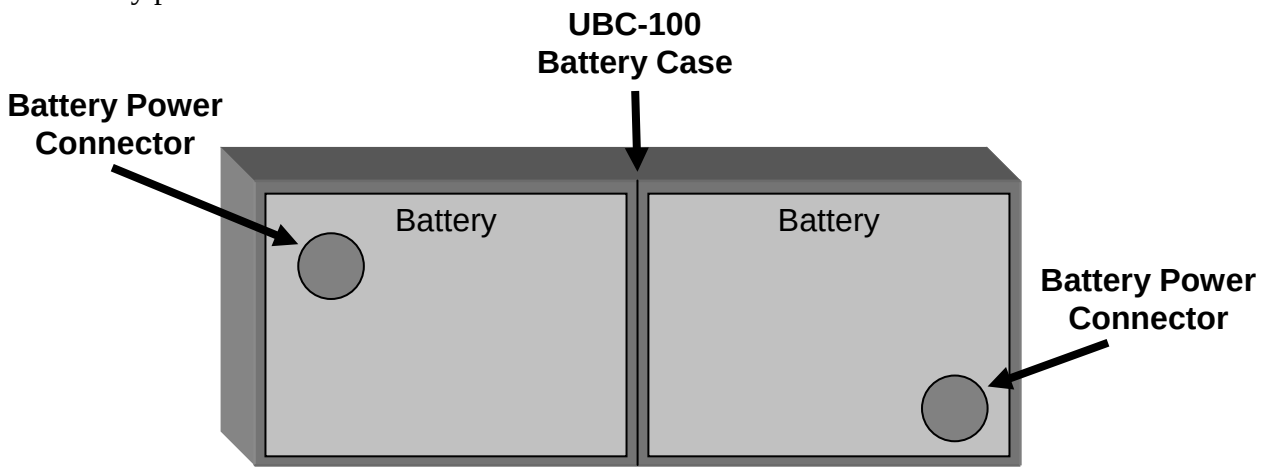


Figure 3 - Battery Case

Install the UBC-100 to the rear of the Transceiver:

1. Ensure the transceiver is turned off by turning VOL/OFF control to OFF.
2. Set transceiver face down on the front panel handles as shown in Figure 4.

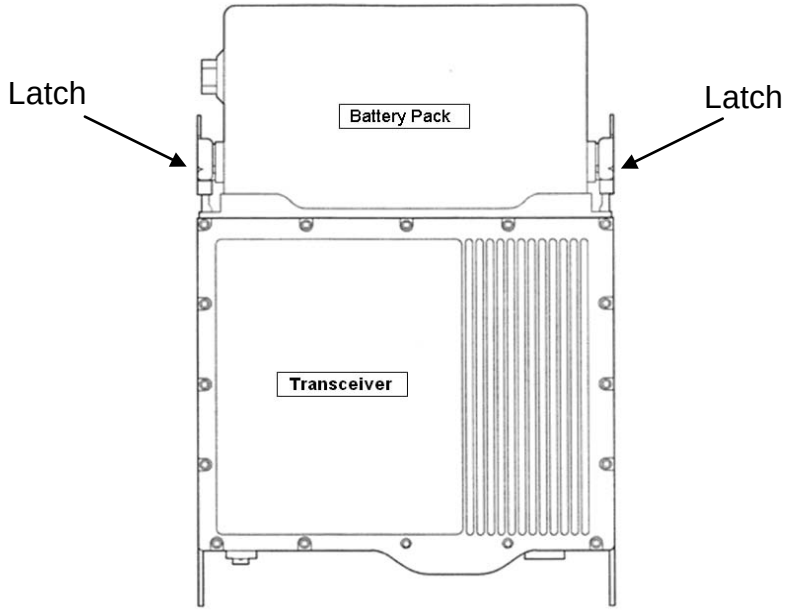


Figure 4 - Battery Pack Installation

3. Place the UBC-100 onto the rear skirt of the transceiver, fastening it into place with the two latches located on the side of the transceiver to secure the UIB-100 case into place.

To remove batteries from the battery pack:

1. Turn off the transceiver by turning VOL/OFF control to OFF.
2. Set transceiver face down on the front panel handles.
3. Undo the two latches, located on the side of the transceiver to unlatch the battery case from the transceiver.
4. Pull the battery case straight up and away from the transceiver.
5. Remove both used batteries from the transceiver.

WARNING

DO NOT THROW BATTERIES IN THE TRASH

Dispose of all used batteries in accordance with all manufacturer, Federal, State and local laws and regulations.

Improper handling, reverse-current operation or high environmental temperatures may cause internally generated heat, fire, or toxic materials and gasses to be released from the battery.

The following precautions must be strictly observed to prevent injury to personnel or damage to equipment:

- DO NOT heat, incinerate, crush, puncture, disassemble or mutilate the batteries.
- DO NOT recharge primary (Non- rechargeable) batteries.
- DO NOT store in equipment during periods of non-use for more than 30 days.
- DO follow all safety instructions that come with the batteries or printed on them.
- TURN OFF the equipment immediately if you (1) detect that the battery compartment is becoming unduly hot, (2) hear battery cells venting (hissing), or (3) smell irritating sulfur dioxide gas. Remove the battery only after it is cool (after 30 to 60 minutes), and dispose of it by following approved procedures.

To replace batteries and install battery pack onto the transceiver:

1. Ensure the transceiver is turned off by turning VOL/OFF control to OFF.
2. Set transceiver face down on the front panel handles as shown in Figure 4.
3. Place the battery pack onto the rear skirt of the transceiver, fastening it into place with the two latches located on the side of the transceiver to secure the UIB-100 case into place.

2.2.1 Attaching the Handset

To attach the handset to the HDST connector, push the handset connector firmly into the mating connector on the transceiver and turn clockwise. The O-ring seal on the handset may require considerable force before it is possible to rotate the mating connector clockwise into a locked position.

2.2.2 Attaching the Antenna

Before attaching the UVU-100 LOS antenna to the transceiver, verify the ball and swivel joint at the mounting base of the antenna is free to swivel. If it is not free, then loosen the swivel clamp ring from the collar ring. These two rings are located at the antenna base.

With the ball and swivel joint free to swivel, screw the antenna to the ANT connector using only the collar ring. Exercise extreme care to prevent the threads on the collar ring from cross-threading with the threads on the ANT connector.

Set the antenna to desired position and tighten the swivel joint clamp ring against the collar ring.

Once the swivel joint clamp ring is tightened, DO NOT use the antenna as a lever to cinch the collar ring to the ANT connector.

CAUTION

Several conditions must be observed when using the UVU-100 LOS antenna mounted on the transceiver's front panel, as serious damage to the transceiver may result if high RF power is allowed to leak into the interior of the transceiver directly from the antenna.

1. Transmit ONLY with the cover of the transceiver securely fastened in place.

2. Use ONLY vendor supplied power supplies, such as the RF shielded battery case (UBC-100) or power supply (UAC-100).

3. Use ONLY tempest approved shielded cables with the REMOTE connector.

CAUTION

To comply with RF exposure requirements, a minimum separation distance of 20 cm (7.9 inches) is required between the antenna and all persons while the transceiver is transmitting. ManPack (backpack) and hand-carry users should not exceed 50% duty cycle, as this approaches RF hazard limits and reduces battery life.

2.2.3 Removing the Antenna

To remove the antenna from the transceiver, loosen the swivel clamp ring to allow the ball and swivel joint, at the antenna’s mounting base, to freely swivel. Then unscrew the collar ring from the ANT connector and remove the antenna. With the swivel joint clamp ring tightened, DO NOT use the antenna as a lever to loosen or remove the collar ring from the ANT connector.

2.2.4 Transceiver Placement and Antenna Sighting

The transceiver operates in the VHF and UHF frequency bands, and so uses Line-Of-Sight (LOS) frequencies. Therefore, placement of the transceiver and antenna sighting greatly affects operating range. The longest range is normally obtained when a direct LOS is maintained between the transceivers. Use of hilltop or tower locations will increase the LOS range. Location in valleys with intervening hills, behind buildings or in dense woods may reduce or prevent communications. If possible, avoid locations near electrical interference sources, such as power and telephone lines, radars, welders and electrical generators.

3.0 PRINCIPLES OF OPERATION

3.1 Transceiver Functional Description

The URC-200 Transceiver operates in VHF and UHF frequency bands in either AM or FM modes. Standard VHF band of frequencies in AM mode is 115 to 149.9950 MHz. In FM mode standard VHF band of frequencies is 115 to 173.9950 MHz. Standard UHF band of frequencies in both AM and FM modes is 225 to 399.9950 MHz. The URC-200 transmits and receives both plain text (PT) and encrypted voice or data messages (Cipher Text - CT). See Table 6 for operational frequency based dependencies.

There is also an optional software-enabled 400-420 MHz extended UHF FM-only mode, both PT and CT. Finally, there is a hardware-based Low VHF 30-90 MHz option, FM-mode only, both PT and CT.

Standard VHF/UHF band tuning increments are 5 kHz, 12.5 kHz, and 25 kHz. There is also a software-enabled 8.33 kHz tuning increment option available for the standard VHF/UHF bands . The 400-420 MHz option has tuning increments of 5 kHz, 12.5 kHz, and 25 kHz. The 30-90 MHz option only has 12.5 kHz and 25 kHz tuning increments.

Where the 8.33 kHz tuning increment option is available and enabled, there are two receive channel spacings (IF filter bandwidths) available in AM PT mode in the 117.975-136.975 MHz band (only): 8.33 kHz (narrowband) and 25 kHz (wideband). There are also two operating modes available under the 8.33 option AM PT scenario: normal and “Aviation” mode. The former follows the legacy URC-200 operation with the added capability of selectable channel spacing. The latter makes the radio an 8.33/25 kHz channel spacing-only transceiver, and follows the ICAO Annex 10 Volume 5 standard for entering and displaying channels. The channel spacing is auto-selected based on channel entered in Aviation mode and is not settable. The LCD display provides an Aviation mode indicator and bandwidth indicators for this purpose.

Normal and Aviation mode are selectable by holding down specific keys during power-up, with each mode applied “globally” to all channels, and maintained throughout power cycling, until de-selected. They are also remotely selectable while the radio is turned ON.

The radio employs transmit pre-emphasis and receive de-emphasis in FM PT mode in the 132-173.995 MHz and 400-420 MHz bands to improve overall signal-to-noise ratio, by correcting for signal magnitude distortion across the frequency band.

Table 6 - URC-200 (V2) Operational Frequency-Based Dependencies

	30-90 MHz[1]	115 - 173.995 MHz	225 - 399.995 MHz	400-420 MHz[1]
AM	N	Y[2]	Y	N
FM	Y	Y	Y	Y
PT	Y	Y	Y	Y
CT	Y	Y	Y	Y
Tone Squelch (150 Hz)	PT only (unless custom code used)	N	N	N
25 kHz Tuning	Y	Y	Y	Y
12.5 kHz Tuning	Y	Y (N in Aviation Mode)	Y (N in Aviation Mode)	Y
5 kHz Tuning	N	Y (N in Aviation Mode)	Y (N in Aviation Mode)	Y
8.33 kHz Tuning[1]	N	Y	Y	N
Selectable IF Filter[1,3] (AM PT)	N	Normal mode: Y Aviation: N (Auto) [4]	N	N
Pre/De-Emphasis (FM PT)	N	Y (132-173.995 MHz)	N	Y
FM RF Output Power	5W, 1W, or 0.15W	10W, 5W, or 0.1W	10W, 5W, or 0.1W	10W, 5W, or 0.1W
AM RF Output Power	NA	10W or 5W	10W or 5W	NA

[1] Indicates Option

[2] Radio operates over full band, but spec is guaranteed from 115 - 149.995 MHz only

[3] The 8.33 kHz filter option only applies to 117.975 – 136.975 MHz

[4] (Auto). Indicates that as you enter the frequency, an 8.33 or 25 kHz channel is selected and the correct filter is automatically selected, depending on the value entered.

The transmitter output power is 10 Watts maximum average power at 80% modulation (7.58 Watts CW power), but can also be set at 5 or 0.1 Watts for FM operation or 5 Watts average power at 80% modulation (3.79 Watts CW power) for AM operation. Transmitter output power is 5W, 1W, or 150mW in the optional 30-90 MHz band.

These and other operational frequency-based functions covered in this document are summarized in Table 1.

The URC-200 is a fully synthesized transceiver having a frequency stability of 1 part per million (ppm). Figure 5 shows a simplified block diagram of the base URC-200 Transceiver (i.e., without the 30-90 MHz option).

Since the 30-90 MHz option is, in effect, a separate transceiver, it is discussed in separate sections.

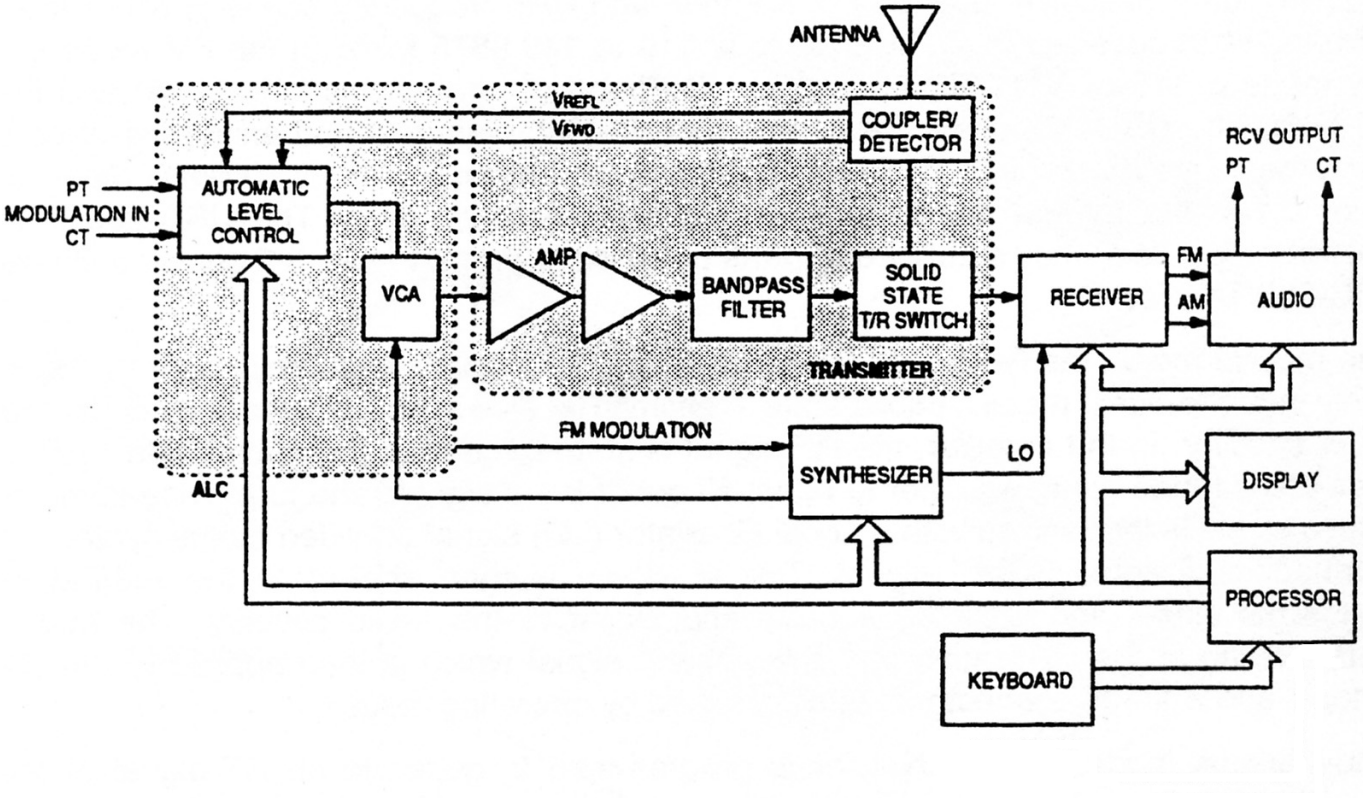


Figure 5 - Transceiver Simplified Functional Block Diagram

In the receive mode, the RF signal arrives at the antenna and passes through the coupler/detector which is used only in the transmit mode. A solid state Transmit/Receive switch connects the RF signal path to the receiver circuitry. In the receiver, the RF signal is first switched to the appropriate VHF or UHF preselector which uses a self-tuned bandpass filter to reject all out-of-band signals and provides some low noise signal amplification. The received signal then mixes with a Local Oscillator (LO) signal provided by the synthesizer to produce a 45.0 MHz Intermediate Frequency (IF) signal. This first IF signal s then filters and applies to the 2nd IF/Baseband circuit, which produces a 10.7 MHz IF using a 2nd LO of 55.7 MHz. An AM detector and FM limiter and discriminator then demodulate the signal and provide a baseband signal to the audio circuitry. The receiver uses a delayed Automatic Gain Control (AGC) scheme to adjust gain along the RF receive chain in order to maintain noise figure at low to medium signal levels. The audio circuitry provides appropriate filtering and amplification of the baseband signal that is then applied to the speaker and/or front panel handset and remote connectors, as determined by the operating mode.

In the transmit mode, the synthesizer is programmed to generate an RF signal at the desired transmit frequency. This RF signal is amplified and applied to a Voltage Controlled Attenuator (VCA) that is used to regulate the signal strength applied to the RF amplifier. The RF signal is amplified to the desired output power by the power amplifier and then filtered by a bandpass filter to reduce harmonic and spurious transmit signals. The RF signal then passes through a coupler/detector that senses the signal strength of the transmitted RF signal. The coupler/detector provides a control voltage to the Automatic Level Control (ALC) circuitry that then sets the appropriate attenuation level of the VCA. This closed loop approach allows the RF output power to

be controlled within 2 dB of nominal settings. The coupler/detector also senses reverse power to detect a high VSWR condition. When a high VSWR is detected, the coupler/detector provides a control voltage to the ALC that reduces the output power so that the RF amplifier is not damaged. For FM operation, the modulation signal is applied directly to the synthesizer and produces an FM modulated RF signal. For AM operation, the RF signal from the synthesizer is unmodulated and the modulation signal is applied to the VCA control voltage that produces an AM modulated signal.

All radio functions are controlled by the processor circuitry that accepts inputs either from the front panel keyboard or from a remote control unit connected to the remote connector. The processor uses a control bus to set the internal transceiver circuitry for appropriate operating modes as determined by the selection of VHF/UHF frequencies, AM/FM modulation, power settings, and receive or transmit operation. An internal power supply is used to accept an input power of +22 to +34 VDC and convert this input power to a filtered internal power source which provides +22 to +34 VDC (depending on the input power), plus regulated ±5 VDC, ±12 VDC, +20 VDC, +70 VDC voltages, and an external DC output limited to +30 VDC and 500mA for URC accessories and other external devices. The radio is capable of self-calibration. This is accomplished by routing the synthesizer to the preselector , where it is detected and calibrated.

3.2 Receiver Functional Description

Figure 6 shows a block diagram of the receiver. The received signal arrives at the antenna and is applied to the preselector that contains RF limiters to protect the receiver from high signal levels (for short durations to prevent damage) and provides RF filtering and low noise amplification for the RF signal. The filtering in the preselector is performed by varactor tuned bandpass filters tuned to the desired receive frequency by the Processor. The received RF signal is mixed with an LO signal from the Synthesizer to produce an IF signal at 45.0 MHz. The IF signal is amplified, wide or narrow bandpass filtered (25 kHz or 8.33 kHz channel), then amplified again before being applied to the 2nd IF/Baseband circuitry. The 2nd IF/Baseband circuitry translates the 45.0 MHz IF signal to 10.7 MHz IF using a 2nd LO frequency of 55.7 MHz and 10.7 MHz bandpass filter (wideband or AM PT VHF narrowband). For FM modulation, the circuit uses a limiter and discriminator to complete the demodulation of the signal to produce a baseband signal that is applied to the audio circuitry. For AM modulation, the 10.7 MHz IF is applied to an AM detector to demodulate the AM signal. The demodulated baseband signal is then applied to the audio circuitry.

The receiver uses a delayed Automatic Gain Control (AGC) scheme to adjust gain along the RF receive chain in order to maintain noise figure at low to medium signal levels. There are four total AGC-controlled points in the receive chain: (1) the voltage controlled attenuators (RF limiters) in the preselector; (2) an attenuator prior to the first 1st IF amplifier; (3) an attenuator prior to the second 1st IF amplifier; and, (4) the 2nd IF amplifier within the 2nd IF/Baseband circuitry. At low signal levels, maximum end-to-end receiver gain is desired. As signal levels increase, the AGC first decreases gain at the 2nd through 4th control points (which have minimal impact on total noise figure), and only decreases gain at the 1st control point (prior to the first low noise amplifier) when strong signals are present (since increased noise figure does not matter as much).

The baseband signal is amplified and applied to either the CT Data Filter or PT (Audio) Filter depending on the operating mode of the transceiver. The CT Filter is a 30 Hz to 10.24 kHz bandpass filter and the PT is a 300 Hz to 3 kHz bandpass filter. For CT operation, the signal is then

amplified and routed to the remote connector on the front panel. For PT operation, the audio signal is amplified and routed to the remote connector, the speaker, and the handset.

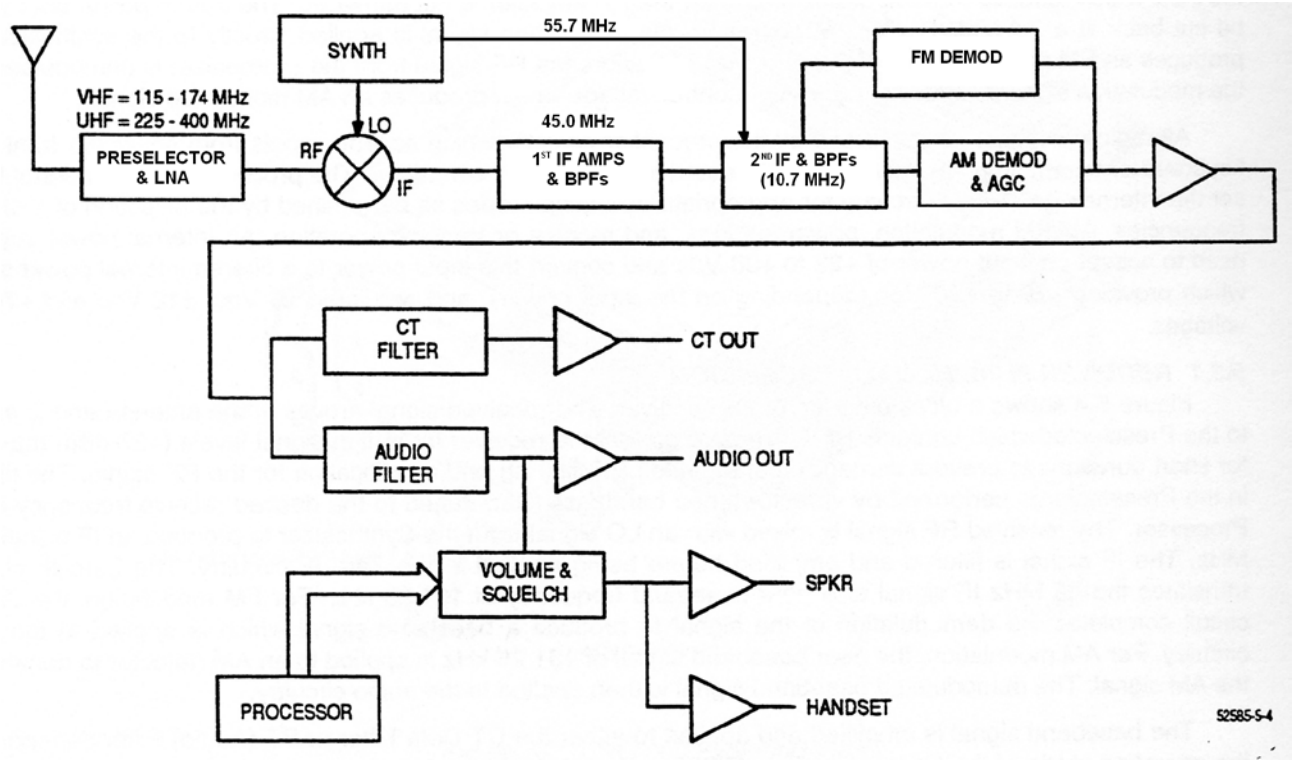


Figure 6 - Receiver Functional Block Diagram

Volume and Squelch control signals are provided by the processor to control the volume and squelch settings of the audio circuitry. The Processor receives the volume setting from the front panel control and uses this setting to set the volume controls in the audio circuitry. For squelch operation, the processor also receives a squelch setting from the front panel control and uses this setting to compare against the received signal strength and noise level to activate the squelch controls. The received signal strength level is provided by the AGC circuitry, which provides a direct indication of relative signal strength. The noise level is measured by coupling the demodulated FM signal through a high-pass filter and a peak detector to provide an indication of relative noise level. The signal-to-noise ratio is compared against the squelch control setting to determine if the squelch threshold is broken.

3.2.1 Receiver Input Signals

Figure 7 shows input and output signals of the receiver. The RF IN signal is the received signal routed from the receiver. The RF IN signal may be either VHF (115 to 149.9950 MHz [AM] or 173.9950 MHz [FM]) or UHF (225 to 399.9950 MHz) signal in either FM or AM mode of modulation. (It may also be an extended UHF [400-420 MHz] signal in FM mode for the 400 MHz option.) The LO signal is provided by the synthesizer and is set at 45.0 MHz above the desired received signal. (Low-side mixing is used for 400-420 MHz band, therefore, data output in this

band is inverted.) The LO is used to mix with the RF signal to produce a 45.0 MHz IF signal. A second LO at 55.7 MHz is mixed with 45.0 MHz IF to produce a 10.7 MHz IF within the receiver.

The processor provides data and clock signals that are used to set the volume controls. An enable line channels the data to the volume control. A Receive/Transmit (R/T) control signal activates/deactivates the receiver circuitry and switches the audio circuitry to receive or transmit operation as desired. The squelch control signal supplied by the processor activates/deactivates the audio circuitry depending on the squelch threshold. FM/AM and PT/CT control signals switch in the appropriate demodulation and audio processing paths while separate VHF and UHF control signals select the appropriate signal path (VHF or UHF) within the preselector. The preselector also receives tuning voltages from the processor circuitry. The tuning voltage tunes the varactor tuned preselector filters to the desired receive frequency.

3.2.2 Receiver Output Signals

As shown in Figure 7, the receiver has six output signals. The VHF and UHF Detector signals provide calibration data to the processor. The Noise Level and Signal Level signals control squelch operation. The PT and CT output signals are the demodulated baseband signals with the Plain Text (PT) signal being an audio signal with a 300 Hz to 3 kHz bandwidth while the Cipher Text (CT) signal is a data signal with a typical data rate of 16 kbps. The bandwidth of the Cipher Text data signal is from 30 Hz to 10.24 kHz.

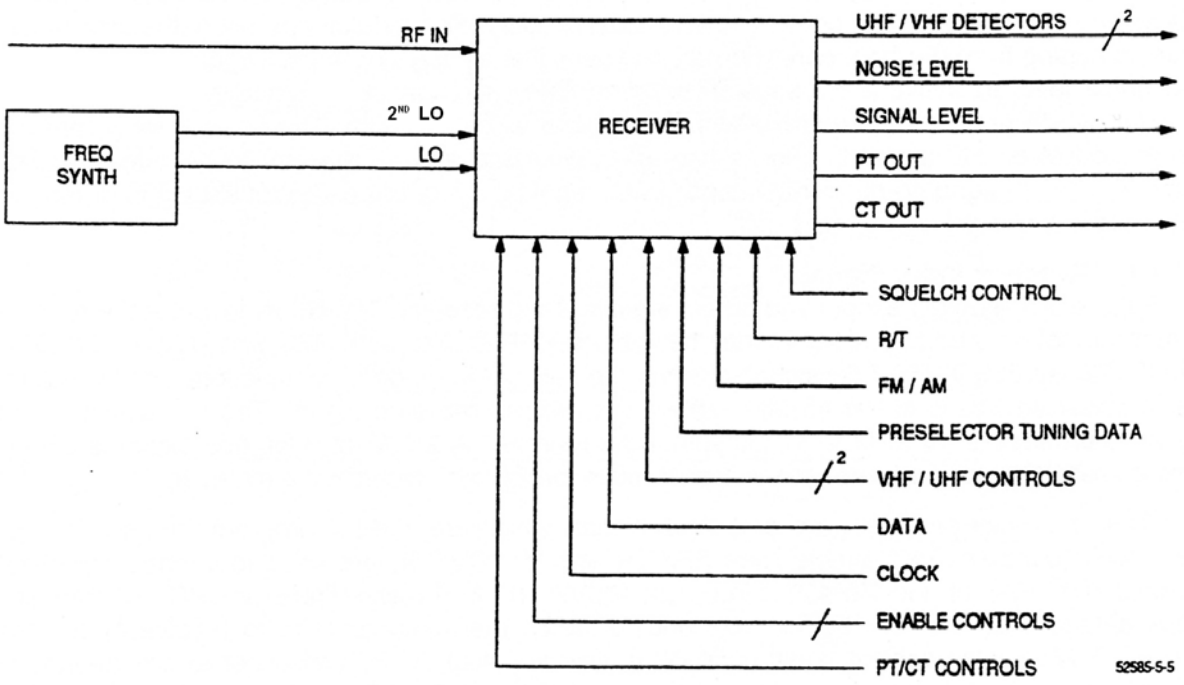


Figure 7 - Receiver Output Signal Diagram

3.3 Transmitter Functional Description

Figure 8 shows the functional block diagram for the transmitter. In the transmit mode, the synthesizer generates the transmit signal at the operating frequency in response to frequency data supplied by the processor. The transmit signal is amplified and applied to the Voltage Controlled Attenuator (VCA). The VCA adjusts the RF drive level to the RF Amplifier by varying the amount of attenuation of the transmit signal. The VCA is controlled by the ALC that uses inputs (VFWD) from the output power detectors to determine the amount of attenuation needed. The ALC also uses inputs (VREFL) from the coupler/detector to determine the reflected power (VSWR) level of at the antenna port. A high VSWR can cause damage to the transmitter, so if a high VSWR is detected, the ALC cuts back the output power accordingly to prevent over stressing the final RF amplifier. Together, the VCA, ALC, and output coupler/detectors form a closed loop which regulates the transmitter output power to within 2 dB of the desired output power and protects the transmitter from damage in case of an antenna or internal circuitry malfunction.

After passing through the VCA, the transmit signal is applied to the final RF amplifier. The final RF amplifier is a fixed gain amplifier which amplifies the transmit signal to a maximum of 10 Watts average power at 80% modulation (7.58 Watts CW power). The actual output power level is determined by the drive level from the VCA, which is controlled by the ALC. The ALC uses a closed analog loop to set the output power to the desired output level as determined by the processor. After final amplification, the transmit signal is passed through a bandpass filter to reduce harmonic and spurious transmit signals, through a solid state T/R switch which switches the antenna between the transmitter and receiver as needed, and through a coupler/detector which senses both forward and reflected power used by the ALC to determine the amount of attenuation required by the VCA.

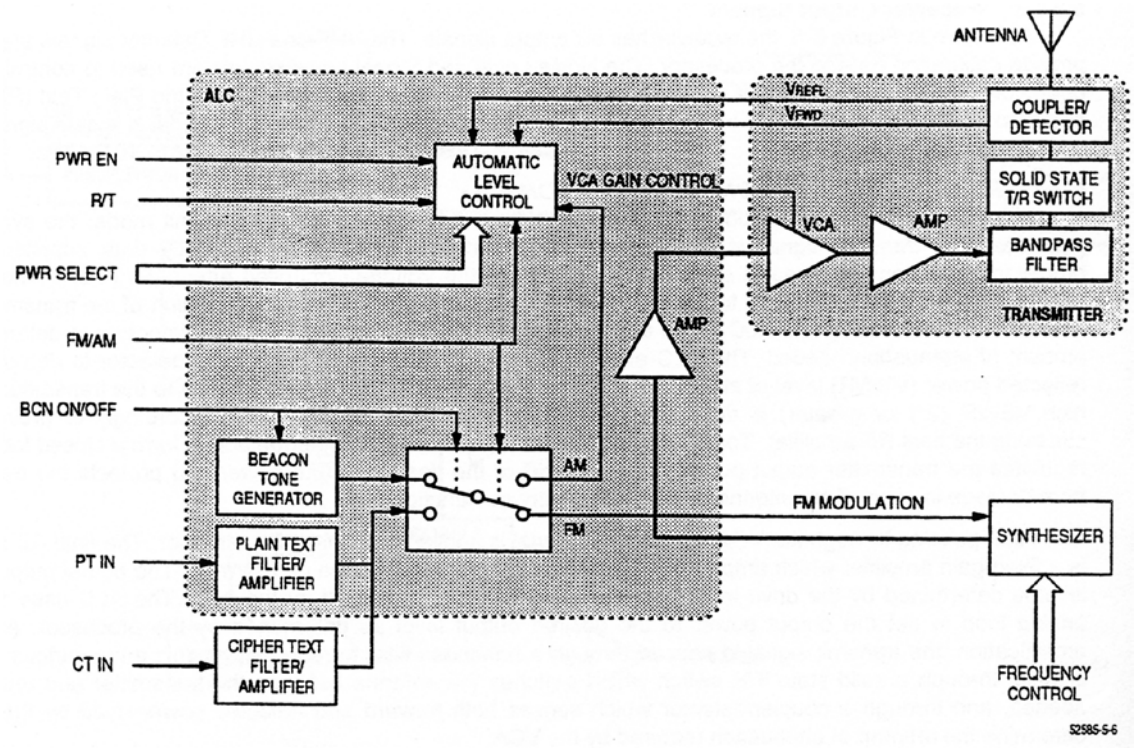


Figure 8 - Transmitter Functional Block Diagram

The transmitter may be modulated with either AM or FM modulation using either Plain Text (audio) or Cipher Text (data) signals. Both the Plain Text and Cipher Text signals are processed through the same filtering and amplification circuitry used to process the baseband signals in the receive mode. A VOGAD (Voice-Operated Gain-Adjusting Device) is used for amplification and automatic gain control of the PT (audio) from the handset microphone or remote high-level balanced audio input.

For AM modulation, the modulation signal is applied to the VCA and is superimposed on the VCA control voltage from the ALC. In this way, the modulation signal varies the attenuation of the VCA which causes the transmit output power amplitude to vary directly in response to the modulation signal. This produces an AM modulated transmit signal.

For FM modulation, the modulating signal is sampled by an analog to digital converter. A CPLD re-formats the data stream and then applies the modulation data to the synthesizer PLL chip. The PLL chip uses the data to dynamically change the programmed frequency of the synthesizer, producing an FM modulated transmit signal.

In addition to Plain Text or Cipher Text operation, the transmitter can be set to transmit an emergency beacon signal. The beacon signal is generated by an oscillator in the audio circuitry. The beacon signal is an audio tone that is swept from 300 Hz to 1 kHz at a 1 second rate. When the beacon is activated, the transmitter continuously transmits the beacon signal, allowing other stations to locate the beacon transmitter using standard direction finding techniques.

3.4 30-90 MHz Option Functional Description

The 30-90 option (01-P37240N) operates in the Low VHF frequency band of 30.0000 to 90.0000 MHz in FM mode (only). The 30-90 option can transmit and receive both plain text (PT) and encrypted voice or data messages (Cipher Text - CT).

The 30-90 MHz option only has 12.5 kHz and 25 kHz tuning increments.

Transmitter output power is 5W, 1W, or 150mW.

Although the 30-90 option has its own separate external RF interface, and is in effect a separate transceiver from the main radio, it shares a dedicated interface with the main radio's APPS board (for processor control, audio circuitry, DC power, and display / keypad functions), and bears many similarities to the main radio architecture at the top level. The 30-90 has its own synthesizer and transmit-receive chain. A 2.1 MHz reference from the APPS board determines its shared frequency stability of 1 part per million (ppm) with the main radio. A simplified block diagram of the 30-90 option is easily derived from Figure 5 for the main radio by simply ignoring references to AM and showing the physical boundary between the 30-90 and APPS boards / functions. Otherwise, the simplified block diagram is identical, as depicted in Figure 9.

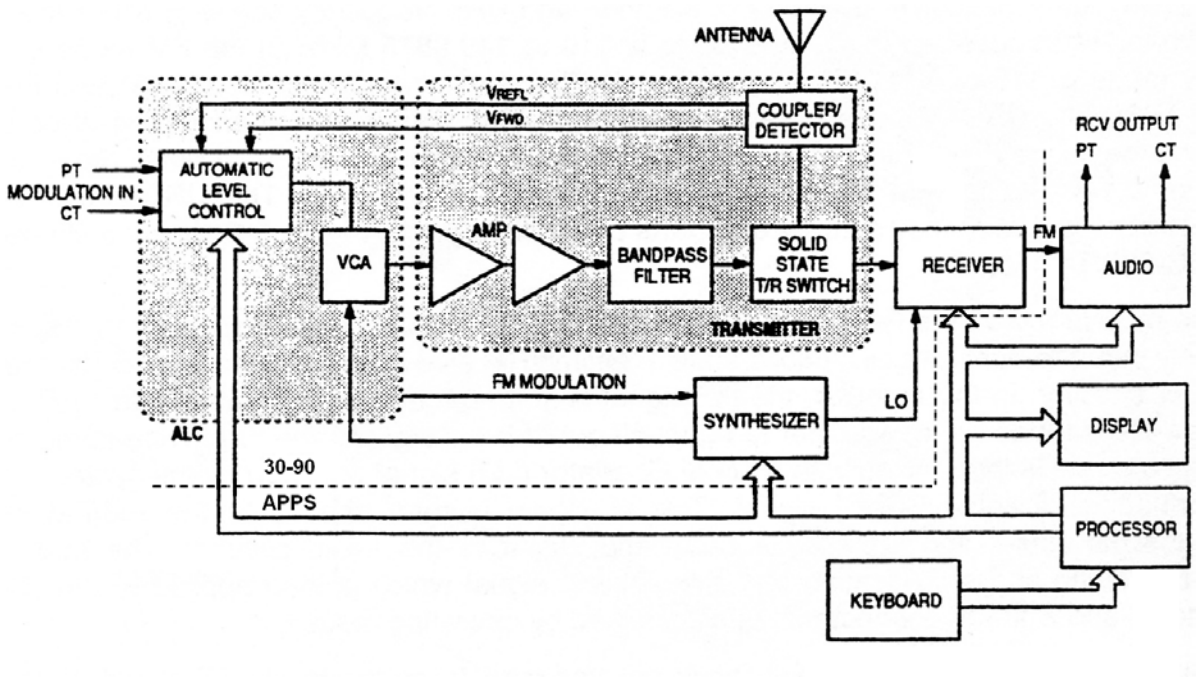


Figure 9 - 30-90 MHz Transceiver Simplified Functional Block Diagram

In receive mode, the RF signal arrives at the 30-90 antenna port and is passed through a coupler/detector which is used only in transmit mode. A solid state Transmit/Receive switch is used to connect the RF signal path to the receiver circuitry. In the receiver, the RF signal is first passed through a preselector that uses a self-tuned bandpass filter to reject all out-of-band signals and to provide some signal amplification. Received signal is then mixed with a Local Oscillator (LO) signal provided by the synthesizer to produce a 10.7 MHz Intermediate Frequency (IF) signal. This first IF signal is then filtered and applied to an integrated 2nd IF/Baseband chip, which produces demodulated FM signal using a 10.245 MHz IF frequency. The APPS board audio circuitry provides appropriate filtering and amplification of the baseband signal that is then applied to the speaker and/or front panel audio and remote connectors, as determined by operating mode. It should be noted that the 30-90 does not employ a delayed AGC scheme in the receive RF chain, as does the main radio receiver.

In transmit mode, the synthesizer is programmed to generate an RF signal at the desired transmit frequency. This RF signal is amplified and applied to a Voltage Controlled Attenuator (VCA) that is used to regulate signal strength applied to the RF amplifier. The RF signal is amplified to desired output power by the RF amplifier and then filtered by a bandpass filter to reduce harmonic and spurious transmit signals. The RF signal then passes through a coupler/detector that senses signal strength of the transmitted RF signal. The coupler/detector provides a control voltage to the Automatic Level Control (ALC) circuitry that then sets the appropriate attenuation level of the VCA. The coupler/detector also senses reverse power to detect a high VSWR condition. When a high VSWR is detected, the coupler/detector provides a control voltage to the ALC that reduces output power so the RF amplifier is not damaged. For FM mode, the modulation signal is applied directly to the synthesizer and produces an FM modulated RF signal.

All 30-90 functions are controlled by the APPS processor circuitry that accepts inputs either from the front panel keyboard or from a remote control unit connected to the remote connector. The processor uses a control bus to set the 30-90 circuitry for appropriate operating modes, as determined by the selection of power settings and receive or transmit operation. The radio's internal power supply on the APPS board is used to provide filtered +24 VDC (nominal unregulated) and regulated +5 VDC, ±12 VDC, +20 VDC, and +70 VDC voltages to the 30-90 board.

Some limitations of the 30-90 are worth noting. The front panel display signal strength meter and power meter do not operate when the radio is in the 30-90 MHz band. Also, the 30-90 option requires use of a different remote control unit than the main radio. (The remote control units are optional accessories.)

Finally, it should be mentioned that most of the 30-90 filters and power amplifier are implemented at 12.5 or 25 ohms characteristic impedance, versus the usual 50 ohms for such designs.

3.4.1 30-90 MHz Receiver Functional Description

Figure 10 shows a block diagram of the 30-90 MHz receiver. The received signal arrives at the 30-90 antenna and is applied to the preselector that contains high-level RF limiting amplifiers to protect the receiver from high signal levels to prevent damage and provides RF filtering and amplification for the RF signal. The filtering in the preselector is performed by varactor tuned bandpass filters tuned to the desired receive frequency by the Processor. The received RF signal is mixed with an LO signal from the Synthesizer to produce an IF signal at 10.7 MHz. The IF signal is filtered before being applied to the integrated 2nd IF/Baseband chip. The 2nd IF/Baseband chip translates the 10.7 MHz IF signal to 455 kHz IF using a 2nd LO frequency of 10.245 MHz generated from a crystal external to the chip. The chip includes a mixer, limiting amplifier, and quadrature discriminator to complete the demodulation of the IF signal to produce a baseband signal that is applied to the APPS audio circuitry.

The baseband signal is amplified and applied to either the CT Data Filter or PT (Audio) Filter depending on the operating mode of the transceiver. The CT Filter is a 30 Hz to 10.24 kHz bandpass filter and the PT is a 300 Hz to 3 kHz bandpass filter. For CT operation, the signal is then amplified and routed to the remote connector on the front panel. For PT operation, the audio signal is amplified and routed to the remote connector, the speaker, and the handset.

Normally the URC-200 in the 30-90 band will use a 150 Hz Tone Squelch (vs. carrier-to-noise squelch), which is compatible with other radios in this band of frequencies. This fixed threshold tone-operated squelch is turned ON/OFF from the keypad. If desired, the tone may be turned OFF; however, "white-noise" will come from the speaker and/or handset with the Squelch Control knob in the full CCW position. Even though the Squelch Control knob may be adjusted CW to squelch this noise, this may result in the incoming signal not being able to overcome the squelch.

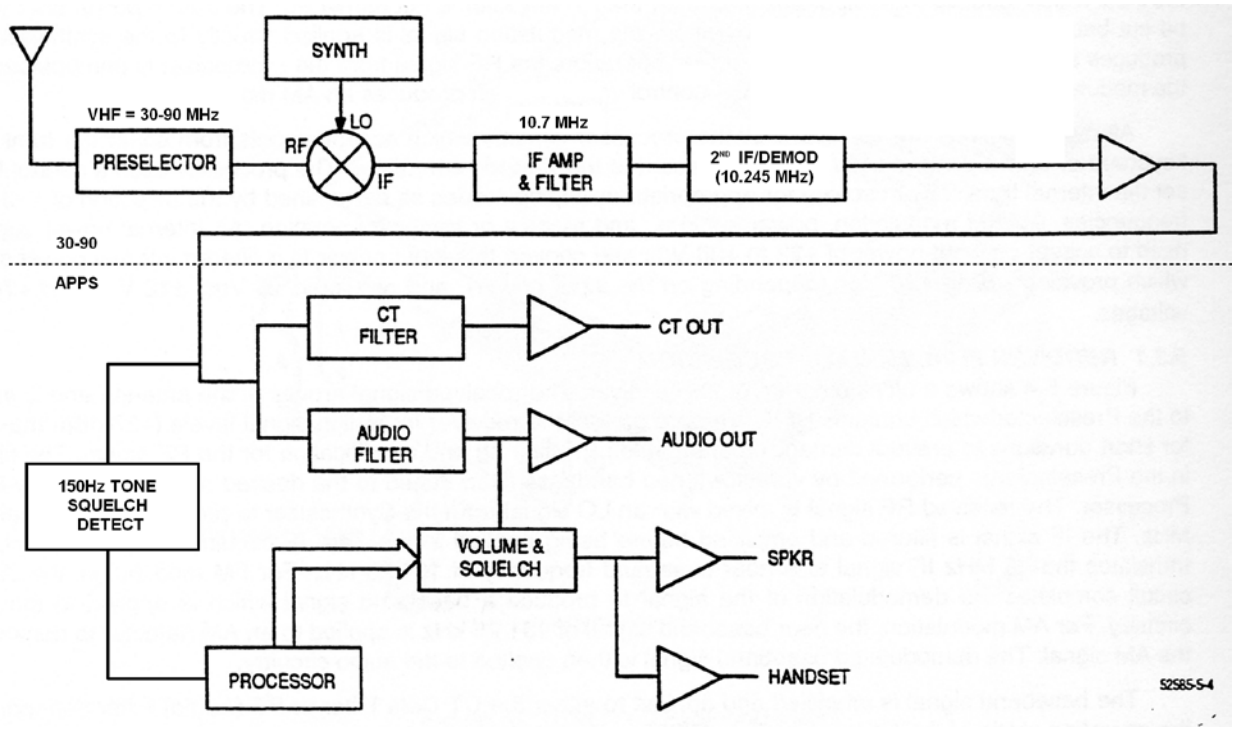


Figure 10 - 30-90 Receiver Functional Block Diagram

3.4.2 30-90 MHz Transmitter Functional Description

Refer to Figure 8 for the functional block diagram for the transmitter. In the transmit mode, the synthesizer generates the transmit signal at the operating frequency in response to frequency data supplied by the processor. The transmit signal is amplified and applied to the Voltage Controlled Attenuator (VCA). The VCA is used to adjust the RF drive level to the RF Amplifier by varying the amount of attenuation of the transmit signal. The VCA is controlled by the ALC that uses inputs (VFWD) from the output power detectors to determine the amount of attenuation needed. The ALC also uses inputs (VREFL) from the coupler/detector to determine the reflected power (VSWR) level of at the antenna port. A high VSWR can cause damage to the transmitter, so if a high VSWR is detected, the ALC cuts back the output power accordingly to prevent over stressing the final RF amplifier. Together, the VCA, ALC, and output coupler/detectors form a closed loop that regulates the transmitter output power and protects the transmitter from damage in case of an antenna or internal circuitry malfunction.

After passing through the VCA, the transmit signal is applied to the final RF amplifier. The final RF amplifier is a fixed gain amplifier which amplifies the transmit signal to a maximum of 5 Watts average power at 80% modulation (3.79 Watts CW power). The actual output power level is determined by the drive level from the VCA, which is controlled by the ALC. The ALC uses a closed analog loop to set the output power to the desired output level as determined by the processor. After final amplification, the transmit signal is passed through a bandpass filter to reduce harmonic and spurious transmit signals, through a solid state T/R switch which switches the antenna between the transmitter and receiver as needed, and through a coupler/detector which

senses both forward and reflected power used by the ALC to determine the amount of attenuation required by the VCA.

The transmitter is modulated with FM modulation only, using either Plain Text (audio) or Cipher Text (data) signals. Both Plain Text and Cipher Text signals are processed through the same APPS board filtering and amplification circuitry used to process baseband signals in the receive mode.

The APPS processor generates the 150 Hz tone (for transmit tone squelch), which is summed with the FM PT transmit audio. The FM modulation signal is applied to the synthesizer where it is superimposed on the Voltage Controlled Oscillator (VCO) control voltage. The VCO generates the RF transmit signal and the frequency of the transmit signal is determined by the VCO control voltage. By varying the VCO control voltage using the modulation signal, the VCO output frequency varies directly in response to the modulation signal. This produces an FM modulated transmit signal.

4.0 OPERATING INSTRUCTIONS

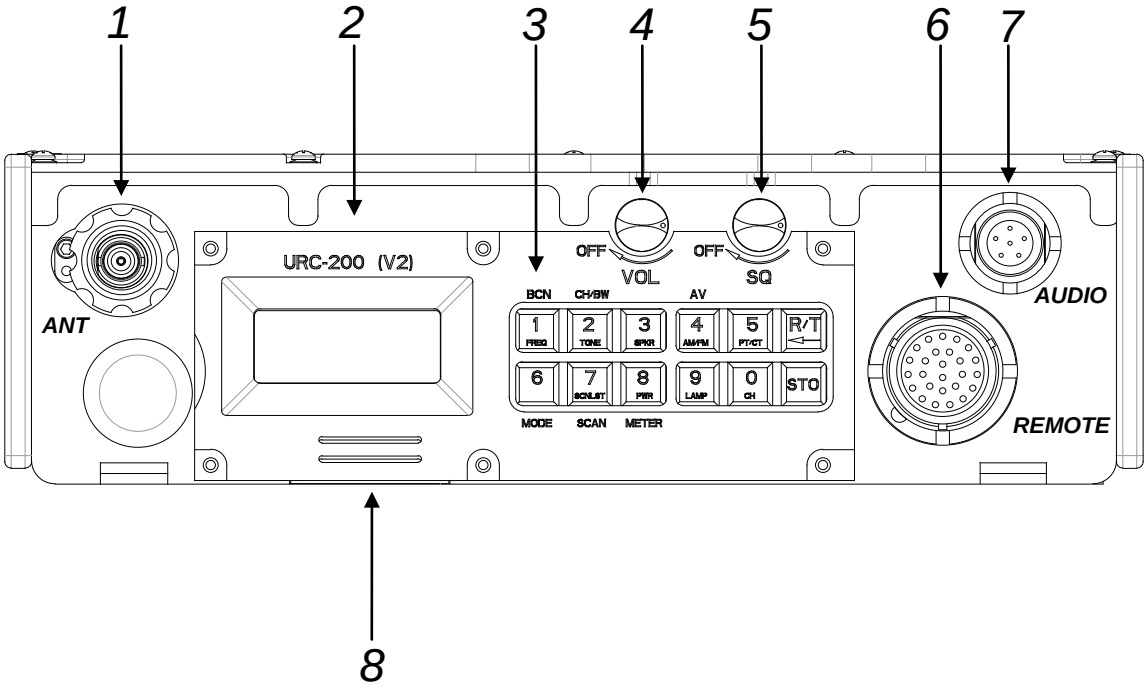
This section provides information for operating the URC-200 (V2) Transceiver. It includes a functional description of all operating controls, indicators, and connectors and procedures for set-up and operation.

4.1 Transceiver Placement and Antenna Sighting

The transceiver operates in the VHF and UHF frequency bands, and so uses Line-Of-Sight (LOS) frequencies. Therefore, placement of the transceiver and antenna sighting greatly affects the operating range. The longest range is normally obtained when a direct LOS is maintained between the transceivers. Use of hilltop or tower locations will increase the LOS range. Location in valleys with intervening hills, behind buildings or in dense woods may reduce or prevent communications. If possible, avoid locations near electrical interference sources, such as power and telephone lines, radars, welders and electrical generators.

4.2 Controls, Indicators And Connectors

The URC-200 (V2) uses a microprocessor to control and display all operating functions. A keypad with 12 key switches is used with a Liquid Crystal Display (LCD) to select frequencies and operating modes for each of the 10 preset channels and to store each channel's operating parameters. Separate volume and squelch controls are provided to adjust the handset and loudspeaker audio level and the receiver squelch threshold. The controls, indicators and connectors shown in Figure 11 are described in Table 7. The display and key-pad functions are shown and described in Figure 12.



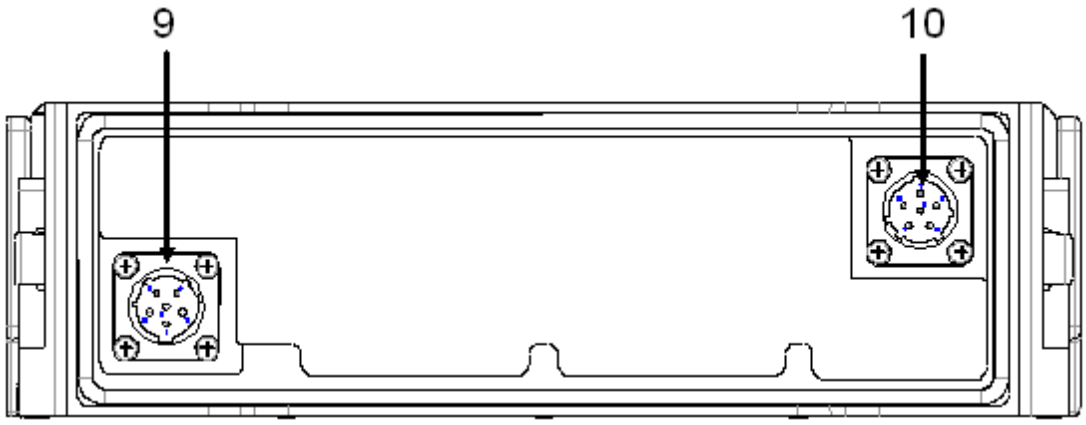


Figure 11 - Front and Rear Panel Controls, Indicators and Connectors

Table 7 - Front Panel Controls, Indicators and Connector and Rear Panel Connectors

Item No.	Controls, Indicators, Connectors	Type	Function
1	Antenna connector, J3	BNC	Connects VHF/UHF Antenna, threaded sleeve is provided to securely fasten flexible antenna to the transceiver.
2	Liquid Crystal Display (LCD)	7-segment display	Alpha-numeric display that shows operating modes, frequency, messages and measurements.
3	Keypad	12-push-button keypad	Used to select all operating modes and frequencies.
4	VOL/OFF a) OFF b) VOL	Rotary control with switch	Full CCW position turns transceiver off. Continuously variable control adjusts handset and speaker audio level.
5	SQ/OFF	Rotary control with switch	Continuously variable control adjusts squelch threshold in the PT mode of operation. Full CCW position turns squelch off. Squelch is not operational when CT is selected.
6	Remote J2	26-pin connector	Connects transceiver to peripheral devices such as COMSEC equipment, remote control unit and test equipment.
7	HDST J4	6-pin audio connector	Handset connector for H-189/GR or H-250/U handset
8	Speaker		Internal speaker

Table 7 - Front Panel Controls, Indicators and Connector and Rear Panel Connectors (Continued)

Item No.	Controls, Indicators, Connectors	Type	Function
9	Battery connector J1 (Located on back-panel)	6-pin battery connector	Connects transceiver to a power source such as the UBC-100 battery case or UAC-100 AC supply. See Paragraph 1.7 for power source options.
10	Battery connector J5 (Located on back-panel)	6-pin battery connector	Connects transceiver to a power source such as the UBC-100 battery case or UAC-100 AC supply. See Paragraph 1.7 for power source options.

4.3 Keypad and Display Functions

The following procedures describe how to set-up the transceiver for operation in any of the possible operating modes. Figure 12 shows the display and the key-pad and identifies the key functions. Each will be discussed in further detail as specific operating modes are described.

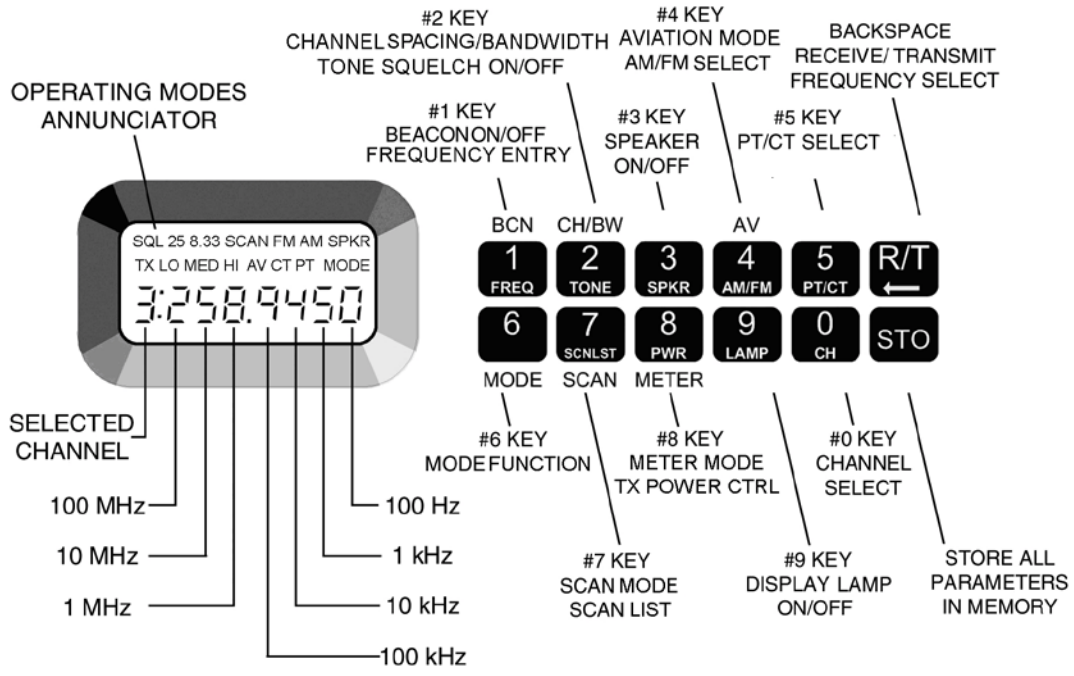
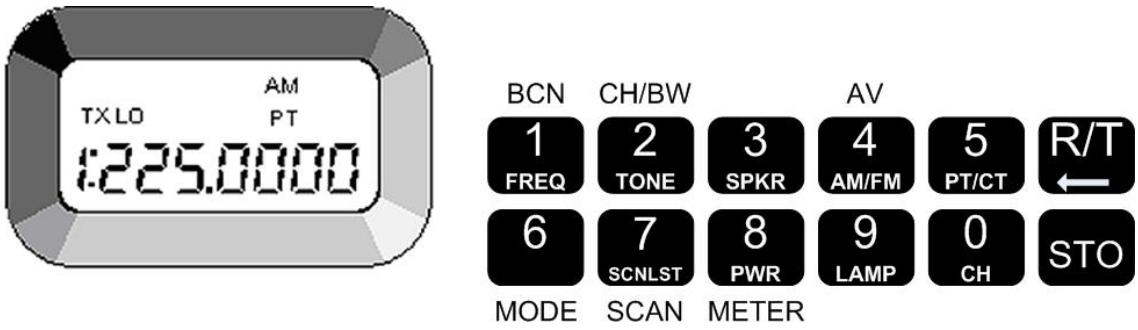


Figure 12 - Key-pad and Display Functions

4.4 Normal Operating Mode Configuration Procedures

The transceiver can be used for operation once it has been installed. The transceiver is fully micro-processor-controlled from push button instructions selected at the front panel. The frequency is tuned either by selecting one of ten preset channels or by manually setting up the frequency on the LCD display. The preset frequencies may be stored in memory and may be changed any time the transceiver is turned on. The memory is maintained using an EEPROM that allows the presets to be stored even when the power is turned off or the transceiver batteries are removed. The EEPROM provides non-volatile memory and does not require the use of a keep-alive-voltage.

In normal operating mode, the display shows the channel currently in use. The receive frequency and its associated data for that channel are displayed while the transceiver is in receive mode. When the PTT is pressed, the transmit frequency and its associated data for that channel are displayed. When transmitting, the transmit annunciator (TX) is on.



If the [R/T] key is pressed while in receive mode, the transmit frequency is displayed, but the transceiver will still be receiving on the current channel's receive frequency. This situation is indicated by a blinking transmit annunciator. Pressing PTT at this point will put the transceiver in transmit mode, causing the transmit annunciator to come on steadily. When the PTT is released, the transceiver will go back into receive mode with the receive frequency and data for this channel being displayed.

4.4.1 Turning on the Unit

Before performing the following steps, refer to Paragraph 4.2 for the location and functional description of the controls and indicators.

1. Make sure the transceiver set is connected for operation according to the installation instructions in Paragraph 2.2.
2. Turn on the transceiver by turning the VOL control clockwise.
3. Set the VOL control for the desired volume (the SQ control must be in maximum counter clockwise position). To hear audio from the loudspeaker the speaker must be enabled per Paragraph 4.4.4.
4. Adjust the SQ control for the threshold by advancing clockwise slowly, just until the noise stops. Advancing the control further will reduce the sensitivity of squelch break.

4.4.2 Cancellation of Presets

To cancel presets, press the [Mode] key while powering on the radio. If the transceiver is powered-up while the [MODE] key is pressed, The transceiver will preset all the channel data for each channel to the default values (225 MHz, PT, AM, low power, 25 kHz channel spacing). This default condition is used as the starting point for the following discussions.

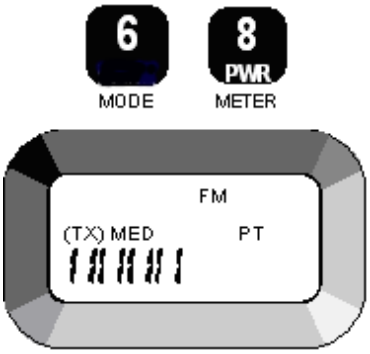
4.4.3 Front Panel Illumination

Pressing the [LAMP] key Controls the backlighting of the display and keyboard. Consecutive key strokes cycles through the four levels of brightness: off (No backlighting), low, medium, and high.
When the transceiver is turned ON, the normal default from the factory is with the backlighting off.

4.4.4 Select Speaker ON/OFF

Pressing the [SPKR] key toggles the loudspeaker ON and OFF. When the [SPKR] key toggles the loudspeaker ON, the **SPKR** annunciator will appear in the upper right corner of the display. This is to signify that the loudspeaker has been turned ON. When the [SPKR] key toggles the loudspeaker OFF, the **SPKR** annunciator will disappear.
When the transceiver is turned ON, the normal default from the factory is with the speaker off.

4.4.5 Select Meter Mode



Press the [MODE] key and then the [METER] key to activate the METER MODE. When the transceiver is in the receive mode, the display becomes a signal strength meter in the form of a bar graph, indicating the relative strength of the incoming receive signal. The meter will indicate a single bar at approximately -115 dBm and be full scale at approximately +3 dBm.

When the transceiver is in the transmit mode (PTT pressed), indicated by the **TX** annunciator, the display becomes a power meter. At high UHF frequencies its accuracy is approximately 1 Watt per bar. As frequency decreases, the power meter may be indicating a decrease in output power. This does not reflect a true reduction in output power. The true output power will be within specification across the frequency band. Press the [Mode] and [PWR] keys again to deactivate this mode.

4.4.6 Setting Preset Channels

This section describes how the preset channels are set. The transceiver is initially assumed to be set up with the following conditions: low power, AM, plain text (PT), and a frequency of 225 MHz (for both receive and transmit), these are default values that are achieved when the transceiver is powered-up with the [MODE] key pressed, as described in Paragraph 4.4.2, above. The transceiver does not need to be set up with these default settings; the following procedure applies for any settings except that the display examples will be different.

4.4.6.1 Select Preset Channels

Pressing the [CH] key and then one of the numbered [n] keys, selects channel [n], the display shows the frequency and the attributes associated with that channel. This example shows the key-press sequence for selecting Preset Channel 1. Any channel from 0 to 9 may be selected.

4.4.6.2 Select Frequencies

With a channel set-up as above, pressing the [FREQ] key (key pad [1]) will cause the transceiver to go into the "enter frequency" mode. The main display is blanked out except for the channel number (the number shown to the left the colon). The first digit of the desired frequency (1, 2, or 3) is pressed next and is displayed to the right of the colon. At this point, the transceiver will still be receiving on the same frequency as before. As the remaining digits of the desired frequency are entered, they will be displayed. Pressing the [<--] key will cause the last digit entered to be erased. If the first digit of the frequency is erased, the display will go back to showing the current receive frequency for this channel. When the sixth digit of the frequency is entered, the rest of the frequency is automatically determined, so the correct frequency is displayed and the transceiver is set to that frequency. Note that this can be used as a "manual" receive channel since the new frequency and any other associated data that has been changed will not be stored in memory until the [STO] key is pressed. If the Receive mode display is shown, entering the frequency will change the frequency for both Receive and Transmit frequencies. If the Transmit mode display is shown, entering the frequency changes only the Transmit frequency. The transceiver will not accept invalid frequencies. If a flashing frequency is displayed on the transceiver's screen, it may be an indication that a malfunction has occurred. Contact General Dynamics Customer Support for further information if this occurs.

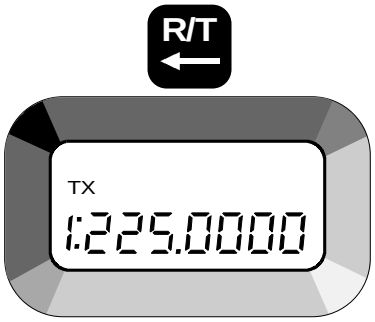
4.4.6.3 Select Modulation Mode

Pressing the [AM/FM] key causes the transceiver to toggle between the AM and FM modulation modes for the currently displayed channel. The new value will take effect immediately, as indicated by the annunciator, but will not be stored until the [STO] key is pressed. This select automatically applies to both sides of the preset channel. That is, if AM is selected for the receive frequency, the transmit frequency is also AM. If the new modulation is AM and the transmit power level was MED, the power level will be automatically changed to HI (there is no AM MED level). If the Receive mode display is shown, the new modulation will apply to both the Receive and Transmit frequencies. If the Transmit mode display is shown, the new modulation will apply to the transmit frequency only.

4.4.6.4 Select Cipher Text/Plain Text

Press the [PT/CT] key to toggle between the plain text and cipher text (data) modes for the currently displayed channel. The new value will take effect immediately, as indicated by the annunciator, but will not be saved until the [STO] key is pressed.

4.4.6.5 Select Receive/Transmit Data



Pressing the [R/T] key switches the display between the receive frequency and its operating data for the selected channel and the transmit frequency and data for that channel. When the transmit data is displayed, the transmit annunciator, TX, will blink. This key is also used as "back-space" when in the frequency select mode as described in Paragraph 4.4.6.2.

4.4.6.6 Storing Presets

Pressing the [STO] key stores into memory the frequencies (receive and transmit), mode (PT/CT), modulation (AM/FM), transmit power (Tx), bandwidth, and scan list membership for the selected channel.

4.4.6.7 Select Scan Channels

Pressing the [SCAN] key switches the selected preset channel on or off the scan list. The scan list must contain from two to ten of the preset channels before the scan mode can operate. The **SCAN** annunciator will light to indicate that this preset channel is on the scan list.

4.4.6.8 Select Transmit Power Levels

Pressing the [PWR] key selects the transmit power levels for the transceiver. The power level annunciator will show the current setting. There are three power levels, **LO**, **MED**, and **HI**, available in the FM modulation mode and two power levels, **LO** and **HI**, when AM is selected. This setting will take effect immediately, as indicated by the annunciator, but will not be saved until the [STO] key is pressed.

4.4.7 Selecting Special Modes

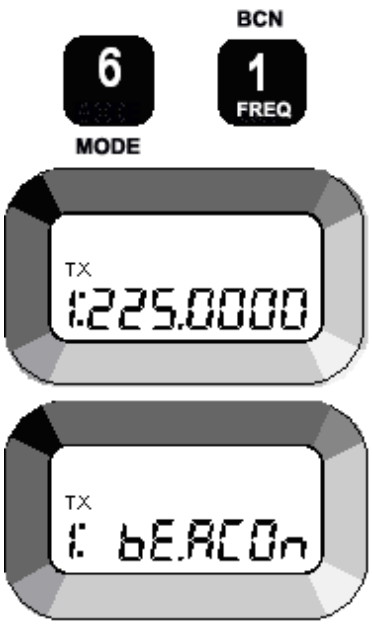
The following paragraphs describe the procedures for special operating modes and functions of the transceiver. The special operating modes consist of the Beacon-, Guard-, and Scan-mode of operation. The special functions consist of Internal Voltage Measurements, and Return to Local Control from Remote operation.

4.4.7.1 Select Scan Mode

Pressing the [MODE] key and then the [SCAN] key activates or de-activates the SCAN MODE. The scan mode causes the transceiver to cycle through the preset channels which are flagged as "scan channels", (see Paragraph 4.4.6.7), searching for an active channel (i.e., one where incoming signal strength is sufficiently large to break squelch). While scanning, the display shows the channel that it is scanning. The transceiver will scan for 0.5 seconds on each selected scan channel. If an active channel is found, the transceiver locks on that channel. If that channel becomes inactive for approximately four seconds, the transceiver continues the scan with the next flagged channel. If the operator wishes to continue the scan while on a channel that is (or was) active, the [SCAN] key can be pressed. When an active channel is found, that channel's receive frequency is displayed. If the push-to-talk key (PTT) is pressed while the transceiver is scanning, it will be ignored. If the PTT is pressed while a channel is active, the transceiver will go out of scan mode and into the normal mode using that channel, transmitting on that channel's preset transmit frequency. If the scan list has less than two channels, then the LCD blinks "Err-noSC" indicating the transceiver cannot enter the scan mode. To return to normal operation press the [CH] key followed by one of the 10 channel numbers [0 through 9]. The Scan Mode is cancelled and the transceiver goes to the selected channel.

When the scan mode is de-activated normally, by using the [MODE] plus [SCAN] keys, or by turning the transceiver OFF and then ON, the transceiver returns to normal operation on the channel that was in use immediately prior to entering the SCAN mode.

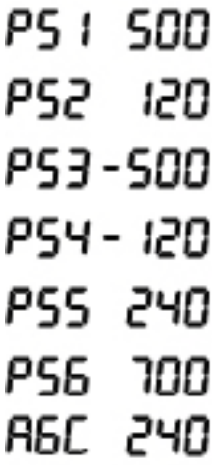
4.4.7.2 Select Beacon Mode



Pressing the [MODE] key and then the [BCN] key activates or de-activates the BEACON MODE. When the BEACON MODE is selected, the transceiver transmits a sweeping emergency audio signal on the selected channel frequency and in the selected modulation mode (AM or FM). The display alternately switches between the word "**BEACON**" and the selected channel information. No other operating functions are available when the BEACON is active.

When the beacon mode is de-activated (by toggling the mode off or by turning the power OFF and then ON), the transceiver goes back into normal mode using the channel that was in use immediately prior to entering the BEACON MODE.

4.4.7.3 Internal Voltage Measurements



Press the [MODE] key and then the [METER] key to activate the METER MODE. Press the [R/T] key to display the voltages of the internal power supplies and of the batteries. The first time [R/T] is pressed the voltage of the +5VDC supply - PS1 is displayed. Each consecutive press of [R/T] brings up the next supply; PS2: +12VDC, PS3: -5VDC, PS4: -12VDC, PS5: +24VDC (external power batteries), PS6: +70VDC and AGC.

NOTE

The voltages displayed on the front panel are relative voltages. If a voltage/s appears to be too low or too high, measure the suspected voltage using a lab type voltmeter. The AGC level displayed is a relative expression of voltage only. The AGC level is expressed as a digital value from 000 to 255.

4.4.7.4 Release from Remote Control

Pressing the [MODE] key and then the [R/T] key returns the transceiver to local control from remote control. This sequence is called Release Remote Key Sequence (RRKS). This key sequence has no effect if the transceiver is not in the remote control mode. There is no on-screen indication that the transceiver is back in local mode.

4.4.8 Voice (PT) Operation

The following procedure enables voice operation.

1. Attach the VHF/UHF antenna and H-189/GR handset to the transceiver.
2. Turn the transceiver on by rotating the VOL control clockwise.
3. Set the transceiver to PT (plain text mode**).**
4. Set the SQ control to OFF and set the VOL control until noise is heard from the handset or the loudspeaker.
5. Select operating modes and frequencies.
6. To transmit, hold the Push-To-Talk (PTT) switch down while talking into the mouthpiece.
7. To receive, release the PTT switch and listen to the handset earpiece or to the loudspeaker.
8. To eliminate the background noise when no receive signal is present, turn the SQ control clockwise just until the noise turns off. Adjusting the control further clockwise reduces the sensitivity of the squelch-break.

4.5 URC-200 (V2) EEPROM Limitations

The URC-200 (V2) transceivers use the Freescale MC9S08DN60AMLH microprocessor for control and interface operations of the transceiver. The processor has 2048 bytes of internal EEPROM that is capable of storing data after the power has been turned off. The EEPROM's write cycle (an erase followed by a write) is only guaranteed for 100,000 operations. However, typical operational life at ambient temperatures (approximately +25°C) is much greater.

Excessive use of the following commands results in a reduction in the EEPROM's write cycle life.

4.5.1 Select Scan Channels

Selecting preset channels changes the currently selected preset and updates the current preset channel number in the EEPROM. Excessive use of this command may result in the transceiver always starting in preset channel 0 at power up. (Reference: Paragraph 4.4.6.7 and Table 11, "C" code.)

4.5.2 Cancellation of Presets

Cancelling presets initializes all channels to a default configuration (AM, low power, 225 MHz receive and transmit, PT, wideband and off scan list). (Reference Paragraph 4.4.2 and Table 11, "I" code.)

4.5.3 Select Preset Channels

Selecting preset channels changes the currently selected preset and updates the current preset channel number in the EEPROM. Excessive use of this command may result in the transceiver always starting in preset channel 0 at power up. (Reference: Paragraph 4.4.6.1 and Table 11, "P" code.)

4.5.4 Storing Presets

Storing presets allows the user to change the stored information for the current reset channel. (Receive/transmit frequency, and selection of AM or FM.) Excessive use of the Q command may result in defective channel data and/or the transceiver may always start in preset channel 0 at power up. (Reference: Paragraph 4.4.6.6 and Table 11, "Q" code.)

4.5.5 Alignment Command Limitations

The warp command should be used only as needed. This command is used to adjust the crystal reference oscillator warp value which effects the frequency accuracy in parts per million. This value should rarely require adjustment (typically once a year or less often). For information concerning the warp alignment command, please contact General Dynamics Customer Service.

4.6 Remote Operation

The URC-200 (V2) can be operated remotely using one of the available Remote Control Units (UEC-120 or UEC-220) or by using a personal computer. The Remote Control Unit (RCU) shown in Figure 13 represents a remote terminal unit (a handset, or a control head connected by a cable of up to 250 ft). As shown, the RCU is connected in a master/slave relationship to the transceiver and the RCU always initiates a given command. All commands are sent as a series of ASCII characters over the RS232 connection.

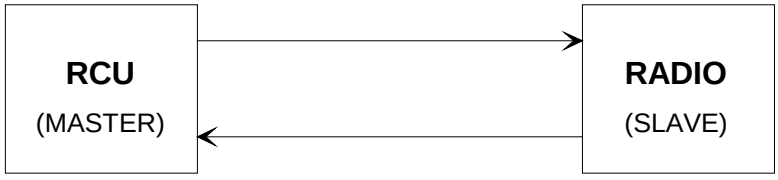


Figure 13 - Remote-Control Unit

When first powered up, the RCU sends an ID interrogation code to query what type of radio it is connected to (what options have been attached). Given this information, the RCU restricts the type of commands that it can transmit to the transceiver. When the remote command is recognized by the transceiver as a valid command, the transceiver will enter into the slave mode (the RCU is the master with the transceiver as the slave). The transceiver will also lock out all local keyboard inputs (except for the Release Remote Key Sequence, RRKS: [Mode] [R/T]) allowing all commands to come from the RCU.

4.6.1 Remote Control Interconnect

See Table 8 for Remote Connector pins used for remote control of the transceiver.

Table 8 - Remote Control Interconnect

Pin #	Description	IMPEDANCE	LOGIC LEVEL
S	Remote Data Out (ASCII data from the transceiver)	470 Ω	RS232
a	Remote Data In (ASCII data to the transceiver)	6.8 kΩ	RS232
X	Ground	N/A	N/A

4.6.2 Data Rates and Logic Levels

If using HyperTerminal configure as shown in Figure 14.

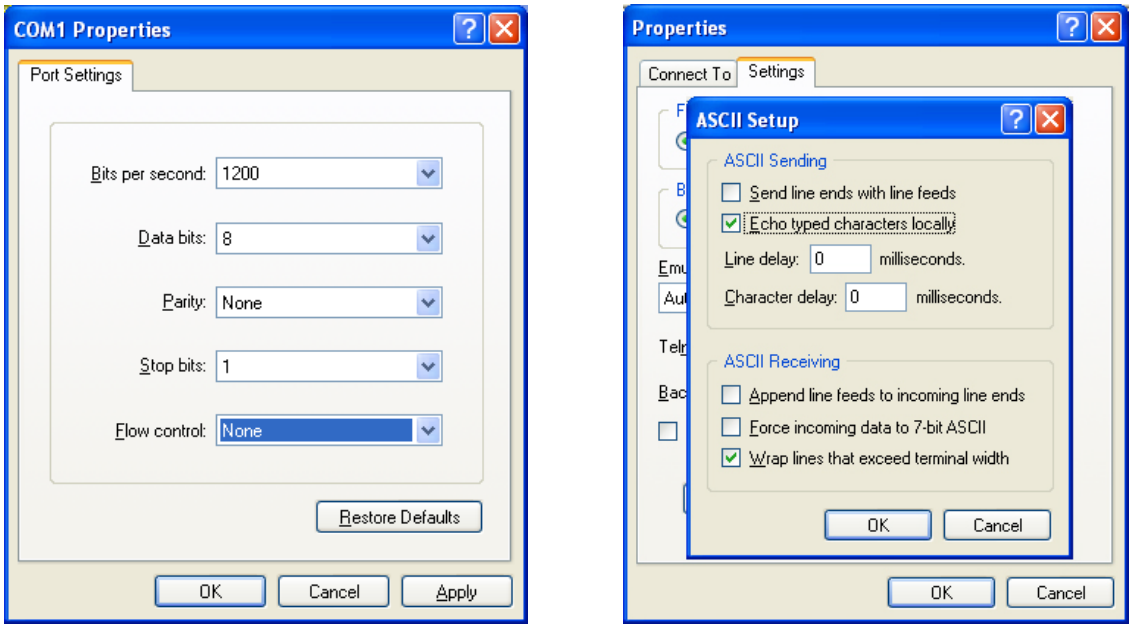


Figure 14 - HyperTerminal Configuration

The data rate is 1200 bps ±5%. The data code is serial 8-bit ASCII including no parity, one start bit and one stop bit, no flow control.

Launch HyperTerminal. In the HyperTerminal window, click File > Properties > Settings tab > ASCII Setup button. In the ASCII Setup window, check “Echo typed characters locally”.

4.6.3 Data Exchange Protocol

The RCU initiates all configuration commands and status inquiries to the transceiver using the RS-232 data communication protocol. Configuration commands control a change of state or a parameter of the transceiver such as AM/FM or transmit frequency. Status inquiries return transceiver data such as internal power supply voltage levels.

Each command or inquiry results in a response from the transceiver. If the transceiver receives a valid command, it performs the command and responds with an ACK reply to the RCU. If the transceiver receives an inquiry that requires a data response, the data is sent first, followed by ACK. If the transceiver receives an invalid command, it responds with a NAK reply. In the case where the transceiver is in manual (keypad) mode and it is commanded to change to the remote mode, it first responds with HT and then responds to further commands with ACK or NAK.

The ACK, NAK, and HT remote responses are summarized in Table 9.

Table 9 - Remote Responses

CODE	NAME	DESCRIPTION
ACK	Acknowledge	Response from the transceiver to a valid RCU command. If the command requires data from the transceiver, the data is sent first, followed by ACK.
NAK	No Acknowledge	Response from the transceiver to an invalid RCU command.
HT	New acknowledge	A response from the transceiver indicating that the transceiver was in the keypad (manual) command mode at the time it received a remote command. The transceiver changes mode to the remote command mode and sends HT. This acknowledge is used instead of an ACK for the first valid remote command received when transceiver was in keypad command mode.

The RCU cannot send a new command until it receives an ACK/NAK/HT or times out, whichever occurs first. If the RCU receives a NAK or times out, send the Z command to re-establish sync with the transceiver.

Provisions must be made on the RCU side to poll the status of the transceiver especially in the over-temp, scan, and synth lock conditions. Another provision that the RCU should make is that after three (3) NAKs from the transceiver for the same command, the RCU should display an error code to indicate that an interface problem or an invalid command has occurred.
The RCU (handset or control head) should display the status on its LCD display only after it has queried the transceiver for data. In this way, the RTU and the transceiver displays will always agree.

NOTE

To conserve power, the RS232 transmitter in the transceiver is automatically turned off after an ACK or HT is sent. This essentially puts the TX in the break state. The remote software must handle any special interrupts etc. that may occur as a result of a break.

4.6.4 Remote Control Codes

The following tables show the remote control command codes for the URC-200 (V2) Transceiver. The commands are organized as follows:

- Remote Transceiver Operation Commands (Table 11)
- Transceiver Customizing Commands (Table 12)
- Transceiver Status Inquiry Commands (Table 13)

The codes for the basic transceiver as well as those for the options are included in the tables. The available options are:

- 30 - 90 MHz extended frequency option, EBN-30
- 400 - 420 MHz extended frequency option, EBN-400

- 8.33 kHz tuning increment / channel spacing option, ECS-8

Many of the commands are only valid for certain transceiver configurations and frequency ranges, Table 10 provides mapping of these dependencies. The commands affected by these dependencies are indicated by a reference to "Note 1" below the command. For example, if the transceiver is equipped with the 30-90 MHz option and is operating in the 30-90 MHz band, AM is not available, but FM, PT and CT are, including the other parameters in the remainder of the column. Similarly, 8.33 kHz tuning is available only for the 115 - 173.995 MHz and 225 - 399.995 MHz bands.

Table 10 - URC-200 (V2) Operational Frequency-Based Dependencies

	30-90 MHz[1]	**115 - 173.995 MHz**	**225 - 399.995 MHz**	**400-420 MHz[1]**
AM	N	Y[2]	Y	N
FM	Y	Y	Y	Y
PT	Y	Y	Y	Y
CT	Y	Y	Y	Y
Tone Squelch (150 Hz)	PT only (unless custom code used)	N	N	N
25 kHz Tuning	Y	Y	Y	Y
12.5 kHz Tuning	Y	Y (N in Aviation Mode)	Y (N in Aviation Mode)	Y
5 kHz Tuning	N	Y (N in Aviation Mode)	Y (N in Aviation Mode)	Y
8.33 kHz Tuning[1]	N	Y	Y	N
Selectable IF Filter[1,3] (AM PT)	N	Normal mode: Y Aviation: N (Auto) [4]	N	N
Pre/De-Emphasis (FM PT)	N	Y (132-173.995 MHz)	N	Y
FM RF Output Power	5W, 1W, or 0.15W	10W, 5W, or 0.1W	10W, 5W, or 0.1W	10W, 5W, or 0.1W
AM RF Output Power	NA	10W or 5W	10W or 5W	NA

1 Indicates an option.
2 Transceiver operates over full band, but spec is guaranteed from 115 - 149.995 MHz only.
3 The 8.33 kHz filter only applies to 117.975 – 136.975 MHz.
4 (Auto). Indicates that as you enter the frequency, an 8.33 or 25 kHz channel is selected and the correct filter is automatically selected, depending on the value entered.

Refer to Paragraph 4.7 of this manual for more information about available options.

Table 11 - Remote Transceiver Operation Commands

CODE	NAME	DESCRIPTION	EQUIVALENT TRANSCEIVER KEYPAD COMMAND
Z	Zap	Command sent to the transceiver to disregard the current remote command (or partial command) and re-sync. Transceiver will ACK/HT	None
$	Squelch Control	The "$" Command followed by three digits in the following format adjusts the remote squelch. "$xxx" where: 'xxx' = a decimal number from 000–255. When in remote mode, the transceiver uses the remote squelch value rather than the squelch knob setting. The remote value is initialized to the knob value when a remote session is initiated.	(There is no equivalent keypad response for the $ Command. The $ Command is equivalent to the SQUELCH Control on the Transceiver's front panel, see Paragraph 4.4.1)
I	Channel Initialization	Initializes all channels to the default values (AM, PT, low power, 225 MHz, Wideband (25 kHz), Aviation Mode Off).	Press 6 MODE and turn ON transceiver (See Paragraph 4.4.2)
L	Lamp Control	The "L" Command followed by a 0, 1, 2, or 3 selects the intensity of the transceiver's display backlighting "L0" = Lamp Off "L1" = Lamp Low "L2" = Lamp Med "L3" = Lamp Hi	9 LAMP (See Paragraph 4.4.3)
J	Speaker On/Off	The "J" Command followed by a 0 or 1 selects whether the transceiver's internal speaker is OFF or ON. "J0" = Speaker Off "J1" = Speaker On	3 SPKR (See Paragraph 4.4.4)
K	Calibration	The "K" Command performs the self-calibration of the transceiver's preselector tuned filters.	None

CAUTION

When performing a self calibration, the radio antenna port(s) must be attached directly to a good 50 ohm load(s). BNC type loads are acceptable. Use of a Type N to BNC adapter is recommended on the 30-90MHz antenna port (if present). The use of attenuators (instead of 50-ohm loads) or cables between load and antenna port can lead to calibration errors if there are strong RF signals present. Failure to follow the above procedure can result in severely degraded performance.

Table 11 – Remote Transceiver Operation Commands (Continued)

CODE	NAME	DESCRIPTION	EQUIVALENT TRANSCEIVER KEYPAD COMMAND
P	Preset Channel Select	The "P" Command selects the preset channel to be displayed and used. The "P" Command followed by a decimal digit from 0 to 9 will select the preset channel. "P0" = Channel 0 "P1" = Channel 1 : : "P9" = Channel 9	0 CH BCN 1 FREQ (See Paragraph 4.4.6.1)

Table 11 – Remote Transceiver Operation Commands (Continued)

CODE	NAME	DESCRIPTION	EQUIVALENT TRANSCEIVER KEYPAD COMMAND
R Note 1	Receive Frequency	The "R" Command sets the receive frequency value for the current preset channel. The “R” Command followed by 6 digits defines a receive frequency value. The 7th digit is automatically determined by the transceiver. The ‘x’ values, along with the 7th digit, must be divisible by 25 kHz, 12.5 kHz, or 5 kHz. "Rxxxxxx" = receive frequency Transceivers with the EBN-30 Option, for the 30-90 MHz band, the first digit following the “R” Command will be a "0" which is then followed by 5 digits to define the receive frequency value. The 7th digit is automatically determined by the transceiver. The ‘x’ values, along with the 7th digit, must be divisible by 25 kHz or 12.5 kHz. “R0xxxxx” = receive frequency for the 30-90 Band Transceivers with the EBN-400 Option, for the 400-420 MHz band, the first digit following the “R” Command will be a "4" which is then followed by 5 digits to define the receive frequency value. The 7th digit is automatically determined by the transceiver. The ‘x’ values, along with the 7th digit, must be divisible by 25 kHz, 12.5 kHz, or 5 kHz. “R4xxxxx” = receive frequency for the 400-420 Band	BCN 1 FREQ 0 - 9 *XXX* (ENTER 6 DIGITS) Note: When using the keypad to input the receive frequency, the transmit frequency is also entered simultaneously. (See Paragraph 4.4.6.2)

Table 11 – Remote Transceiver Operation Commands (Continued)

CODE	NAME	DESCRIPTION	EQUIVALENT TRANSCEIVER KEYPAD COMMAND
T Note 1	Transmit Frequency	The "T" Command sets the transmit frequency value for the current preset channel. The "T" Command followed by 6 digits defines a transmit frequency value. The 7th digit is automatically determined by the transceiver. The 'x' values, along with the 7th digit, must be divisible by 25 kHz, 12.5 kHz, or 5 kHz. "Txxxxxx" = transmit frequency Transceivers with the EBN-30 Option, for the 30-90 MHz band, the first digit following the "T" Command will be a "0" which is then followed by 5 digits to define the transmit frequency value. The 7th digit is automatically determined by the transceiver. The 'x' values, along with the 7th digit, must be divisible by 25 kHz or 12.5 kHz. "T0xxxxx" = transmit frequency for the 30-90 Band Transceivers with the EBN-400 Option, for the 400-420 MHz band, the first digit following the "T" Command will be a "4" which is then followed by 5 digits to define the transmit frequency value. The 7th digit is automatically determined by the transceiver. The 'x' values, along with the 7th digit, must be divisible by 25 kHz, 12.5 kHz, or 5 kHz. "T4xxxxx" = transmit frequency for the 400-420 Band	R/T ← BCN 1 FREQ 0 – 9 *XXX* (ENTER 6 DIGITS) (See Paragraphs 4.4.6.2 and 4.4.6.5)

Table 11 – Remote Transceiver Operation Commands (Continued)

CODE	NAME	DESCRIPTION	EQUIVALENT TRANSCEIVER KEYPAD COMMAND
M Note 1	Modulation Mode TRANSMIT/RECEIVE	The “M” Command followed by a 0 or 1 selects the transmit and receive modulation mode that is to be displayed and used. "M0" = TRANSMIT/RECEIVE AM "M1" = TRANSMIT/RECEIVE FM	AV 4 AM/FM (See Paragraph 4.4.6.3)
N Note 1	Modulation Mode TRANSMIT only	The “N” Command followed by a 0 or 1 selects only the transmit modulation mode that is to be displayed and used. "N0" = TRANSMIT AM "N1" = TRANSMIT FM	R/T ← AV 4 AM/FM (See Paragraphs 4.4.6.3 And 4.4.6.5)
X Note 1	Text Mode	The “X” Command followed by a 0 or 1 selects between PT (Plain Text, Voice) and CT (Cipher Text, Data). "X0" = Plain Text (PT) "X1" = Cipher Text (CT) (Returns a NAK if in Aviation Mode) For transceivers with the EBN-30 Option: If the 150Hz Tone Squelch is activated the transceiver reverts to the Plain Text (PT) mode only.	5 PT/CT (See Paragraph 4.4.6.4)
Q	Store Function	The “Q” Command stores the entered data in EEPROM for the current preset channel.	STO (See Paragraph 4.4.6.6)
C	Scan list member	The “C” Command followed by a 0 or 1 selects whether the current preset channel is ON or OFF the Scan List. "C0" = OFF the scan list "C1" = ON the scan list	7 SCNLST SCAN (See Paragraph 4.4.6.7)

Table 11 – Remote Transceiver Operation Commands (Continued)

CODE	NAME	DESCRIPTION	EQUIVALENT TRANSCEIVER KEYPAD COMMAND
# Note 1	Power Level Setting	The "#" Command followed by a 0, 1, or 2 selects the transmitter's output power for the current preset channel. "#0" = FM: Lo power, AM: Lo power "#1" = FM: Med power, AM: Hi power "#2" = FM: Hi power, AM: Hi power	[8 PWR] METER (See Paragraph 4.4.6.8)
S	Scan Mode	The "S" Command followed by a 0 or 1 places the transceiver in the Scan Mode. "S0" = Scan Mode Off "S1" = Scan Mode On **NOTE** If the scan list has less than two preset channels, the transceiver returns a "NAK". Only Inquiry Command ?02 is available during the scan operation.	[6] MODE [7 SCNLST] SCN (See Paragraph 4.4.7.1)
*	Beacon Mode	The "*" Command followed by a 0 or 1 places the transceiver in the Beacon Mode. "*0" = Beacon Mode Off, "*1" = Beacon Mode On	[6] BCN [1 FREQ] (See Paragraph 4.4.7.2)
+	Keypad Control	When in the Remote Mode, the "+" Command remotely re-enables the keypad.	[6] MODE [R/T ←] (See Paragraph 4.4.7.4)

Table 11 – Remote Transceiver Operation Commands (Continued)

CODE	NAME	DESCRIPTION	EQUIVALENT TRANSCEIVER KEYPAD COMMAND
B	Transmit Command	The “B” Command sets the transceiver into the transmit mode from the receive mode. **NOTE** To set the transceiver back to the receive mode, use the "E" Command as described below.	None
E	Receive Mode	The “E” Command returns the transceiver from the transmit mode back to the receive mode. **NOTE** To set the transceiver into the transmit mode, use the "B" Command as described above.	None
The following command applies to transceivers with the EBN-30 Option, 30-90 MHz Band Enhancement			
> Note 1	150 Hz Tone Squelch	This command is only effective for 30 - 90 MHz range frequencies. Transceivers with the EBN-30 Option, for the 30-90 MHz band, the “>” Command followed by a 0, 1, 2, or 3 enables/disables the 150 tone squelch. “>0” = Turns OFF the 150 Hz tone squelch for both receive and transmit. “>1” = Turns ON the 150 Hz tone squelch for receive only. “>2” = Turns ON the 150 Hz tone squelch for transmit only. “>3” = Turns ON the 150 Hz tone squelch for both receive and transmit.	CH/BW 2 TONE

Note 1 – Please see Table 10 (Operational Frequency-Based Dependencies) for restrictions.

Table 12 - Transceiver Customizing Codes

CODE	NAME	DESCRIPTION
e	Transceiver's Internal Speaker	The "e" Command followed by the appropriate two decimal digits sets the state of the transceiver's internal speaker when transceiver is turned ON. "e00" = Speaker is OFF at transceiver turn ON (default) "e01" = Speaker is ON at transceiver turn ON
	Transceiver's Front Panel Backlighting	The "e" Command followed by the appropriate two decimal digits sets the intensity of the backlighting on the transceiver's front panel keyboard and display when transceiver is turned ON. "e10" = Backlighting OFF (default) "e11" = Backlighting at intensity level 1 (low) "e12" = Backlighting at intensity level 2 (medium) "e13" = Backlighting at intensity level 3 (high)
q	Squelch Control when in the CT mode	The "q" Command followed by the appropriate three decimal digits sets the state of the CT squelch. "q020" = CT squelch is always broken. The Squelch Control has no effect. (default) "q021" = CT squelch is broken by the signal level as controlled by the Squelch Control. **NOTE** 1. The Squelch Control can be either the front panel SQUELCH Control or the remote squelch as controlled by the "$xxx" command. 2. PT squelch is unaffected by the "qxxx" command.
	Scan Control	The "q" Command followed by the appropriate three decimal digits sets the state of the Scan function. "q030" = Scanning stops upon completion of a transmission. (default) "q031" = Scanning resumes upon a completion of a transmission.
^	Delay and Timing Parameters	xx = 00 to 01 yyy = 000 to 255. xx = device number yyy = device value Device descriptions: ***00:*** *DVI Shutdown Time (Obsolete)* ***01:*** *PTT Check Squelch Delay* Specifies the amount of time In 10 ms units) to wait before checking squelch after entering receive mode following a PTT release. Example: ^01060 sets delay to 600 msecs.

Table 12 - Transceiver Customizing Codes (Continued)

CODE	NAME	DESCRIPTION
!	Aviation Mode ECS-8 Option Only	Initializes all channels to the default values including Aviation Mode On, AM, PT, low power, 118 MHz, Wideband 25 kHz. **NOTE** Use the "I" command to defeat Aviation Mode.
<	Wideband vs. Narrowband selection ECS-8 Option Only	<1: Enable 25kHz Channel Spacing <2: Enable 8.33kHz Channel Spacing Returns a NAK if ECS-8 Option is not enabled.
Wxxxx	Warp Command	ONLY VALID for software version 1.6 and later. For previous software versions, please call General Dynamics. The "W" command followed by four decimal digits from 0000 to 1023 adjusts the crystal warp value. This is used to fine tune the transceiver frequency accuracy. Refer to Appendix A for procedure.

Table 13 - Transceiver Status Inquiry Commands

CODE	NAME	DESCRIPTION
?01	Synth Lock/Unlock	The transceiver responds to whether its synthesizer is in a lock or unlock condition. "A0" = synthesizer is unlocked "A1" = synthesizer is locked
?02	Channel Scan Detect	This inquiry is used to determine whether or not squelch has been broken during scan mode. If so, the channel number is identified. "Q0" = Channel 0 detected during scan "Q1" = Channel 1 detected during scan : : "Q9" = Channel 9 detected during scan "QN" = No channel currently detected Note: This is the only inquiry command allowed while in the Scan mode.
?03	Receive Sig Strength	The transceiver responds to the value of the SQ CL, which represents the signal strength of a received signal. "Nxxx" – where 'xxx' = a decimal value (000-255) representing the signal strength.
?04	Calibration Status	The transceiver responds with the status of the tuning procedure. H0 if calibration is not complete. H1 if calibration is complete.
?05	Power Supply Status	The transceiver responds with the decimal values of the power supplies (without the decimal points). "Vaaabbbcccdddeeefff" – where: 'aaa' = the +5 VDC reading (a.aa) 'bbb' = the +12 VDC reading (bb.b) 'ccc' = the -5 VDC reading (c.cc) 'ddd' = the -12 VDC reading (dd.d) 'eee' = the +24 VDC reading (ee.e) 'fff' = the +70 VDC reading (ff.f)
?06	VFWD Status	The transceiver responds by sending back the value of the VFWD read. "Zxxx" – where 'xxx' = the decimal value
?07	VRFD Status	The transceiver responds by sending back the value of the VRFD read. "Ixxx" – where 'xxx' = the decimal value.

Table 13 – Transceiver Status Inquire Commands (Continued)

CODE	NAME	DESCRIPTION
?08	SW Version	The transceiver responds by sending back a value representing the software version followed by the date and time of compilation. “Ux” – 'U' represents the URC-200 (V2) version and “x” represents the Rev level followed by the date and time as follows: “tr ccccccccc **Ver**vv ‘Mmm dd yyyy hh:mm:ss’” t = Radio type (‘V’ = urc200) r = Revision level. ccc… = Control drawing number Ie: 98-P41135F) vv = Version number. mmm = Month (Jan, Feb, …) dd = Day. yyyy = Year. hh = Hour. mm = Minute. ss = Second.
?09	Squelch Level Setting	The value of the squelch setting of the transceiver. This command returns the front panel control setting or the remote setting depending on whether the transceiver is in local or remote at the time the inquiry is sent. "$xxx" – where ‘xxx’ is a decimal number from 0 to 255.
?10	Current Preset Status	Gives status of the various values of the current preset. "Txxxxxxx" = Transmit Frequency "Rxxxxxxx" = Receive Frequency "Mx" – AM/FM – TRANSMIT/RECEIVE “M0” = TRANSMIT/RECEIVE AM “M1” = TRANSMIT/RECEIVE FM "Nx" – AM/FM – TRANSMIT only “N0” = TRANSMIT AM “N1” = TRANSMIT FM "Cx" – SCAN LIST ON/OFF “C0” = Not on scan list “C1” = On scan list "Px" – PRESET NUMBER "#x" – Power Level “#0” = Lo Power “#1” = Med Power “#2” = High Power

Table 13 – Transceiver Status Inquire Commands (Continued)

CODE	NAME	DESCRIPTION	
?11	General Status	Gives the general status of the transceiver in the form : "**X**x**J**j**L**l**d**y**F**f**v**zzz" "Xx" – PT/CT "X0" = PT "X1" = CT "Jx" – SPEAKER OFF/ON "J0" = Speaker OFF "J1" = Speaker ON "Lx" – LAMP OFF/LO/MED/HI "L0" = Lamp Off "L1" = Lamp Lo "L2" = Lamp Med "L3" = Lamp Hi "dx" – Option Status "d0" - no options "d1" - obsolete "d2" - 30_90 option selected "d3" - obsolete "d4" - 420 option selected "d5" - obsolete "d6" - both 30_90 and 420 option selected "d7" - obsolete "Fx" – Overtemp Condition "F0" - Temperature OK "F1" - Overtemp Condition zzz = 000 if no options are selected = 001 to 255 depending on the options enabled (see the 'd' cmd).	
?12	General Mode Status	Gives the mode of the transceiver with one of the codes shown below. This will indicate whether it is in the Beacon, normal receive, or transmit mode. "*1" = Beacon mode "U0" = Receive mode "U1" = Transmit mode	
?13	Squelch Status	"[0" = Transceiver Squelched "[1" = Transceiver Squelch Broken	
?14	Warp Value	<u>SW version 1.5 and earlier:</u> Returns the current warp value in the following format: "Wxxx" where: 'W' = Warp and 'xxx' = the current Warp value.	<u>SW version 1.6 and later:</u> Returns the current warp value in the following format: "Wxxxx" where: 'W' = Warp and 'xxxx' = the current Warp value.

Table 13 – Transceiver Status Inquire Commands (Continued)

CODE	NAME	DESCRIPTION
?16	Power Level Values	Returns value in the form: "**&**aaabbbcccdddeeefffgggghhhiiijjjkkk" aaa = AM Low value. bbb = AM High value. ccc = FM Low value. ddd = FM Medium value. eee = FM High value. fff = AM high value at 115 MHz. ggg = AM high value at 152 MHz. hhh = AM high value at 174 MHz. iii = AM high value at 225 MHz. jjj = AM high value at 400 MHz. kkk = AM high value at 420 MHz.
?17	Tuning Filter Value	Returns value of the tuning filter pot. "}nnn" is the value returned where: 'nnn' = a value from 0 - 255.
?18	Reserved	
?19	30_90 Tone	Returns value in the form ">n" n = 0 if receive and transmit tones are off. = 1 if 150 Hz receive-tone is on. = 2 if 150 Hz transmit-tone is on. = 3 if both receive and transmit tones are on.
?20 to ?70	Deviation Values	Returns value in the form "**F**xxx" xxx = current value of that variable.
?71	Flat Slope Status	Returns "fx" where 'x' = 0 if pre-emphasis and 'x' = 1 if no pre-emphasis is set.
?72	5 kHz Spacing	Returns value in the form: "**n**x" x = 0 if 5 kHz spacing is disabled. X = 1 if 5 kHz spacing is enabled.
?73	Startup Enable Values	Returns the startup enable values as shown below: "e.0a.1b" -- where: a = 0 if speaker is off. = 1 if speaker is on. b = 0 if display lamp is off. = 1 if display lamp is at intensity level 1. = 1 if display lamp is at intensity level 2. = 1 if display lamp is at intensity level 3.

Table 13 – Transceiver Status Inquire Commands (Continued)

CODE	NAME	DESCRIPTION
?74	Transceiver Control Modes	Value is returned in the form: "**q.00**a**.01**b**.02**c**.03**d" a = 0 if transceiver in old RF card mode. = 1 if transceiver in new RF card mode. b = 0 if PT & CT are channel specific. = 1 if PT & CT are global. c = 0 if CT squelch control is static. = 1 if CT squelch control is dynamic. d = 0 if scan stops after a PTT press/release. = 1 if scan continues after a PTT press/release
?75	Timing and Delay Parameters	Value is returned in the form: "^**.00**aaa**.01**bbb" aaa = DVI Shutdown Time (obsolete) bbb = PTT Squelch Delay In 10 ms units)
?76	Squelch Detect Parameters	Value is returned in the form: "**w.0**aaa**.1**bbb**.2**ccc **.3**ddd**.4**eee**.5**fff" aaa = 30 to 90 MHz squelch level scalar bbb = Carrier level slope scalar ccc = Noise level slope scalar ddd = Squelch level offset eee = Squelch pot slope scalar fff = Squelch threshold offset
?77 to ?79	Reserved	
?80 to ?85	Deviation Values	Returns value in the form "**F**xxx" xxx = current value of that variable.
?86	Read PA-PATH discrete	Returns values in the form: "Dx". x = 0 if PA-PATH discrete low, x = 1 if PA-PATH discrete high.
?87	Read muxed analog values	Returns value in the form: "abbbcccdddeeefff" bbb = CAL_DET_CTRL, ccc = B3_CAL_DET_CTRL, ddd = B3_LOCK_DET_CTRL, eee = B3_TONE_DET_CTRL, fff = LOCK_DET_CTRL.
?88	Read analog values	Returns value in the form: "bxxxcccdddeeefff" xxx = A2D_OVERTEMP, ccc = A2D_VOL_POT, ddd = A2D_SQL_NL, eee = A2D_SQL_CL, fff = A2D_SQL_POT.
?89	Aviation Mode	Returns value in the form: "!n" n=0 Disable Aviation Mode n=1 Enable Aviation Mode

Table 13 – Transceiver Status Inquire Commands (Continued)

CODE	NAME	DESCRIPTION
?90	Receiver Filter Bandwidth Selection	Returns value in the form: "<xxxx" xxxx = bandwidth value for the current Rx channel (25 KHz or 8.33 KHz)
?99	Debug Inquiry	Returns value in the form: "?" The string returned by this command depends on debug code provided by the developer. If the chip was not compiled with the debug option, then this command returns a NAK.
The following inquiry command applies to transceivers with the EBN-30 Option, 30-90 MHz Band Enhancement.		
?19	30_90 SQL	Returns the status of the 150 Hz tone squelch. See ">" command in the Transceiver Adjustment Commands. Returns ">n" where 'n' = 0 for unsquelched, and 'n' = 1 for squelched.

4.7 Options

The following options are available for the URC-200 and URC-200 (V2).

4.7.1 EBN-30, 30 TO 90 MHz Option

Part Number 01-P37200N001. This option provides the 30 to 90 MHz (LVHF) band to the URC-200 (V2) Radio Set. Many of the operational features in the 30 to 90 MHz frequency band are the same as in the VHF or UHF frequency bands.

4.7.1.1 Frequency Range

The 30 to 90 MHz range of frequencies resides in the Low VHF (LVHF) band of frequencies. The LVHF frequencies on the URC-200 (V2) have a center frequency tuning increment of 12.5 kHz.

4.7.1.2 Tone Squelch

Normally the URC-200 (V2) in the LVHF band will use a 150 Hz Tone Squelch that is compatible with other radios in this band of frequencies. If desired, the tone may be turned OFF, however, "white-noise" will be coming from the speaker.

4.7.1.3 Modulation

The URC-200 (V2) using the 30 to 90 MHz option will receive and transmit FM modulation only.

4.7.1.4 Carrier-to-Noise Squelch

The carrier-to-noise squelch, which is set by the Squelch Control when the URC-200 (V2) is in the VHF or UHF frequency bands, is effectively disabled in 30-90 MHz band.

4.7.1.5 Select Meter Mode

The front panel display signal strength meter and power meter do not operate when the transceiver is in the 30 to 90 MHz band.

4.7.1.6 UEC-120/220 Remote Control Optional Accessory

Use only the UEC-120/220 Remote Control Units when operating the URC-200 (V2) with the 30 to 90 MHz Option. The optional remote control accessory, UEC-100/200, was designed only for the VHF and UHF frequency bands. The UEC-100/200 will not operate in the 30 to 90 MHz (LVHF) frequency band and, therefore, cannot be used with the URC-200 (V2) when using the LVHF band.

4.7.1.7 Specifications

Table 14 identifies the specifications pertaining only to the 30 to 90 MHz option within a URC-200 (V2) transceiver.

Table 14 - 30 to 90 MHz Specifications

General

Frequency Range:	LVHF - 30 to 90 MHz
Modulation:	FM only

Receiver Characteristics

Sensitivity:	
PT - 10 dB SINAD:	≤ -110 dBm, 1 kHz modulation with ±10 kHz deviation
CT – 10 $^{-3}$BER (Bit Error Rate):	≤ -105 dBm, 16 kb/sec (kilo bits per second) with ±6.5 kHz deviation
Spurious Response:	≥ 80 dB
Squelch Type:	• 150 Hz Tone Squelch (tone ON) • No squelch when the 150 Hz tone is OFF
Squelch Range:	• Tone Squelch: <-110 dBm, fixed trip point • No squelch when the 150 Hz tone is OFF.

Transmitter Characteristics

High Power Output:	5 watts +2/-1 dB (37 dBm +2/-1 dB)
Medium Power Output:	1 watts +3/-2 dB (30 dBm +3/-2 dB)
Low Power Output:	150 mW +3/-2 dB (21.8 dBm +3/-2 dB)
Modulation:	
PT:	±10.0 kHz at 1 kHz
CT:	±6.5 kHz at 8 kHz

4.7.1.8 Required System Equipment

Table 15 identifies minimum required equipment for a self-contained LOS communications device operating in the LVHF band.

Table 15 - LVHF Band Required Equipment

Quantity Required	Part Number	Nomenclature
1	01-P36744M003	URC-200 (V2) Transceiver
1	01-P37200N001	30 to 90 MHz URC-200 (V2) Module Assembly. EBN -30 Option
1	85-P35988M001	Antenna VHF/UHF
1	10454	Antenna LVHF
1	01-P04535L001	Handset, H-189/GR
1	01-P36751M001	Battery Box

4.7.1.9 Sighting in LVHF Band

Although ionospheric scatter propagation is possible in the 30 to 90 MHz range, the results can be unpredictable and sporadic. When using the URC-200 (V2) in the 30 to 90 MHz frequency band (LVHF) it is recommended that the same line-of-sight (LOS) sighting considerations be applied as when operating in the VHF or UHF frequency bands.

4.7.1.10 Antenna Installation

Connect the LVHF antenna to the type “N” connector on the front panel (Figure 15). Route the gooseneck portion of the antenna base so the antenna is oriented vertically. Satisfactory performance can be achieved with the LVHF antenna and the VHF/UHF antenna mounted on the URC-200 (V2) at the same time. However, the unused antenna should be removed for optimum antenna performance.

4.7.1.11 Selecting LVHF Frequencies

Press the [FREQ] key (keypad [1]) to select the frequency entry mode. To select a frequency in the LVHF band, press zero (0) before entering the desired frequency. For example, to enter 35.6 MHz, press [0] [3] [5] [6] [0] [0].

4.7.1.12 Squelch

The 30 to 90 MHz band employs a 150 Hz Tone Squelch. To activate the Tone Squelch, press the [TONE] key (keypad [2]). A lower case “t” appears at the 100 MHz position on the display when the Tone Squelch is active, or turned ON. When using the 150 Hz Tone Squelch, the Squelch Control will not affect the tone squelch threshold. It should be noted that the only signals that will break the receiver’s squelch, when the Tone Squelch is ON, are those that are on-channel and are being modulated with a 150 Hz tone that has a sufficient deviation level to break the receiver’s tone squelch threshold.

If desired, the 150 Hz Tone Squelch may be deactivated, or turned OFF. The lower case “t” will disappear from the 100 MHz position on the display when the Tone Squelch is turned OFF. With the tone turned OFF there is no squelching of the white-noise on the URC-200 (V2).

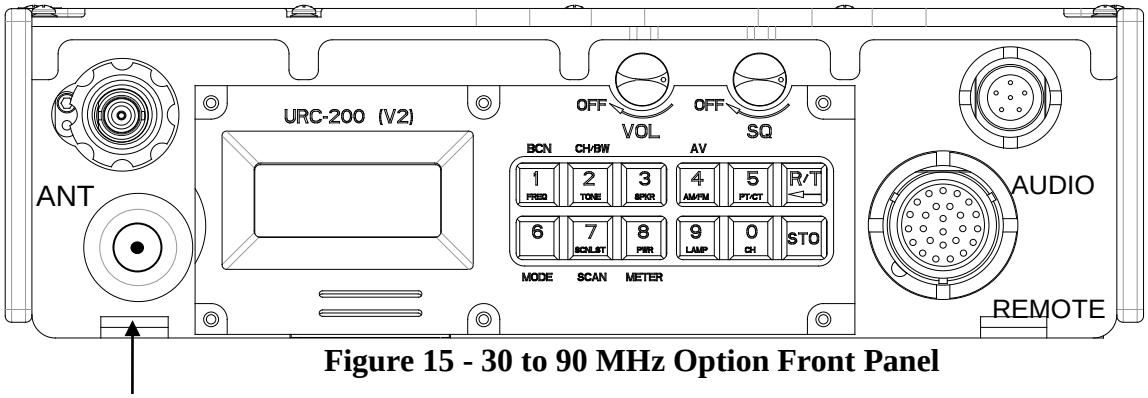


Figure 15 - 30 to 90 MHz Option Front Panel

4.7.2 EBN-400, 400 TO 420 MHZ Option

Part Number 01-P39234N001. This option extends the URC-200 (V2) Radio Set’s UHF band to 420 MHz. Many of the operational features in the 400 to 420 MHz frequency band are the same as in the UHF band.

4.7.2.1 Frequency Range

The 400 to 420 MHz band of frequencies in the URC-200 (V2) includes tuning increments of 25, 12.5 and 5 kHz.

4.7.2.2 Modulation

The URC-200 (V2) with the 400 to 420 MHz option receives and transmits using FM modulation.

4.7.2.3 Text Mode

When in 400 to 420 MHz band, received data is inverted whether the URC-200 (V2) is in Plain Text (PT) mode or Cipher Text (CT) mode.

4.7.2.4 Specifications

Table 16 identifies specifications pertaining only to the 400 to 420 MHz option within a URC-200 (V2) transceiver.

Table 16 - 400 to 420 MHz Specifications

General

Frequency Range:	400 to 420 MHz
Modulation:	FM

Operating Modes

Text Mode:	PT or CT

Transmitter Characteristics

High Power Output:	10 Watts -2 dB,+ 2 dB into 50 Ω
Medium Power Output:	5 Watt -2 dB,+2dB into 50 Ω
Low Power Output:	0.1 Watts -5 dB,+5 dB into 50 Ω

4.7.2.5 Required System Equipment

Table 17 identifies the minimum equipment required for a self contained LOS communications device operating in the 400 to 420 MHz band.

Table 17 - 400 to 420 MHz Band Required Equipment

Quantity Required	Part Number	Nomenclature
1	01-P36744M003	URC-200 (V2) Transceiver
N/A	01-P39234N001	400 to 420 MHz URC-200 (V2) Module Assembly Option
1	85-P35988M001	Antenna VHF/UHF
1	01-P04535L001	Handset, H-189/GR
1	15-P35722M001	Battery Box

4.7.2.6 Selecting 400 to 420 MHz Frequencies

Press the [FREQ] key (keypad [1]) to select frequency entry mode. To select a frequency, enter the desired frequency.

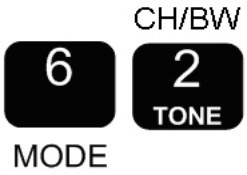
4.7.3 ECS-8, 8.33 kHz Option

Part Number 01-P42311K001. The ECS-8 option provides three features:

- ECS-8 allows the user to choose a channel spacing of either 25 kHz or 8.33 kHz in the frequency range of 117.9750 to 136.9750 MHz when in AM PT mode. This is discussed below.
- ECS-8 also provides 8.33kHz tuning increments over the entire VHF/UHF frequency range of the transceiver in AM, FM, PT and CT. Normally the tuning increments are 25 kHz, 12.5 kHz and 5 kHz. The ECS-8 option allows the additional 8.33 kHz increment to be entered directly using the front panel keypad or remote control. See Paragraph 4.7.3.3 for a description of tuning increments vs. channel spacing.
- ECS-8 also provides an Aviation Mode of operation. When this mode is engaged, the radio is restricted to AM PT operation in the frequency range of 117.9750 to 136.9750 MHz. Channel spacing of either 25 kHz or 8.33 kHz is determined by the channel entered into the radio in accordance with ICAO standards per Annex 10 to the Convention on International Civil Aviation, Volume V. This is discussed further below.

4.7.3.1 Manual Channel Spacing Selection

This feature is only available in the AM, PT mode in the tuning range of 117.9750 to 136.9750 MHz if the Aviation Mode is not engaged. Enter the desired frequency within this range and then press [Mode] [2]. The display toggles between 25 and 8.33 to indicate which channel spacing is selected. The new value takes effect immediately, as indicated by the annunciator, but is not saved until the [STO] key is pressed.



Aviation mode

To place the transceiver in the Aviation Mode, start with the transceiver powered off and then press and hold the 4 [AV] keypad while turning on the power. The unit remains in the aviation mode through subsequent power cycles until it is returned to the normal operating mode.

The transceiver sets all the channel data for each channel to a default value (118 MHz, PT, AM, 25 kHz bandwidth, low power). Existing channel data (presets) will not be retained.

To return to the normal operating mode, start with the transceiver powered off and press and hold the 6 [MODE] key while turning on power.

The transceiver will reset all the channel data (presets) for each channel to the default values (225 MHz, PT, AM, 25 kHz bandwidth, low power).

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4.7.3.2 Tuning and Channel Spacing in Aviation Mode

When in the Aviation Mode, the format in which the channel is entered determines the actual operating frequency and the channel spacing. The ICAO standard mandates that specific channel spacings (either 25 or 8.33 kHz) shall be assigned to specific channel entries. This also means the channel that is entered and displayed may be different from the actual frequency the transceiver is tuned to.

The Aviation Mode Frequency Chart (Table 18) shows an example of how to enter channels to select the desired operating frequency and channel spacing. The table uses 118 MHz as an example; however, any frequency from 117.9750 to 136.9750 kHz may be selected.

For example, if the desired actual operating frequency is 118.000 MHz with a channel spacing of 25 kHz, enter 118000 using the keypad or remote command. The result will be what is shown in line 1 of the chart. If, however, the desired frequency is 118.000 MHz but with a channel spacing of 8.33kHz, enter 118005 and the result will be as shown in line 2 of the chart. Note that the transceiver will display 118005 even though it is tuned to 118.000 MHz.

In some cases, only 8.33 kHz channel spacing is allowed. Examine lines 3 and 4 of the chart. Because tuning increments of 8.33 kHz are allowed, the next possible operating frequency after 118.000 MHz is 118.0083 MHz. In this case only 8.33 kHz channel spacing is available for this frequency. To tune this frequency, enter 118010 into the transceiver. The entered value is what will be displayed even though the transceiver will be operating at 118.0083 MHz.

In a similar fashion, line 4 of the chart shows that the next available frequency is 118.0166 MHz. This also is only allowed to have a channel spacing of 8.33 kHz. To operate at this setting, enter 118015 to the transceiver.

Lines 5 and 6 of the chart show that the process repeats at this point.
If the user attempts to enter a frequency that is not allowed, the transceiver will simply not accept the input until a valid value is entered.

Table 18 - Aviation Mode Frequency Chart

Line Number	Channel Entered (MHz)	Actual Operating Frequency (MHz)	Channel bandwidth (KHz)
1	118.000	118.0000	25
2	118.005	118.0000	8.33
3	118.010	118.0083	8.33
4	118.015	118.0166	8.33
5	118.025	118.0250	25
6	118.030	118.0250	8.33
7	118.035	118.0333	8.33
8	118.040	118.0416	8.33
9	118.050	118.0500	25
10	118.055	118.0500	8.33
11	118.060	118.0583	8.33
12	118.065	118.0666	8.33
13	118.075	118.0750	25
14	118.080	118.0750	8.33
15	118.085	118.0833	8.33
16	118.090	118.0916	8.33
17	118.100	118.1000	25
18	118.105	118.1000	8.33
19	etc.	etc.	etc.

4.7.3.3 Tuning Increment vs. Channel Spacing, Electrical Characteristics

The “tuning increment” is the minimum incremental change in operating frequency by which a transceiver is capable of tuning.
The “channel spacing” is the window (or the bandwidth in kHz) in which a tuned transceiver operates, and represents the minimum acceptable adjacent channel separation. This window, or bandwidth, is determined by the receiver’s adjacent channel rejection (selectivity or bandwidth) and the transmitter’s adjacent channel power. Please refer to Table 1 for typical URC-200 performance parameters for both 25kHz and 8.33kHz channel spacings.

In the URC-200 (V2) without the ECS-8 option installed, the channel spacing (IF selectivity) is fixed at 25kHz, regardless of whether the tuning increment is 5kHz, 12.5kHz or 25kHz.

In the URC-200 (V2) with the ECS-8 option installed (8.33kHz tuning), the channel spacing (IF selectivity) is selectable (8.33kHz or 25kHz) within the 117.975 to 137.975 MHz band in AM PT mode, in accordance with ICAO standards per Annex 10 to the Convention on International Civil Aviation, Volume V.

5.0 MAINTENANCE

The URC-200 (V2) has no serviceable parts. Do not disassemble the device. Devices requiring repair must be returned to General Dynamics for repair.

Perform maintenance procedures annually or as specified in local directives.

5.1 Cleaning

Exterior Cleaning - To clean the unit's exterior, use a clean lint-free cloth moistened in a solution of mild household detergent and water. Follow this by wiping down with a clean lint-free cloth moistened in clean water, and then wipe dry. Never use harsh detergents, chemical cleaning agents, abrasive compounds, or bristle brushes to clean the unit because these may permanently mar the surface.

5.2 Performance Verification

This section provides a system-level performance test to check all operations of the URC-200 (V2) Radio Set. A list of required tools and test equipment is provided below.

NOTE

This section does not include system-level performance tests to check the various URC-200 (V2) options listed in Paragraph 1.3.1.

5.3 Manual System Test

The manual system test checks the operating parameters of the URC-200 (V2) under test, using General Dynamics Analyzer (R2600 series) as the primary test equipment.

CAUTION

To comply with RF exposure requirements, a minimum separation distance of 20 cm (7.9 inches) is required between the antenna and all persons while the transceiver is transmitting. ManPack (backpack) and hand-carry users should not exceed 50% duty cycle, as this approaches RF hazard limits and reduces battery life.

5.3.1 Test Equipment Required

Testing and troubleshooting the transceiver requires the test equipment listed in Table 19. If a R2600 Communications System Analyzer is not available, the alternate test equipment listed in Table 20 may be substituted to perform its functions. A schematic diagram for the breakout box is shown in Figure 16.

Table 19 - Test Equipment Required

Qty.	Description	Part No.	Supplier
1	Power Supply, 28 VDC, 5A	HP-6291 A	Hewlett-Packard
1	Communications System Analyzer	R2600	General Dynamics
1	Breakout Box For REMOTE Connector	-	-
1	Current Meter	HP-428B	Hewlett-Packard

NOTE

- Verify the test equipment has been calibrated.
- When verifying the various test measurements against the operating parameters as listed in Table 1, take into consideration the accuracy of the test equipment being used.

Table 20 - Alternate Test Equipment

Qty.	Description	Part No.	Supplier
1	Frequency Counter	HP-5383A	Hewlett-Packard
1	Signal Generator	HP-8640B	Hewlett-Packard
1	Distortion Analyzer	HP-334A	Hewlett-Packard
1	Digital Voltmeter	HP-3465A	Hewlett-Packard
1	RMS Voltmeter	HP-3400A	Hewlett-Packard
1	30dB, 100-Watt Power Attenuator	769-30	Narda
1	3 dB Power Attenuator	766-3	Narda
1	Power Meter	HP-436A	Hewlett-Packard
1	Modulation Meter	HP-8901A	Hewlett-Packard
1	Audio Oscillator	HP-201C	Hewlett-Packard
1	Oscilloscope	465	Tektronix
1	Power Supply, 28 VDC, 5A	HP-6291A	Hewlett-Packard
1	Breakout Box for REMOTE Connector	-	-
1	Current Meter	HP-428B	Hewlett-Packard

5.3.2 Receiver Tests

WARNING

DO NOT THROW BATTERIES IN THE TRASH

Dispose of all used batteries in accordance with all manufacturer, Federal, State and local laws and regulations.

Improper handling, reverse-current operation or high environmental temperatures may cause internally generated heat, fire, or toxic materials and gasses to be released from the battery.

The following precautions must be strictly observed to prevent injury to personnel or damage to equipment:

- DO NOT heat, incinerate, crush, puncture, disassemble or mutilate the batteries.
- DO NOT recharge primary (Non- rechargeable) batteries.
- DO NOT store in equipment during periods of non-use for more than 30 days.
- DO follow all safety instructions that come with the batteries or printed on them.
- TURN OFF the equipment immediately if you (1) detect that the battery compartment is becoming unduly hot, (2) hear battery cells venting (hissing), or (3) smell irritating sulfur dioxide gas. Remove the battery only after it is cool (after 30 to 60 minutes), and dispose of it by following approved procedures.

The following tests evaluate the performance of the receiver circuits. The functions that will be tested are receiver sensitivity and distortion at various frequencies in AM and FM, and in CT and PT modes. Squelch sensitivity will also be checked. If the transceiver fails any of the tests, or if it cannot be adjusted to the specified values, it must be sent to General Dynamics C4 Systems for repair.

5.3.2.1 FM PT Sensitivity and Distortion

1. Set up the test equipment as shown in Figure 16. Connect the VERT/SINAD/DIST/DVM/COUNTER IN connector on the R2600 to Pin E (PT OUT) of the Breakout Box. Pin A or D of the remote connector is return ground.
2. Set the input power supply to 28 ± 01 VDC.

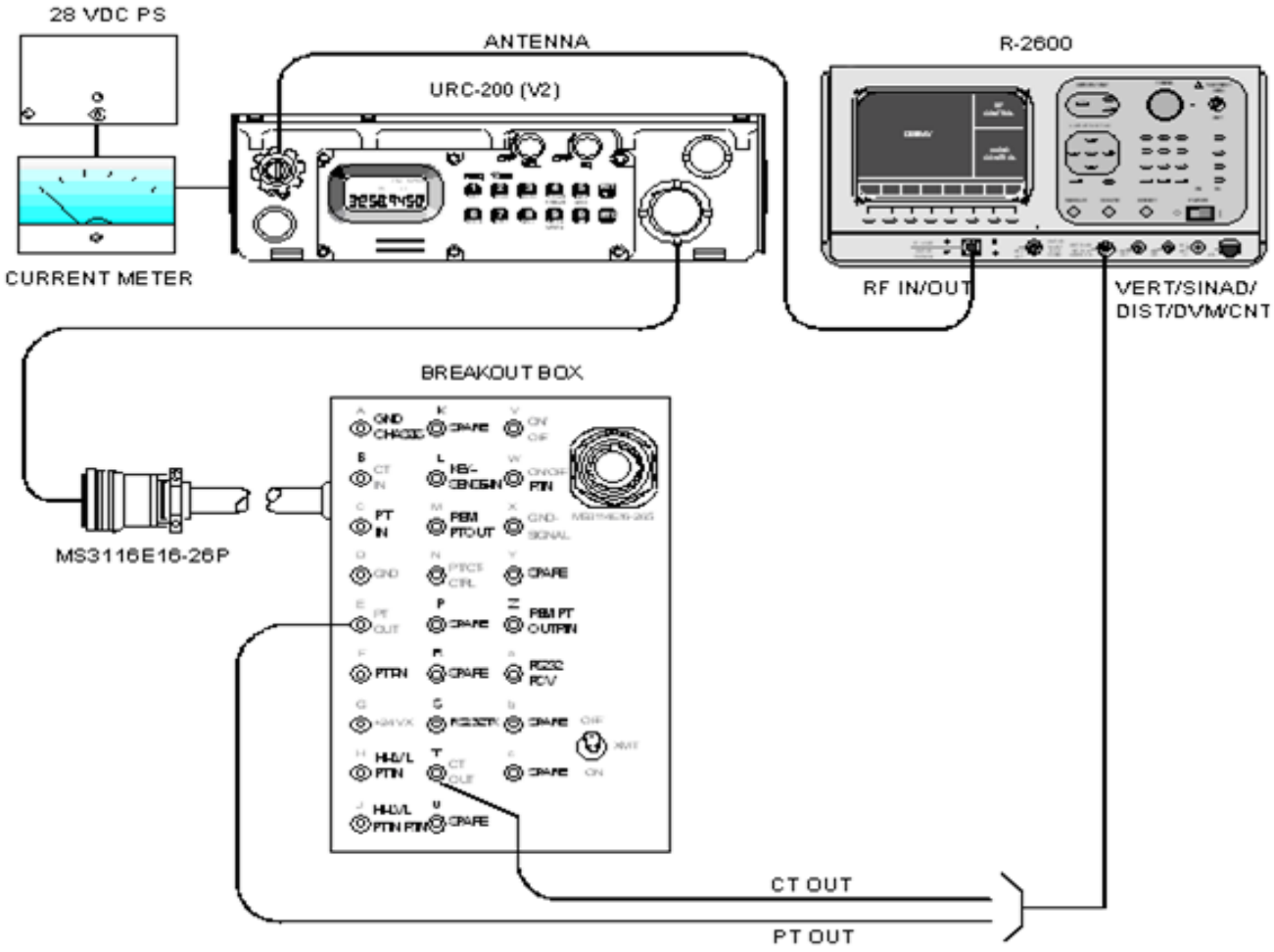


Figure 16 - Receiver Test Equipment Setup

3. Preset the R2600 by performing the following steps.

   a. Press the MEM (Memory) key on the R2600 panel for the preset-screen.

   b. Use the CURSOR POSITION keys to highlight preset 01.

   c. Press the "view preset" soft key.

NOTE

The soft keys are the eight keys under the CRT screen on the R2600.

   d. Using the CURSOR POSITION keys move to the Monitor Frequency position and enter 115.000 from the R2600 keypad.

   e. Move the cursor to Modulation Type and press the "FM" soft key.

   f. Move the cursor to the Generate Frequency position and enter 115.000 from the R2600 keypad.

   g. Move the cursor to Modulation Type and press the "FM" soft key.

   h. Move the cursor to bandwidth and press the "NARROW ±5 kHz" soft key.

i. Move the cursor to the Duplex Offset position and press the "DON'T CARE" soft key.

j. Move the cursor to Synth. Format Sel (Synthesizer Format Select) and select the "Tone A" soft key.

k. Move the cursor to Freq (Frequency) and enter 01000.0 from the keypad.

l. Move the cursor to the DTMF Code position and press the "DON'T CARE" soft key.

NOTE

The “more” soft key may have to be depressed for the “DON’T CARE” soft key to be displayed.

m. Use Table 21 to program the frequency presets in steps D and F above.

n. Press the "return" soft key.

Table 21 - FM Frequency Presets

Preset		Frequency
URC-200 (V2)	R2600	MHz
CH1	CH01	115.000
CH2	CH02	145.025
CH3	CH03	173.975
CH4	CH04	225.075
CH5	CH05	275.000
CH6	CH06	299.975
CH7	CH07	300.000
CH8	CH08	312.000
CH9	CH09	355.000
CH0	CH10	399.975

4. Perform the following steps to complete the setup on the R2600 analyzer.

a. Press RF key on the R2600 panel. Move the cursor to RF Control and press the "GEN" soft key.

b. Move the cursor to the Output Lvl (RF Output Level) position and enter a level of -050.0 dBm from the keypad.

c. Move the cursor to the Gen RF Out position and press the "RF IN/OUT" soft key.

d. Depress the AUD (Audio) key on the R2600 panel. Move the cursor to the Synth (Synthesizer) position and enter 6.50 kHz from the keypad.

NOTE

This is FM Deviation. Depress the RIGHT ARROW CURSOR CONTROL key and depress “Cont” (Continuous) soft key.

e. Move the cursor to the Fixed 1 kHz position. Depress the LEFT ARROW CURSOR CONTROL key and then depress the "Off" soft key.

f. Verify the DTMF position and the External position are both OFF.

g. Depress the DISP (Display) key on the R2600 panel. Move the cursor to the Meter position and depress the "AC VOLTS" soft key.

h. Move the cursor to the Range position and depress the "AUTO" soft key.

i. Move the cursor to the Display position and depress the "EXT SCOPE" soft key.

j. Move the cursor to the Coupling position and depress the "AC" soft key.

k. Move the cursor to the Trigger position and depress the "AUTO" soft key.

l. Move the cursor to the Trigger Lvl (Trigger Level) position and enter 500 from the keypad.

m. Move the cursor to the Horiz (Horizontal) position and depress the "500 us" soft key.

n. Move the cursor to the Vert (Vertical) position and depress the "1 V" soft key.

o. Move the cursor to the Pos (Position) position and depress the "move up" or "move down" soft keys as appropriate to center the displayed scope screen trace. The TUNING knob on the R2600 panel may be used in lieu of the "move up" or "move down" soft keys.

p. Adjust both the SQUELCH and VOLUME controls on the front panel to their maximum CCW positions.

5. Setup the URC-200 (V2) as follows:

a. Turn the transceiver on and note the input current. It should be approximately 240mA. If the current exceeds 330mA, a problem exists in the transceiver. Turn off the power and troubleshoot the transceiver.

b. Set the frequency presets as listed in Table 21 on the URC-200 (V2). For each preset channel, adjust the URC-200 (V2) for the following:

FM, PT, SCN OFF, BCN OFF,

To configure presets, refer to Paragraph 4.4.6.

6. On the R2600, do the following:

a. Verify the "AC VOLTS" is on in the Meter position of the DISP (Display) segment.

b. Verify the "AUTO" is on in the Range position of the DISP (Display) segment.

c. Set the presets on both the URC-200 (V2) and the R2600 to channel 01. Adjust the Volume control on the URC-200 (V2) to give an output level of 1.0 VAC ±0.1 VAC as read on the R2600 display.

d. Receiver FM PT Sensitivity Measurement**:** Move the cursor to the Meter position and depress the "SINAD" soft key. Depress the RF key on the R2600 panel and move the cursor to the Output Lvl (RF Output Level) position. Position the highlight to the one-tenth position by depressing the RIGHT ARROW CURSOR POSITION key three times. Rotate the TUNING control counter-clockwise on the R2600 panel until an average of 10 dB of SINAD is read on the CRT display. Verify compliance with Table 1.

e. Readjust the Output Lvl back to -50 dBm by rotating the TUNING control clockwise to -50 dBm. This can also be accomplished by moving the highlight back to the beginning of the Output Lvl position by using the CURSOR CONTROL keys and then entering -50 dBm on the keypad.

f. Receiver FM PT Distortion Measurement**:** Depress the DISP (Display) and move the cursor to the Meter position. Depress the "EXT DIST" (External Distortion) soft key. The

FM PT Distortion is displayed in percent in the Display area of the CRT screen. Verify compliance with Table 1.

g. On both the URC-200 (V2) and the R2600 repeat steps A through F for preselect channels 2 through 9 and channel 0 on the URC-200 (V2) with the R2600 set on preset channel 10.

5.3.2.2 FM CT Sensitivity

1. Set up the test equipment as shown in Figure 16. Connect the VERT/SINAD/DIST/DVM/COUNTER IN connector on the R2600 to Pin T (CT Out) of the Remote connector. Pin A of the Remote connector is return ground.
2. Set the input power supply to 28 ± 1 VDC.
3. Preset the R2600 by performing the following steps.

   a. Press the MEM (Memory) key on the R2600 panel for the preset-screen.

   b. Use the CURSOR POSITION keys to highlight preset 01.

   c. Press the "view preset" soft key.

NOTE

The soft keys are the eight keys under the CRT screen on the R2600.

   d. Use the CURSOR POSITION keys to the Monitor Frequency position and enter 115.000 from the R2600 keypad.

   e. Move the cursor to Modulation Type and press the "FM" soft key.

   f. Move the cursor to the Generate Frequency position and enter 115.000 from the R2600 keypad.

   g. Move the cursor to Modulation Type and press the "FM" soft key.

   h. Move the cursor to bandwidth and press the "NARROW ±5 kHz" soft key.

   i. Move the cursor to the Duplex Offset position and press the "DON'T CARE" soft key.

   j. Move the cursor to Synth. Format Sel (synthesizer format select) and select the "Tone B" soft key.

   k. Move the cursor to Freq (frequency) and enter 08000.0 from the keypad.

   l. Move the cursor to the DTMF Code position and press the "DON'T CARE" soft key.

NOTE

The “more” soft key may have to be depressed for the “DON”T CARE” soft key to be displayed.

   m. Press the "return" soft key. Repeat steps A through K for presets 02 through 10. Use Table 21 to program the frequency presets in steps D and F above.

   n. Press the "return" soft key.

4. Perform the following steps to complete the setup on the R2600 analyzer.

a. Press RF key on the R2600 panel. Move the cursor to RF Control and press the "GEN" soft key.

b. Move the cursor to the Output Lvl (RF Output Level) position and enter a level of -050.0 dBm from the keypad.

c. Move the cursor to the Gen RF Out position and press the "RF IN/OUT" soft key.

d. Depress the AUD (Audio) key on the R2600 panel. Move the cursor to the Synth (Synthesizer) position and from the keypad enter 5.00 kHz for VHF frequencies or 5.6 kHz for UHF frequencies.

NOTE

This is FM Deviation. Depress the RIGHT ARROW CURSOR CONTROL key and depress “Cont” (Continuous) soft key.

e. Move the cursor to the Fixed 1 kHz position. Depress the LEFT ARROW CURSOR CONTROL key and then depress the "Off" soft key.

f. Verify the DTMF position and the External position are both OFF.

g. Depress the DISP (Display) key on the R2600 panel. Move the cursor to the Meter position and depress the "AC VOLTS" soft key.

NOTE

The “more” soft key may have to be depressed for the “AC VOLTS” soft key to be displayed.

h. Move the cursor to the Range position and depress the "AUTO" soft key.

i. Move the cursor to the Display position and depress the "EXT SCOPE" soft key.

j. Move the cursor to the Coupling position and depress the "AC" soft key.

k. Move the cursor to the Trigger position and depress the "AUTO" soft key.

l. Move the cursor to the Trigger Lvl (Trigger Level) position and enter 500 from the keypad.

m. Move the cursor to the Horiz (Horizontal) position and depress the "50 us" soft key.

NOTE

The “more” soft key may have to be depressed for the “50 us” soft key to be displayed.

n. Move the cursor to the Vert (Vertical) position and depress the "5 V" soft key.

NOTE

The “more” soft key may have to be depressed for the “5 V” soft key to be displayed.

o. Move the cursor to the Pos (Position) position and depress the "move up" or "move down" soft keys as appropriate to center the displayed scope screen trace. The TUNING knob on the R2600 panel may be used in lieu of the “move up" or "move down" soft keys.

p. Adjust both the SQUELCH and VOLUME controls on the front panel to their maximum CCW positions.

5. Setup the URC-200 (V2) as follows:

   a. Turn the transceiver on and note the input current. It should be approximately 240mA. If the current exceeds 330mA, a problem exists in the transceiver. Turn off the power and troubleshoot the transceiver.

   b. Set the frequency presets as listed in Table 21 on the URC-200 (V2). For each preset channel, adjust the URC-200 (V2) for the following.

      FM, CT, SCN OFF, BCN OFF

      To configure presets, refer to Paragraph 4.4.6.

6. Receiver FM CT Sensitivity Measurement:

   a. Depress the RF key on the R2600 panel. Move the cursor to the Preset position and set it for Preset 01. Adjust the URC-200 (V2) for channel 1.

   b. Move the cursor to the Output Lvl (RF Output Level) position. Position the highlight to the one-tenth position by depressing the RIGHT ARROW CURSOR POSITION key three times. Rotate the TUNING control counter-clockwise on the R2600 panel until the RF Output Level reads the limit for FM CT Sensitivity as stated in Table 1.

   c. Verify the 8kHz waveform pattern on the screen of the R2600 has an amplitude of 4 VPP to 24 VPP. Verify the square wave pattern is the same as it was with a -50dBm signal except for the slight jumping around of the 8kHz pattern. It may be helpful to observe the 8kHz pattern as the RF input level is decreased. The jumping around of the pattern will turn into a random breakup of the pattern.

   d. On both the URC-200 (V2) and the R2600 repeat steps A through C for preselect channels 2 through 9 and channel 0 on the URC-200 (V2) with the R2600 set on preset channel 10.

5.3.2.3 Receive AM PT Sensitivity and Distortion

1. Set up the test equipment as shown in Figure 16. Connect the VERT/SINAD/DIST/DVM/COUNTER IN connector on the R2600 to Pin E (PT OUT) of the Remote connector. Pin A or D of the remote connector is return ground.
2. Set the input power supply to 28 ±1 VDC.
3. Preset the R2600 by performing the following steps.

   a. Press the MEM (Memory) key on the R2600 panel for the preset-screen.

   b. Use the CURSOR POSITION keys to highlight preset 01.

   c. Press the "view preset" soft key.

NOTE

The soft keys are the eight keys under the CRT screen on the R2600.

   d. Use the CURSOR POSITION keys to the Monitor Frequency position and enter 115.000 from the R2600 keypad.

e. Move the cursor to Modulation Type and press the "AM" soft key.

f. Move the cursor to the Generate Frequency position and enter 115.000 from the R2600 keypad.

g. Move the cursor to Modulation Type and press the "AM" soft key.

h. Move the cursor to bandwidth and press the "NARROW ±5 kHz" soft key.

i. Move the cursor to the Duplex Offset position and press the "DON'T CARE" soft key.

j. Move the cursor to Synth. Format Sel (synthesizer format select) and select the "Tone A" soft key.

k. Move the cursor to Freq (frequency) and enter 01000.0 from the keypad.

l. Move the cursor to the DTMF Code position and press the "DON'T CARE" soft key.

NOTE

The “more” soft key may have to be depressed for the “DON”T CARE” soft key to be displayed.

m. Press the "return" soft key. Repeat steps A through K for presets 02 through 10. Use Table 22 to program the frequency presets in steps D and E above.

n. Press the "return" soft key.

Table 22 - AM Frequency Presets

Preset		Frequency
URC-200 (V2)	R2600	MHz
CH1	CH01	115.000
CH2	CH02	133.025
CH3	CH03	149.975
CH4	CH04	225.075
CH5	CH05	275.000
CH6	CH06	299.975
CH7	CH07	300.000
CH8	CH08	312.000
CH9	CH09	355.000
CH0	CH10	399.975

4. Perform the following steps to complete the setup on the R2600 analyzer.

a. Press RF key on the R2600 panel. Move the cursor to RF Control and press the "GEN" soft key.

b. Move the cursor to the Output Lvl (RF Output Level) position and enter a level of -050.0 dBm from the keypad.

c. Move the cursor to the Gen RF Out position and press the "RF IN/OUT" soft key.

d. Depress the AUD (Audio) key on the R2600 panel. Move the cursor to the Synth (Synthesizer) position and enter 30% from the keypad.

NOTE

This is AM Modulation. Depress the RIGHT ARROW CURSOR CONTROL key and depress “Cont” (Continuous) soft key.

e. Move the cursor to the Fixed 1 kHz position. Depress the LEFT ARROW CURSOR CONTROL key and then depress the "Off" soft key.

f. Verify the DTMF position and the External position are both OFF.

g. Depress the DISP (Display) key on the R2600 panel. Move the cursor to the Meter position and depress the "AC VOLTS" soft key.

NOTE

The “more” soft key may have to be depressed for the “AC VOLTS” soft key to be displayed.

h. Move the cursor to the Range position and depress the "AUTO" soft key.

i. Move the cursor to the Display position and depress the "EXT SCOPE" soft key.

j. Move the cursor to the Coupling position and depress the "AC" soft key.

k. Move the cursor to the Trigger position and depress the "AUTO" soft key.

l. Move the cursor to the Trigger Lvl (Trigger Level) position and enter 500 from the keypad.

m. Move the cursor to the Horiz (Horizontal) position and depress the "500 us" soft key.

NOTE

The “more” soft key may have to be depressed for the “500 us” soft key to be displayed.

n. Move the cursor to the Vert (Vertical) position and depress the "1 V" soft key.

NOTE

The “more” soft key may have to be depressed for the “1 V” soft key to be displayed.

o. Move the cursor to the Pos (Position) position and depress the "move up" or "move down" soft keys as appropriate to center the displayed scope screen trace. The TUNING knob on the R2600 panel may be used in lieu of the "move up" or "move down" soft keys.

p. Adjust both the SQUELCH and VOLUME controls on the front panel to their maximum CCW positions.

5. Setup the URC-200 (V2) as follows:

a. Turn the transceiver on and note the input current. It should be approximately 240mA. If the current exceeds 330mA, a problem exists in the transceiver. Turn off the power and troubleshoot the transceiver.

b. Set the frequency presets as listed in Table 22 on the URC-200 (V2). For each preset channel, adjust the URC-200 (V2) for the following:

AM, PT, SCN OFF, BCN OFF

To configure presets, refer to Paragraph 4.4.6.

6. On the R2600, do the following:

a Verify the "AC VOLTS" is on in the Meter position of the DISP (Display) segment.

b. Verify the "AUTO" is on in the Range position of the DISP (Display) segment.

c. Set the presets on both the URC-200 (V2) and the R2600 to channel 01. Adjust the Volume control on the URC-200 (V2) to give an output level of 1.0 VAC ±01 VAC as read on the R2600 display.

d. Receiver AM PT Sensitivity Measurement**:** Move the cursor to the Meter position and depress the "SINAD" soft key. Depress the RF key on the R2600 panel and move the cursor to the Output Lvl (RF Output Level) position. Position the highlight to the one-tenth position by depressing the RIGHT ARROW CURSOR POSITION key three times. Rotate the TUNING control counter-clockwise on the R2600 panel until an average of 10 dB of SINAD is read on the CRT display. Verify compliance with Table 1.

e. Readjust the Output Lvl back to -50 dBm by rotating the TUNING control clockwise to -50 dBm. This can also be accomplished by moving the highlight back to the beginning of the Output Lvl position by using the CURSOR CONTROL keys and then entering -50 dBm on the keypad.

f. Receiver AM PT Distortion Measurement**:** Depress the DISP (Display) and move the cursor to the Meter position. Depress the "EXT DIST" (External Distortion) soft key. The AM PT Distortion is displayed in percent in the Display area of the CRT screen. Verify compliance with Table 1.

g. On both the URC-200 (V2) and the R2600 repeat steps A through F for preselect channels 2 through 9 and channel 0 on the URC-200 (V2) with the R2600 set on preset channel 10.

5.3.2.4 Receiver AM CT Sensitivity

1. Set up the test equipment as shown in Figure 16. Connect the VERT/SINAD/DIST/DVM/COUNTER IN connector on the R2600 to Pin T (CT Out) of the Remote connector. Pin A and D of the remote connector are return ground.

2. Set the input power supply to 28 ± 1 VDC.

3. Preset the R2600 by performing the following steps.

a. Press the MEM (Memory) key on the R2600 panel for the preset-screen.

b. Use the CURSOR POSITION keys to highlight preset 01.

c. Press the "view preset" soft key.

NOTE

The soft keys are the eight keys under the CRT screen on the R2600.

d. Use the CURSOR POSITION keys to the Monitor Frequency position and enter 115.000 from the R2600 keypad.

e. Move the cursor to Modulation Type and press the "AM" soft key.

f. Move the cursor to the Generate Frequency position and enter 115.000 from the R2600 keypad.

g. Move the cursor to Modulation Type and press the "AM" soft key.

h. Move the cursor to bandwidth and press the "NARROW ±5 kHz" soft key.

i. Move the cursor to the Duplex Offset position and press the "DON'T CARE" soft key.

j. Move the cursor to Synth. Format Sel (synthesizer format select) and select the "Tone B" soft key.

k. Move the cursor to Freq (frequency) and enter 08000.0 from the keypad.

l Move the cursor to the DTMF Code position and press the "DON'T CARE" soft key.

NOTE

The “more” soft key may have to be depressed for the “DON’T CARE” soft key to be displayed.

m. Press the "return" soft key. Repeat steps A through K for presets 02 through 10. Use Table 22 to program the frequency presets in steps D and E above.

n. Press the "return" soft key.

4. Perform the following steps to complete the setup on the R2600 analyzer.

a. Press RF key on the R2600 panel. Move the cursor to RF Control and press the "GEN" soft key.

b. Move the cursor to the Output Lvl (RF Output Level) position and enter a level of -050.0 dBm from the keypad.

c. Move the cursor to the Gen RF Out position and press the "RF IN/OUT" soft key.

d. Depress the AUD (Audio) key on the R2600 panel. Move the cursor to the Synth (Synthesizer) position and enter 70% from the keypad.

NOTE

This is AM Modulation. Depress the RIGHT ARROW CURSOR CONTROL key and depress “Cont” (Continuous) soft key.

e. Move the cursor to the Fixed 1 kHz position. Depress the LEFT ARROW CURSOR CONTROL key and then depress the "Off" soft key.

f. Verify the DTMF position and the External position are both OFF.

g. Depress the DISP (Display) key on the R2600 panel. Move the cursor to the Meter position and depress the "AC VOLTS" soft key.

NOTE

The “more” soft key may have to be depressed for the “AC VOLTS” soft key to be displayed.

h. Move the cursor to the Range position and depress the "AUTO" soft key.

i. Move the cursor to the Display position and depress the "EXT SCOPE" soft key.

j. Move the cursor to the Coupling position and depress the "AC" soft key.

k. Move the cursor to the Trigger position and depress the "AUTO" soft key.

l. Move the cursor to the Trigger Lvl (Trigger Level) position and enter 50 from the keypad.

m. Move the cursor to the Horiz (Horizontal) position and depress the "50 us" soft key.

NOTE

The “more” soft key may have to be depressed for the “50 us” soft key to be displayed.

n. Move the cursor to the Vert (Vertical) position and depress the "5 V" soft key.

NOTE

The “more” soft key may have to be depressed for the “5V” soft key to be displayed.

o. Move the cursor to the Pos (Position) position and depress the "move up" or "move down" soft keys as appropriate to center the displayed scope screen trace. The TUNING knob on the R2600 panel may be used in lieu of the "move up" or "move down" soft keys.

p. Adjust both the SQUELCH and VOLUME controls on the front panel to their maximum CCW positions.

5. Setup the URC-200 (V2) as follows:

   a. Turn the transceiver on and note the input current. It should be approximately 240mA. If the current exceeds 330mA, a problem exists in the transceiver. Turn off the power and troubleshoot the transceiver.

   b. Set the frequency presets as listed in Table 22 on the URC-200 (V2). For each preset channel, adjust the URC-200 (V2) for the following.

      AM, CT, SCN OFF, BCN OFF

      To configure presets, refer to Paragraph 4.4.6.

6. Receiver AM CT Sensitivity Measurement:

   a. Depress the RF key on the R2600 panel. Move the cursor to the Preset position and set it for Preset 01. Adjust the URC-200 (V2) for channel 1.

   b. Move the cursor to the Output Lvl (RF Output Level) position. Position the highlight to the one-tenth position by depressing the RIGHT ARROW CURSOR POSITION key three times. Rotate the TUNING control counter-clockwise on the R2600 panel until the RF Output Level reads the limit for AM CT Sensitivity as stated in Table 1.

c. Verify the 8kHz waveform pattern on the screen of the R2600 has an amplitude of 4 VPP to 24 VPP. Verify the square wave pattern is the same as it was with a -50dBm signal except for the slight jumping around of the 8kHz pattern. It may be helpful to observe the 8kHz pattern as the RF input level is decreased. The jumping around of the pattern will turn into a random breakup of the pattern.

d. On both the URC-200 (V2) and the R2600 repeat steps A through C for preselect channels 2 through 9 and channel 0 on the URC-200 (V2) with the R2600 set on preset channel 10.

5.3.2.5 CT Audio Response

1. Set up the test equipment as shown in Figure 16. Connect the VERT/SINAD/DIST/DVM/COUNTER IN connector on the R2600 to Pin T (CT Out) of the Remote connector. Pin A of the Remote connector is return ground.
2. Set the input power supply to 28 ± 1 VDC.
3. Preset the R2600 by performing the following steps.

   a. Press the MEM (Memory) key on the R2600 panel for the preset-screen.

   b. Use the CURSOR POSITION keys to highlight preset 08.

   c. Press the "view preset" soft key.

NOTE

The soft keys are the eight keys under the CRT screen on the R2600.

   d. Use the CURSOR POSITION keys to the Monitor Frequency position and enter 312.000 from the R2600 keypad.

   e. Move the cursor to Modulation Type and press the "FM" soft key.

   f. Move the cursor to the Generate Frequency position and enter 312.000 from the R2600 keypad.

   g. Move the cursor to Modulation Type and press the "FM" soft key.

   h. Move the cursor to bandwidth and press the "NARROW ±5 kHz" soft key.

   i. Move the cursor to the Duplex Offset position and press the "DON'T CARE" soft key.

   j. Move the cursor to Synth. Format Sel (synthesizer format select) and select the "Tone A" soft key.

   k. Move the cursor to Freq (frequency) and enter 01000.0 from the keypad.

   l. Move the cursor to the DTMF Code position and press the "DON'T CARE" soft key.

NOTE

The “more” soft key may have to be depressed for the “DON’T CARE” soft key to be displayed.

   m. Press the "return" soft key twice.

4. Perform the following steps to complete the setup on the R2600 analyzer.

a. Press RF key on the R2600 panel. Move the cursor to RF Control and press the "GEN" soft key.

b. Move the cursor to the Output Lvl (RF Output Level) position and enter a level of -080.0 dBm from the keypad.

c. Move the cursor to the Gen RF Out position and press the "RF IN/OUT" soft key.

d. Depress the AUD (Audio) key on the R2600 panel. Move the cursor to the Synth (Synthesizer) position and from the keypad enter 5.00 kHz for VHF frequencies or 5.6 kHz for UHF frequencies.

NOTE

This is FM Deviation. Depress the RIGHT ARROW CURSOR CONTROL key and depress “Cont” (Continuous) soft key.

e. Move the cursor to the Fixed 1 kHz position. Depress the LEFT ARROW CURSOR CONTROL key and then depress the "Off" soft key.

f. Verify the DTMF position and the External position are both OFF.

g. Depress the DISP (Display) key on the R2600 panel. Move the cursor to the Meter position and depress the "AC VOLTS" soft key.

NOTE

The “more” soft key may have to be depressed for the “AC VOLTS” soft key to be displayed.

h. Move the cursor to the Range position and depress the "AUTO" soft key.

i. Move the cursor to the Display position and depress the "EXT SCOPE" soft key.

j. Move the cursor to the Coupling position and depress the "DC" soft key.

k. Move the cursor to the Trigger position and depress the "AUTO" soft key.

l. Move the cursor to the Trigger Lvl (Trigger Level) position and enter 500 from the keypad.

m. Move the cursor to the Horiz (Horizontal) position and depress the "500 us" soft key.

NOTE

The “more” soft key may have to be depressed for the “500 us” soft key to be displayed.

n. Move the cursor to the Vert (Vertical) position and depress the "10 V" soft key.

NOTE

The “more” soft key may have to be depressed for the “10 V” soft key to be displayed.

o. Move the cursor to the Pos (Position) position and depress the "move up" or "move down" soft keys as appropriate to center the displayed scope screen trace. The TUNING knob on the R2600 panel may be used in lieu of the "move up" or "move down" soft keys.

p. Adjust both the SQUELCH and VOLUME controls on the front panel to their maximum CCW positions.

5. Setup the URC-200 (V2) as follows:

   a. Turn the transceiver on and note the input current. It should be approximately 240mA. If the current exceeds 330mA, a problem exists in the transceiver. Turn off the power and troubleshoot the transceiver.

   b. Adjust the URC-200 (V2) for preset channel 8. On the URC-200 (V2) set the frequency to the preset frequency as listed in Table 21 for channel 8. Adjust the URC-200 (V2) for the following. See Paragraph 4.4.6 for information on presetting the URC-200 (V2).

FM, CT, SCN OFF, BCN OFF

To configure presets, refer to Paragraph 4.4.6.

6. CT Audio Response Measurement (1 kHz):

   a. Note amplitude of the waveform in Vpp.

7. CT Audio Response Measurement (10 Hz): Measure the 10 Hz audio response by doing the following on the R2600:

   a. Depress the AUD (Audio) key

   b. Depress the cursor keys for the Tone A frequency. Adjust it to 10 Hz

   c. Depress the DISP (Display) key.

   d. Depress the Horizontal key.

   e. Depress the cursor control keys for 50 mS.

   f. Read and record the amplitude of the waveform in Vpp. This reading should be the same as the reading in step 6a.

8. CT Audio Response Measurement (10 kHz)**:** Measure the 10 kHz audio response by doing the following on the R2600:

   a. Depress the AUD (Audio) key

   b. Depress the cursor keys for the Tone A frequency. Adjust it to 10 kHz

   c. Depress the DISP (Display) key.

   d. Depress the cursor control keys for 50 uS

   e. Read and record the amplitude of the waveform in Vpp. This reading should be 4 to 24 VPP.

5.3.2.6 Squelch Sensitivity

1. Set up the test equipment as shown in Figure 16. Connect the VERT/SINAD/DIST/DVM/COUNTER IN connector on the R2600 to Pin E (PT OUT) of the Remote connector. Pin D of the Remote connector is return ground.

2. Set the input power supply to 28 ± 1 VDC.

3. Preset the R2600 by performing the following steps.
   a. Press the MEM (Memory) key on the R2600 panel for the preset-screen.
   b. Use the CURSOR POSITION keys to highlight preset 08.
   c. Press the "view preset" soft key.

NOTE

The soft keys are the eight keys under the CRT screen on the R2600.

   d. Use the CURSOR POSITION keys to the Monitor Frequency position and enter 312.000 from the R2600 keypad.
   e. Move the cursor to Modulation Type and press the "FM" soft key.
   f. Move the cursor to the Generate Frequency position and enter 312.000 from the R2600 keypad.
   g. Move the cursor to Modulation Type and press the "FM" soft key.
   h. Move the cursor to bandwidth and press the "NARROW ±5 kHz" soft key.
   i. Move the cursor to the Duplex Offset position and press the "DON'T CARE" soft key.
   j. Move the cursor to Synth. Format Sel (synthesizer format select) and select the "Tone A" soft key.
   k. Move the cursor to Freq (frequency) and enter 01000.0 from the keypad.
   l. Move the cursor to the DTMF Code position and press the "DON'T CARE" soft key.

NOTE

The “more” soft key may have to be depressed for the “DON’T CARE” soft key to be displayed.

   m. Press the "return" soft key twice.

4. Perform the following steps to complete the setup on the R2600 analyzer.
   a. Press RF key on the R2600 panel. Move the cursor to RF Control and press the "GEN" soft key.
   b. Move the cursor to the Output Lvl (RF Output Level) position and enter a level of -080.0 dBm from the keypad.
   c. Move the cursor to the Gen RF Out position and press the "RF IN/OUT" soft key.
   d. Depress the AUD (Audio) key on the R2600 panel. Move the cursor to the Synth (Synthesizer) position and enter 6.50 kHz from the keypad.

NOTE

This is FM Deviation. Depress the RIGHT ARROW CURSOR CONTROL key and depress “Cont” (Continuous) soft key.

   e. Move the cursor to the Fixed 1 kHz position. Depress the LEFT ARROW CURSOR CONTROL key and then depress the "Off" soft key.

f. Verify the DTMF position and the External position are both OFF.

g. Depress the DISP (Display) key on the R2600 panel. Move the cursor to the Meter position and depress the "AC VOLTS" soft key.

NOTE

The “more” soft key may have to be depressed for the “AC VOLTS” soft key to be displayed.

h. Move the cursor to the Range position and depress the "AUTO" soft key.

i. Move the cursor to the Display position and depress the "EXT SCOPE" soft key.

j. Move the cursor to the Coupling position and depress the "AC" soft key.

k. Move the cursor to the Trigger position and depress the "AUTO" soft key.

l. Move the cursor to the Trigger Lvl (Trigger Level) position and enter 500 from the keypad.

m. Move the cursor to the Horiz (Horizontal) position and depress the "500 us" soft key.

NOTE

The “more” soft key may have to be depressed for the “500 us” soft key to be displayed.

n. Move the cursor to the Vert (Vertical) position and depress the "1 V" soft key.

NOTE

The “more” soft key may have to be depressed for the “1 V” soft key to be displayed.

o. Move the cursor to the Pos (Position) position and depress the "move up" or "move down" soft keys as appropriate to center the displayed scope screen trace. The TUNING knob on the R2600 panel may be used in lieu of the "move up" or "move down" soft keys.

p. Adjust both the SQUELCH and VOLUME controls on the front panel to their maximum CCW positions.

5. Setup the URC-200 (V2) as follows:

a. Turn the transceiver on and note the input current. It should be approximately 240mA. If the current exceeds 330mA, a problem exists in the transceiver. Turn off the power and troubleshoot the transceiver.

b. Adjust the URC-200 (V2) for preset channel 8. On the URC-200 (V2) set the frequency to the preset frequency as listed in Table 21 for channel 8. Adjust the URC-200 (V2) for the following:

FM, PT, SCN OFF, BCN OFF, SPKR ON

To configure presets, refer to Paragraph 4.4.6.

c. Adjust the SQ (Squelch) control fully counter-clockwise, past its detent, to the OFF position.

6. Squelch Sensitivity Measurements:

a. On the R2600 front panel depress the RF key. Move the cursor to the Output Lvl (RF Output Level) position. Using the TUNING knob on the front panel adjust the RF Output Level to <-130 dBm.

b. Adjust the Squelch control clockwise until the speaker just squelches. Adjust the TUNING knob that is adjusting the RF Output Level clockwise until the speaker just releases squelch. The TUNING knob's resolution may have to be adjusted so it is controlling tenths of a dB of RF Output Level. To do this, depress the RIGHT or LEFT ARROW CURSOR CONTROL keys to position the cursor on the RF Output Level's tenth of a dB position.

c. Read the RF Output Level. Verify compliance with Table 1.

5.3.2.7 Scan Function

1. Set up the test equipment as shown in the Figure 16. Connect the VERT/SINAD/DIST/DVM/COUNTER IN connector on the R2600 to Pin E (PT Out) of the Remote connector. Pin A of the Remote connector is return ground.

2. Set the input power supply to 28 ±1 VDC.

3. Preset the R2600 by performing the following steps.

   a. Press the MEM (Memory) key on the R2600 panel for the preset-screen.

   b. Use the CURSOR POSITION keys to highlight preset 06.

   c. Press the "view preset" soft key.

NOTE

The soft keys are the eight keys under the CRT screen on the R2600.

   d. Use the CURSOR POSITION keys to the Monitor Frequency position and enter 299.975 from the R2600 keypad.

   e. Move the cursor to Modulation Type and press the "FM" soft key.

   f. Move the cursor to the Generate Frequency position and enter 299.975 from the R2600 keypad.

   g. Move the cursor to Modulation Type and press the "FM" soft key.

   h. Move the cursor to bandwidth and press the "NARROW ±5 kHz" soft key.

   i. Move the cursor to the Duplex Offset position and press the "DON'T CARE" soft key.

   j. Move the cursor to Synth. Format Sel (synthesizer format select) and select the "Tone A" soft key.

   k. Move the cursor to Freq (frequency) and enter 01000.0 from the keypad.

   l. Move the cursor to the DTMF Code position and press the "DON'T CARE" soft key.

NOTE

The “more” soft key may have to be depressed for the “DON’T CARE” soft key to be displayed.

   m. Press the "return" soft key. Repeat steps A through K for presets 07 and 08. Use Table 21 to program the frequency presets in steps D and E above.

   n. Press the "return" soft key.

4. Perform the following steps to complete the setup on the R2600 analyzer.

   a. Press RF key on the R2600 panel. Move the cursor to RF Control and press the "GEN" soft key.

   b. Move the cursor to the Output Lvl (RF Output Level) position and enter a level of -080.0 dBm from the keypad.

   c. Move the cursor to the Gen RF Out position and press the "RF IN/OUT" soft key.

   d. Depress the AUD (Audio) key on the R2600 panel. Move the cursor to the Synth (Synthesizer) position and enter 6.50 kHz from the keypad.

NOTE

This is FM Deviation. Depress the RIGHT ARROW CURSOR CONTROL key and depress “Cont” (Continuous) soft key.

e. Move the cursor to the Fixed 1 kHz position. Depress the LEFT ARROW CURSOR CONTROL key and then depress the "Off" soft key.

f. Verify the DTMF position and the External position are both OFF.

g. Depress the DISP (Display) key on the R2600 panel. Move the cursor to the Meter position and depress the "AC VOLTS" soft key.

NOTE

The “more” soft key may have to be depressed for the “AC VOLTS” soft key to be displayed.

h. Move the cursor to the Range position and depress the "AUTO" soft key.

i. Move the cursor to the Display position and depress the "EXT SCOPE" soft key.

j. Move the cursor to the Coupling position and depress the "AC" soft key.

k. Move the cursor to the Trigger position and depress the "AUTO" soft key.

l. Move the cursor to the Trigger Lvl (Trigger Level) position and enter 500 from the keypad.

m. Move the cursor to the Horiz (Horizontal) position and depress the "500 us" soft key.

NOTE

The “more” soft key may have to be depressed for the “500 us” soft key to be displayed.

n. Move the cursor to the Vert (Vertical) position and depress the "1 V" soft key.

NOTE

The “more” soft key may have to be depressed for the “1 V” soft key to be displayed.

o. Move the cursor to the Pos (Position) position and depress the "move up" or "move down" soft keys as appropriate to center the displayed scope screen trace. The TUNING knob on the R2600 panel may be used in lieu of the "move up" or "move down" soft keys.

p. Adjust both the SQUELCH and VOLUME controls on the front panel to their maximum CCW positions.

5. Setup the URC-200 (V2) as follows:

a. Turn the transceiver on and note the input current. It should be approximately 240mA. If the current exceeds 330mA, a problem exists in the transceiver. Turn off the power and troubleshoot the transceiver.

b. Set the channels 6, 7, and 8 for the preset frequencies as listed in Table 21. Adjust the URC-200 (V2) for the following:

FM, PT, SCN ON, BCN OFF, SPKR ON, CH 8

To configure presets, refer to Paragraph 4.4.6.

c. Adjust the SQ (Squelch) control fully counter-clockwise, past its detent, to the OFF position.

6. Scan Function Measurements**:**

a. On the R2600 front panel depress the RF key. Move the cursor to the Output Lvl (RF Output Level) position. Using the TUNING knob on the front panel adjust the RF Output Level to <-130 dBm.

b. Adjust the Squelch control clockwise until the speaker just squelches. Adjust the TUNING knob that is adjusting the RF Output Level clockwise until the speaker just releases squelch. The TUNING knob's resolution may have to be adjusted so it is controlling tenths of a dB of RF Output Level. To do this, depress the RIGHT or LEFT ARROW CURSOR CONTROL keys to position the cursor on the RF Output Level's tenth of a dB position.

c. Set the transceiver to SCAN channels 6 through 8 as described in Paragraph 4.4.6.7.

d. Turn SCN ON as described in Paragraph 4.4.7.1.

e. Adjust SQ control clockwise until speaker squelches. After approximately eight seconds, the display should show that channels 6 through 8 are being scanned.

f. On the R2600, increase the RF Output Level with the TUNING control until the speaker releases squelch. The display on the transceiver should now stop scanning and show Channel 8 (312 MHz).

g. Using the TUNING knob on the front panel adjust the RF Output Level to <-130 dBm. Select preset channel 6.

h. On the R2600, increase the RF Output Level with the TUNING control, until the speaker releases squelch. The display on the transceiver should now stop scanning and show Channel 6 (300.000 MHz).

5.3.2.8 Signal-Strength Meter

1. Set up the test equipment as shown in Figure 16. Connect the VERT/SINAD/DIST/DVM/COUNTER IN connector on the R2600 to Pin E (PT Out) of the Remote connector. Pin A of the Remote connector is return ground.

2. Set the input power supply to 28 ± 1 VDC.

3. Preset the R2600 by performing the following steps.

a. Press the MEM (Memory) key on the R2600 panel for the preset-screen.

b. Use the CURSOR POSITION keys to highlight preset 03.

c. Press the "view preset" soft key.

NOTE

The soft keys are the eight keys under the CRT screen on the R2600.

d. Use the CURSOR POSITION keys to the Monitor Frequency position and enter 173.975 from the R2600 keypad.

e. Move the cursor to Modulation Type and press the "FM" soft key.

f. Move the cursor to the Generate Frequency position and enter 173.975 from the R2600 keypad.

g. Move the cursor to Modulation Type and press the "FM" soft key.

h. Move the cursor to bandwidth and press the "NARROW ±5 kHz" soft key.

i. Move the cursor to the Duplex Offset position and press the "DON'T CARE" soft key.

j. Move the cursor to Synth. Format Sel (synthesizer format select) and select the "Tone A" soft key.

k. Move the cursor to Freq (frequency) and enter 01000.0 from the keypad.

l. Move the cursor to the DTMF Code position and press the "DON'T CARE" soft key.

NOTE

The “more” soft key may have to be depressed for the “DON’T CARE” soft key to be displayed.

m. Press the "return" soft key twice.

4. Perform the following steps to complete the setup on the R2600 analyzer.

a. Press RF key on the R2600 panel. Move the cursor to RF Control and press the "GEN" soft key.

b. Move the cursor to the Output Lvl (RF Output Level) position and enter a level of -130.0 dBm from the keypad.

c. Move the cursor to the Gen RF Out position and press the "RF IN/OUT" soft key.

d. Depress the AUD (Audio) key on the R2600 panel. Move the cursor to the Synth (Synthesizer) position and enter 6.50 kHz from the keypad.

NOTE

This is FM Deviation. Depress the RIGHT ARROW CURSOR CONTROL key and depress “Cont” (Continuous) soft key.

e. Move the cursor to the Fixed 1 kHz position. Depress the LEFT ARROW CURSOR CONTROL key and then depress the "Off" soft key.

f. Verify the DTMF position and the External position are both OFF.

g. Depress the DISP (Display) key on the R2600 panel. Move the cursor to the Meter position and depress the "AC VOLTS" soft key.

NOTE

The “more” soft key may have to be depressed for the “AC VOLTS” soft key to be displayed.

h. Move the cursor to the Range position and depress the "AUTO" soft key.

i. Move the cursor to the Display position and depress the "EXT SCOPE" soft key.

j. Move the cursor to the Coupling position and depress the "AC" soft key.

k. Move the cursor to the Trigger position and depress the "AUTO" soft key.

l. Move the cursor to the Trigger Lvl (Trigger Level) position and enter 500 from the keypad.

m. Move the cursor to the Horiz (Horizontal) position and depress the "500 us" soft key.

NOTE

The “more” soft key may have to be depressed for the “500 us” soft key to be displayed.

n Move the cursor to the Vert (Vertical) position and depress the "1 V" soft key.

NOTE

The “more” soft key may have to be depressed for the “1 V” soft key to be displayed.

o. Move the cursor to the Pos (Position) position and depress the "move up" or "move down" soft keys as appropriate to center the displayed scope screen trace. The TUNING knob on the R2600 panel may be used in lieu of the "move up" or "move down" soft keys.

p. Adjust both the SQUELCH and VOLUME controls on the front panel to their maximum CCW positions.

5. Setup the URC-200 (V2) as follows:

a. Turn the transceiver on and note the input current. It should be approximately 240mA. If the current exceeds 330mA, a problem exists in the transceiver. Turn off the power and troubleshoot the transceiver.

b. Set the channel 3 for the preset frequency as listed in Table 21. Adjust the URC-200 (V2) for the following:

FM, PT, SCN OFF, BCN OFF, SPKR ON, CH 3

To configure presets, refer to Paragraph 4.4.6.

c. Adjust the SQ (Squelch) control fully counter-clockwise, past its detent, to the OFF position.

d. Select METER MODE per Paragraph 4.4.5.

6. Signal-Strength Meter Measurement:

a. Move the cursor to the Gen RF Out position and select GEN. Move the cable from the RF IN/OUT connector to the GEN OUT connector. Position the cursor to the Output Lvl position and enter a signal level to -80.0 dBm. Verify at least one bar is present. Readjust the Output Lvl to 0dBm and verify fourteen 14 bars are present on the URC-200 (V2) display with the possibility that the 14th bar may be flickering on and off.

b. Move the cursor back to the Gen RF Out position and select RF IN/OUT. Move the cable back to the RF IN/OUT connector.

5.3.3 Transmitter Tests

The following tests evaluate the performance of the XMT circuits. Tests include frequency accuracy, output power, PT/CT modulation, modulation distortion, and beacon. If the transceiver fails any of the tests, or if it cannot be adjusted to specified values, it must be sent to General Dynamics C4 Systems for repair.

WARNING

DO NOT THROW BATTERIES IN THE TRASH

Dispose of all used batteries in accordance with all manufacturer, Federal, State and local laws and regulations.

Improper handling, reverse-current operation or high environmental temperatures may cause internally generated heat, fire, or toxic materials and gasses to be released from the battery.

The following precautions must be strictly observed to prevent injury to personnel or damage to equipment:

- DO NOT heat, incinerate, crush, puncture, disassemble or mutilate the batteries.
- DO NOT recharge primary (Non- rechargeable) batteries.
- DO NOT store in equipment during periods of non-use for more than 30 days.
- DO follow all safety instructions that come with the batteries or printed on them.
- TURN OFF the equipment immediately if you (1) detect that the battery compartment is becoming unduly hot, (2) hear battery cells venting (hissing), or (3) smell irritating sulfur dioxide gas. Remove the battery only after it is cool (after 30 to 60 minutes), and dispose of it by following approved procedures.

Do not attempt to change the operating frequency while the transmitter is keyed on. Although the radio set will not be damaged, the radiated frequency will be uncontrolled during retuning and can cause unnecessary interference to other radio systems.

CAUTION

DO NOT attempt to change the operating frequency while the transmitter is keyed on. Although the radio set will not be damaged, the radiated frequency will be uncontrolled during tuning and can cause unnecessary interference to other radio systems.

CAUTION

DO NOT install the LOS antenna on the transceiver during testing in the transmit mode with (1) the cover removed or (2) the transceiver powered from an external power supply via test leads that are unshielded. RF from the antenna can radiate into the transceiver, circumvent the protection loops, and cause severe damage to the transmitter circuits.

5.3.3.1 Frequency Accuracy and FM Power Output

NOTE

If the frequency accuracy measurement fails refer to Appendix A for crystal warp adjustment procedures. This procedure only applies to transceivers with software version 1.6 and later. For radios with older software please contact General Dynamics Customer Support.

1. Set up the test equipment as shown in Figure 17. Connect the VERT/SINAD/DIST/DVM/COUNTER IN connector to the DEMOD connector on the R2600. For now, do not connect the R2600 MOD OUT port to either pins B or H of the Remote connector on the URC-200 (V2). Also for now, do not connect the PTT (Push-to-Talk) line (pin F) to ground.

NOTE

When the PTT line is grounded the URC-200 (V2) transmitter is keyed and begins transmitting.

2. Set the input power supply to 28 ±1 VDC.

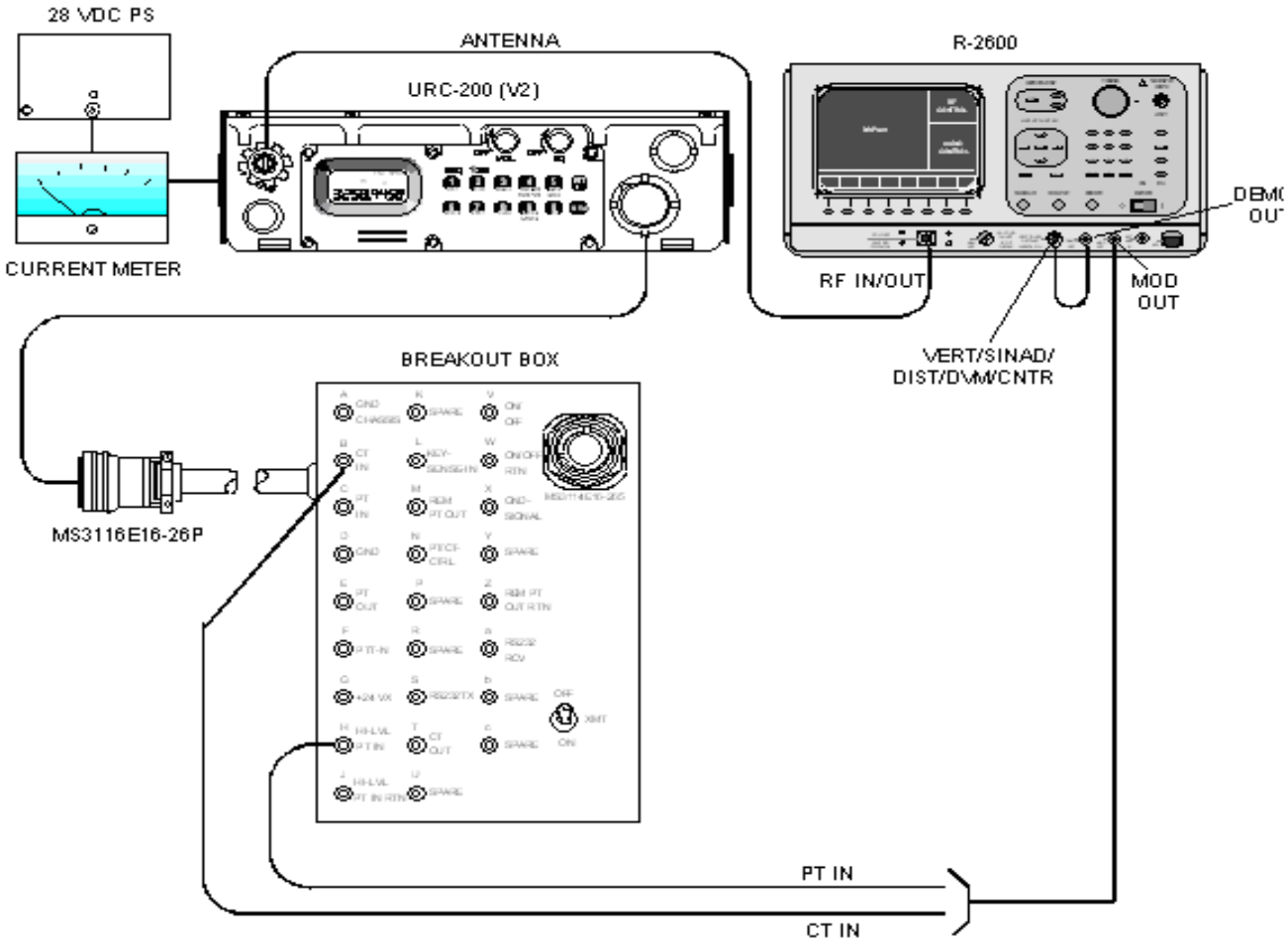


Figure 17 - Transmitter Test Setup

3. Preset the R2600 by performing the following steps.

   a. Press the MEM (Memory) key on the R2600 panel for the preset-screen.

   b. Use the CURSOR POSITION keys to highlight preset 01.

   c. Press the "view preset" soft key.

NOTE

The soft keys are the eight keys under the CRT screen on the R2600.

   d. Using the CURSOR POSITION keys move to the Monitor Frequency position and enter 115.000 from the R2600 keypad.

   e. Move the cursor to Modulation Type and press the "FM" soft key.

   f. Move the cursor to the Generate Frequency position and enter 115.000 from the R2600 keypad.

   g. Move the cursor to Modulation Type and press the "FM" soft key.

   h. Move the cursor to bandwidth and press the "NARROW ±5kHz" soft key.

i. Move the cursor to the Duplex Offset position and press the "DON'T CARE" soft key.

j. Move the cursor to Synth. Format Sel (Synthesizer Format Select) and select the "Tone A" soft key.

k. Move the cursor to Freq (Frequency) and enter 01000.0 from the keypad.

l. Move the cursor to the DTMF Code position and press the "DON'T CARE" soft key.

NOTE

The “more” soft key may have to be depressed for the “DON’T CARE” soft key to be displayed.

m. Press the "return" soft key. Repeat steps A through K for presets 02 through 10. Use Table 21 to program the frequency presets in steps D and E above.

n. Press the "return" soft key.

4. Perform the following steps to complete the setup on the R2600 analyzer.

a. Press RF key on the R2600 panel. Move the cursor to RF Control and press the "MON" soft key.

b. Move the cursor to the Attenuation position and press the "40" soft key.

c. Move the cursor to the Mon RF Out position and press the "RF IN/OUT" soft key.

d. Depress the AUD (Audio) key on the R2600 panel. Move the cursor to the Synth (Synthesizer) position and enter 0.77 V peak from the keypad.

NOTE

This is FM Deviation. Depress the RIGHT ARROW CURSOR CONTROL key and depress “Cont” (Continuous) soft key.

e. Move the cursor to the Fixed 1 kHz position. Depress the LEFT ARROW CURSOR CONTROL key and then depress the "Off" soft key.

f. Verify the DTMF position and the External position are both OFF.

g. Depress the DISP (Display) key on the R2600 panel. Move the cursor to the Meter position and depress the "RF DISPLAY" soft key.

NOTE

The “more” soft key may have to be depressed for the “RF DISPLAY” soft key to be displayed.

h. Move the cursor to the Input Lvl Input Level) position and depress the "dBm" soft key.

i. Move the cursor to the Display position and depress the "EXT SCOPE" soft key.

j. Move the cursor to the Coupling position and depress the "AC" soft key.

k. Move the cursor to the Trigger position and depress the "AUTO" soft key.

l. Move the cursor to the Trig Lvl (Trigger Level) position and enter 500 from the keypad.

m. Move the cursor to the Horiz (Horizontal) position and depress the "500 us" soft key.

NOTE

The “more” soft key may have to be depressed for the “500 us” soft key to be displayed.

n. Move the cursor to the Vert (Vertical) position and depress the "200 mV" soft key.

NOTE

The “more” soft key may have to be depressed for the “200 mV” soft key to be displayed.

o. Move the cursor to the Pos (Position) position and depress the "move up" or "move down" soft keys as appropriate to center the displayed scope screen trace. The TUNING knob on the R2600 panel may be used in lieu of the "move up" or "move down" soft keys.

p. Adjust both the SQUELCH and VOLUME controls on the front panel to their maximum CCW positions.

5. Setup the URC-200 (V2) as follows:

   a. Turn the transceiver on and note the input current. It should be approximately 240mA. If the current exceeds 330mA, a problem exists in the transceiver. Turn off the power and troubleshoot the transceiver.

   b. Set the frequency presets as listed in Table 21 on the URC-200 (V2). For each preset channel, adjust the URC-200 (V2) for the following:

      FM, LO POWER, PT, SCN OFF, BCN OFF

      To configure presets, refer to Paragraph 4.4.6.

6. Transmitter Frequency Accuracy and FM Power Output Measurements:

   a. Set the presets on both the URC-200 (V2) and the R2600 to channel 01. Verify the URC-200 (V2) is in the LO POWER mode.

   b. Key the transceiver into the R2600 test set and read the frequency error displayed on the screen. Verify the ppm as listed in Table 1 is within compliance by dividing the frequency error by the operating frequency. In keying the transceiver the PTT line, pin F, will be grounded.

   c. Measure the transmit power on the R2600 screen. Verify compliance with Table 1.

   d. Unkey the URC-200 (V2) and adjust it for MED POWER. Rekey the URC-200 (V2) and verify compliance with Table 1.

   e. Unkey the URC-200 (V2) and adjust it for HI POWER. Rekey the URC-200 (V2) and verify compliance with Table 1.

   f. On both the URC-200 (V2) and the R2600 repeat steps A through E for preselect channels 2 through 9 and channel 0 on the URC-200 (V2) with the R2600 set on preset channel 10.

5.3.3.2 FM PT Deviation and Distortion

1. Set up the test equipment as shown in Figure 17.

Connect the VERT/SINAD/DIST/DVM/COUNTER IN connector to the DEMOD connector on the R2600. On the R2600 connect the MOD OUT connector to pins H and J of the REMOTE connector on the URC-200 (V2). Use Pin J as the return line, ground. Do not connect the PTT (Push-to-Talk) line (pin F) to ground.

NOTE

When the PTT line is grounded, the URC-200 (V2)'s transmitter will key itself ON.

2. Set the input power supply to 28 ± 1 VDC.
3. Preset the R2600 by performing the following steps.

   a. Press the MEM (Memory) key on the R2600 panel for the preset-screen.

   b. Use the CURSOR POSITION keys to highlight preset 01.

   c. Press the "view preset" soft key.

NOTE

The soft keys are the eight keys under the CRT screen on the R2600.

   d. Using the CURSOR POSITION keys move to the Monitor Frequency position and enter 115.000 from the R2600 keypad.

   e. Move the cursor to Modulation Type and press the "FM" soft key.

   f. Move the cursor to the Generate Frequency position and enter 115.000 from the R2600 keypad.

   g. Move the cursor to Modulation Type and press the "FM" soft key.

   h. Move the cursor to bandwidth and press the "NARROW ±5kHz" soft key.

   i. Move the cursor to the Duplex Offset position and press the "DON'T CARE" soft key.

   j. Move the cursor to Synth. Format Sel (Synthesizer Format Select) and select the "Tone A" soft key.

   k. Move the cursor to Freq (Frequency) and enter 01000.0 from the keypad.

   l. Move the cursor to the DTMF Code position and press the "DON'T CARE" soft key.

NOTE

The "more" soft key may have to be depressed for the "DON'T CARE" soft key to be displayed.

   m. Press the "return" soft key. Repeat steps A through K for presets 02 through 10. Use Table 21 to program the frequency presets in steps D and E above.

   n. Press the "return" soft key.

4. Perform the following steps to complete the setup on the R2600 analyzer.

   a. Press RF key on the R2600 panel. Move the cursor to RF Control and press the "MON" soft key.

b. Move the cursor to the Attenuation position and press the "40" soft key.

c. Move the cursor to the Mon RF Out position and press the "RF IN/OUT" soft key.

d. Depress the AUD (Audio) key on the R2600 panel. Move the cursor to the Synth (Synthesizer) position and enter 0.77 V peak from the keypad.

NOTE

This is FM Deviation. Depress the RIGHT ARROW CURSOR CONTROL key and depress “Cont” (Continuous) soft key.

e. Move the cursor to the Fixed 1 kHz position. Depress the LEFT ARROW CURSOR CONTROL key and then depress the "Off" soft key.

f. Verify the DTMF position and the External position are both OFF.

g. Depress the DISP (Display) key on the R2600 panel. Move the cursor to the Meter position and depress the "RF DISPLAY" soft key.

NOTE

The “more” soft key may have to be depressed for the “RF DISPLAY” soft key to be displayed.

h. Move the cursor to the Input Lvl Input Level) position and depress the "dBm" soft key.

i. Move the cursor to the Display position and depress the "EXT SCOPE" soft key.

j. Move the cursor to the Coupling position and depress the "AC" soft key.

k. Move the cursor to the Trigger position and depress the "AUTO" soft key.

l. Move the cursor to the Trig Lvl (Trigger Level) position and enter 500 from the keypad.

m. Move the cursor to the Horiz (Horizontal) position and depress the "500 us" soft key.

NOTE

The “more” soft key may have to be depressed for the “500 us” soft key to be displayed.

n. Move the cursor to the Vert (Vertical) position and depress the "200 mV" soft key.

NOTE

The “more” soft key may have to be depressed for the “200 mV” soft key to be displayed.

o. Move the cursor to the Pos (Position) position and depress the "move up" or "move down" soft keys as appropriate to center the displayed scope screen trace. The TUNING knob on the R2600 panel may be used in lieu of the "move up" or "move down" soft keys.

p. Adjust both the SQUELCH and VOLUME controls on the front panel to their maximum CCW positions.

5. Setup the URC-200 (V2) as follows:

a. Turn the transceiver on and note the input current. It should be approximately 240mA. If the current exceeds 330mA, a problem exists in the transceiver. Turn off the power and troubleshoot the transceiver.

b. Set the frequency presets as listed in Table 21 on the URC-200 (V2). For each preset channel, adjust the URC-200 (V2) for the following:

FM, LO POWER, PT, SCN OFF, BCN OFF

To configure presets, refer to Paragraph 4.4.6.

6. Transmitter FM PT Deviation and Distortion Measurements:

a. Set the presets on both the URC-200 (V2) and the R2600 to channel 01. Verify the URC-200 (V2) is in the LO POWER mode.

b. Key the transceiver into the R2600 test set and read the FM deviation on the R2600 screen. Verify compliance with Table 1. In keying the transceiver the PTT line, pin F, will be grounded.

c. Depress the DISP key on the R2600 front panel and move the cursor to the Meter position and press the "EXT DIST" soft key.

NOTE

The “more” soft key may have to be depressed for the “EXT DIST” soft key to be displayed.

d. Read the FM distortion on the R2600 screen and verify compliance with Table 1.

e. Depress the DISP key on the R2600 front panel and move the cursor to the Meter position and press the "RF DISPLAY" soft key.

NOTE

The “more” soft key may have to be depressed for the “RF DISPLAY” soft key to be displayed.

f. On both the URC-200 (V2) and the R2600 repeat steps A through E for preselect channels 2 through 9 and channel 0 on the URC-200 (V2) with the R2600 set on preset channel 10.

5.3.3.3 FM CT Deviation and Distortion

1. Set up the test equipment as shown in Figure 17.

   Connect the VERT/SINAD/DIST/DVM/COUNTER IN connector to the DEMOD connector on the R2600. On the R2600 connect the MOD OUT connector to pin B of the REMOTE connector on the URC-200 (V2). Do not connect the PTT (Push-to-Talk) line (pin F) to ground.

NOTE

When the PTT line is grounded, the URC-200 (V2)'s transmitter will key itself ON.

2. Set the input power supply to 28 ± 1 VDC.
3. Preset the R2600 by performing the following steps.
   a. Press the MEM (Memory) key on the R2600 panel for the preset-screen.
   b. Use the CURSOR POSITION keys to highlight preset 01.
   c. Press the "view preset" soft key.

NOTE

The soft keys are the eight keys under the CRT screen on the R2600.

   d. Using the CURSOR POSITION keys move to the Monitor Frequency position and enter 115.000 from the R2600 keypad.
   e. Move the cursor to Modulation Type and press the "FM" soft key.
   f. Move the cursor to the Generate Frequency position and enter 115.000 from the R2600 keypad.
   g. Move the cursor to Modulation Type and press the "FM" soft key.
   h. Move the cursor to bandwidth and press the "WIDE ±100kHz" soft key.
   i. Move the cursor to the Duplex Offset position and press the "DON'T CARE" soft key.
   j. Move the cursor to Synth. Format Sel (Synthesizer Format Select) and select the "Tone A" soft key.
   k. Move the cursor to Freq (Frequency) and enter 01000.0 from the keypad.
   l. Move the cursor to the DTMF Code position and press the "DON'T CARE" soft key.

NOTE

The "more" soft key may have to be depressed for the "DON'T CARE" soft key to be displayed.

   m. Press the "return" soft key. Repeat steps A through K for presets 02 through 10. Use Table 21 to program the frequency presets in steps D and E above.
   n. Press the "return" soft key.

4. Perform the following steps to complete the setup on the R2600 analyzer.
   a. Press RF key on the R2600 panel. Move the cursor to RF Control and press the "MON" soft key.
   b. Move the cursor to the Attenuation position and press the "40" soft key.
   c. Move the cursor to the Mon RF Out position and press the "RF IN/OUT" soft key.
   d. Depress the AUD (Audio) key on the R2600 panel. Move the cursor to the Synth (Synthesizer) position and enter 0.77 V peak from the keypad.

NOTE

This is FM Deviation. Depress the RIGHT ARROW CURSOR CONTROL key and depress “Cont” (Continuous) soft key.

   e. Move the cursor to the Fixed 1 kHz position. Depress the LEFT ARROW CURSOR CONTROL key and then depress the "Off" soft key.
   f. Verify the DTMF position and the External position are both OFF.
   g. Depress the DISP (Display) key on the R2600 panel. Move the cursor to the Meter position and depress the "RF DISPLAY" soft key.

NOTE

The “more” soft key may have to be depressed for the “RF DISPLAY” soft key to be displayed.

   h. Move the cursor to the Input Lvl Input Level) position and depress the "dBm" soft key.
   i. Move the cursor to the Display position and depress the "EXT SCOPE" soft key.
   j. Move the cursor to the Coupling position and depress the "AC" soft key.
   k. Move the cursor to the Trigger position and depress the "AUTO" soft key.
   l. Move the cursor to the Trig Lvl (Trigger Level) position and enter 500 from the keypad.
   m. Move the cursor to the Horiz (Horizontal) position and depress the "500 us" soft key.

NOTE

The “more” soft key may have to be depressed for the “500 us” soft key to be displayed.

   n. Move the cursor to the Vert (Vertical) position and depress the "200 mV" soft key.

NOTE

The “more” soft key may have to be depressed for the “200 mV” soft key to be displayed.

   o. Move the cursor to the Pos (Position) position and depress the "move up" or "move down" soft keys as appropriate to center the displayed scope screen trace. The TUNING knob on the R2600 panel may be used in lieu of the "move up" or "move down" soft keys.
   p. Adjust both the SQUELCH and VOLUME controls on the front panel to their maximum CCW positions.

5. Setup the URC-200 (V2) as follows:
   a. Turn the transceiver on and note the input current. It should be approximately 240mA. If the current exceeds 330mA, a problem exists in the transceiver. Turn off the power and troubleshoot the transceiver.
   b. Set the frequency presets as listed in Table 21 on the URC-200 (V2). For each preset channel, adjust the URC-200 (V2) for the following:

      FM, LO POWER, CT, SCN OFF, BCN OFF

      To configure presets, refer to Paragraph 4.4.6.

6. Transmitter FM CT Deviation and Distortion Measurements:
   a. Set the presets on both the URC-200 (V2) and the R2600 to channel 01. Verify the URC-200 (V2) is in the LO POWER mode.
   b. Key the transceiver into the R2600 test set and read the FM deviation on the R2600 screen. Verify compliance with Table 1. In keying the transceiver the PTT line, pin F, will be grounded.
   c. Observe the scope display on the R2600, it should be showing a pseudo square wave 1 kHz signal.
   d. On both the URC-200 (V2) and the R2600 repeat steps A through C for preselect channels 2 through 9 and channel 0 on the URC-200 (V2) with the R2600 set on preset channel 10.

5.3.3.4 AM Power Output, PT % Modulation and PT Distortion

1. Set up the test equipment as shown in Figure 17.

   Connect the VERT/SINAD/DIST/DVM/COUNTER IN connector to the DEMOD connector on the R2600. Connect the R2600 MOD OUT port to pin H of the Remote connector on the URC-200 (V2). Do not connect the PTT (Push-to-Talk) line (pin F) to ground.

NOTE

When the PTT line is grounded, the URC-200 (V2)'s transmitter will key itself ON.

2. Set the input power supply to 28 ±1 VDC.
3. Preset the R2600 by performing the following steps.
   a. Press the MEM (Memory) key on the R2600 panel for the preset-screen.
   b. Use the CURSOR POSITION keys to highlight preset 01.
   c. Press the "view preset" soft key.

NOTE

The soft keys are the eight keys under the CRT screen on the R2600.

d. Using the CURSOR POSITION keys move to the Monitor Frequency position and enter 115.000 from the R2600 keypad.

e. Move the cursor to Modulation Type and press the "AM" soft key.

f. Move the cursor to the Generate Frequency position and enter 115.000 from the R2600 keypad.

g. Move the cursor to Modulation Type and press the "AM" soft key.

h. Move the cursor to bandwidth and press the "NARROW ±5kHz" soft key.

i. Move the cursor to the Duplex Offset position and press the "DON'T CARE" soft key.

j. Move the cursor to Synth. Format Sel (Synthesizer Format Select) and select the "Tone A" soft key.

k. Move the cursor to Freq (Frequency) and enter 01000.0 from the keypad.

l. Move the cursor to the DTMF Code position and press the "DON'T CARE" soft key.

NOTE

The “more” soft key may have to be depressed for the “DON’T CARE” soft key to be displayed.

m. Press the "return" soft key. Repeat steps A through K for presets 02 through 10. Use Table 22 to program the frequency presets in steps D and E above.

n. Press the "return" soft key.

4. Perform the following steps to complete the setup on the R2600 analyzer.

a. Press RF key on the R2600 panel. Move the cursor to RF Control and press the "MON" soft key.

b. Move the cursor to the Attenuation position and press the "40" soft key.

c. Move the cursor to the Mon RF Out position and press the "RF IN/OUT" soft key.

d. Depress the AUD (Audio) key on the R2600 panel. Move the cursor to the Synth (Synthesizer) position and enter 0.77 V peak from the keypad.

NOTE

This is AM Modulation. Depress the RIGHT ARROW CURSOR CONTROL key and depress “Cont” (Continuous) soft key.

e. Move the cursor to the Fixed 1 kHz position. Depress the LEFT ARROW CURSOR CONTROL key and then depress the "Off" soft key.

f. Verify the DTMF position and the External position are both OFF.

g. Depress the DISP (Display) key on the R2600 panel. Move the cursor to the Meter position and depress the "RF DISPLAY" soft key.

NOTE

The “more” soft key may have to be depressed for the “RF DISPLAY” soft key to be displayed.

h. Move the cursor to the Input Lvl Input Level) position and depress the "dBm" soft key.

i. Move the cursor to the Display position and depress the "EXT SCOPE" soft key.

j. Move the cursor to the Coupling position and depress the "AC" soft key.

k. Move the cursor to the Trigger position and depress the "AUTO" soft key.

l. Move the cursor to the Trig Lvl (Trigger Level) position and enter 500 from the keypad.

m. Move the cursor to the Horiz (Horizontal) position and depress the "500 us" soft key.

NOTE

The “more” soft key may have to be depressed for the “500 us” soft key to be displayed.

n. Move the cursor to the Vert (Vertical) position and depress the "200 mV" soft key.

NOTE

The “more” soft key may have to be depressed for the “200 mV” soft key to be displayed.

o. Move the cursor to the Pos (Position) position and depress the "move up" or "move down" soft keys as appropriate to center the displayed scope screen trace. The TUNING knob on the R2600 panel may be used in lieu of the "move up" or "move down" soft keys.

p. Adjust both the SQUELCH and VOLUME controls on the front panel to their maximum CCW positions.

5. Setup the URC-200 (V2) as follows:

   a. Turn the transceiver on and note the input current. It should be approximately 240mA. If the current exceeds 330mA, a problem exists in the transceiver. Turn off the power and troubleshoot the transceiver.

   b. Set the frequency presets as listed in Table 22 on the URC-200 (V2). For each preset channel, adjust the URC-200 (V2) for the following:

      AM, LO POWER, PT, SCN OFF, BCN OFF

      To configure presets, refer to Paragraph 4.4.6.

6. Transmitter AM Power Output, PT % Modulation, and PT Distortion Measurements:

   a. Set the presets on both the URC-200 (V2) and the R2600 to channel 01. Verify the URC-200 (V2) is in the LO POWER mode.

   b. Key the transceiver by grounding pin F, see Figure 17, and measure the transmit output power on the R2600 screen. Verify compliance with Table 1.

NOTE

When measuring AM transmitter output power on the R2600 or on any power meter that has a peak detector, which includes virtually all of the portable inline or direct power meters, the carrier power that is read on the wattmeter will need to be converted to average power to verify compliance as indicated above. To convert carrier power to average power use the following formula:

$$P_{AVG} = P_C [1 + (m^2 / 2)]$$

where:
P_{AVG} = Average Power
P_C = Carrier Power
m = modulation as a decimal; i.e., 80% = .8
It should be noted, that in order to obtain the modulation value for the above formula, the next step (c) will need to be completed.

c. Read the AM % modulation on the R2600 screen. Verify compliance with Table 1.

d. Depress the DISP key on the R2600 front panel. Move the cursor to the Meter position and press the "EXT DIST" soft key.

NOTE

The “more” soft key may have to be depressed for the “EXT DIST” soft key to be displayed.

e. Read the % of distortion on the R2600 screen. Verify compliance with Table 1.

f. Unkey the URC-200 (V2) and adjust it for HI POWER. Depress the DISP key on the R2600 front panel. Move the cursor to the Meter position and press the "RF DISPLAY" soft key.

NOTE

The “more” soft key may have to be depressed for the “RF DISPLAY” soft key to be displayed.

g. Rekey the URC-200 (V2) and verify compliance with Table 1.

NOTE

When measuring AM transmitter output power on the R2600 or on any power meter that has a peak detector, which includes virtually all of the portable inline or direct power meters, the carrier power that is read on the wattmeter will need to be converted to average power to verify compliance as indicated above. To convert carrier power to average power use the following formula:

$$P_{AVG} = P_C [1 + (m^2 / 2)]$$

where:
P_{AVG} = Average Power
P_C = Carrier Power
m = modulation as a decimal; i.e., 80% = .8
It should be noted, that the modulation has to be measured in order to obtain the modulation value for the above formula.

h. On both the URC-200 (V2) and the R2600 repeat steps A through E for preselect channels 2 through 9 and channel 0 on the URC-200 (V2) with the R2600 set on preset channel 10.

5.3.3.5 AM CT % Modulation and CT Distortion

1. Set up the test equipment as shown in Figure 17.

   Connect the VERT/SINAD/DIST/DVM/COUNTER IN connector to the DEMOD connector on the R2600. On the R2600 connect the MOD OUT connector to pin B of the REMOTE connector on the URC-200 (V2). Do not connect the PTT (Push-to-Talk) line (pin F) to ground.

NOTE

When the PTT line is grounded, the URC-200 (V2)'s transmitter will key itself ON.

2. Set the input power supply to 28 ±1 VDC.
3. Preset the R2600 by performing the following steps.

   a. Press the MEM (Memory) key on the R2600 panel for the preset-screen.
   b. Use the CURSOR POSITION keys to highlight preset 01.
   c. Press the "view preset" soft key.

NOTE

The soft keys are the eight keys under the CRT screen on the R2600.

   d. Using the CURSOR POSITION keys move to the Monitor Frequency position and enter 115.000 from the R2600 keypad.
   e. Move the cursor to Modulation Type and press the "AM" soft key.
   f. Move the cursor to the Generate Frequency position and enter 115.000 from the R2600 keypad.
   g. Move the cursor to Modulation Type and press the "AM" soft key.
   h. Move the cursor to bandwidth and press the "WIDE ±100kHz" soft key.
   i. Move the cursor to the Duplex Offset position and press the "DON'T CARE" soft key.
   j. Move the cursor to Synth. Format Sel (Synthesizer Format Select) and select the "Tone A" soft key.
   k. Move the cursor to Freq (Frequency) and enter 01000.0 from the keypad.
   l. Move the cursor to the DTMF Code position and press the "DON'T CARE" soft key.

NOTE

The “more” soft key may have to be depressed for the “DON’T CARE” soft key to be displayed.

m. Press the "return" soft key. Repeat steps A through K for presets 02 through 10. Use Table 22 to program the frequency presets in steps D and E above.

n. Press the "return" soft key.

4. Perform the following steps to complete the setup on the R2600 analyzer.

a. Press RF key on the R2600 panel. Move the cursor to RF Control and press the "MON" soft key.

b. Move the cursor to the Attenuation position and press the "40" soft key.

c. Move the cursor to the Mon RF Out position and press the "RF IN/OUT" soft key.

d. Depress the AUD (Audio) key on the R2600 panel. Move the cursor to the Synth (Synthesizer) position and enter 0.77 V peak from the keypad.

NOTE

This is AM Modulation. Depress the RIGHT ARROW CURSOR CONTROL key and depress “Cont” (Continuous) soft key.

e. Move the cursor to the Fixed 1 kHz position. Depress the LEFT ARROW CURSOR CONTROL key and then depress the "Off" soft key.

f. Verify the DTMF position and the External position are both OFF.

g. Depress the DISP (Display) key on the R2600 panel. Move the cursor to the Meter position and depress the "RF DISPLAY" soft key.

NOTE

The “more” soft key may have to be depressed for the “RF DISPLAY” soft key to be displayed.

h. Move the cursor to the Input Lvl Input Level) position and depress the "dBm" soft key.

i. Move the cursor to the Display position and depress the "EXT SCOPE" soft key.

j. Move the cursor to the Coupling position and depress the "AC" soft key.

k. Move the cursor to the Trigger position and depress the "AUTO" soft key.

l. Move the cursor to the Trig Lvl (Trigger Level) position and enter 500 from the keypad.

m. Move the cursor to the Horiz (Horizontal) position and depress the "500 us" soft key.

NOTE

The “more” soft key may have to be depressed for the “500 us” soft key to be displayed.

n. Move the cursor to the Vert (Vertical) position and depress the "200 mV" soft key.

NOTE

The “more” soft key may have to be depressed for the “200 mV” soft key to be displayed.

o. Move the cursor to the Pos (Position) position and depress the "move up" or "move down" soft keys as appropriate to center the displayed scope screen trace. The TUNING knob on the R2600 panel may be used in lieu of the "move up" or "move down" soft keys.

p. Adjust both the SQUELCH and VOLUME controls on the front panel to their maximum CCW positions.

5. Setup the URC-200 (V2) as follows:

a. Turn the transceiver on and note the input current. It should be approximately 240mA. If the current exceeds 330mA, a problem exists in the transceiver. Turn off the power and troubleshoot the transceiver.

b. Set the frequency presets as listed in Table 22 on the URC-200 (V2). For each preset channel, adjust the URC-200 (V2) for the following:

AM, LO POWER, CT, SCN OFF, BCN OFF

To configure presets, refer to Paragraph 4.4.6.

6. Transmitter AM CT % Modulation and Distortion Measurements:

a. Set the presets on both the URC-200 (V2) and the R2600 to channel 01. Verify the URC-200 (V2) is in the LO POWER mode.

b. Key the transceiver into the R2600 test set and read the AM modulation on the R2600 screen. Verify compliance with Table 1. In keying the transceiver the PTT line, pin F, will be grounded.

c. Observe the scope display on the R2600, it should be showing a square wave 1 kHz signal.

d. On both the URC-200 (V2) and the R2600 repeat steps A through C for preselect channels 2 through 9 and channel 0 on the URC-200 (V2) with the R2600 set on preset channel 10.

5.3.3.6 Beacon

1. Set up the test equipment as shown in Figure 17.

Connect the VERT/SINAD/DIST/DVM/COUNTER IN connector to the DEMOD connector on the R2600. On the R2600 connect the MOD OUT connector to pin B of the REMOTE connector on the URC-200 (V2). Do not connect the PTT (Push-to-Talk) line (pin F) to ground. Note: When the PTT line is grounded the URC-200 (V2)'s transmitter will key itself ON.

2. Set the input power supply to 28 ±1 VDC.

3. Preset the R2600 by performing the following steps.

a. Press the MEM (Memory) key on the R2600 panel for the preset-screen.

b. Use the CURSOR POSITION keys to highlight preset 08.

c. Press the "view preset" soft key.

NOTE

The soft keys are the eight keys under the CRT screen on the R2600.

d. Using the CURSOR POSITION keys move to the Monitor Frequency position and enter 312.000 from the R2600 keypad.

e. Move the cursor to Modulation Type and press the "FM" soft key.

f. Move the cursor to the Generate Frequency position and enter 312.000 from the R2600 keypad.

g. Move the cursor to Modulation Type and press the "FM" soft key.

h. Move the cursor to bandwidth and press the "WIDE ±100kHz" soft key.

i. Move the cursor to the Duplex Offset position and press the "DON'T CARE" soft key.

j. Move the cursor to Synth. Format Sel (Synthesizer Format Select) and select the "Tone A" soft key.

k. Move the cursor to Freq (Frequency) and enter 01000.0 from the keypad.

l. Move the cursor to the DTMF Code position and press the "DON'T CARE" soft key.

NOTE

The “more” soft key may have to be depressed for the “DON’T CARE” soft key to be displayed.

m. Press the "return" soft key twice.

4. Perform the following steps to complete the setup on the R2600 analyzer.

a. Press RF key on the R2600 panel. Move the cursor to RF Control and press the "MON" soft key.

b. Move the cursor to the Attenuation position and press the "40" soft key.

c. Move the cursor to the Mon RF Out position and press the "RF IN/OUT" soft key.

d. Depress the AUD (Audio) key on the R2600 panel. Move the cursor to the Synth (Synthesizer) position and enter 0.77 V peak from the keypad.

NOTE

This is FM Deviation. Depress the RIGHT ARROW CURSOR CONTROL key and depress “Cont” (Continuous) soft key.

e. Move the cursor to the Fixed 1 kHz position. Depress the LEFT ARROW CURSOR CONTROL key and then depress the "Off" soft key.

f. Verify the DTMF position and the External position are both OFF.

g. Depress the DISP (Display) key on the R2600 panel. Move the cursor to the Meter position and depress the "RF DISPLAY" soft key.

NOTE

The “more” soft key may have to be depressed for the “RF DISPLAY” soft key to be displayed.

h. Move the cursor to the Input Lvl Input Level) position and depress the "dBm" soft key.

i. Move the cursor to the Display position and depress the "EXT SCOPE" soft key.

j. Move the cursor to the Coupling position and depress the "AC" soft key.

k. Move the cursor to the Trigger position and depress the "AUTO" soft key.

l. Move the cursor to the Trig Lvl (Trigger Level) position and enter 500 from the keypad.

m. Move the cursor to the Horiz (Horizontal) position and depress the "500 us" soft key.

NOTE

The “more” soft key may have to be depressed for the “500 us” soft key to be displayed.

n. Move the cursor to the Vert (Vertical) position and depress the "200 mV" soft key.

NOTE

The “more” soft key may have to be depressed for the “200 mV” soft key to be displayed.

o. Move the cursor to the Pos (Position) position and depress the "move up" or "move down" soft keys as appropriate to center the displayed scope screen trace. The TUNING knob on the R2600 panel may be used in lieu of the "move up" or "move down" soft keys.

p Adjust both the SQUELCH and VOLUME controls on the front panel to their maximum CCW positions.

5. Setup the URC-200 (V2) as follows:

a. Turn the transceiver on and note the input current. It should be approximately 240mA. If the current exceeds 330mA, a problem exists in the transceiver. Turn off the power and troubleshoot the transceiver.

a. On the URC-200 (V2) set the frequency presets to channel 8 and program it to 312.000 MHz. Adjust the URC-200 (V2) for the following:

FM, LO POWER, CT, SCN OFF, BCN OFF

To configure presets, refer to Paragraph 4.4.6.

6. Transmitter Beacon Measurements:

a. Set the presets on both the URC-200 (V2) and the R2600 to channel 08. Verify the URC-200 (V2) is in the LO POWER mode.

b. On the transceiver, set BCN ON per Paragraph 4.4.7.2.

c. Read the transmitter output power on the R2600. Verify compliance of the output power (LO POWER mode) with Table 1. Turn up the VOLUME control on the R2600; the

variable frequency emergency beacon tone should be audible and visible on the R2600 display.

5.3.4 Power Supply Voltages

The internal power supply in the URC-200 (V2) is located on the Audio, Processor, Power Supply (APPS) printed wiring board. The power supply has one input voltage (+24 VDC) and five output voltages (+5 VDC, -5 VDC, +12 VDC, -12 VDC, and +70 VDC).

5.3.4.1 Input Voltage

The input voltage can be measured on pin G of the Remote connector that is located on the front panel. Depending on what is being used to supply power to the transceiver (batteries, external power supply, or etc., the normal input voltage can vary from approximately 22 VDC to 34 VDC. This voltage can also be displayed on the front panel of the transceiver using the R/T key as described in Paragraph 4.4.7.3.

NOTE

If the transceiver is being operated from batteries and the voltage reading is below 22 VDC, install fresh batteries in the battery pack.

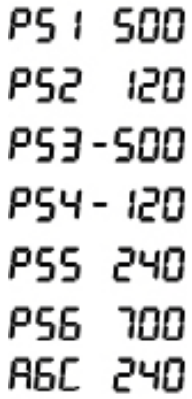
5.3.4.2 Internal voltages

Six internal voltages can be displayed on the front panel (Table 23). The following table shows the tolerance range for each. If the input voltage is within the specified range and any of the internal voltages are out of tolerance, the transceiver should be returned to General Dynamics for repair.

Table 23 - Internal Voltages

Display	Internal Voltage	Tolerance
PS1	+5 VDC	+4.8V to +5.3V DC
PS2	+12 VDC	+11V to +13V DC
PS3	-5 VDC	-4.7V to -5.3V DC
PS4	-12 VDC	-11V to -13V DC
PS6	+70 VDC	+62V to +78V DC

5.3.4.3 Voltage Measurements



With the transceiver set-up in the meter-mode per Paragraph 4.4.5, pressing the [R/T] key will display the voltages of the internal power supplies and of the batteries. The first time [R/T] is pressed the voltage of the +5VDC supply - PS1 is displayed. Each consecutive press of [R/T] brings up the next supply; PS2: +12VDC, PS3: -5VDC, PS4: -12VDC, PS5: +24VDC (external power batteries), PS6: +70VDC and AGC.

NOTE

The AGC level displayed is a relative expression of voltage only.
The AGC is expressed as a digital value from 000 to 255.

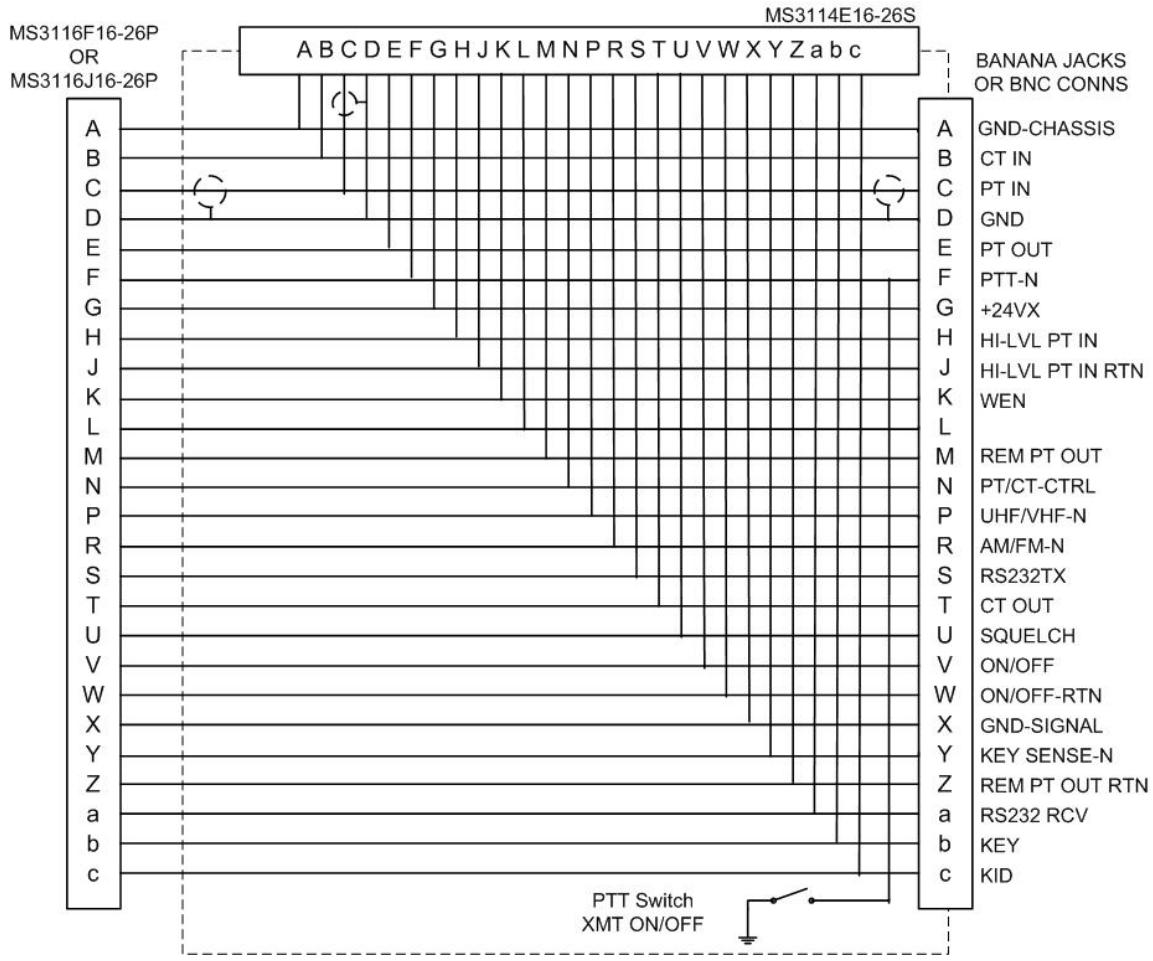


Figure 18 - Breakout Box Schematic

When performing the Receiver Tests in accordance with Paragraph 5.3.2 and Figure 16:

- For the PT OUT on pin E of the Breakout Box, Pin D is the ground return.
- For the CT OUT on pin T of the Breakout Box, Pin D is the ground return.

When performing the Transmitter Tests in accordance with Paragraph 5.3.3 and Figure 17:

- For the CT IN on pin B of the Breakout Box, Pin D is the ground return.
- For the HI-LVL PT IN on pin H of the Breakout Box, Pin J is the ground return.

5.4 Inspection

Inspect for signs of wear, corrosion or other deterioration of exposed surfaces. Ensure mounting hardware is secure and free of corrosion. Inspect cables and connectors for signs of wear. Ensure heatsinks and other thermal radiating surfaces are free of dust or other blockage that could impede airflow and result in overheating of components. Replace or repair as required.

5.5 Troubleshooting

The following eight error messages are produced by the URC-200 (V2) Transceiver and are displayed on the front panel screen. The displayed error, the error title, and a description of the error are indicated below in Table 24.

Table 24 - Error Messages

Display	Error Title	Description
Err – bEAC	Beacon Lock Failure	This message indicates that there is no synthesizer lock on beacon.
Err – EEPr	EEprom Failure	This message indicates that data could not be written into the EEPROM and that the processor should be replaced.
Err – FACt	Factory Init Incomplete	This message is produced after the installation of a newly programmed microprocessor. It indicates that the initialization has not been completed for this transceiver.
Err – noSC	Scan Error	This message indicates that an attempt to begin scanning failed because less than two channels are selected for Scan mode.
Err – trPr	PA Path Over	This message indicates that the VFWD is below the calculated threshold value.
Err – UOLt	Voltage Out of Range	This message indicates that the 70 volt supply is out of its normal range either high (>80 V) or low (<60 V).
tOO – HOt	Over Temp Error	This message indicates that the transmitter's power amplifier temperature is above normal range. When this alarm condition exists, the transceiver will automatically reduce the transmitter power by 15 dB until the temperature returns to normal range.

5.6 Shipping

Use the original shipping container and packing material to re-pack the hardware for shipping. To pack the hardware, re-use the protective packing material. Tape container closed with strapping or package tape. If the original packing materials are not available, pack hardware in a cardboard container surrounded on all sides by rigid foam so it does not shift in the container. Tape container closed with strapping or package tape.

5.7 Storage

Parameter	Specification
Storage temperature	-50°C to +70°C*
Humidity	95% non-condensing
Altitude	50,000 ft., non-operating

* Storage temperature does not include the front panel display. The display is rated for storage at -40°C to +70°C.

5.8 Electrical Interfaces

Figure 11 shows interface connector locations for the URC-200 (V2). The following tables list the interface characteristics of the voltages and signals of the URC-200 (V2) power, HDST, and Remote connectors, respectively. Connector reference designation and connector part numbers are given in each table title. Table 29 provides part identification data for each connector.

Table 25 - Power Connector J1 (CA110821-1) Pin Characteristics

PIN	FUNCTION
1	12V Battery 1 - Negative / Transceiver Ground for External Power Source
2	12V Battery 2 - Negative (Tied to Pin 4 internal to the Transceiver)
3	Rechargeable battery sense. No connection for non-rechargeable battery. Grounded for rechargeable battery.
4	12V Battery 1 - Positive (Tied to Pin 2 internal to the Transceiver)
5	12V Battery 2 - Positive / +24 V transceiver power from External Power Source
6	No Connection

Table 26 - Power Connector J5 (CA110821-1) Pin Characteristics

PIN	FUNCTION
1	12V Battery 1 - Negative / Transceiver Ground for External Power Source
2	12V Battery 2 - Negative (Tied to Pin 4 internal to the Transceiver)
3	Rechargeable battery sense. No Connection for non-rechargeable battery. Grounded for rechargeable battery.
4	12V Battery 1 - Positive (Tied to Pin 2 internal to the Transceiver)
5	12V Battery 2 - Positive / +24 V transceiver power from External Power Source
6	No Connection

Table 27 - Handset Connector J4 (GC283F-1-050) Pin Characteristics

PIN	FUNCTION
A	GND - Ground
B	PT OUT. Adjustable from 0V to 11.5 V Peak at full modulation into 600 Ω
C	PTT-N. Push-to-Talk. Ground to Transmit
D	PT IN. 1-200 mVrms nominal into 150 Ω load.
E	Connected to pin B. (See Pin B)
F	Squelch. Receiver Squelch Output for RETRANSMIT, 0 TO +5V, logic gate output with a 100 Ω series resistor. +5V = Squelched. 0V = Not squelched.

Table 28 - Remote Connector J2 (MS3114E16-26S) Pin Characteristics

PIN	Signal Label	Function	Impedance	Level
TX AUDIO – PLAIN TEXT (VOICE)				
C	PT IN	Plain Text (Voice) Input	150 Ω	1-200 mV RMS nominal
D	GND	Ground, Audio	GND	GND
H	HI LVL PT IN	Hi-Level PT In, Bal.	600 Ω Balanced.	0.77 V RMS
J	HI LVL PT IN RTN	Hi-Level PT In, Bal.	600 Ω Balanced.	0.77 V RMS
RX AUDIO – PLAIN TEXT (VOICE)				
E	PT OUT	Plain Text (Voice) Output	Low impedance	0 V to 11.5 V Peak at full modulation
D	GND	Ground, Audio	GND	GND
M	REM PT OUT	Plain Text Output, Bal.	600 Ω Balanced	5.5 V RMS @ Max. Mod.
Z	REM PT OUT RTN	Plain Text Output, Bal.	600 Ω Balanced.	5.5 V RMS @ Max. Mod.
TX CIPHER TEXT (CT) - DATA				
B	CT IN	Cipher/Data Input	-	RS232
D	GND	Ground, Audio	GND	GND
RX CIPHER TEXT (CT) - DATA				
T	CT OUT	Cipher Text Output	-	RS232
D	GND	Ground, Audio	GND	GND
TX KEY LINE - PUSH-TO-TALK (PTT)				
F	PTT-N	Push-To-Talk Input, Ground to Transmit	10 kΩ to +5V	RCV: +5 V XMT: GND
D	GND	Ground, Audio	GND	GND
or				
X	GND-SIGNAL	DC Ground	-	-

RS-232 REMOTE

S	RS232 TX	Remote Control Data Output	470 Ω	RS232
a	RS232 RCV	Remote Control Data Input	6.8 kΩ	RS232
X	GND-SIGNAL	DC Ground	-	-

ON/OFF REMOTE

V	ON/OFF	Remote Power On/Off	-	+24 V @ 7 mA. (Source)
W	ON/OFF RTN	Remote Power On/Off	-	+24 V @ 7 mA. Input)

PIN	Signal Label	Function	Impedance	Level

OTHER REMOTE LINES

N	PT/CT CTRL	Plain Text/Cipher Text Control	150 kΩ	PT - Open CT - Ground
P	UHF/VHF-N	Amplifier Control	-	HI = UHF
R	FM/AM-N	Amplifier Control	-	HI = FM
X	GND-SIGNAL	DC Ground	-	-

24VDC OUTPUT VOLTAGE

G	+24VX	+24 VDC Output	Battery or Power Source	30 VDC Maximum, 500 mA Maximum Drain
X	GND-SIGNAL	DC Ground	-	-
		or		
A	GND-CHASSIS	Chassis Ground	-	GND

SQUELCH OUTPUT

U	SQUELCH	Squelch State Output	-	HI = Squelched
X	GND-SIGNAL	DC Ground	-	-
		or		

PIN	Signal Label	Function	Impedance	Level
A	GND-CHASSIS	Chassis Ground	-	GND

SPARE

K	-	-	-	-
Y	-	-	-	-
b	-	-	-	-
c	-	-	-	-
L	-	-	-	-

GROUNDS

A	GND-CHASSIS	Chassis Ground	-	GND
D	GND	Ground, Audio	GND	GND
X	GND-SIGNAL	DC Ground	-	-

The part numbers indicated in Table 29 are 3rd party vendor specific and therefore are subject to change without notice.

Table 29 - URC-200 (V2) Connector Identification

Connector Number	Name	Part Number	Mating Connector
J1	Power	CA110821-1	44249-6S HIRELCO
J2	Remote	851-07A16-26S50-A7	851-06AC16-26P50
J3	Ant	24BNC-50-2-42	STD BNC (Male)
J4	Handset	28-P26618A003	U-329/U
J5	Power	CA110821-1	44249-6S HIRELCO

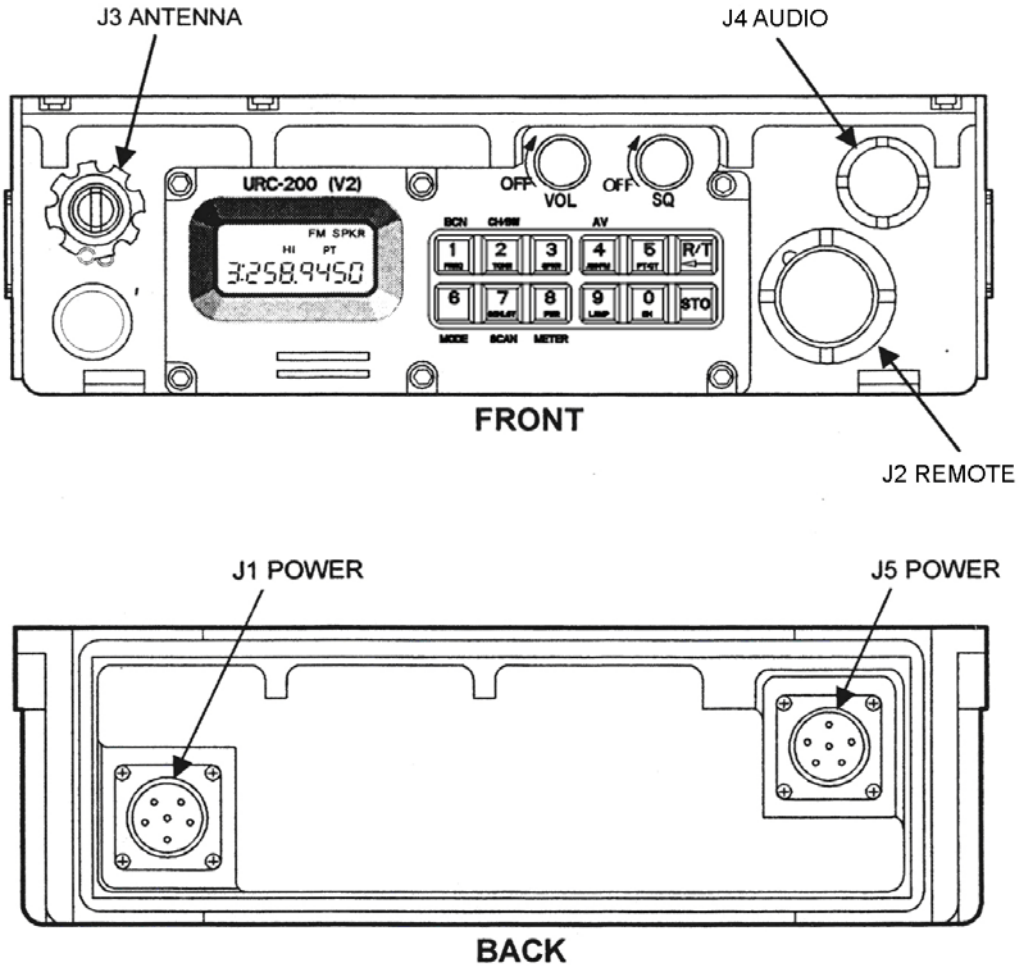


Figure 19 - URC-200 (V2) Interfaces

6.0 PARTS LIST

Table 30 identifies the URC-200 (V2) parts.

Table 30 - URC-200 (V2) Parts

Item Number	Part Number	Description
1	01-P36744M003	Transceiver URC-200 (V2)
2	85-P35988M001	Antenna UVU-100
3	01-P04535L001	Handset PTHS-110
4	01-P36751M001	Battery Box UBC-100* *Does not include batteries.

7.0 URC-200 (V2) SYSTEMS

As a convenience for operators, this section provides information on two commonly installed systems using the URC-200 (V2). Refer to the individual equipment manuals for more detailed information on each of the system components.

7.1 Rack Mounted Base System

The Rack Mounted Base System is a UHF/VHF high power transceiver system consisting of the following components installed in a 19-inch rack mounted tray (Figure 20):

- URC-200 (V2) Transceiver
- UPA-55H Power Amplifier
- UFB-100 or UIB-100 Filtered or Unfiltered 28VDC Power Interface Box
- UAC-350 AC Power Supply (not used if powering from DC source)
- UEC-120 or UEC-220 Remote Control Units (control up to one or two systems, respectively)

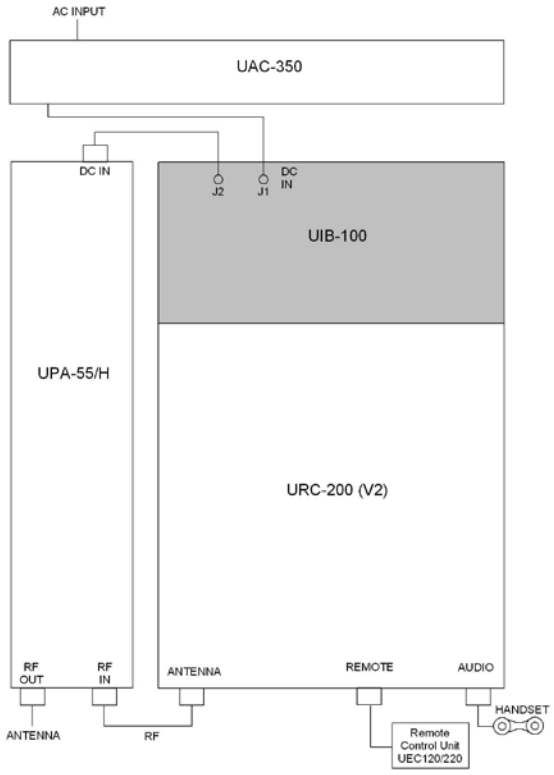


Figure 20 - Rack Mount System Components

7.1.1 Rack Mounted Base System Description of Operation

Figure 21 indicates the basic interface between the Rack Mounted System components.

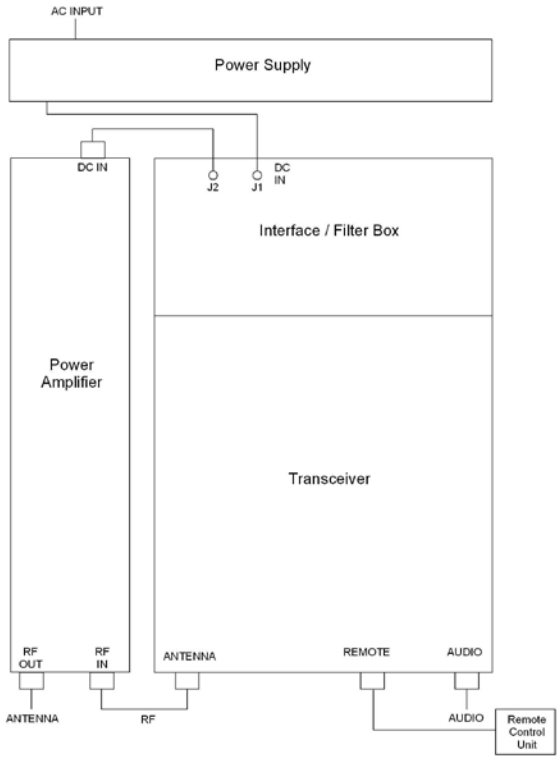


Figure 21 - Rack Mount System Block Diagram with AC Power Supply

7.1.1.1 Component Interoperation:

Power for the system is provided via an external AC power source in the range of 90 to 254 volts or an external DC power source in the range of +26 to +32 VDC (+28 VDC nominal). When operated from an AC source, the UAC-350 Power Supply is used. The UAC-350 provides an isolated and regulated +28 VDC output to the power interface box for distribution to the transceiver and power amplifier. When operated from a DC power source, the power supply is not used, and +28 VDC is applied directly to the DC input on the power interface or power filter box.

The UIB-100 Power Interface Box attaches directly to the rear of the URC-200 (V2) and provides the mechanical connections to distribute +28 volts DC to the transceiver, as well as to the power amplifier via a cable connection from the interface box to the power amplifier DC input. The UIB-100 Power Interface Box does not filter the DC input from the power supply or DC source before distribution to the transceiver or amplifier. If the UFB-100 is used in place of the UIB-100, then filtered power is supplied to the transceiver and unfiltered power is supplied to the power amplifier.

The heart of the Rack Mounted System is the URC-200 (V2) multimode transceiver. The transceiver is a lightweight, tactical, Line-Of-Sight (LOS) transceiver that provides AM or FM communication of nonsecure voice or data in the VHF or UHF bands. The user

configures and monitors the desired operating mode from either the front panel or via a remote control unit attached to the remote connector. Two remote control units are available: the UEC-120, which controls one transceiver/amplifier pair, and the UEC-220, which can control up to two transceiver/amplifier pairs.

The URC-200 (V2) Transceiver provides up to 10 Watts average power at 80% modulation (7.78 Watts CW power) RF output, but is normally set to low power in AM or medium power in FM when connected to the UPA-55H Power Amplifier. Under normal conditions, when the power amplifier detects RF at its input, it transitions to the amplify/transmit mode and amplifies the input signal. The UPA-55H has two power settings, “Low” and “High”. When switched to low power mode, the UPA-55H amplifies the URC-200 (V2) input to 20 Watts FM and 20 Watts AM average (15.15 Watt CW) output power and passes it to the antenna system. When switched to the high power mode, the UPA-55H amplifies the URC-200 input to 50 Watt FM and 30 Watt AM average (22.72 CW) output power. When no power is detected at the input, the amplifier transitions to the bypass/receive mode and passes the received signals to the transceiver.

7.1.1.2 Signal Flow:

Audio is applied to the transceiver locally via the front panel audio input or remotely via the remote connector depending on the external system connections. When keyed by means of a PTT signal, the transceiver processes the audio and passes modulated RF signal to the power amplifier via the antenna output. This triggers the power amplifier, when on, to operate in the amplify mode. The power amplifier then amplifies the signal to transmit at either high or low power, depending on the power switch setting, and subsequently transmits the signal out the connected antenna.

Conversely, if the transceiver is not keyed to transmit, the power amplifier operates in the bypass (receive) mode. Signals received by the antenna are passed straight through the power amplifier to the transceiver through the antenna port. The transceiver then demodulates the RF signal, converting it into voice data that is then sent out the audio port to be listened to by the user.

NOTE

For additional equipment descriptions and operational information on the equipment that makes up the Rack Mounted Base System, refer to the individual equipment manuals.

7.1.2 Rack Mounted Base System Installation

For installation instructions for the rack mounted system, please refer to the *URM and UST Family of Mounting Trays Operation and Maintenance Manual*, document number 99-P44032F.

7.1.3 Rack Mounted Base System Operation

7.1.3.1 UAC-350 Operation:

1) Ensure the transceiver and power amplifier ON/OFF switches are set in the OFF position.
2) Connect the UAC-350 output cable to the DC input of the UIB-100 interface box.
3) Using the supplied IEC type power supply cord, connect the UAC-350 input to a suitable AC power source.

7.1.3.2 URC-200 (V2) Operation:

1) Set the transceiver ON/OFF switch to the ON position.
2) Program the following settings via the front panel or remote control unit:
   - Operating frequency
   - AM or FM modulation mode selection
   - PT (audio) or CT (data) mode selection
   - Power level to LOW in AM mode or MED in FM mode for connection to the power amplifier
   - Speaker ON or OFF
   - Scan or Beacon modes (if desired)
3) Set the squelch setting to full counterclockwise, and then turn clockwise until receiver noise is not heard.

NOTE

Squelch may be set to OFF (fully clockwise) depending on the operation of the baseband system connected to the transceiver input.

7.1.3.3 UPA-55H Operation:

1) Set the front panel switches:
   - AM or FM selection to match the URC-200 (V2)
   - VHF or UHF selection to match the URC-200 (V2)
   - Amplifier power output level to LOW or HIGH
   - Speaker ON or OFF
   - Scan or Beacon modes (if desired)
2) Set the power amplifier ON/OFF switch to the ON position.

NOTE

The UPA-55H output power level cannot be controlled by the URC-200(V2). It is controlled by the power amplifier front panel switch.

7.1.3.4 System Functional Test

To test the setup, key the transceiver by pressing the PTT switch on the attached audio interface. Before keying, the BYPASS LED on the power amplifier should be lit. When keyed, the URC-200 will display a "TX" symbol on the LCD display, and the power amplifier's BYPASS LED will turn off. When PTT is released, the BYPASS LED should return to a lit state. If these events occur, the system has been set up correctly (assuming the desired power, band, modulation, and other settings are correct on both the transceiver and the power amplifier). If these events do not occur, refer to paragraph 7.1.4 for troubleshooting.

7.1.4 Rack Mounted Base System Troubleshooting

When troubleshooting, check the Rack Mount System setup to ensure that the UPA-55H and URC-200 are both powered and connected correctly. Also check the configuration settings (power level, modulation, frequency band, etc.) to ensure they are configured to corresponding settings. For specific troubleshooting of the Rack Mounted System, refer to Section 5, UPA-55H Manual (99-P44032F), or Section 5.0 of this document.

7.1.5 Rack Mounted System Remove and Replace Procedures

Figure 22 depicts the Rack Mount System, as installed. In order to remove one of the four components (power amplifier, power supply, power interface box, or transceiver), it may be necessary to uninstall the rack mount tray from the 19" rack, depending on accessibility to the components and their mounting screws/brackets, etc. The following sections outline the procedures for removing the rack mount tray or one of the system components. Figure 23 depicts the tray's hardware, for reference during component removal.

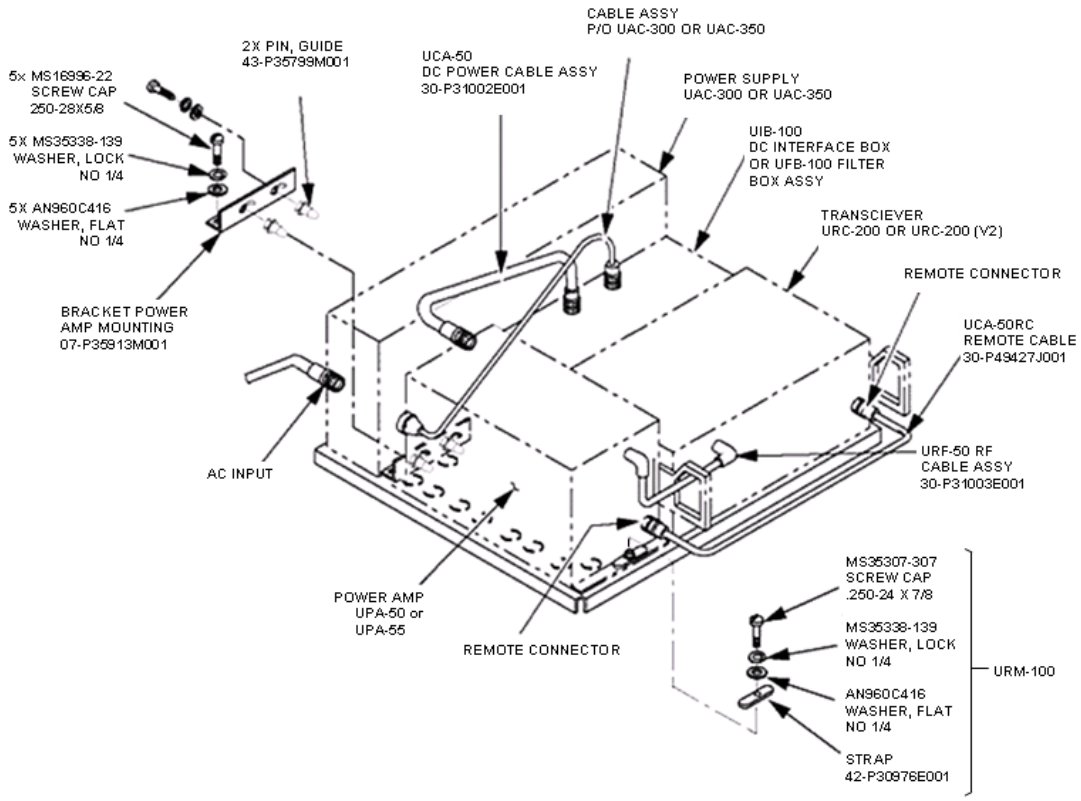


Figure 22 – Rack Mounted Installed System

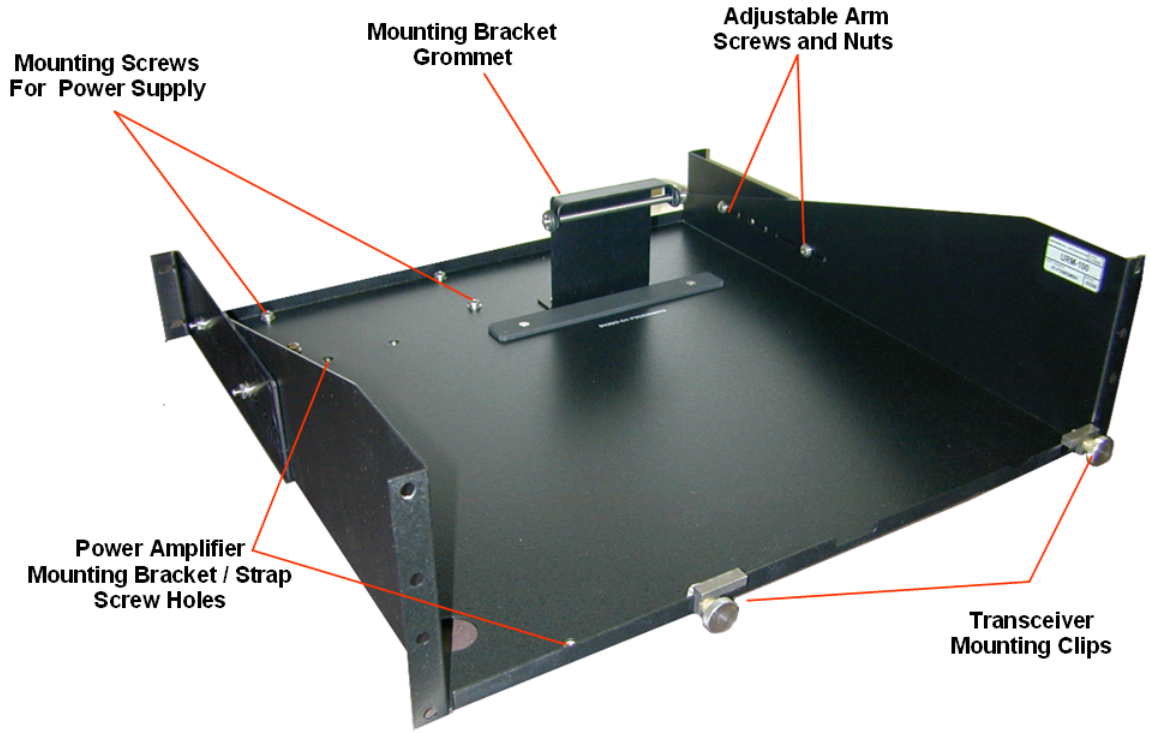


Figure 23 - Rack Mount Tray Hardware

7.1.5.1 Removing the URC-200 Transceiver and UIB-100 Interface Box:

The following steps outline the procedure for removing the URC-200 Transceiver and UIB-100 Interface Box from the Rack Mount System. It is necessary to remove the interface box with the transceiver, because they cannot be detached while installed. If the following steps cannot be performed due to space restrictions, it may be necessary to first uninstall the tray from the 19" rack.

1. Ensure the power amplifier and transceiver are turned off, and that the power supply is disconnected from the AC power source.
2. Disconnect the following cables from the transceiver and interface box:
    - Cable assembly from the power supply to the interface box
    - DC power cable from the interface box to the power amplifier
    - RF cable from the transceiver to the power amplifier
    - Remote connector from the transceiver to the power amplifier (only applicable if Remote mode was being used on power amplifier)
    - Audio cable / remote control connector on front panel of transceiver, if present
3. Loosen the screws on the two front transceiver mounting clips.
4. Slide the transceiver and interface box out from under the mounting bracket, and remove from the tray.
5. Disconnect the interface box from the transceiver by unlatching the two side latches on the interface box.

For reinstallation steps, refer to Section 2.0, the UIB-100, Interface Box Manual (99-P44032F).

7.1.5.2 Removing the UPA-55H Power Amplifier:

The following steps outline the procedure for removing the UPA-55H Power Amplifier from the Rack Mount System. If the steps cannot be performed due to space restrictions, then it may be necessary to first uninstall the tray from the 19" rack.

1. Ensure the power amplifier and transceiver are turned off, and that the power supply is disconnected from the AC power source.
2. Disconnect the following cables from the power amplifier:
    - DC power cable from the interface box to the power amplifier
    - RF cable from the transceiver to the power amplifier
    - Antenna RF cable
    - Remote connector from the transceiver to the power amplifier (only applicable if Remote Mode was being used for power amplifier)

3. Unscrew the single cap screw from in front of the power amplifier.
4. Slide the power amplifier out from the tray, to release it from the two rear guide pins.

For reinstallation steps the URM-100 Rack Mount Tray Manual (99-P44032F), and the UPA-55H Manual (99-P44032F).

7.1.5.3 Removing the UAC-350 Power Supply:

The following steps outline the procedure for removing the UAC-350 Power Supply from the Rack Mount System. If the steps cannot be performed due to space restrictions, then it may be necessary to first uninstall the tray from the 19" rack.

1. Ensure the power amplifier and transceiver are turned off, and that the power supply is disconnected from the AC power source.
2. Disconnect the following cables from the power supply:
    - AC input power cable
    - Power cable assembly from power supply to interface box
3. Unscrew the six power supply mounting screws.
4. Remove the power supply from the tray.

7.2 Portable Backpack System

The Portable Backpack System (Figure 24) is a 10 Watt UHF/VHF Mobile Transceiver System consisting of the following:

- URC-200 (V2) Transceiver with the ECS-8 8.33 kHz Frequency Tuning Increment option installed
- UVU-100 Radio Antenna
- PTHS-110 Handset
- UAD-100A Uninterruptible Power Supply with two batteries
- UCB-200 Carrying Bag

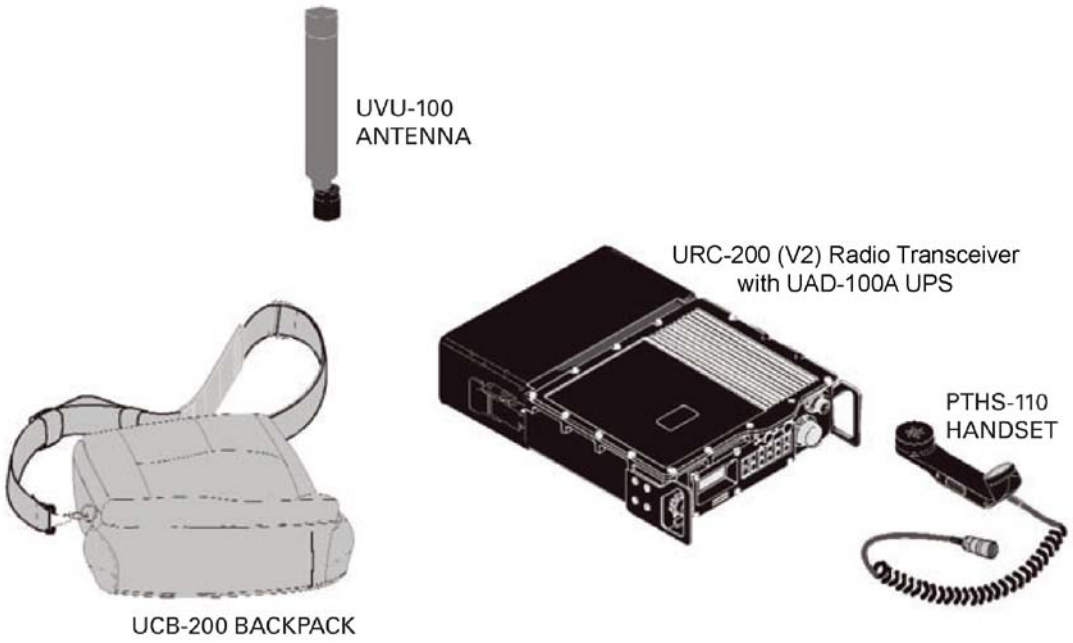


Figure 24 - Backpack System Components

7.2.1 Backpack System Description of Operation

Figure 25 depicts the main components and interfaces of the Backpack System.

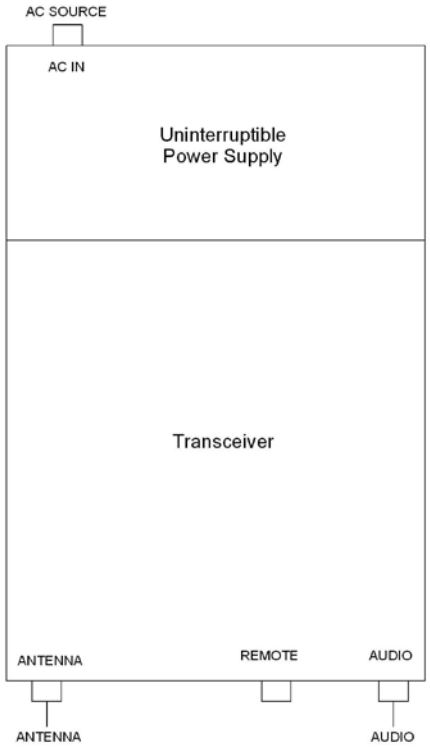


Figure 25 - Backpack System Block Diagram

The URC-200 (V2) VHF/UHF Transceiver is a lightweight, tactical, Line-Of-Sight (LOS) transceiver that provides AM and FM communication of nonsecure voice or data.

The UVU-100 Radio Antenna is a ManPack antenna for backpack configuration, weighing approximately one pound, and supporting frequencies of 115 to 174 MHz in VHF band, and 225 to 400 MHz in UHF Band.

The PTHS-110 Handset is a PTT controlled handset that connects to the transceiver via the front panel audio port.

The UAD-100A Uninterruptable Power Supply is made for “jerk-and-run” applications, and operates from a 110/220-VAC source but includes two batteries which power the radio when disconnected from the source.

The transceiver may be powered either directly by the batteries in the UAD-100A, or by an AC source connected to the power supply. When the user keys the transceiver to transmit by pressing the PTT button on the handset, audio from the handset is sent into the transceiver through the *Audio* connector on the front panel. The audio is then converted into an RF signal, and transmitted out the antenna connected to the RF I/O port of the transceiver. When not keyed, the transceiver receives RF signals through the antenna, and converts the signals back into voice heard by the user listening through the handset.

7.2.2 Backpack System Installation

Installing the Backpack System involves the following steps:

1. Insert two batteries into the UAD-100A Uninterruptable Power Supply.
2. Attach power supply to the back of the transceiver, using the side latches.
3. Attach UVU-100 antenna to the RF/IO front panel connector on the transceiver.
4. Connect handset to Audio connector on the transceiver.
5. If using an AC power source, connect the power supply to the appropriate VAC power source.

For further information regarding Backpack System installation, refer to paragraph 7.2.3.

7.2.3 Backpack System Operation

7.2.3.1 UAD-100A Operation:

1) Ensure the transceiver ON/OFF switches is set to the OFF position.
2) Connect UAC-100A input power cord to a suitable AC power source to keep the internal batteries charged for ManPack “jerk-and-run” operation.

7.2.3.2 URC-200 (V2) Operation:

1) Set the transceiver ON/OFF switch to the ON position.
2) Program the following settings via the front panel or remote control unit:
   - Operating frequency
   - AM or FM modulation mode selection
   - PT (audio) or CT (data) mode selection
   - Power level to LOW in AM mode or MED in FM mode for connection to the power amplifier
   - Speaker ON or OFF
   - Scan or Beacon modes (if desired)
3) Set the squelch setting to full counterclockwise, and then turn clockwise until receiver noise is not heard.
4) To transmit, key the transmitter by holding down the PTT switch on the handset, and speak into the handset microphone. To receive, unkey the PTT switch on the handset, and listen via the handset earphone or the transceiver’s internal speaker.
5) Return the transceiver ON/OFF switch to the OFF position, if desired, if transceiver is ON.

7.2.3.3 Jerk-and-Run Operation:

1) Disconnect power cord from the AC input for the transceiver.

2) Place the transceiver in the supplied canvas carry bag, if desired.
3) Move to desired location and transmit and receive normally using battery power.

7.2.4 Backpack System Troubleshooting

When troubleshooting the Backpack System, ensure the following connections are secure:

- UAD-100A Power Supply to URC-200 Transceiver
- UVU-100 Antenna to URC-200 Transceiver
- VAC Power Source to UAD-100A Power Supply (if using AC power)
- PTHS-110 Handset to URC-200 Transceiver

Also, check to make sure the transceiver is configured properly. Refer to paragraph 4.4 of this document, for specific instructions on configuring the radio. For specific tests and troubleshooting, refer to Section 5.0 of this document.

7.2.5 Backpack System Remove and Replace Procedures

To remove any of the system components, follow these guidelines:

- Ensure the transceiver is powered down, and that the power supply is not connected to an AC power source.
- To remove the antenna, handset, or uninterruptable power supply, simply unscrew the antenna, disconnect the handset, or unlatch the power supply.
- To remove the transceiver, disconnect the antenna, handset, and power supply.
- To remove or replace the batteries in the uninterruptable power supply, unlatch the power supply from the transceiver, and remove the batteries.

APPENDIX A – URC-200 (V2) CRYSTAL WARP ADJUSTMENT

Software version 1.6 or later only. For software versions prior to 1.6 please contact General Dynamics Customer Support.

Introduction

The warp adjustment is used to fine tune the transceiver's frequency accuracy to within ±1ppm. This equates to ± 400 Hz at 400 MHz. To perform the procedure, the radio must be given the Warp command via the REMOTE connector on the front panel of the radio. This command puts the radio into the remote control state and sets the transmit frequency to 400 MHz, AM, Plain Text mode. The transceiver's front panel display does not update to show this change. The display continues to show whatever the transceiver was set to when it received the warp command. The transceiver will revert to the original settings when power is cycled. This will release it from the remote control state.

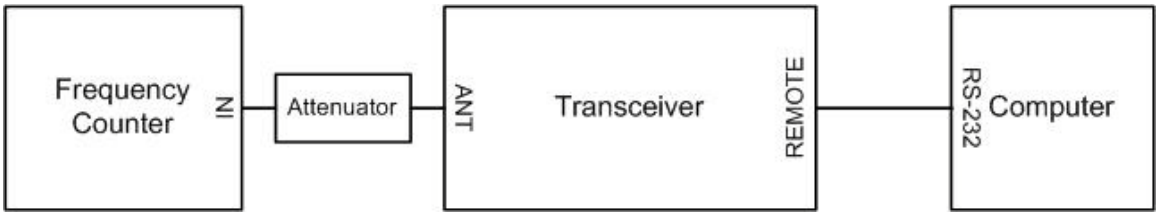
Refer to Paragraph 4.6 for additional remote operating procedures.

Equipment required:

- Frequency counter: HP-5383A or equivalent. Must have ≤10Hz measurement resolution and be capable of counting 400MHz.
- Computer with RS-232 communications port, configured in accordance with Paragraph 4.6.
- Cable to connect computer to transceiver. Refer to Table 8 for signals and pin connections.

Equipment Setup:

Configure equipment as shown below.



Software version determination.

The warp adjustment procedure applies only to URC-200(V2) radios with software version 1.6 and later. The software version can be checked two ways:

Power On Method:

The current software version is always displayed for a short time upon power-on in the URC-200(V2) transceivers. Turn on power to the radio while observing the display. The first screen will show the software version in the following format:

The display indicates that the software version is 01.06.00 (that is, version 1.6).

Remote Interrogation Method:

1. Connect the radio to a PC running a terminal emulation application such as HyperTerminal configured in accordance with Paragraph 4.6.

2. Type ?08 and the radio will return with a message similar to the following:

VC 98-P42306K V0106 *Month Day Year Time*

In this example V0106 indicates the current software version – 1.6. See also Table 13 for additional information about queries.

If your radio has an older version of software installed contact General Dynamics support for information concerning the Warp command.

Warp adjust procedure.

This procedure places the transceiver into the remote command mode until the user releases it from that mode by cycling power. The front panel display will be locked to the current value while in this state.

1. Type ?14.

The radio will enter the remote command mode and return a warp value in the form Waaaa where aaaa is a four-digit number between 0000 and 1023.

2. Record this value. _____ This is W_a. Include leading zeros, if any.
3. Type Waaaa (Upper-case W followed by the four-digit value just recorded.) the transceiver will enter the Warp Adjustment mode and the current frequency will change to approximately 400 MHz but nothing on the display will change to indicate this.
4. Key the transceiver and record the frequency. _____ This is f_a.
5. Type ?14 again to confirm the warp value.
6. Substitute the values for W_a and f_a in the following formula:

$$W_b = [(400{,}000{,}000 - f_a) * 0.11] + W_a$$

7. Solve for W_b. Round to the nearest whole number and record. _____
8. Type the resultant value for W_b using the terminal emulation application. Use the form Wbbbb. Remember this is a four-digit number so use a leading zero if required.
9. Key the transmitter and measure the frequency. It should be within 1ppm at 400 MHz.
10. If it isn't, repeat the process using the new values for f_a and W_a.
11. When the transmit frequency is within specifications, cycle power to the transceiver to return the radio to the normal operating mode.
12. Key the transceiver and measure the frequency. If it is within specifications, the procedure is complete. If not, contact General Dynamics technical support.