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DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

PURCHASE DESCRIPTION

ULTRA HIGH FREQUENCY (UHF) RECEIVERS AND TRANSMITTERS

Supporting UHF Radio
Equipment Operating within the Frequency Range of
225.000-400.000 MHz

The NEXCOM Integrated Product Team, AND-360

RECORD OF CHANGES

Revision	Date	Action
0.0	4/16/2002	UHFR/T PD 4/11/02 Draft Baselined as Revision 0.0

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1.0 SCOPE

1.1 Identification

This product description (PD) identifies the minimum requirements for ground based Ultra High Frequency (UHF) radios to be used by Air Traffic Control (ATC) for air/ground (A/G) voice communications with military aircraft. The performance requirements in this document are based on the existing PDs FAA-P-2883 and FAA-P-2884. This document complies with the format requirements of FAA-STD-005e.

1.2 System Overview

The UHF radio program will replace aging, unsupportable UHF radios currently operating in the NAS and will provide radios for expansion projects and new facility starts. While the new radios will utilize recent technology components and include some additional features, they must support the existing legacy interfaces and be physically compatible with existing equipment. The radios will operate using the existing analog 25 kHz Double Side Band-Amplitude Modulated (DSB-AM) waveform. The significant new features are a remote monitoring and control capability and high power transmitter that will eliminate the need for separate Linear Power Amplifiers.

2.0 APPLICABLE DOCUMENTS

2.1 Government Documents

The following documents form a part of this PD and are applicable to the extent specified here. In case of conflict between the documents referenced here and the contents of this PD, the contents of this PD **shall** take precedence.

2.1.1 Specifications

FAA:

FAA-G-2100G	Electronic Equipment, General Requirements, October 22, 2001
FAA-P-2883	Purchase Description, VHF/UHF Air/Ground Radio Communications Receivers, April 14, 1994
FAA-P-2884	Purchase Description, VHF/UHF Air/Ground Radio Communications Transmitters, April 14, 1994

2.1.2 Standards

FAA:

FAA-STD-020B	Grounding, Bonding and Shielding, 1992

Military:

MIL-HDBK-454(1)	General Guidelines for Electronic Equipment, May 28, 1997
MIL-STD-461E	Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference, August 20, 1999
MIL-STD-810F	Environmental Test Methods and Engineering Guidelines, January 1, 2000
MIL-STD-889B	Dissimilar Metals, May 17, 1993

2.1.3 Other Government Documents

FAA:

DOT/FAA/CT -96/1	Human Factors Design Guide for Acquisition of Commercial Off-the-Shelf Subsystems, Non-Developmental Items, and Developmental Systems, January 15, 1996

FCC:

47 CFR Part 2	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations, October 1998
47 CFR Part 87	Aviation Services, October 1998

NIST:

FIPS PUB 140-1	Federal Information Processing Standards Publication, Security Requirements for Cryptographic Modules, National Institute of Standards and Technology, January 11, 1994
FIPS PUB 186-2	Federal Information Processing Standards Publication, Specifications for Digital Signature Standard (DSS), National Institute of Standards and Technology, January 27, 2000

NTIA:

National Telecommunications and Information Administration, Regulations and Procedures for Federal Radio Frequency Management, September 1995 Edition with Revisions for September 1996 and May 1997

2.2 Non-Government Documents

EIA:

EIA-310-E	Cabinets, Racks, Panels, and Associated Equipment, March 17, 1999

IEEE/ANSI:

C62.31-1987	IEEE Standard Test Specifications for Gas-Tube Surge Protective Devices
C62.36-1994	IEEE Standard Test Method for Surge Protectors Used in Low-Voltage Data, Communications, and Signaling Circuits
C62.41-1991	IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits
C62.47-1992	IEEE Guide on Electrostatic Discharge (ESD): Characterization of the ESD Environment

2.3 Documentation Sources

2.3.1 FAA Documents

Copies of FAA specifications, standards, and publications may be obtained from the UHF radio Contracting Officer, FAA, 800 Independence Avenue SW, Washington, DC 20591. Requests should clearly identify the desired material by number and state the intended use of the material. Revision FAA-G-2100G may be downloaded from the FAA at web site http://www.faa.gov/asd/standards/index.htm.

2.3.2 Military and Federal Documents

Single copies of unclassified military and federal specifications, standards, and publications may be obtained by writing the Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120 or by calling (215) 697-3321 Monday through Friday, 8:00 a.m. to 4:30 p.m. (EST).

2.3.3 Federal Communications Commission Documents

Copies of 47 CFR, Part 2 and Part 87 may be obtained from the FCC, 445 12th Street, SW, Washington D.C. or by downloading from the FCC web site at www.fcc.gov/oet/info/rules.

2.3.4 Electronic Industries Alliance Documents

Copies of Electronic Industries Alliance (EIA) standards may be obtained from the Electronic Industries Alliance, 2500 Wilson Boulevard, Arlington, VA 22201-3834, by calling (703) 907-7500, or through the web site http://www.eia.org.

2.3.5 National Telecommunications and Information Administration Documents

Copies of National Telecommunications and Information Administration (NTIA) materials may be obtained from NTIA, Department of Commerce, 14th Street and Constitution Avenue NW, Washington, DC 20230, by calling (202) 377-1832, or through the web site http://www.ntia.doc.gov.

2.3.6 ASTM Documents

Copies of American Society for Testing and Materials (ASTM) materials may be obtained from the ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, by calling (610) 832-9585, or through the web site http://www.astm.org.

2.3.7 IEEE/ANSI Documents

Copies of IEEE/ANSI documents may be obtained from IEEE Customer Service, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, or by calling (800) 701-4333 (in U.S. and Canada), or (732) 981-0060 (outside of U.S. and Canada).

2.3.8 NIST Documents

Copies of National Institute of Standards and Technology may be obtained from NIST, 100 Bureau Drive, Gaithersburg, MD 20899-3460, or by calling (301) 975-6478.

3.0 REQUIREMENTS

3.1 Definitions

3.1.1 "Shall"

When used in this PD, the word "**shall**" refers to an explicit requirement of a system component or the complete system.

3.1.2 "Should"

When used in this PD, the word "***should***" refers to a desired characteristic of a system component or the complete system.

3.1.3 "Will"

When used in this PD, the word "will" provides information for a characteristic of a system component or a complete related system.

3.2 UHF Radio Requirements

The system characteristics described in this PD are for ground UHF radio equipment. Unless otherwise stated, the UHF radio requirements apply to both UHF radio receiver and UHF radio transmitter for:

1) operational mode of Section 3.2.1.1,
2) the entire frequency range of Section 3.2.1.1.1,
3) the operating conditions of Section 3.4.3.1,
4) both fixed-tuned and remotely tunable configurations.

a) The UHF radio **shall$_1$** be implemented as a separate UHF radio receiver and separate UHF radio transmitter.

b) All UHF radio receiver and transmitter requirements **shall$_2$** be met under all operating conditions, with the Antenna Transfer Relay (ATR) (See Section 3.2.2.2.14) in place.

3.2.1 UHF Radio Functions and Software Requirements

3.2.1.1 Mode of Operation

a) The UHF radio receivers and UHF radio transmitters **shall$_3$** operate in the ICAO DSB-AM Mode using 25 kHz channel separation.

3.2.1.1.1 Tuning Range and Channel Increments

a) The UHF radio receivers and UHF radio transmitters **shall$_4$** tune to any 25 kHz channel between 225.000 MHz and 399.975 MHz.

b) The frequency **shall$_5$** default to the last tuned frequency.

3.2.1.2 DSB-AM Modulation Method

a) The modulation method **shall$_{6}$** be A3E DSB-AM in accordance with the CFR 47, Part 2 and Part 87 and the NTIA, Regulations and Procedures for Federal Radio Frequency Management (Chapter 6, paragraph 6.3).

3.2.1.3 Software and Processor Requirements

If the UHF radio equipment utilizes software and processors, then:

a) The equipment **shall$_{7}$** allow the UHF radio receiver and UHF radio transmitter to operate in the known approved ICAO standardized communication waveform for 25 kHz DSB-AM.
b) The UHF radio receiver and transmitter equipment, as separate entities, **shall$_{8}$** use no more than 50 percent of their non-volatile memory (See Section 6.2.13) or storage, under worst-case conditions (e.g., when the UHF radio has both the software-in-use and a second software version loaded).
c) The UHF radio receiver and transmitter, as separate entities, **shall$_{9}$** use no more than 50 percent of their Random Access Memory (RAM), under worst-case conditions.
d) The processor utilization of the UHF radio receiver and UHF radio transmitter, as separate entities, **shall$_{10}$** peak at 50 percent or less.
e) The UHF radio receiver and UHF radio transmitter **shall$_{11}$** revert to the previous version of software and restart, if the UHF radio does not successfully restart after receipt and execution of any new software.
f) If the Software upload is rejected, the UHF radio **shall$_{12}$** send a control reply message indicating the reason for rejection.

3.2.2 Performance Requirements

3.2.2.1 UHF Radio Receiver Requirements

3.2.1.1.1 Receiver Audio Interfaces

a) The UHF radio receiver main audio level **shall$_{13}$** be controllable both locally and remotely from the MDT.
b) The UHF radio receiver **shall$_{14}$** provide a main audio output on the rear of the UHF radio receiver (See Section 3.3.1.3).
c) There **shall$_{15}$** be a local audio output jack located on the front panel of the UHF radio receiver to be used with a headset/headphone. (See Section 3.3.1.5.)
d) The main and local audio outputs **shall$_{16}$** have a balanced 600 ohms (±10 percent) output impedance.
e) The local audio output level **shall$_{17}$** be independently controllable from the front panel.

3.2.2.1.2 Receiver Sensitivity

a) The UHF radio receiver RF input **shall$_{18}$** have a 50 ohm characteristic impedance.
b) The UHF radio receiver **shall$_{19}$** produce a SINAD (ratio of (Signal plus Noise plus Distortion) to (Noise plus Distortion)) of 10 dB or greater at the main and local audio outputs when an RF signal of no more than -102 dBm (modulated at 30 percent with a 1004 Hz tone) is present at the UHF radio receiver antenna input.

c) The sensitivity values **shall$_{20}$** be achieved with the UHF radio receiver in the fixed-tuned and remotely-tunable configurations.

3.2.2.1.3 Receiver Rejection of Signals Inside the UHF Band

See Section 3.2.2.1.16.

3.2.2.1.4 Receiver Selectivity

a) The selectivity of the UHF radio receiver **shall$_{21}$** conform to Table 3-1 with respect to the tuned channel center frequency across the entire frequency band:

Table 3-1

Selectivity Profile

Level	DSB-AM Bandwidth (25 kHz Ch.)
- 6.0 dB	± 9 kHz Minimum
- 60.0 dB	± 25 kHz Maximum

3.2.2.1.5 Receiver Image Rejection

a) The sensitivity requirements of Section 3.2.2.1.2 **shall$_{22}$** not be degraded more than 3 dB in the presence of an unmodulated carrier at any image frequency of the receiver applied to the UHF radio receiver RF input at a level 80 dB above the desired signal (-102 dBm (modulated at 30 percent with a 1004 Hz tone)).

3.2.2.1.6 Receiver Distortions

3.2.2.1.6.1 Receiver Intermodulation

a) The sensitivity requirements defined in Section 3.2.2.1.2 **shall$_{23}$** not be degraded by more than 3 dB in the presence of two –5 dBm FM modulated interfering signals, with 75 kHz deviation, modulated with a 400 Hz tone, with the interfering frequencies chosen in the 87.5 MHz to 107.9 MHz range, such that one of the 3rd order products is located on the chosen receive frequency.

b) In the fixed tune mode, the sensitivity requirements defined in Section 3.2.2.1.2 **shall$_{24}$** not be degraded by more than 3 dB in the presence of two +5 dBm interfering signals, one FM modulated with 75 kHz deviation modulated with a 400 Hz tone and the other interferer a continuous wave (CW) signal, with the interfering frequencies chosen in the 87.5 MHz to 107.9 MHz range, such that one of the 3rd order products is located on the chosen receive frequency.

c) The sensitivity requirements defined in Section 3.2.2.1.2 **shall$_{25}$** not be degraded by more than 3 dB in the presence of two –35 dBm interfering signals 90 percent DSB-AM modulated with a 400 Hz tone, in the 225.000 MHz to 400.000 MHz band, with the frequencies of the interfering signals offset from the desired channel by +2.0 MHz and +4.0 MHz, or –2.0 MHz and –4.0 MHz, respectively.

d) In the fixed tune mode, the sensitivity requirements defined in Section 3.2.2.1.2 **shall$_{26}$** not be degraded by more than 3 dB in the presence of two +5 dBm signals, one signal, amplitude modulated 30 percent with 1004 Hz tone and the other interferer a continuous wave (CW) signal. The two interfering frequencies are chosen from the 118.000 – 137.000 MHz range, such that the 2nd order products ($2f_1$, f_1+f_2) are located on the chosen UHF receive frequency.

3.2.2.1.6.2 Cross Modulation

a) An on-channel signal (modulated 30 percent with a 1004 Hz tone) adjusted to produce a 10.0 dB SINAD ratio, **shall$_{27}$** produce not less than 8.0 dB SINAD ratio in the presence of an off-channel signal modulated 30 percent with a 400 Hz tone separated from the desired on-channel signal by ± 0.5 MHz, at a level 70.0 dB above the desired signal.
b) An on-channel signal (modulated 30 percent with a 1004 Hz tone) adjusted to produce a 10.0 dB SINAD ratio, **shall$_{28}$** produce not less than 8.0 dB SINAD ratio in the presence of an off-channel signal modulated 30 percent with a 400 Hz tone separated from the desired on-channel signal by ± 1.0 MHz, at a level 75.0 dB above the desired signal.
c) An on-channel signal (modulated 30 percent with a 1004 Hz tone) adjusted to produce a 10.0 dB SINAD ratio, **shall$_{29}$** produce not less than 8.0 dB SINAD ratio in the presence of an off-channel signal modulated 30 percent with a 400 Hz tone separated from the desired on-channel signal by ± 1.5 MHz, at a level 80.0 dB above the desired signal.

3.2.2.1.7 Receiver Reference Frequency Tolerance

a) The UHF radio receiver reference signal frequency tolerance **shall$_{30}$** be within ± 0.0002 percent (± 2 ppm) of its reference value for a period of one year following alignment over the full frequency range specified in Section 3.2.1.1.1, and the temperature range specified in Section 3.4.3.1.
b) The reference signal frequency used to generate the UHF radio receiver operating frequency **shall$_{31}$** have a tuning adjustment to compensate for the operational life of the equipment.
c) The UHF radio receiver selected operating frequency **shall$_{32}$** be set to within ± 2 ppm.
d) The UHF radio receiver **shall$_{33}$** provide an output of the reference signal on the front panel for measurement, testing and alignment.
e) An external reference frequency monitor port **shall$_{34}$** be provided with the following characteristics:
   1) Impedance: 50 Ohm
   2) Reference Signal Level: 0 dBm (± 3 dB)
f) A Reference Frequency Monitor Port **shall$_{35}$** be sufficiently isolated such that a short circuit applied from the reference frequency monitor port to ground does not degrade the UHF radio receiver performance.

3.2.2.1.8 Receiver Audio Output Control

a) The local audio level **shall$_{36}$** be continuously adjustable with the front panel volume control from –25 dBm to +20 dBm with an RF input consisting of a -87 dBm carrier DSB-AM modulated 30 percent with a 1004 Hz tone.

3.2.2.1.9 Receiver Audio Level Regulation

a) With the UHF radio receiver adjusted for an initial audio level of +20 dBm in the presence of a –87 dBm RF input signal that is 30 percent modulated with a 1004 Hz tone, the audio signal **shall$_{37}$** not vary more than ± 1.0 dB as the RF input signal modulation is increased from 30 percent to 100 percent.
b) With an initial audio output of +20 dBm into a 600 ohm load resistance, the audio output **shall$_{38}$** not drop below +16 dBm with a reduction of the load resistance to 120 ohms.

3.2.2.1.10 Receiver Audio Automatic Level Stabilization

a) The audio output level of the UHF radio receiver **shall$_{39}$** not differ more than ± 3 dB from the reference level produced by a -50 dBm RF input signal modulated 30 percent with a 1004 Hz tone, for any RF input signal between -95 dBm and -7 dBm.

3.2.2.1.11 Receiver Audio Mute and Attenuation

a) The UHF radio receiver **shall$_{40}$** have a control input for muting the UHF radio receiver main audio output.
b) Muting **shall$_{41}$** be activated or deactivated locally and remotely via the MDT.
c) The attenuation level for the muting function **shall$_{42}$** be selectable from -15 dB, -20 dB, or no audio (no audio defined as at least 80 dB down from a reference level of +20 dBm).
d) The tolerances for the selectable attenuation **shall$_{43}$** be ± 2 dB.
e) The default **shall$_{44}$** be no audio.

3.2.2.1.12 Receiver Average Audio Output

a) After adjusting the UHF radio receiver Audio Output Level setting to produce an –8 dBm audio output from an RF input of –87 dBm 30 percent modulated with a 400 Hz tone, the UHF radio receiver **shall$_{45}$** generate, with no further audio level adjustment, at the main audio output:
    1) an average audio output of –13 dBm (± 2 dB) averaged over 3 seconds, and
    2) a peak audio output that does not exceed 0 dBm from an RF input of –87 dBm 90 percent modulated with a contractor-developed speech sample that is approved by the FAA.

3.2.2.1.13 Receiver Audio Distortion

a) The total distortion in the main and local audio output **shall$_{46}$** not be more than 2.0 percent for 30 percent modulation with any RF input level between -67 dBm and -27 dBm, for input tones varying between 300 Hz and 3.0 kHz.
b) The total distortion in the main and local audio output **shall$_{47}$** not be more than 5.0 percent for 90 percent modulation with any RF input level between -67 dBm and -27 dBm, for input tones varying between 300 Hz and 3.0 kHz.

3.2.2.1.14 Receiver Audio Frequency Response

a) With an RF input signal between -102 dBm and – 7 dBm modulated 90 percent, the maximum variation in the main and local audio output **shall$_{48}$** not be more than ± 2.0 dB from the level

achieved with a 1004 Hz input reference, when the input is varied between 300 Hz and 3.0 kHz.

b) The main and local audio output **shall$_{49}$** decrease monotonically as the frequency increases above 3.0 kHz and 10 kHz.
c) The main and local audio output **shall$_{50}$** be down at least 20.0 dB at 10.0 kHz and above.
d) The main and local audio output **shall$_{51}$** decrease as the frequency decreases and be down at least 10.0 dB at 100 Hz.

3.2.2.1.15 Receiver Squelch

3.2.2.1.15.1 Squelch

a) The UHF radio receiver **shall$_{52}$** have a squelch system consisting of both an RF level threshold and an audio signal-to-noise threshold.
b) In the squelch-enabled condition, with an input RF level less than the squelch RF threshold level, there **shall$_{53}$** be no audio output, defined as a signal level at least 80 dB down from a reference level of +20 dBm.
c) Main and local audio level spikes due to squelch or RF Automatic Gain Control (AGC) action, or any combination of the two, **shall$_{54}$** be 20.0 dB below the audio alignment level under any operating conditions. (The alignment level may be between -25 dBm to +20 dBm; in general, it is –8 dBm.)

3.2.2.1.15.2 Receiver Squelch Adjustment, Sensitivity, and Hysteresis

a) The squelch adjustment **shall$_{55}$** provide the means to control squelch sensitivity locally and remotely using the MDT.
b) The UHF radio receiver main and local audio **shall$_{56}$** be enabled when both an audio Signal-to-Noise ratio and RF power level exceed threshold values defined in c) and d) below.
c) The audio Signal-to-Noise threshold value **shall$_{57}$** be adjustable (± 2 dB) anywhere in the range of +5 dB (minimum) to +15 dB.
d) The RF CW power level threshold value **shall$_{58}$** be adjustable (± 2 dB) from –102 dBm to –50 dBm.
e) Squelch closing hysteresis on the RF power level **shall$_{59}$** be not less than 2 dB and not greater than 5 dB with respect to the RF CW power level (see item d above) threshold level to which the UHF radio receiver is adjusted.

3.2.2.1.15.3 Receiver Squelch Attack and Release Times

a) The squelch attack time **shall$_{60}$** not exceed 10 ms with any RF input signal level between -97 dBm and -7 dBm, DSB-AM modulated 30 percent with a 1004 Hz tone.
b) The release time **shall$_{61}$** not exceed 35 ms.

3.2.2.1.16 Collocation

a) While in a fixed tuned configuration, the DSB-AM sensitivity requirements defined in Section 3.2.2.1.2 ***should$_{1}$*** not be degraded by more than 14 dB (-88 dBm) in the presence of an off channel

transmitter, keyed, with a 10 watt output, DSB-AM modulated 30 percent with a 400 Hz tone when the frequency separation and transmit-receive path isolation in Case A below is provided.

b) While in a fixed tuned configuration, the DSB-AM sensitivity requirements defined in Section Section 3.2.2.1.2 **shall$_{62}$** not be degraded by more than 7 dB (-95 dBm) in the presence of an off channel transmitter, keyed, with a 10 watt output, DSB-AM modulated 30 percent with a 400 Hz tone when the frequency separation and transmit-receive path isolation in Case B below is provided.

c) While in a remotely tunable configuration, the DSB-AM sensitivity requirements defined in Section Section 3.2.2.1.2 ***should$_{2}$*** not be degraded by more than 26 dB (-76 dBm) in the presence of an off channel transmitter, keyed, with a 10 watt output, DSB-AM modulated 30 percent with a 400 Hz tone when the frequency separation and transmit-receive path isolation in Case A or Case B below is provided.

Case A

(1) UHF Isolation of 31 dB (8 feet/2.4 meters) between receive and transmit antennas
(2) Transmit/Receive frequency separation of 2.0 MHz or greater

Case B

(1) UHF Isolation of 31 dB (8 feet/2.4 meters) between receive and transmit antennas
(2) Transmit/Receive frequency separation of 3.1 MHz or greater

3.2.2.1.17 Receiver Adjacent Channel Rejection

a) The sensitivity requirement as defined in Section 3.2.2.1.2 **shall$_{63}$** not be degraded by more than 3 dB in the presence of a -53 dBm adjacent channel (centered on ± 25 kHz) interfering DSB-AM signal, modulated 90 percent with a 400 Hz tone.

3.2.2.1.18 Receiver Rejection of Signals Outside the UHF Band

a) The sensitivity (see Section 3.2.2.1.2) while in a fixed tuned configuration **shall$_{64}$** not be degraded to a value worse than 10 dB SINAD when any of the below specified unwanted signals is applied in addition to the wanted signal set at an RF signal level of -100 dBm at the receiver antenna connector.

Unwanted signal requirement:	
Level :	- 4 dBm
Modulation :	None
Frequency:	All frequencies above and below 224 – 401 MHz including those of 118 – 137.975 MHz, 88 – 108 MHz

3.2.2.1.19 Receiver Desired Signal Dynamic Range

a) The UHF radio receiver **shall$_{65}$** achieve a SINAD of 10 dB or greater when operating with desired signals modulated 90 percent with a 1004 Hz tone at an RF level from –102 dBm up to – 7 dBm at the UHF radio receiver antenna input.

b) The UHF radio receiver **shall$_{66}$** not be "blocked" with inputs up to +13 dBm.

Note: "Blocked" is defined as a 3 dB reduction in the audio level referenced to the audio level setting at the desired signal input of –7 dBm modulated 90 percent with a 1004 Hz tone.

3.2.2.1.20 Receiver Automatic Gain Control (AGC) Stabilization

a) The UHF radio receiver **shall$_{67}$** produce a +10 dB SINAD with the minimum signal specified in Section 3.2.2.1.16, Case B, either fixed or remotely tuned, no later than 20 milliseconds after insertion of a +10 dBm CW signal up to ± 3.1 MHz away from the frequency to which the UHF radio receiver is tuned.
b) The UHF radio receiver **shall$_{68}$** produce a +10 dB SINAD with the minimum signal specified in Section 3.2.2.1.2, either fixed or remotely tuned, no later than 150 milliseconds after removal of a +10 dBm CW signal up to ± 3.1 MHz away from the frequency to which the UHF radio receiver is tuned.

3.2.2.1.21 Receiver Internal Noise Level

a) The SINAD at the UHF radio receiver audio output **shall$_{69}$** be at least 25 dB for a –85 dBm RF input signal DSB-AM modulated at 30 percent with a 1004 Hz tone.

3.2.2.2 UHF Radio Transmitter Requirements

a) There **shall$_{70}$** be two configurations of transmitters:
   1) one configuration with an output power level adjustable from 2 watts to 10 watts, and
   2) a configuration with an output power level adjustable from 10 watts to 50 watts.

   Note: The two configurations may be delivered in a single enclosure. In order for a single enclosure UHF radio transmitter to satisfy both the 10 Watt and the 50 Watt configurations, the output power level must be adjustable from 2 to 50 watts.

b) For single enclosure designs where requirements for the 10 watt and 50 watt configurations differ, the more stringent requirement **shall$_{71}$** be met, as detailed in the note for that Section.

3.2.2.2.1 Transmitter Audio Interfaces

a) There **shall$_{72}$** be two audio inputs to the transmitter:
   1) remote audio from the control site and
   2) local audio from the microphone jack on the front panel of the transmitter.
b) The transmission of the voice input **shall$_{73}$** be PTT controlled independently either from the microphone or from the control site.
c) Only one of the two audio inputs **shall$_{74}$** be active at one time.
d) The UHF radio transmitter **shall$_{75}$** have a main audio input at the rear of the transmitter. See Section 3.3.1.4.
e) The main audio input **shall$_{76}$** have a balanced 600 ohm (± 10 percent) impedance.
f) The transmitter **shall$_{77}$** be able to receive local audio via a push-to-talk microphone. (See Section 3.3.1.6.)

3.2.2.2.2 Transmitter Time-Out

a) The transmitter **shall$_{78}$** contain a time-out function for protection against, and the elimination of, extended periods of inadvertent continuous keying.
b) This adjustable transmitter time-out **shall$_{79}$** range from 5 seconds up to 5 minutes in 5-second steps (limiting the maximum continuous keying of the transmitter to this time period).
c) The time-out feature **shall$_{80}$** have provisions for disabling to allow the transmitter unlimited continuous transmit operation.
d) Upon time-out, the UHF radio transmitter **shall$_{81}$** cease radiating until the associated input PTT key is released and re-asserted.

3.2.2.2.3 Transmitter Distortion

a) The modulation distortion **shall$_{82}$** not exceed 5 percent RMS with a transmitter modulated 90 percent with an audio frequency between 300 Hz and 3.0 kHz and the audio input level setting is between -25.0 dBm to +20.0 dBm.
b) The modulation distortion **shall$_{83}$** not exceed 10 percent RMS over the same frequency range and audio input level settings with maximum limiting (see Section 3.2.2.2.4).

3.2.2.2.4 Transmitter Modulation Level

a) The UHF radio transmitter **shall$_{84}$** prevent overmodulation of the carrier under all conditions and to retain a modulation level:
   1) at ±10 percent of the setting of the transmitter modulation level, and
   2) that does not exceed 100 percent for a 1004 Hz tone with an audio level that varies over the full specified input range regardless of the audio input level setting.

3.2.2.2.5 Transmitter RF Output Power

a) The UHF radio transmitter **shall$_{85}$** operate in the 25 kHz DSB-AM mode at any power level for a load Voltage Standing Wave Ratio (VSWR) up to and including 3.0:1.
b) The UHF radio transmitter **shall$_{86}$** not suffer any damage nor suffer subsequent performance degradation, i.e., meets all its requirements, when transmitting at any power level into a complex impedance of any magnitude and phase, including open and short circuit terminations.
c) The UHF radio transmitter **shall$_{87}$** operate at a VSWR of 2.0:1 or less with no damage, with no part exceeding dissipation limits and with no performance degradation.
d) The UHF radio transmitter **shall$_{88}$** deliver not less than 50 percent of the set CW RF signal power into any impedance having a maximum VSWR of 3.0:1 at any phase angle.

3.2.2.2.5.1 Power Output Configurations

a) <u>10 Watt Configuration Power Output</u>
   1) The UHF radio transmitter **shall$_{89}$** deliver a minimum of 10 watts and a maximum of 12.5 watts into a nominal 50 ohm load impedance when transmitting an unmodulated CW signal.
   2) The UHF radio transmitter **shall$_{90}$** be adjustable, at a minumum, to levels of 2, 5, and 10 watts.

3) The power levels ***should*$_3$** be adjustable in additional increments between 2 and 10 watts.
4) The UHF radio transmitter **shall$_{91}$** deliver not less than 50 percent of the set CW RF signal power into any impedance having a maximum VSWR of 3:1 at any phase angle.

b) 50 Watt Configuration Power Output
1) The UHF radio transmitter **shall$_{92}$** deliver a minimum of 50 watts and a maximum of 56 watts into a nominal 50 ohm load impedance when transmitting a CW signal.
2) The UHF radio transmitter ***should*$_4$** be adjustable over the range from 10 watts to 50 watts unmodulated CW RF power.

Note: For a single enclosure transmitter to satisfy both the 10 watt and the 50 watt configurations, the output power level adjustability must include settings of 2, 5, 10 and 50 watts.

3.2.2.2.5.2 Transmitter Leakage

a) The UHF radio transmitter **shall$_{93}$** not produce more than -97 dBm in-band leakage measured at the UHF radio RF OUT connector when unkeyed.

3.2.2.2.6 Transmitter Back Intermodulation

a) In the fixed tuned configuration, the amplitude of each radio frequency back intermodulation product **shall$_{94}$** be at least 33 dB below the amplitude of an interfering signal fed into the UHF radio transmitter output connector 31 dB below the transmitter maximum output level and spaced ± 2.0 MHz from the UHF radio transmitter output frequency.
b) In the fixed tuned configuration, the amplitude of each radio frequency back intermodulation product **shall$_{95}$** be at least 39 dB below the amplitude of an interfering signal fed into the UHF radio transmitter output connector 31 dB below the transmitter maximum output level and spaced ± 3.1 MHz from the UHF radio transmitter output frequency.

3.2.2.2.7 Transmitter Duty Cycle

a) The UHF radio transmitter **shall$_{96}$** operate at a 100 percent duty cycle at the maximum rated output continuously for a minimum of 8,760 hours.

3.2.2.2.8 Transmitter Spurious Emissions

a) Spurious emission levels that fall in the 225 – 400 MHz band of the ATC UHF band **shall$_{97}$** meet the ultimate noise floor limits imposed by the transmitter mask of Section 3.2.2.2.10.
b) Spurious emissions that fall outside these bands **shall$_{98}$** be less than –80 dBc.

Note: Spurious emissions exclude the harmonics specified in Section 3.2.2.2.9.

3.2.2.2.9 Transmitter Harmonic Output

a) The level of each harmonic frequency of the carrier **shall$_{99}$** be less than -80.0 dBc (-65 dBm within the Global Navigation Satellite System (GNSS) band) when measured at the antenna connector at 10 watts for the 10 watt transmitter.

b) The level of each harmonic frequency of the carrier **shall$_{100}$** be less than -80.0 dBc (-65 dBm within the Global Navigation Satellite System (GNSS) band) when measured at the antenna connector at 50 watts for the 50 watt transmitter.

3.2.2.2.10 Transmitter Adjacent Channel Power

a) 10 Watt and 50 Watt Configurations, Fixed-Tuned Configuration, DSB-AM Modulated 90 Percent with a 1004 Hz Tone
   1) The amount of power from a UHF radio transmitter under all operating conditions when measured over the 25 kHz channel bandwidth of the first adjacent channel **shall$_{101}$** not exceed -40 dBc (-62 dBc in center 16 kHz).
   2) The amount of power from a UHF radio transmitter under all operating conditions when measured over the 25 kHz channel bandwidth of the second and third adjacent channels **shall$_{102}$** be -65 dBc maximum, -70 dBc maximum for the fourth through seventh adjacent channels, -75 dBc maximum for the eighth through to 500 kHz, - 89 dBc maximum for any frequency greater than 500 kHz up to 2.0 MHz, -112 dBc maximum for any frequency equal or greater than 2 MHz from the tuned channel center, -119 dBc maximum for any frequency equal to or greater than 3.1 MHz from the tuned channel center over the 225.000-400.000 MHz band and –130 dBc maximum for any frequency over 112.000-137.000 MHz band.

b) 10 Watt and 50 Watt Configurations, Remotely Tunable Configuration, DSB-AM Modulated 90 Percent with a 1004 Hz tone)
   1) The amount of power from a UHF radio transmitter under all operating conditions when measured over the 25 kHz channel bandwidth of the first adjacent channel **shall$_{103}$** not exceed -40 dBc (-62 dBc in center 16 kHz) while in a remotely tunable configuration.
   2) The amount of power from a UHF radio transmitter under all operating conditions when measured over the 25 kHz channel bandwidth of the second and third adjacent channels ***should$_{5}$*** be -65 dBc maximum, -70 dBc maximum for the fourth through seventh adjacent channels, -75 dBc maximum for the eighth through to 500 kHz, -89 dBc maximum from 500 kHz through to 2.0 MHz, and -100 dBc maximum for any frequency equal to or greater than 2 MHz from the tuned channel center over the 225.000-400.000 MHz band and the 112.000-137.000 MHz band.

3.2.2.2.11 Transmitter Carrier-Induced Noise (Residual AM)

a) The carrier-induced audio noise level due to the UHF radio transmitting a CW signal **shall$_{104}$** be at least 40.0 dB below the audio output measured at the UHF radio receiver when the carrier is modulated 90 percent with a 1004 Hz tone.

3.2.2.2.12 Transmitter Keying

a) The UHF radio transmitter **shall$_{105}$** accept both local and remote keying signals.
b) The local keying signal **shall$_{106}$** be via a push-to-talk microphone connected to the front panel microphone jack on the transmitter. See Section 3.3.1.6.
c) Remote keying signals **shall$_{107}$** be via the application of a ground, or alternately, +6 VDC to +48 VDC. See Section 3.3.1.4.

d) Remote keying signals ***should*$_6$** take priority over local keying signals when the UHF radio transmitter is operating.
e) The remote keying signals for current or voltage control **shall$_{108}$** be on separate pins of the UHF radio transmitter remote interface connector.
f) For ground keying, the source current required **shall$_{109}$** not exceed 10 milliamperes and not generate a pull-up voltage exceeding 40 volts.
g) The keying time **shall$_{110}$** not exceed 30 milliseconds as measured from the application of a keying signal to the time when the UHF radio transmitter is at 90 percent of the full power level.
h) The sink current **shall$_{111}$** not exceed 0.5 ma with voltage keying.
i) An open keyline **shall$_{112}$** be interpreted as non-keyed.
j) The UHF radio transmitter **shall$_{113}$** continue to transmit while the keying signal is present per item 3.2.2.2.12.2c above.
k) The UHF radio transmitter **shall$_{114}$** provide a Transmit Confirmation via the Transmitter Remote Connector for as long as the UHF radio is keyed.

3.2.2.2.13 Transmitter Frequency Tolerance

a) The UHF radio transmitter frequency tolerance **shall$_{115}$** be within ± 0.0002 percent (± 2.0 ppm) for any period of one year following alignment over the full frequency range specified in Section 3.2.1.1.1, and the temperature range specified in Section 3.4.3.1.
b) The reference used to derive the transmitter operating frequency **shall$_{116}$** have a tuning adjustment adequate to compensate for aging during the operational life of the equipment.
c) The frequency **shall$_{117}$** be adjustable within ± 1 ppm.

3.2.2.2.14 Antenna Transfer Relay (ATR) Operation

a) The UHF radio transmitter **shall$_{118}$** include an ATR function that connects a single, shared antenna to the host UHF radio transmitter (i.e., the UHF radio transmitter with both the ATR function and the direct connection to the antenna) and another UHF radio.

Note: Envisioned configurations of multiple UHF radios are described in Section 6.3. The concept of the ATR function is illustrated in Figure 6-1, Section 6.2.14.

b) The ATR **shall$_{119}$** support the following antenna configurations:
   1) Transmitter/Receiver on the same frequency for transceiver (T/R) operation (see example in Figure 6-2);
   2) Transmitter/Transmitter on the same frequency for main/standby (TX M/S) operation (see example in Figure 6-3);
c) The ATR **shall$_{120}$** be controlled by the UHF radio's need to transmit.
d) The ATRC (common) connector **shall$_{121}$** be routed to the ATR2 connector when the antenna is in use by the local UHF radio (actively transmitting).
e) The ATRC (common) connector **shall$_{122}$** be routed to the ATR1 connector when the antenna is not in use by the local UHF radio.
f) Failure of the local UHF radio **shall$_{123}$** not prevent or degrade the ATRC to ATR1 path (e.g., the failed or default Path is ATRC to ATR1).

g) The ATR **shall$_{124}$** provide sufficient isolation between the ATR1 and ATR2 connector paths during UHF radio transmissions (ATRC to ATR2) to prevent signals stronger than –7 dBm from reaching the UHF radio receiver (ATR1) in the T/R configuration.
h) The ATR **shall$_{125}$** provide sufficient leakage from the UHF radio transmitter (ATR2) to the UHF radio receiver (ATR1) to allow the UHF radio receiver(s) to monitor if the UHF radio transmitter is operating, without damaging the UHF radio receiver(s) in the T/R configuration.
i) The ATR **shall$_{126}$** provide sufficient isolation between the ATR1 and ATR2 connector paths to prevent damage to the non-radiating transmitter in the TX M/S configuration.
j) The ATR **shall$_{127}$** provide connectivity between the ATRC and ATR1 or ATR2 based on the ATR Switch State (e.g. ATR1 (Remote) for Standby Transmitter operation and ATR2 (Local) for Main Transmitter operation).
k) The ATR operation **shall$_{128}$** allow for the use of the internal filter and/or an external RF filter in any configuration (see Figures 6-2 and 6-3).
l) The UHF radio **shall$_{129}$** be equipped with three external, removable jumpers capable of operational use to provide connectivity between: 1) the UHF radio RF and ATR2 connectors, 2) the UHF radio RF to Connection to Filter CF1 connectors, and 3) the CF2 to ATR2 connectors.
m) The ATR **shall$_{130}$** have a maximum allowable loss of 1 dB. This loss is considered additional degradation beyond the required power output and receiver sensitivity.
n) The ATR Switch **shall$_{131}$** not degrade:
   1) Performance of the transmitter connected directly to the antenna;
   2) Performance of the transmitter connected to the antenna through its ATR switch;
   3) Performance of a second transmitter connected to the antenna through the ATR switch;
   4) Performance of the receiver connected to the antenna through the ATR switch, except as specified in Section 3.2.2.2.14n.

3.2.3 Site Control and Monitoring

a) The UHF radio **shall$_{132}$** allow local and remote control and monitoring by interface and interoperation with a Maintenance Data Terminal (MDT).
b) The UHF radio control and monitoring signal interface for the UHF radio equipment **shall$_{133}$** be provided by the contractor.

3.2.3.1 UHF Radio Monitoring and Control

a) The UHF radio control functions **shall$_{134}$** support real-time system management actions via the MDT connectors located on the front and on the rear of the UHF radio receiver and transmitter. (See Section 3.3.2.1.)
b) The UHF radio **shall$_{135}$** accept control input, provide control replies, and provides monitoring output and alarm/alert indications locally and remotely via the MDT.
c) The UHF radio **shall$_{136}$** be addressable (up to 16 addresses) such that each radio may be addressed individually for monitoring and control through the software locally and remotely via an MDT.

3.2.3.1.1 Maintenance Data Terminal (MDT) Interface

The following requirements, which support the MDT operation, apply to the UHF radio receiver and transmitter:

a) The UHF radio **shall**$_{137}$ accept control input, provide control replies, and provide monitoring output and alarm/alert indications locally and remotely via the MDT connector(s).
b) The UHF radio **shall**$_{138}$ continue to operate with an MDT connected, logged in, and upon removal of the MDT.

3.2.3.1.2 Maintenance Data Terminal Interface Software

a) The MDT interface software **shall**$_{139}$ meet specified requirements while operating on industry standard laptop/notebook Personal Computers that are configured with, at a minimum, the following:
   1) Windows 95, 98, 2000 and NT
   2) 100 Mb of Hard Drive space for MDT software exclusive use
   3) 32 Mb of RAM
   4) 800x600x8 display
   5) Pentium 200 processor
   6) RS-232 serial interface using DB-9 connector
   7) Single Standard High Density Floppy drive

3.2.3.2 Control Parameter Adjustments

a) The UHF radio ***should***$_{7}$ allow modification of the control parameters of the UHF radio receiver and transmitter as a minimum in the following areas:
   1) Time (both Rx and Tx),
   2) Tuned Frequency (both Rx and Tx), (See Section 3.2.1.1.1)
   3) Receiver Squelch, (See Section 3.2.2.1.15.2)
   4) Receiver Audio Output Level, (See Section 3.2.2.1.1)
   5) Receiver Mute, (See Section 3.2.2.1.11)
   6) Receiver Mute Level, (See Section 3.2.2.1.11)
   7) Transmitter Power Output, (See Section 3.2.2.2.5)
   8) Transmitter Modulation, (See Section 3.2.2.2.4)
   9) Transmitter ATR Control, (See Section 3.2.2.2.14)
   10) Transmitter Timeout, (See Section 3.2.2.2.2)
   11) Transmitter PTT (See Section 3.2.2.2.1)
b) The UHF radio control parameter modification ***should***$_{8}$ be accomplished locally and remotely via an MDT.
c) The UHF radio ***should***$_{9}$ set parameters to within the tolerance of the associated monitoring parameter.
d) The UHF radio ***should***$_{10}$ reply to Control request messages with a Control reply message containing the parameter setting actually enacted by the UHF radio.
e) Rejected Control request messages ***should***$_{11}$ contain the original parameter setting with an error code indicating the reason for rejection.

3.2.3.3 UHF Radio Monitoring and Reporting

a) The UHF radio monitoring function ***should$_{12}$*** perform real-time system performance monitoring and provide real-time system performance reporting when the UHF radio is operating. (See Section 3.2.3.5)
b) The UHF radio ***should$_{13}$*** only support those Monitoring and Reporting functions to which it can report within specified tolerances.
c) The UHF radio monitoring and reporting of parameters ***should$_{14}$*** consist of, as a minimum:
   1) The execution of measurements on those parameters to obtain collected/calculated data
   2) The comparison of the collected/calculated data to the stored system parameter thresholds and/or element status to determine whether each data element and/or element status is within the specified limits and
   3) The reporting of the results of those parameter and/or element status determinations
d) There ***should$_{15}$*** be three instances where monitoring messages are sent locally and remotely to the MDT:
   1) Upon request via a control message,
   2) When an alert or alarm threshold is crossed,
   3) When a monitored parameter returns to a value within the normal range.
e) The alert or alarm status messages ***should$_{16}$*** be sent within 4 seconds of when the parameter being monitored crosses the threshold level.

3.2.3.3.1 Non-Congesting Monitoring

a) The UHF radio ***should$_{17}$*** monitor automatically on a continuous basis without blocking or delaying operational communications and management and without the need for the insertion of an external command.
b) The UHF radio monitoring ***should$_{18}$*** not cause the UHF radio function to degrade below requirements during operation of the system.
c) The UHF radio monitoring ***should$_{19}$*** not prevent the reception and processing of commands regardless of the frequency of alarm and alert status messages.

3.2.3.3.2 Alarm/Alert Monitoring Suppression

a) The UHF radio receiver and transmitter ***should$_{20}$*** suppress upon command alarm and alert status messages locally and remotely to an MDT.
b) The UHF radio receiver and transmitter ***should$_{21}$*** send the alert event acknowledging the command to suppress alarm and alert status messages before suppressing alarm and alert radio monitoring messages.

3.2.3.4 Alarm/Alert Processing

a) The UHF radio parameters to be monitored ***should$_{22}$*** be described by three monitored parameter states:
   1) Normal
   2) Alert
   3) Alarm
b) The monitored parameter states ***should$_{23}$*** be defined by a range of values that are adjoined such that the value range of the alert state is bordering on the normal state at one end of its

range and the alarm state on the other side of its range. Figure 3-1 illustrates Normal, Alert and Alarm Range for a Parameter that has both and upper and lower alert and alarm range.

Note: Monitored parameters may have alarm/alert ranges on both sides of the normal range, on just one side, and may have both alert ranges and alarms ranges, or just an alarm or an alert range.

c) A monitored parameter ***should***$_{24}$ change state when the monitored parameter value transitions from a value within one range to a value within another range, if applicable for the parameter.

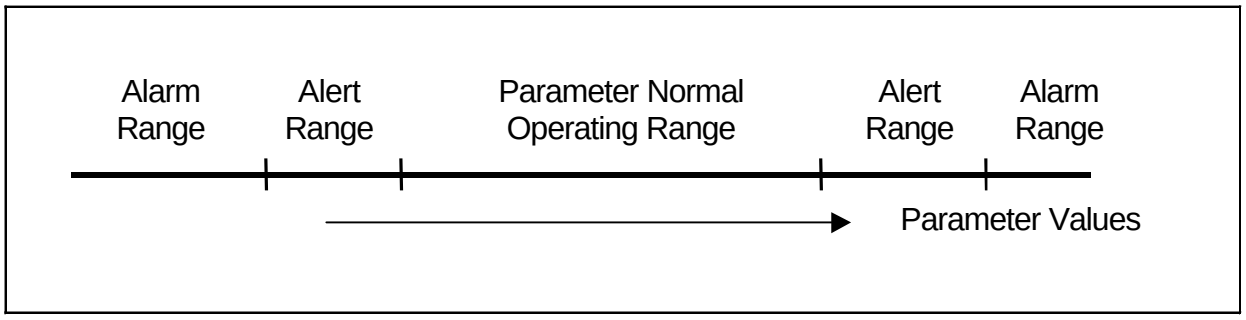


Figure 3-1

Illustration of Normal, Alert and Alarm Range for a Parameter

d) The UHF radio ***should***$_{25}$ determine the change between normal state, alert state, and alarm state of UHF radio status parameters by comparing data to pre-established thresholds.
e) The UHF radio ***should***$_{26}$ apply a discriminating function (hysteresis) at the boundaries of the ranges to minimize the declaration of alarms and alerts generated under monitored parameter transient conditions.
f) The UHF radio ***should***$_{27}$ automatically declare an alert event when a monitored parameter and/or element status changes to a value that is outside the normal range but within the alert range.
g) The alert event ***should***$_{28}$ be reported once per occurrence.
h) The UHF radio ***should***$_{29}$ not generate spurious alert events.
i) The UHF radio ***should***$_{30}$ automatically declare a return to normal event when a monitored parameter and/or element status that was previously outside the normal range changes to a value that is inside the normal range.
j) The return to normal event ***should***$_{31}$ be reported once per occurrence.
k) The UHF radio ***should***$_{32}$ automatically declare an alarm event when a monitored parameter and/or element status changes to a value crossing from the normal or alert range to the alarm range.
l) The alarm event ***should***$_{33}$ be reported once per occurrence.
m) The UHF radio ***should***$_{34}$ not generate spurious alarm events.

n) The UHF radio ***should***$_{35}$ automatically declare a state change event when the value changes for a monitored parameter and/or element status that indicates a configuration change to the UHF radio.
o) The UHF radio State change event ***should***$_{36}$ be reported once per occurrence.
p) The UHF radio ***should***$_{37}$ provide unsolicited radio monitoring message notification within 4 seconds of alarm/alert occurrence. The response time is measured from the time of the alarm/alert-inducing monitored parameter value change to the time the first notification is reported by the UHF radio.

3.2.3.5 UHF Radio Monitoring Parameters

a) The UHF radio ***should***$_{38}$ include all of the sensors, devices and algorithms required to provide for parameter, state and failure monitoring.
b) The UHF radio ***should***$_{39}$ monitor the following respective unit parameters as a minimum:
   1) Time (both),
   2) Tuned Frequency (both),
   3) Receiver Squelch,
   4) Receiver Audio Output Level,
   5) Receiver Mute,
   6) Receiver Mute Level,
   7) Transmitter Power Output,
   8) Transmitter Modulation,
   9) Transmitter ATR Control,
   10) Transmitter Timeout,
   11) Transmitter PTT.

3.2.3.6 INFOSEC Requirements

3.2.3.6.1 Verification

a) The UHF radio ***should***$_{40}$ verify the authenticity of the digital signed information received locally and remotely via an MDT.
b) The UHF radio ***should***$_{41}$ verify the integrity the digital signed information received locally and remotely via an MDT.
c) The UHF radio ***should***$_{42}$ verify the time validity of the digital signed information received locally and remotely via an MDT.
d) The digital signature algorithm that performs this verification ***should***$_{43}$ correspond to at least one of the algorithms defined in FIPS 186-2.
e) The digital signature function ***should***$_{44}$ meet or exceed security level 1 as defined in FIPS 140-1.
f) The digital signature function ***should***$_{45}$ be validated according to FIPS 140-1 by an accredited FIPS 140-1 testing laboratory.

3.2.3.6.2 Keys

a) The UHF radio ***should***$_{46}$ provide storage for 10 public key certificates, any of which may be used in verifying the digital signature.

b) The storage for public keys ***should***$_{47}$ be in non-volatile memory and be maintained through power loss and restoral.
c) The UHF radio ***should***$_{48}$ provide a mechanism to add and delete public keys locally and remotely via an MDT.

3.2.3.6.3 Security Procedures

a) All control parameter commands ***should***$_{49}$ be accepted only if the requesting device establishes a control session, by providing a valid digitally signed authorization token ("security token").
b) All control parameter commands received without establishment of, or outside of, a control session, or are associated with a security token that fails digital signature verification, ***should***$_{50}$ be rejected and reported as a system event.
c) The UHF radio ***should***$_{51}$ receive and authenticate the security token each time a log in occurs.

3.2.3.6.3.1 Control Session

a) The UHF radio ***should***$_{52}$ initiate a control session upon successful authentication locally and remotely from an MDT log on / security token.
b) The UHF radio ***should***$_{53}$ terminate the control session upon log-out, MDT disconnection or after no control parameter is received within 30 minutes.

Note: A session is used by the MDT to convey control parameters, and receive both control replies and radio-monitoring messages. A control session is not required for radio monitoring messages.

3.2.3.6.4 Boot Cycle

a) The UHF radio boot cycle or equivalent **shall**$_{140}$ be secured such that the possibility of an illegitimate reconfiguration of the UHF radio operating software during the boot cycle or equivalent is extremely low.

3.2.3.7 Vendor Built In Test

a) The vendor **shall**$_{141}$ make their built-in test results for the UHF radio equipment accessible to the FAA.

3.2.3.8 UHF Radio Failure Detection and Reporting

a) The UHF radio **shall**$_{142}$ detect and report critical equipment failures to the MDT Interface(s) via the MDT connectors and front panel status indicator automatically.

Note: See Section 6.2.13 for definitions of critical and non-critical equipment failures

3.3 Interfaces

3.3.1 Legacy Interfaces to the UHF Radio

a) UHF radio receiver and transmitter equipment **shall$_{143}$** support the existing interfaces for remote receiver interfaces, remote transmitter interfaces, local receiver audio and local microphone.

3.3.1.1 Radio Frequency (RF) Connectors

a) External Radio Frequency (RF) connectors **shall$_{144}$** be 50 ohm coaxial type N female.

3.3.1.1.1 UHF Radio RF Connector

a) The UHF radio RF connector **shall$_{145}$** be used for the transmitter RF output and receiver RF input.

3.3.1.1.2 CF1 Connector

a) The CF1 connector **shall$_{146}$** be used for the input to the internal cavity filter in all configurations.

3.3.1.1.3 CF2 Connector

a) The CF2 connector **shall$_{147}$** be used for the output from the internal cavity filter in all the configurations.

3.3.1.1.4 ATRC Connector

a) The ATRC connector **shall$_{148}$** be used for the antenna connection in the configurations based on Section 3.2.2.2.14.

3.3.1.1.5 ATR1 Connector

a) The ATR1 connector **shall$_{149}$** be used for the remote UHF radio connection in the configurations based on Section 3.2.2.2.14.

3.3.1.1.6 ATR2 Connector

a) The ATR2 connector **shall$_{150}$** be used for the local UHF radio connection in the configurations based on Section 3.2.2.2.14.

3.3.1.2 Electrical Input Power Connectors

a) Electrical input power connectors **shall$_{151}$** be of the following male types: two-conductor polarized for DC inputs and three-conductor National Electrical Manufacturers Association (NEMA) type for AC inputs.
b) Both power connectors **shall$_{152}$** conform to FAA-G-2100. Commercial equivalent connectors are acceptable if available.

3.3.1.3 Receiver Remote Interface

a) This electrical connector **shall**$_{153}$ be located on the rear of the UHF radio receiver.
b) Signals and their levels **shall**$_{154}$ be per able 3-6:

Table 3-6

Receiver Remote Connector

Signal	Level	Impedance (Ohms)	Input / Output	Notes
Voice Audio	As per setting of the receiver	600 ± 60	Output	
Receiver Mute	0 VDC ± 1 V (Ground) – Muted Open – No Mute		Input	.5 ma <40 VDC Grounded for Mute Operation
Receiver Mute Confirmation	Short Circuit = Confirm, Open Circuit = No Confirm		Output	1 amp max, < 80 VDC max
Squelch Break	Short Circuit = Active, Open Circuit = Not Active		Output	1 amp max, < 80 VDC max

3.3.1.4 Transmitter Remote Interface

a) Signals and levels **shall**$_{155}$ be as per Table 3-7:

Table 3-7

Transmitter Remote Connector

Signal	Level	Impedance (Ohms)	Input / Output	Notes
Voice Audio	As per setting of the transmitter	600 ± 60	Input	
Transmitter Key (Current Controlled)	0 VDC ± 1V (Ground) - Keyed Open - No Key		Input	10 mA max, <40 VDC grounded for duration of key
Transmitter Key (Voltage controlled)	+6 VDC to +48 VDC - Keyed Open - No Key		Input	0.5 mA max sink current applied for duration of key
Transmit Confirmation	Short Circuit = Transmitting, Open Circuit = Not Radiating		Output	1 amp max, < 80 VDC max

3.3.1.5 Receiver Local Headset Connector

a) The UHF radio receiver local headset connector **shall**$_{156}$ be located on the front panel of the UHF radio receiver and be a mono type MIL-J-641/6 jack for headphones (tip and sleeve).

Table 3-8

Receiver Local Headset Connector

Pin Number	Signal
1 (Tip)	Headset Audio Output
2 (Sleeve)	Headset Audio Return

3.3.1.6 Transmitter Local Microphone Connector

a) The UHF radio transmitter local microphone connector **shall**$_{157}$ be located on the front panel of the UHF radio transmitter and mate with plug type PJ068 for use with either an M85/U carbon microphone, or equivalent.

Table 3-9

Transmitter Local Microphone Connector

Pin Number	Signal
1 (Ring)	Microphone Audio Input
2 (Sleeve)	Ground
3 (Tip)	Keyline

3.3.2 UHF Radio Additional Connectors

3.3.2.1 MDT Connectors

a) The connectors (2 each per unit) for the MDT **shall**$_{158}$ be located on the front panel and the rear of the UHF radio receiver and transmitter.
b) Each MDT connector **shall**$_{159}$ be isolated such that access and use of one connector will not disrupt the operation of the UHF radio equipment or other equipment connected to the other connector.
c) The connector **shall**$_{160}$ be a female DB-9, RS-232 serial interface.

3.3.2.2 Reference Frequency Monitor Connector

a) The reference frequency monitor connector **shall**$_{161}$ be located on the front panel of the UHF radio receiver.
b) The connector **shall**$_{162}$ be a female BNC with shielded termination.
c) The termination **shall**$_{163}$ be attached to the UHF radio front panel via a short piece of metal chain.

3.4 Construction Requirements

3.4.1 Physical Requirements

3.4.1.1 Workmanship

a) Workmanship **shall**$_{164}$ be in accordance with the requirements of this specification, FAA-G-2100, and MIL-HDBK-454, Guideline 9.

3.4.1.2 Equipment Size

a) The UHF radio receivers and transmitters **shall**$_{165}$ be constructed to allow for installation into a standard EIA 19" equipment rack.
b) Mounting hole dimensions, spacing, and panel size **shall**$_{166}$ be as specified in EIA-310E (old designation EIA-RS-310D).
c) Each UHF radio receiver **shall**$_{167}$ not exceed 2 units in height and 18.5 inches in depth. (1 unit is equal to 1.75 inches)
d) Each 10 watt UHF radio transmitter configuration **shall**$_{168}$ not exceed 3 units in height and 18.5 inches in depth.
e) Each 50 watt UHF radio transmitter configuration **shall**$_{169}$ not exceed 4 units in height and 18.5 inches in depth.
f) The UHF radio **shall**$_{170}$ not protrude greater than 2 inches from the front mounting plane.

Note: In order for a single enclosure UHF radio transmitter to satisfy both the 10 Watt and the 50 Watt configurations, the height will not exceed 3 units.

3.4.1.3 Equipment Weight

a) The individual UHF radio receiver and the 10 watt transmitter weight **shall**$_{171}$ not exceed 37 pounds for each unit in accordance with FAA-G-2100, Section 3.3.6.3, male and female maximum weight lift.
b) The individual UHF 50 watt transmitter weight **shall**$_{172}$ not exceed 50 pounds.
c) The individual UHF 50 watt transmitter ***should***$_{54}$ not exceed 44 pounds.
d) The individual UHF 50 watt transmitter ***should***$_{55}$ not exceed 37 pounds in accordance with FAA-G-2100, Section 3.3.6.3, male and female maximum weight lift.

Note: It is the intent of paragraphs c and d to allow the contractor to meet the Human Factors requirements.

3.4.1.4 Equipment Slides

a) The UHF radio equipment **shall**$_{173}$ include slides that:
   1) extend the UHF radio equipment 4 inches past the front of the UHF radio equipment rack when extended
   2) permit the removal and replacement of the UHF radio from the front of the rack without the removal of other equipment
   3) have end-stops that prevent over-extension
   4) meet FAA-G-2100, Section 3.1.2.3.1 b), and 3.1.2.4.4
   5) have the slide component attached to the UHF radio be separable, without tools, from the slide-component that will be attached to the equipment rack.

3.4.1.5 Nameplates

a) Each UHF radio receiver and transmitter provided **shall**$_{174}$ have a nameplate mounted on the front of the chassis as specified in FAA-G-2100, Section 3.3.3.1 and associated Subsections.

3.4.1.6 Pin Layout Identification

a) Numbering or lettering on, or immediately adjacent to, the connectors **shall**$_{175}$ identify the connector.

3.4.1.7 UHF Radio Installation/Removal

a) The UHF radio receiver and transmitter **shall**$_{176}$ be constructed to be installed, removed, and reinstalled with a minimum of common tools and without extensive disassembly.

3.4.1.8 UHF Radio Set-Up

a) The UHF radio receiver and transmitter **shall**$_{177}$ be initially set up and adjusted under normal operating conditions (see Section 3.4.3.1), following the procedures in the technical instruction book.

3.4.1.9 UHF Radio Warm-up

a) The UHF radio receiver and transmitter **shall**$_{178}$ meet the requirements of full power operation within 30 seconds of turn on.

3.4.1.10 Shock and Vibration Protection

a) Shock and vibration protection **shall**$_{179}$ conform to MIL-STD-810, Method 516.3, Procedure VI - Bench Handling.
b) In all cases, no fixed part **shall**$_{180}$ become loose.
c) No movable part or permanently set adjustment **shall**$_{181}$ shift its setting or position.
d) No degradation in UHF radio receiver and transmitter performance **shall**$_{182}$ occur under the environmental service and operational conditions specified herein.

3.4.1.11 Grounding, Bonding, and Shielding

a) The UHF radio receiver and transmitter grounding, bonding, and shielding protection **shall**$_{183}$ be as specified in FAA-STD-020B, Sections 3.8, 3.9, and 3.10, and associated Subsections.

3.4.1.12 Materials, Processes, and Parts

a) All parts and materials used in the UHF radio receiver and transmitter **shall**$_{184}$ be new.
b) The components **shall**$_{185}$ be equal to or better than those components meeting the applicable EIA standards and suitable for the purpose intended.
c) All parts used in the UHF radio receiver and transmitter **shall**$_{186}$ be operated within their electrical ratings and the environmental requirements of this specification.

3.4.1.12.1 Ferrous Materials

a) Ferrous materials, if used, **shall**$_{187}$ be corrosion-resisting types.

3.4.1.12.2 Arc-resistant Materials

a) Arc-resistant materials **shall**$_{188}$ be used for insulation of electrical power circuits where arcing is likely to occur.

3.4.1.12.3 Dissimilar Metals

a) Selection and protection of dissimilar metal combinations **shall**$_{189}$ be in accordance with FAA-G-2100, Section 3.3.1.1.1 and MIL-STD-889.

3.4.1.12.4 Fibrous Material

a) Fibrous material **shall**$_{190}$ not be used.

3.4.1.12.5 Flammable Materials

a) In accordance with FAA-G-2100, Section 3.3.1.1.3, flammable materials **shall**$_{191}$ not be used.

3.4.1.13 Safety

a) An UHF radio equipment malfunction **shall**$_{192}$ in no way contribute to the destruction of the equipment or any part of its environment.
b) Safety **shall**$_{193}$ conform to the requirements of FAA-G-2100, Section 3.3.5 and associated Subsections.

3.4.1.14 Human Performance/Human Engineering

a) The UHF radio receiver and transmitter **shall**$_{194}$ conform to the applicable criteria contained in FAA-G-2100, Section 3.3.6 and the FAA Human Factors Design Guide.

3.4.1.15 Removable Parts, Mating Connectors, and Interface Cables

a) Each UHF radio receiver and transmitter **shall**$_{195}$ be complete with an installed set of fuses, lamps, plug-in type components, and other similar parts that are used in the equipment and are constructed for quick removal and replacement.
b) When two or more pieces of equipment require interconnection, the necessary mating connectors and signal interface cable(s) except for the cables required by Section 3.2.2.2.14k **shall**$_{196}$ be supplied for both the UHF radio and associated equipment that interfaces with the UHF radio.

3.4.1.16 Controls

a) The UHF radio receiver and transmitter **shall**$_{197}$ have provisions for both local and remote control operation.

3.4.1.16.1 Frequency Change Time

a) The time required to completely retune the UHF radio receiver or transmitter to a new frequency, including any required realignment **shall**$_{198}$ not exceed 30 minutes including retuning of the cavity filters.
b) UHF radio receivers and transmitters **shall**$_{199}$ include protective features to guard against inadvertent frequency changes.

3.4.1.16.2 Detents

a) The controls with an "OFF" position **shall**$_{200}$ have a detent or equivalent in the ON position to prevent inadvertent shutoff of operation.

3.4.1.16.3 Adjustment Range

a) The adjustment range of the UHF radio receiver and transmitter operation and maintenance controls **shall**$_{201}$ be constructed to preclude damage to the equipment or its subassemblies when adjusted to the limits of the control travel.
b) The range of control **shall**$_{202}$ be constructed to reduce the sensitivity and criticality of the adjustment task to the maximum extent possible.

3.4.1.16.4 Power Switches/Power On Indicators

a) The UHF radio receiver and transmitter **shall**$_{203}$ have a front panel mounted power switch.
b) A green indicator **shall**$_{204}$ be lit when the power switch is on.
c) The power switch **shall**$_{205}$ be protected from inadvertent action (operation).

3.4.1.16.5 Front Panel Display

a) The UHF radio receiver and transmitter **shall**$_{206}$ have a front panel display.
b) The UHF radio receiver and transmitter front panel display ***should***$_{56}$ provide:
   1) an alphanumeric display of the selected frequency;

2) three separate visual indicators (e.g., LEDs) for quick-look status

c) The UHF radio receiver and transmitter visual indicators ***should*$_{57}$** provide visual indications on the front panel as follows:
   1) A green indicator that is lit when the UHF radio is operating normally.
   2) A yellow indicator that is lit in the event of an alert, and flashes in the event of an alarm.
   3) A red indicator that is lit in the event of a failure.

d) The visual indications for failure events, alarm events and alert events ***should*$_{58}$** remain until the failure, alarm or alert is cleared.

e) The UHF radio transmitter front panel **shall$_{207}$** have an additional visual indicator, physically separate from the other visual indicators that indicate PTT keying.

f) The visual indicators **shall$_{208}$** be viewable for at least ±60 degrees off horizontal or vertical axis and be clearly visible from 10 feet away in a brightly lit room.

g) The front panel display **shall$_{209}$** be back-lit, and viewable for at least ± 30 degrees off horizontal or vertical axis.

3.4.1.16.6 Functions and Labeling

a) Labeling **shall$_{210}$** be permanent, legible, and mounted so that the data are visible to personnel without the need to disassemble the part or adjacent functional or structural parts.

b) Connectors **shall$_{211}$** be identified on the plug-in side by labels that describe their specific functions.

c) All fuse positions **shall$_{212}$** be marked with the rated current capacity, voltage rating, and type of fuse to be used.

d) Delayed action fuses **shall$_{213}$** have the additional designation "SLOW".

e) All fuse markings **shall$_{214}$** be on the insertion side, so as to be visible when replacing fuses.

f) The following functions and corresponding labels **shall$_{215}$** be available on the UHF radio receiver and transmitter as specified in Table 3-2:

Table 3-2

UHF Radio Functions and Labeling

Function	Labeling
Power ON/OFF Switch (Rx & Tx)	PWR ON
AC Power Indication Light (Rx & Tx)	AC PWR
DC Power Indication Light (Rx & Tx)	DC PWR
Transmitter Local Microphone Connector (Tx only)	MIC
Receiver Local Headset Connector (Rx only)	HEADSET
Local Volume Control (Rx only)	VOLUME CONTROL
AC Fuse Holder/Circuit Breaker AMP (TBS) (Rx & Tx)	120 VAC/60 Hz
DC Fuse Holder/Circuit Breaker AMP (TBS) (Rx & Tx)	24 VDC
AC Input Power Connector (Rx & Tx)	120 VAC/60 Hz
DC Input Power Connector (Rx & Tx)	24 VDC
UHF Radio Antenna RF Out Connector (Rx & Tx) *	RF OUT
UHF Radio Antenna RF In Connector (Tx) *	RF IN

Internal Cavity Filter Input Connector (Tx) *	CF1
Internal Cavity Filter Output Connector (Rx & Tx) *	CF2
Antenna Transfer Relay (Common) Connector (Tx) *	ATRC
Antenna Transfer Relay Connector #1 (Tx) *	ATR1
Antenna Transfer Relay Connector #2 (Tx) *	ATR2
MDT Connector front and rear of units (Rx & Tx)	MDT
Receiver Remote Interface (Rx)	REM INT
Transmitter Remote Interface (Tx)	REM INT
Reference Frequency Monitoring (RX)	REF MON
Tuning of Internal Filter (Rx & Tx)	TUNING

TBS = To Be Supplied * See Figure 6-1

3.4.1.16.7 Filter Tuning

a) The filter **shall$_{216}$** be tunable via the front panel if the cavity filter is manually tunable, .
b) The UHF radio transmitter **shall$_{217}$** be tunable within the spectral mask requirements specified in Section 3.2.2.2.10a and 3.2.2.2.10b, without the use of an external signal generator.

3.4.1.17 UHF Radio Identification (ID) Numbering

a) Each UHF radio **shall$_{218}$** have a permanent, non-changeable and unique identification (ID) number that is both marked on the front panel and accessible via the monitoring and control functions.
b) UHF radio ID numbers **shall$_{219}$** be assigned so that Transmitter ID numbers are odd numerically and Receiver ID numbers are even numerically.

3.4.2 Electrical Requirements

3.4.2.1 Input Power Requirements

a) The UHF radio equipment **shall$_{220}$** meet the requirements of this specification with an AC input voltage of 120 VAC (±10 percent), 60 Hz (±3 Hz) single phase and and/or with a DC input voltage of 24 VDC, negative ground, (-10/+20 percent).
b) During the loss of either input voltage (or non-availability of AC voltage) the equipment **shall$_{221}$** have an internal automatic line voltage switchover.
c) The UHF radio equipment **shall$_{222}$** operate under varying conditions, such as slow variations of AC and DC line voltages and AC line frequency, within the ranges specified herein.
d) The UHF radio equipment **shall$_{223}$** automatically resume normal operation when subjected to power interruptions and/or outages in accordance with FAA-G-2100, Section 3.1.1.8.
e) Both AC and DC voltage inputs **shall$_{224}$** be from the rear of the UHF radio equipment, and when practical, be located on the lower right side of the UHF radio equipment as viewed from the rear.
f) The maximum current limits for the UHF radio equipment **shall$_{225}$** be as listed in Table 3-3.
g) If both AC and DC voltage inputs are available to the UHF radio, the UHF radio **shall$_{226}$** operate from either power source.

Table 3-3

Maximum Current Limits

Component	AC Current (AMPERES)	DC Current (AMPERES)
UHF Radio Receiver	1.0	3.0
UHF Radio Transmitter (10 Watt RF Output Maximum)	4.0	10.0
UHF Radio Transmitter (50 Watt RF Output Maximum)	8.0	20.0
Single Enclosure UHF Transmitter (Set at or below 10 Watts)	4.0	10.0
Single Enclosure UHF Transmitter (Set above 10 watts)	8.0	20.0

Note: The actual average current values will be supplied by the vendor.

3.4.2.1.1 Power Cords

a) The UHF radio equipment **shall**$_{227}$ be provided with:
   1) a removable six-foot, three-conductor AC power cord, and
   2) a removable six-foot, two-conductor DC power cord,
b) The AC cord(s) **shall**$_{228}$ have the AC protection ground lead configured to ground the chassis as specified in FAA-G-2100, Section 3.1.1.9.

3.4.2.2 Reverse Polarity Protection

a) The UHF radio receiver and transmitter **shall**$_{229}$ incorporate reverse polarity protection to prevent damage to the UHF radio equipment if the polarity of the 24 VDC input voltage is reversed.

3.4.2.3 Circuit Protection

a) All UHF radio receiver and transmitter input/output circuits **shall**$_{230}$ include circuit protection which prevents opens or shorts at the input/output terminals from damaging the equipment.
b) When the short or open is removed, circuit performance **shall**$_{231}$ show no sign of performance degradation in accordance with FAA-G-2100, Section 3.1.1.8.

3.4.2.3.1 Current Overload Protection

a) Current overload protection for the UHF radio receiver and transmitter **shall**$_{232}$ be provided by fuses, circuit breakers, or other protective devices for primary input AC and DC circuits as specified in FAA-G-2100, Section 3.1.1.6.

3.4.2.3.2 Protective Measures for Electrical Connectors

a) Protective caps for mating with normally unmated or infrequently used connectors (i.e., local microphone input jacks or test/diagnostic input/output connectors) on the UHF radio receiver and transmitter **shall**$_{233}$ be provided in accordance with FAA-G-2100, Section 3.3.1.3.3.4.

3.4.2.3.3 Transient Protection

a) The UHF radio receiver and transmitter **shall**$_{234}$ contain protective devices in the audio circuits that conform to IEEE/ANSI Standards C62.36-1994, (Surge Protectors Used in Low-voltage Data, Communications, and Signaling Circuits), in the RF circuits that conform to IEEE/ANSI Standards C62.31-1987, (Gas-Tube Surge-Protective Devices), and in the AC power circuits that conform to IEEE/ANSI Standards C62.41-1991, (IEEE Recommended Practice on Surge Voltages in Low-voltage AC Power Circuits).

Note: Discrete gas-tube surge protectors are discouraged.

b) The UHF radio receiver and transmitter **shall**$_{235}$ provide overall unit protection as outlined in IEEE/ANSI Standard C62.47-1992, (IEEE Guide on Electrostatic Discharge (ESD)).

3.4.2.4 Test Points

a) External test points **shall**$_{236}$ be female BNC type connectors.

3.4.2.5 Loss of Input Voltage

a) The loss or variance of input voltage, including loss of voltage caused by activation of circuit protector devices, **shall**$_{237}$ not cause or induce any damage to any component in the UHF radio receiver and transmitter or other interfacing equipment.

3.4.3 Environmental Conditions

a) The UHF radio receiver and transmitter **shall**$_{238}$ be constructed of materials to withstand any combination of environmental and service conditions specified below without causing damage or degradation of performance below the requirements of this specification.

3.4.3.1 Operating Conditions

a) The UHF radio receiver and transmitter **shall**$_{239}$ be able to operate in a facility under the operating conditions specified in Table 3-4:

Table 3-4

Operating Conditions

Temperature Range	-10^{o} C to $+50^{o}$ C
Relative Humidity	5 to 90 percent (above 40 °C, the relative humidity is based on the dew point of 40°C)
Altitude	0 to 15,000 Feet

3.4.3.2 Non-Operating Conditions

a) Non-operating conditions for the UHF radio receiver and transmitter are those conditions affecting equipment in storage, in shipment, in the process of being installed at a site, and installed at a site but non-operating. The UHF radio equipment **shall$_{240}$** meet the requirements for non-operating conditions in Table 3-5:

Table 3-5

Non-Operating Conditions

Temperature Range	-40° C to +70° C
Relative Humidity	up to 100 percent including condensation due to temperature changes
Altitude	0 to 50,000 Feet

3.4.3.3 Equipment Ventilation and Cooling

a) The UHF radio front panel **shall$_{241}$** not present a thermal contact hazard to personnel in accordance with FAA Human Factors Guide, Section 12.10.1 and FAA-G-2100, Section 3.1.2.5 (except item g).

3.4.4 Electromagnetic Compatibility Requirements

a) Electromagnetic emission and susceptibility of the UHF radio receiver and transmitter **shall$_{242}$** not exceed the limits in MIL-STD-461 requirements CE-102, CS-101, CS-114, CS-115, CS-116, RE-102 and RS-103. Where conflict exists between "Navy Procurement", "Air Force Procurement", and "Army Procurement", the "Army Procurement" takes precedence.

3.4.5 FCC Type Acceptance Certificate

a) The UHF receiver and transmitter **shall$_{243}$** be FCC type accepted.

3.5 Quality Factors

3.5.1 Reliability

3.5.1.1 Mean Time Between Failures

a) The predicted Mean Time Between Failures (MTBF) for the UHF radio receiver and transmitter **shall$_{244}$** be not less than 26,280 hours.

3.5.2 Maintainability

a) The UHF radio receiver and transmitter **shall$_{245}$** provide parameter adjustments for routine maintenance.
b) The UHF radio receiver and transmitter each alone **shall$_{246}$** be classified as an LRU.
c) This concept is that site repair will be limited to the exchange of a LRU(s) in restoring service.

d) The UHF radio receiver and transmitter maintenance procedures **shall**$_{247}$ not require any additional test equipment that is not already in the FAA inventory.

3.5.2.1 Mean Time To Repair

a) The Mean Time To Repair (MTTR) of the UHF radio receiver or transmitter **shall**$_{248}$ not be greater than 30 minutes at the site (LRU Replacement).

3.5.2 2 Periodic Maintenance

a) The UHF radio receiver and transmitter **shall**$_{249}$ be configured so that periodic maintenance can be performed without disrupting other UHF radios that are operating.
b) Periodic maintenance intervals **shall**$_{250}$ meet or exceed one year.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 Testing Conditions

a) Unless otherwise specified, all testing will be performed under the following conditions:
   1) Temperature: Room Ambient, +19°C (+67°F) to +25°C (+77°F)
   2) Pressure: Nominal atmospheric pressure of 29.92 inches of mercury
   3) Humidity: Greater than 25 percent relative humidity

4.2 Tests

4.2.1 Electromagnetic Compatibility Tests

a) The UHF radio equipment EMC compatibility tests will be carried out in accordance with the conditions specified in Section 3.4.4. Proof of a successful one-time EMC compatibility test on the equipment is requested to be provided with the proposal, if available.

4.3 Verification Methods

a) Verification methods will be utilized in measuring equipment performance and compliance of individual requirements contained in this specification. The four verification methods, TEST, DEMONSTRATION, ANALYSIS, and INSPECTION, listed in decreasing order of complexity, are described as follows:
   1) TEST. Test is a method of verification wherein performance is measured during or after the controlled application of functional and/or environmental stimuli. Quantitative measurements are analyzed to determine the degree of compliance. The process uses laboratory equipment, procedures, items, and services.
   2) DEMONSTRATION. Demonstration is a method of verification where qualitative determination of properties is made for an end item, including the use of technical data and documentation. The items being verified are observed, but not quantitatively measured, in a dynamic state.
   3) ANALYSIS. Analysis is a method of verification that consists of comparing hardware design with known scientific and technical principles, procedures and practices to estimate the capability of the proposed design to meet the mission and system requirements.
   4) INSPECTION. Inspection is a method of verification to determine compliance without the use of special laboratory appliances, procedures, or services, and consists of a non-destructive static-state examination of the hardware, the technical data and documentation.

5.0 PREPARATION FOR DELIVERY

a) The UHF radio receiver and transmitter will be delivered in accordance with Section F of the contract.

6.0 NOTES

6.1 Notes on Information Items

The contents of this Section are for informational purposes only and are not a part of the requirements of this specification. They are not contract requirements nor binding on either the Government or the Contractor. In order for these terms to become a part of the resulting contract, they must be specifically incorporated in the schedule of the contract. Any reliance placed by the Contractor on the information in these Subsections is wholly at the Contractor's own risk.

6.2 Applicable Definitions

6.2.1 Very High Frequency (VHF)

In this document the term VHF applies specifically to the frequency range 112.000 MHz – 137.000 MHz, the frequency range reserved for Aeronautical Mobile (Route) Service.

6.2.2 Ultra High Frequency (UHF)

In this document the term UHF applies specifically to the frequency range 225.000 MHz -399.975 MHz, the frequency range reserved for military navigation and communications.

6.2.3 Mean Time Between Failures (MTBF)

A basic measure of reliability for LRUs is the sum of the operating time for the failed LRUs divided by the number of failures.

6.2.4 Mean Time To Repair (MTTR)

A basic measure of maintainability: the sum of corrective maintenance times at any specific level of repair, divided by the total number of failures within an item repaired at that level, during a particular interval under stated conditions.

6.2.5 Duty Cycle

Duty cycle is defined as the percentage of time that the transmitter is keyed in proportion to total service time.

6.2.6 Modular Construction

Equipment constructed so all subassemblies are modules that plug into the main chassis.

6.2.7 Line Replaceable Unit (LRU)

An item which may consist of a unit, an assembly (circuit card assembly, electronic component assembly, etc.), a subassembly, or a part, that is removed and replaced at the site maintenance level in order to restore the system/equipment to operational status.

6.2.8 Co-channel Interference

The power ratio of the wanted signal level to the unwanted signal level at the specified voice quality is the co-channel interference protection in dB (positive value). The co-channel interference protection for DSB-AM voice is the overall capability of the receiver to provide intelligible voice in the presence of an unwanted modulated signal at the same assigned frequency. The co-channel interference requirement has a major impact on frequency re-use planning criteria.

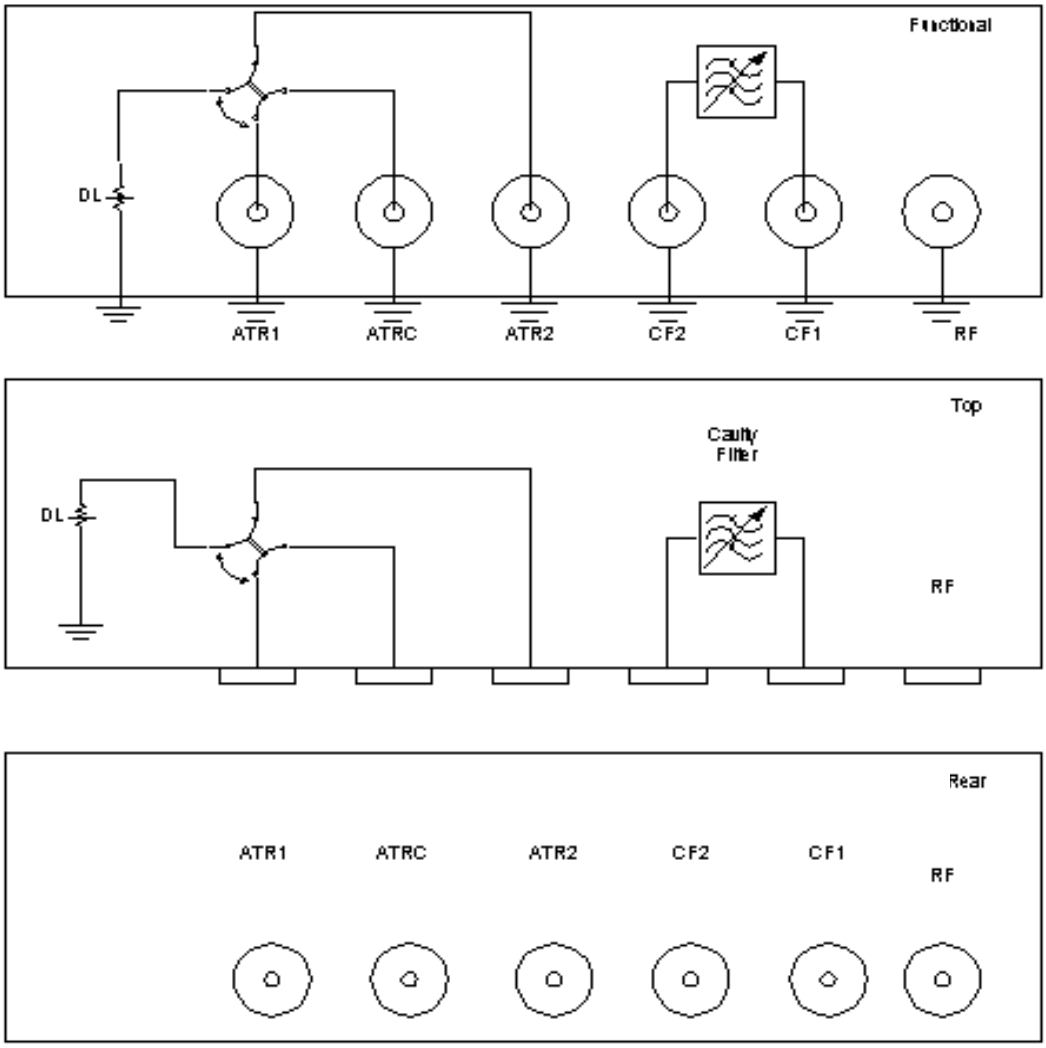
6.2.9 Adjacent Channel Emissions

Adjacent channel emissions are interference signals resulting from modulated RF signal power transmitted that are outside of the assigned channel. Adjacent channel emissions include discrete frequency spurious signals, and noise like signals (including phase noise) at the transmitter output.

6.2.10 Definitions for Fixed and Remotely Tunable Configurations

6.2.10.1 Fixed Tuned Configuration

The UHF radio receiver and transmitter configurations are similar to the present day radios in the NAS. The UHF radio receiver and transmitter will contain a fixed tuned internal cavity filter that is tunable by the system specialist with common hand tools. In addition, the UHF radio transmitter will also contain a transfer relay that allows multiple UHF radios to be connected to a single antenna. This is illustrated in Figure 6-1. This configuration will differ from its present implementation in that the filter can be by-passed. The system specialist will have the option of using the internal fixed tuned filter or using the radio without the filter present.



ATR1 Connection to ATR connector 1
ATR2 Connection to ATR connector 2
ATRC Connection to the ATR common connector
CF1 Input connection to the internal filter
CF2 Output connection from the internal filter

Figure 6-1

Cavity Filter/Antenna Transfer Relay Configuration

6.2.10.2 Remotely Tunable Configuration

This UHF radio configuration allows the radio to be tuned locally or remotely via the local MDT connector on the radio. The only equipment required to facilitate a frequency change will be a MDT (locally or remotely).

6.2.11 Initialization

Initialization (also cold start) occurs when, a) the UHF radio receiver or transmitter is first turned on when delivered from the factory, and b) when the UHF radio receives a Reset command with Value of Factory Reset. A result of the initialization function is that all control parameters return to their default values.

6.2.12 Non-Volatile Memory

The UHF radio memory storage that will retain data for the life of the equipment.

6.2.13 Equipment Failures

Equipment failure is classified into non-critical failure and critical failure.

6.2.13.1 Non-critical Equipment Failure

Non-critical equipment failures are failures of the UHF radio that will not affect the operations of the UHF radio, e.g., front panel display and power indicator failures.

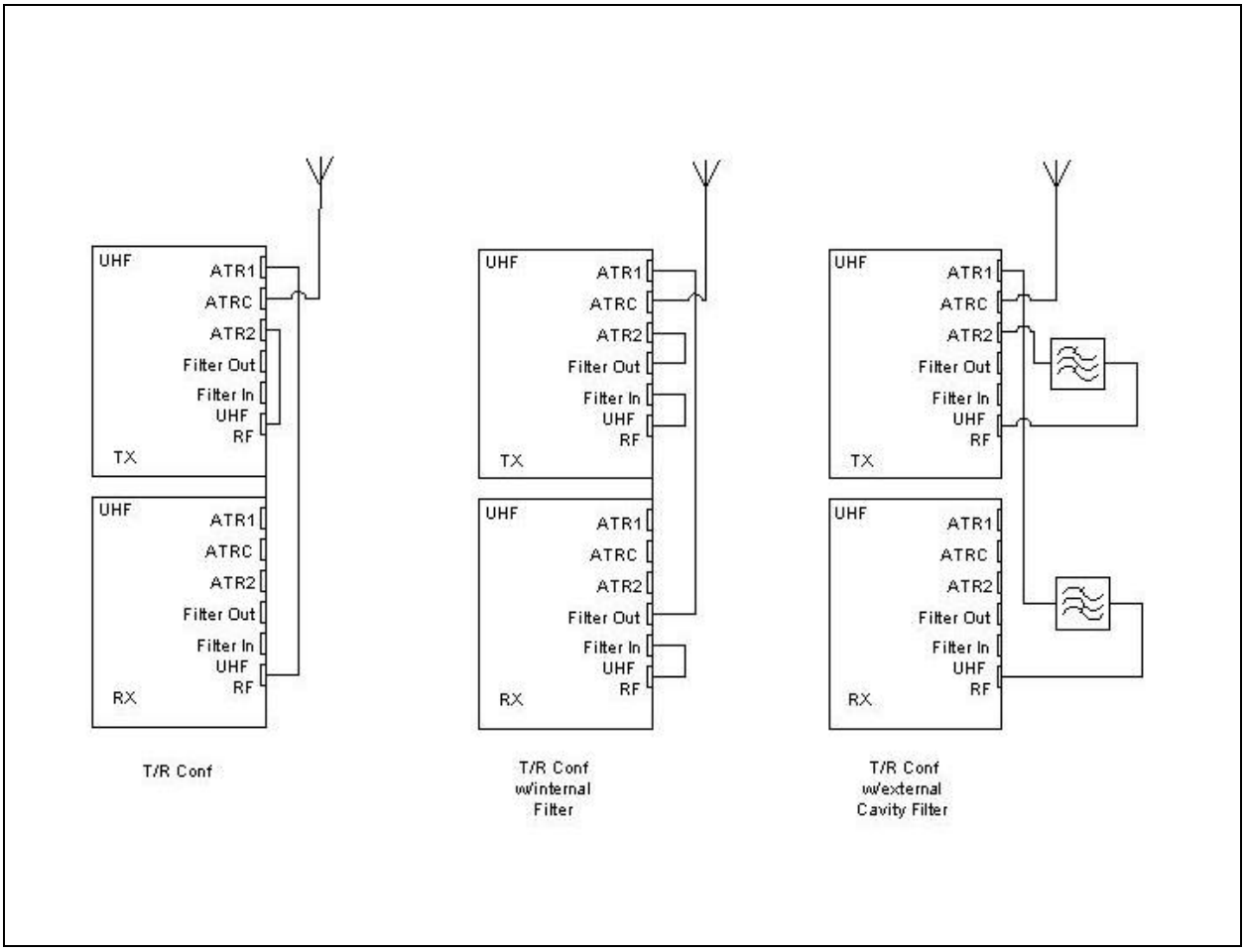
6.2.13.2 Critical Equipment Failure

Critical equipment failures are failures of the UHF radio that will either disrupt the operational traffic flow or that will result in loss of capabilities and functions required for continued safe operation of the UHF radio. Examples of the former include failure to the power amplifier in the transmitter, failure to the RF front end in the receiver, and failure to the power supply subsystem of the UHF radio.

6.2.14 Configuration of Chaining Multiple UHF Radios to a Common Antenna Using the ATR

The UHF radio needs a capability to connect multiple UHF radio units to a single antenna. The series of figures that follow illustrate the various cases of connections prevalent in the FAA installations that the UHF radio is expected to handle internally.

Figure 6-2 shows the transceiver configuration, i.e., transmitter and receiver sharing an antenna. The figure illustrates three cases, first without filters, the second with the use of internal filters, the third the use of external filters.

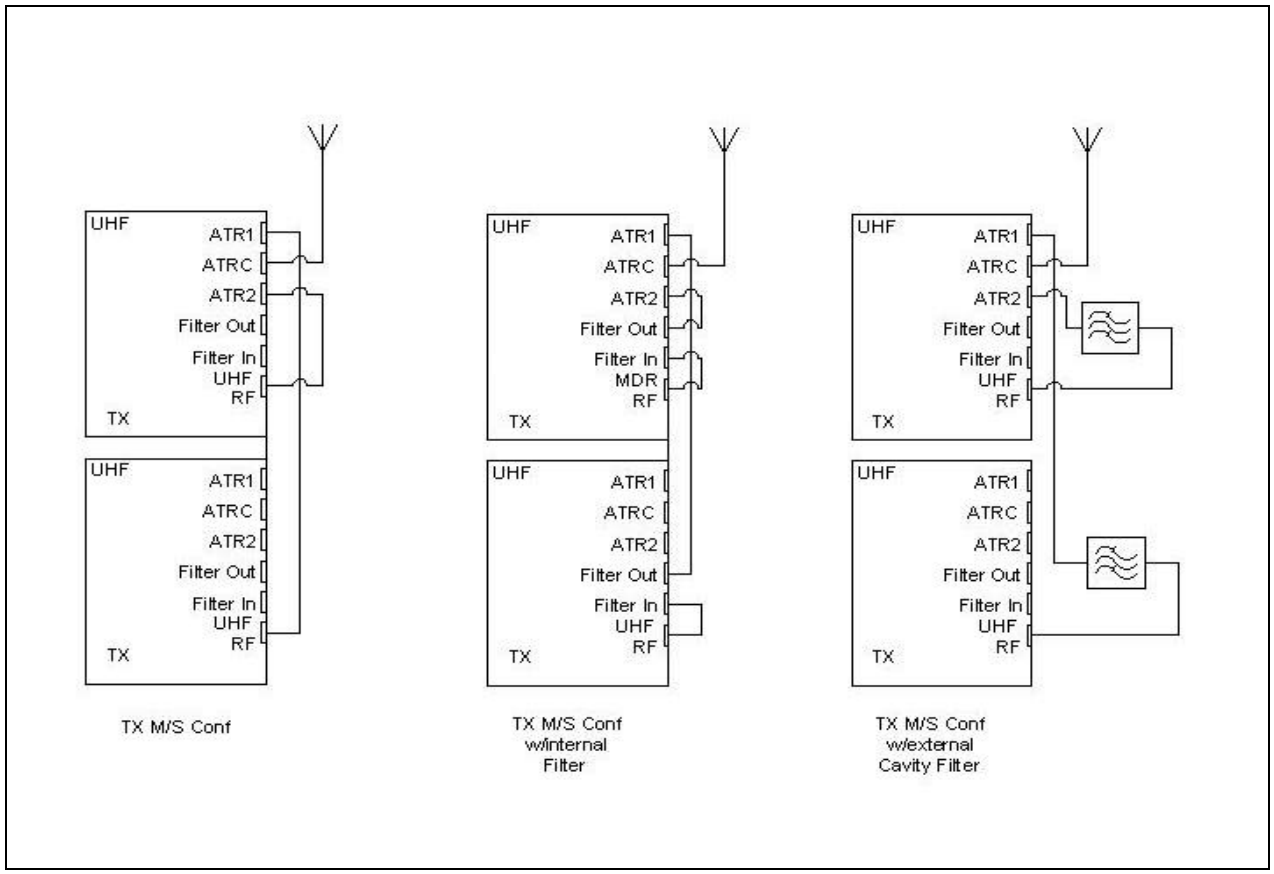


ATR1 Connection to ATR connector 1
ATR2 Connection to ATR connector 2
ATRC Connection to the ATR common connector
CF1 Input connection to the internal filter
CF2 Output connection from the internal filter

Figure 6-2

Conceptual Illustration of Transceiver Configuration

Figure 6-3 shows the configuration of a main and standby transmitter sharing an antenna. The three cases indicated in the previous paragraph are also shown for this configuration.



ATR1 Connection to ATR connector 1
ATR2 Connection to ATR connector 2
ATRC Connection to the ATR common connector
CF1 Input connection to the internal filter
CF2 Output connection from the internal filter

Figure 6-3

Conceptual Illustration of Transmitter Main/Standby Configuration

APPENDIX A

List of Acronyms

A/G	Air-Ground
AGC	Automatic Gain Control
AM	Amplitude Modulation
ANSI	American National Standards Institute
ASTM	American Society of Testing and Materials
ATC	Air Traffic Control
ATR	Antenna Transfer Relay
ATRC	Antenna Transfer Relay Center Connection
C	Centigrade
CF	Connection to Filter
CW	Continuous Wave
dB	Decibel
dBc	Decibels referenced to carrier
dBm	Decibels referenced to 1 milliwatt
DSB-AM	Double Side-Band Amplitude Modulation
EMC	Electromagnetic Compatibility
EIA	Electronic Industries Alliance
ESD	Electrostatic Discharge
FAA	Federal Aviation Administration
FM	Frequency Modulation
GME	Global Management Entity
GNSS	Global Navigation Satellite System
Hz	Hertz
ICAO	International Civil Aviation Organization
ICD	Interface Control Document
IEEE	Institute of Electrical and Electronic Engineers
ISO	International Standards Organization
kHz	kilohertz
LED	Light Emitting Diodes
LME	Local Management Entity
LRU	Line Replaceable Unit
ma	Milliampere
MDT	Maintenance Data Terminal
MHz	Megahertz
ms	Milliseconds
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
N/A	Not Applicable
NAS	National Airspace System
NEMA	National Electrical Manufacturers Association
NTIA	National Telecommunications and Information Administration

ppm	Parts Per Million
PTT	Push-to-Talk
RAM	Random Access Memory
RF	Radio Frequency
RMM	Remote Maintenance Monitoring
RMMC	Remote Maintenance Monitoring Control
Rx	Receiver
SINAD	Ratio of Signal plus Noise plus Distortion to Noise plus Distortion
SRS	Software Requirements Specification
Tx	Transmitter
UHF	Ultra High Frequency
VA	Volt Ampere
VDC	Volts Direct Current
VHF	Very High Frequency
V	Volt
VSWR	Voltage Standing Wave Ratio