NOTE: The cover page of this standard has been changed for administrative reasons. There are no other changes to this document.

MIL-STD-188-242
20 JUNE 1985

DEPARTMENT OF DEFENSE INTERFACE STANDARD

INTEROPERABILITY AND PERFORMANCE STANDARDS FOR TACTICAL SINGLE CHANNEL VERY HIGH FREQUENCY (VHF) RADIO EQUIPMENT

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DEPARTMENT OF DEFENSE
Washington, DC 20301

Interoperability and
Performance Standards for
Tactical Single Channel
Very High Frequency
(VHF) Radio Equipment

MIL-STD-188-242

1. This Military Standard is approved and mandatory for use by all Departments and Agencies of the Department of Defense, in accordance with the Memorandum of the Office of the Under Secretary of Defense for Research and Engineering, dated 16 August 1983. (See Appendix A.)

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to:

Commander
U.S. Army Communications-Electronics Command
ATTN: AMSEL-SEI-I
Fort Monmouth, NJ 07703-5203

by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FOREWORD

1. Originally, Military Standard 188 (MIL-STD-188) covered technical standards for tactical and long haul communications, but later evolved through revisions (MIL-STD-188A, MIL-STD-188B) into a document applicable to tactical communications only (MIL-STD-188C).

2. The Defense Communications Agency (DCA) published DCA Circulars (DCAC) promulgating standards and engineering criteria applicable to the long haul Defense Communications System (DCS) and to the technical support of the National Military Command System (NMCS).

3. As a result of a Joint Chiefs of Staff (JCS) action, standards for all military communications are now being published in a MIL-STD-188 series of documents. The MIL-STD-188 series is subdivided into a MIL-STD-188-100 series covering common standards for tactical and long haul communications, a MIL-STD-188-200 series covering standards for tactical communications only, and a MIL-STD-188-300 series covering standards for long haul communications only. Emphasis is being placed on developing common standards for tactical and long haul communications published in the MIL-STD-188-100 series.

4. This document contains technical standards and design objectives for tactical single channel VHF radio equipment. It supersedes paragraph 4.5.8 of MIL-STD-188C applying to tactical single channel VHF radio equipment.

IDENTIFICATION OF
INTERNATIONAL STANDARDIZATION AGREEMENT

Certain provisions of this standard (see 4.2) are the subject of international standardization agreements STANAG 4204 and QSTAG 263B. When amendment, revision, or cancellation of this standard is proposed which will modify the international agreement concerned, the preparing activity will take appropriate action through international standardization channels, including departmental standardization offices to change the agreement or make other appropriate accommodations.

CONTENTS

APPENDICES

1. SCOPE

1.1 Purpose. The purpose of this document is to promulgate technical design and engineering parameters in the form of mandatory system standards and optional design objectives that are considered necessary to ensure interoperability and to promote compatibility and commonality among tactical single channel very high frequency (VHF) radio equipment. It is also the purpose of this document to establish a level of performance of tactical single channel VHF radio equipment considered necessary to satisfy the requirements of a majority of users. The technical parameters promulgated by this document represent, in general, minimum interoperability and performance characteristics which may be exceeded in order to satisfy specific requirements. For example, other signal levels may be added to the minimum mandatory interoperability characteristics as stated in the note of 5.1.3.7.

Standards contained in this document have been based on measured performance of existing VHF radio equipment according to the definition of system standards as stated in Federal Standard (FED-STD) 1037. Consequently, it is not the purpose of this document to establish all standards considered necessary to ensure interoperability of future VHF radio equipment that is currently being designed and developed. However, this document provides guidance to the designers of future VHF radio equipment by standardizing the technical characteristics of existing VHF radio equipment to facilitate the necessary design decision required to achieve interoperability between existing and future VHF radio equipment.

It is not the purpose of this document to serve as a stand-alone, comprehensive reference containing all technical parameters and other details required for the design of new equipment or the preparation of specifications. Therefore, parameters for such items as size and weight limitations, connectors, cable assemblies, or power supplies are not contained in this document. These parameters and other design details have to be established, based on specific requirements, and have to be carefully tailored in accordance with the policies of DoD Directive (DoDD) 4120.21.

This document is not intended to be an engineering textbook or a reference handbook for VHF radio equipment. It is assumed that users of this document have a basic technical background in the design and engineering of VHF radio equipment. This document also is not intended to inhibit advances in communications technology. Such advances are encouraged by including design objectives which should be achieved if economically feasible. Additionally, such advances are facilitated by standardizing upper or lower limits rather than fixed parameters values and by not specifying the technology that should be used in the design and development of VHF radio equipment to meet the required standards.

1.2 Application. This document applies to the design and development of new single channel VHF radio equipment for tactical communications. This document applies also to the operation of existing single channel VHF radio equipment for tactical communications. In a few cases, reference is made to other documents which provide standards for specific applications.

1.3 System standard and design objective. The parameters and other requirements specified in this document are mandatory system standards (see Appendix A) if the word "shall" is used in connection with the parameter value or requirement under consideration. Nonmandatory design objectives are indicated by parentheses after a standardized parameter value or by the word "should" in connection with the parameter value or requirement under consideration. For a definition of the terms "System Standard" and "Design Objective" see FED-STD-1037.

2. REFERENCED DOCUMENTS

2.1 Government documents.

2.1.1 Standards and handbooks. Unless otherwise specified, the following standards and handbooks of the issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this standard to the extent specified herein.

STANDARDS

FEDERAL

FED-STD-1037	Glossary of Telecommunication Terms

MILITARY

MIL-STD-188-114	Electrical Characteristics of Digital Interface Circuits
MIL-STD-188-200	System Design and Engineering Standards for Tactical Communications
MIL-STD-449	Radio Frequency Spectrum Characteristics, Measurement of
MIL-STD-461	Electromagnetic Interface Characteristics Requirements for Equipment
MIL-STD-462	Electromagnetic Interference Characteristics, Measurement of
MIL-STD-463	Definition and System of Units, Electromagnetic Interference and Electromagnetic Compatibility Technology

MILITARY HANDBOOKS

MIL-HDBK-232	RED/BLACK Engineering-Installation Guidelines (U)

2.1.2 Other Government documents and publications. The following other Government documents and publications form a part of this standard to the extent specified herein.

DoD Directive 4120.21, Specifications and Standards Application

NACSIM 5100, Compromising Emanations Laboratory Test Requirements, Electromagnetics (U)

NACSEM 5201, TEMPEST Guidelines for Equipment/System Design (U)

North Atlantic Treaty Organization (NATO) Standardization Agreements (STANAG)

STANAG 4204 Technical Standards for Single Channel VHF Radio Equipment

Quadripartite Standardization Agreement (QSTAG)

QSTAG-263B Standards to Achieve Interoperability of ABCA Armies Very High Frequency Combat Net Radio Equipments

(Copies of specifications, standards, handbooks, drawings, and publications required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this standard to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted shall be those listed in the issue of the DoDISS specified in the solicitation. The issues of the documents which have not been adopted shall be those in affect on the date of the cited DoDISS.

International Telecommunication Union (ITU), Radio Regulations

(Copies of the above regulations may be purchased from the International Telecommunication Union, Place des Nations, CH-1211 Geneva 20, Switzerland.)

International Civil Aviation Organization (ICAO), Standards and Recommended Practices for Aeronautical Telecommunications, Annex 10 to the Convention on International Civil Aviation

(Copies of the above regulation may be purchased from the International Civil Aviation Organization, Attn: Distribution Officer, PO BOX 400, Succursale: Place De Aviation Internationale, 1000 Cherbrooke St. West, Montreal, Quebec, Canada, H3S2R2.)

2.3 Order of precedence. In the event of a conflict between the text of this standard and the references cited herein, the text of this standard shall take precedence.

3. DEFINITIONS

3.1 Definition of terms. Definition of terms used in this document shall be as specified in FED-STD-1037. Definitions of electromagnetic compatibility (EMC) terms shall be as specified in MIL-STD-463.

3.2 Abbreviations and acronyms. The abbreviations and acronyms used in this document are listed in Appendix B.

4. GENERAL REQUIREMENTS

4.1 General. The VHF band is generally considered to cover from 30 megahertz (MHz) to 300 MHz. However, for military purposes, the portion of the band above 225 MHz is considered to be within the ultra high frequency (UHF) band. The military frequency modulation (FM) portion of the band generally ranges from 30 MHz to 88 MHz while the military amplitude modulation (AM) portion generally begins above 116 MHz.

The VHF band is used by both military and non-military services. A portion of this band is allocated to commercial FM and television broadcasting. For military tactical communications, the VHF band is primarily utilized for surface-to-surface and surface-to-air communications in point-to-point and net operations.

The tactical single channel VHF radio equipment normally provides analog voice, digitized voice and data service to the user. Data service may be provided by utilizing a modulator/demodulator (modem) which will convert the digital bit stream to a quasi-analog signal that is compatible with the voice frequency (VF) channel. Wideband (16 kilobits per second (kb/s)) digitized voice or data service may be provided by utilizing direct interface to the radio modulator and demodulator.

4.1.1 Radio regulations. The use of the radio frequency (rf) spectrum is regulated by international agreements embodied in the Radio Regulations, published by the General Secretariat of the International Telecommunication Union (ITU), Geneva, Switzerland, and modified periodically by a World Administrative Radio Conference (WARC). These radio regulations are further qualified at the national level through Federal Government agencies, such as the Interdepartment Radio Advisory Committee (IRAC), and through military agencies, such as the Joint Chiefs of Staff (JCS) and Military Communications-Electronics Board (MCEB). Military frequency planning, including joint functional frequency allocation tables, is established as a joint action area under the MCEB.

The equipment design, the choice and performance of the equipment, as well as frequencies and emissions of any radio equipment, shall satisfy the provision of those radio regulations. Adequate familiarity with these regulations is, therefore, required of designers and users of radio equipment. Final approval of frequency bands, operating modes, and equipment characteristics within the DoD rests with the MCEB.

Appendix J of MIL-STD-188-200 contains information based on the ITU Radio Regulations concerning the classification and designation of emissions and necessary bandwidths for radio transmission.

4.2 Interoperability requirements.

4.2.1 Interconnection of single channel VHF radio equipment with telephone facilities. The interconnection of single channel radio equipment

with telephone facilities shall comply with the applicable requirements of subparagraph 5.4.5 of MIL-STD-188-200.

4.2.2 Interoperability with NATO. For interoperation with NATO member nations, the technical characteristics of single channel VHF FM radio equipment shall comply with the applicable requirements of the current edition of STANAG 4204.

NOTE: The standards contained in this document comply with STANAG 4204.

4.2.3 Interoperability with American-British-Canadian-Australian (ABCA) Armies. For interoperation with ABCA Armies, the technical characteristics of single channel VHF FM radio equipment shall comply with the applicable requirements of the current edition of QSTAG-263B.

NOTE: The standards contained in this document comply with QSTAG-263B.

4.2.4 Interoperability with civil aviation organizations. For interoperation with civil organizations in the areas of air navigation and air traffic control, the technical characteristics of single channel VHF AM radio equipment shall comply with the applicable requirements of the current edition of Annex 10 to the Convention on International Civil Aviation published by the ICAO.

NOTE: The standards contained in this document have been based on, and are compatible with, the standards promulgated by the ICAO.

4.3 Frequency coverage. The equipment shall be capable of having the rf carrier tuned and aligned over the required frequency range in steps which allow operation in compliance with the channeling plans approved by the MCEB. Receiver selectivity shall be such as to allow single channel equipment to operate within a single channel as stated in the MCEB channeling plans.

4.4 Electronic warfare (EW) vulnerability and electronic counter-countermeasures (ECCM) capabilities. The EW vulnerability and ECCM capabilities of single channel VHF radio equipment should comply with the applicable requirements of subparagraph 5.1.2.3 of MIL-STD-188-200.

4.5 Electromagnetic compatibility (EMC) requirements. The EMC requirements for single channel VHF radio equipment serving functionally in an electromagnetic environment in the broadest sense of the term environment, shall comply with the applicable requirements of the current edition of MIL-STD-461. Techniques used for the measurement and determination of EMC characteristics shall comply with the applicable requirements of the current edition of MIL-STD-462.

4.6 Compromising emanations (TEMPEST) requirements. Single channel VHF radio equipment shall comply with the applicable TEMPEST criteria of the current edition of the NACSIM 5100 series.

NOTE: NACSEM 5201 provides design guidance and MIL-HDBK-232 provides installation guidance for compromising emanations.

4.7 Electromagnetic pulse (EMP) vulnerability. EMP vulnerability should be considered during the concept formulation stage. The development of single channel VHF radio equipment should include, but not necessarily be limited to, an evaluation of:

a. surge protection and filtering between EMP-sensitive circuits and potential EMP entry points such as power lines, antennas, and microphone connectors;

b. amplitude limiters in radio equipment to reduce transient power pulses;

c. circuit layout procedures to reduce internal coupling of transients; and

d. proper grounding, bonding and shielding practices should be employed to help minimize susceptibility.

4.8 VHF spectrum characteristics. The spectral characteristics of all single channel VHF radio equipment and antennas shall be measured in accordance with the applicable requirements of the current edition of MIL-STD-449.

5. DETAILED REQUIREMENTS

5.1 AM radio equipment. Single channel VHF AM radio equipment is normally used for air traffic control communications, employing only the analog (nondigitized) voice mode. The standards contained in 5.1 for AM radio equipment have been based on, and are compatible with, the standards promulgated by the ICAO.

5.1.1 Equipment parameters. The parameters listed under this heading are those that are common to both AM transmitters and AM receivers.

5.1.1.1 Rf accuracy. The rf accuracy of AM radio equipment, including tolerance and long-term stability but not any effect due to the doppler frequency shift, shall be such that the measured operating frequency does not differ from the designated frequency by more than ±500 Hz under all operational conditions.

5.1.1.2 Channel spacing. AM radio equipment shall have a channel spacing of 25 kHz within the allocated frequency band for the equipment. (See 4.1.1.)

5.1.2 AM transmitter parameters.

5.1.2.1 Amplitude frequency response. The amplitude frequency response of AM transmitters over the frequency band from 300 Hz to 3000 Hz shall be within the limits of ±2 dB.

5.1.2.2 Envelope delay. The absolute envelope delay of AM transmitters over the frequency band from 300 Hz to 3000 Hz shall not exceed 2.5 milliseconds (ms).

5.1.2.3 Carrier noise level. The carrier noise level of AM transmitters shall be at a level which is at least 50 dB (Design Objective 60 dB) below the unmodulated carrier level at full rated rf output power, measured at any frequency within the limits from 0.95 f to 1.05 f, where f is the carrier frequency.

5.1.2.4 Total harmonic distortion. The total harmonic distortion of VF signals passing through the VF and rf circuits of an AM transmitter shall be at a level which is at least 33 dB below reference level (-33 dBm0), while the Design Objective should be -43 dBm0. The total harmonic distortion shall be measured using a single-frequency test signal with a frequency between 300 Hz and 3000 Hz and a level that produces 90 percent modulation at full rated rf output power.

5.1.2.5 Intermodulation distortion. The intermodulation distortion of VF signals passing though the VF and rf circuits of an AM transmitter shall be at a level which is at least 30 dB below reference level (-30 dBm0), while the Design Objective should be -40 dBm0. The intermodulation

distortion shall be measured using any two equal level single-frequency test signals between 300 Hz and 3000 Hz that produces 90 percent modulation at full rated rf output power.

NOTE: The frequencies of the two equal level signals should be selected so that at least the third order harmonic product falls within the specified frequency band.

5.1.2.6 Occupied bandwidth. The occupied bandwidth of AM transmitters shall be less than 14 kHz.

5.1.2.7 Rf output impedance. The rf output impedance of AM transmitters shall be nominal 50 ohms, unbalanced to ground.

5.1.2.8 Modulator input impedance. The modulator input impedance of AM transmitters shall be 150 ohms, unbalanced to ground, with a minimum return loss of 20 dB against a 150-ohm resistance over the frequency bandwidth from 300 Hz to 3000 Hz. As a Design Objective, the modulator input impedance should be 600 ohms, balanced to ground, with a minimum return loss of 26 dB against a 600-ohm resistance over the frequency bandwidth from 300 Hz to 3000 Hz. (See note.) The electrical symmetry should be sufficient to suppress longitudinal currents to a level which is at least 40 dB below reference level (-40 dBm0).

NOTE: A terminal impedance balanced to ground is recommended for tactical equipment operating in an environment that has a high electromagnetic interference (EMI) level, such as in aircraft and vehicles. Measurements have shown that an electrical noise rejection improvement of up to 20 dB can be achieved for balanced terminations, compared with unbalanced terminations.

5.1.2.9 Modulator input signal level. Not standardized.

NOTE: Requirements for modulator input signal levels will be determined in the applicable equipment specification.

5.1.2.10 Spurious emissions. The in-band spurious emissions of AM transmitters shall be at a level which is at least 80 dB below the unmodulated carrier at full rated rf output power, when the AM transmitter is 90 percent modulated with any single-frequency test signal between 300 Hz and 3000 Hz. In-band spurious emissions shall be measured within the limits from 0.95 f to 1.05 f, where f is the carrier frequency.

NOTE: MIL-STD-461 specifies limits of spurious emissions for the out-of-band frequencies which are outside of the 0.95 f to 1.05 f frequency range. (See 4.5.)

5.1.3 AM receiver parameters.

5.1.3.1 Amplitude frequency response. The amplitude frequency response of AM receivers over the frequency band from 300 Hz to 3000 Hz shall be within the limits of ±2 dB.

5.1.3.2 Envelope delay. The absolute envelope delay of AM receivers over the frequency band from 300 Hz to 3000 Hz shall not exceed 2.5 ms.

5.1.3.3 Total harmonic distortion. The total harmonic distortion of VF signals passing through an AM receiver shall be at a level which is at least 23 dB below reference level (-23 dBm0), while the Design Objective should be -33 dBm0. The total harmonic distortion shall be measured using a single-frequency test signal with a frequency between 300 Hz and 3000 Hz and a level that produces full rated VF output power.

5.1.3.4 Intermodulation distortion. The intermodulation distortion of VF signals passing through an AM receiver shall be at a level which is at least 20 dB below reference level (-20 dBm0), while the Design Objective should be -30 dBm0. The intermodulation distortion shall be measured using any two equal level single-frequency test signals between 300 Hz and 3000 Hz that produces full rated VF output power.

NOTE: The frequencies of the two equal level signals should be selected so that at least the third order harmonic product falls within the specified frequency band.

5.1.3.5 Rf input impedance. The rf input impedance of AM receivers shall be nominal 50 ohms, unbalanced to ground.

5.1.3.6 VF output impedance. The VF output impedance of AM receivers shall be 600 ohms, balanced to ground, with a minimum return loss of 26 dB against a 600-ohm resistance over the frequency band from 300 Hz to 3000 Hz. The electrical symmetry shall be sufficient to suppress longitudinal currents to a level which is at least 40 dB below reference level (-40 dBm0).

5.1.3.7 VF output signal level. The VF output signal level of AM receivers shall be continuously variable between at least -20 dBm and 0 dBm.

NOTE: Additional requirements for signal levels different from the levels stated in 5.1.3.7 and 5.2.1.3.7 or for automatic level (or gain) control may be stated in applicable equipment specifications and may be implemented either externally, for example, in the form of an applique, or internally as an integral part of the receiver.

5.1.3.8 Internally generated spurious signals. Not standardized.

NOTE: Spurious signals at the VF output of AM receivers, produced in the absence of rf input signals by mixing of signals that are generated internally in the receiver will have sufficiently low levels to allow unrestricted tuning and the reception of wanted signals in any channel. Detailed requirements will be stated in the applicable equipment specifications.

5.1.3.9 Hum and noise level. Hum and noise measured at the VF output of AM receivers shall be at a level which is at least 50 dB below reference level (-50 dBm0), while the Design Objective should be -56 dBm0.

5.1.3.10 Adjacent channel rejection. The adjacent channel rejection of AM receivers shall be at least 60 dB.

5.2 FM radio equipment. Single channel VHF FM radio equipment is normally capable of two modes, a narrowband mode using a VF channel and a wideband mode for digitized voice and data.

5.2.1 Narrowband (VF) channel.

5.2.1.1 Equipment parameters. The parameters listed under this heading are those that are common to both FM transmitters and FM receivers.

5.2.1.1.1 Rf accuracy. The rf accuracy of FM radio equipment, including tolerance and long-term stability but not any effect due to the doppler frequency shift, shall be such that the measured operating frequency does not differ from the designated frequency by more than ±500 Hz under all operational conditions.

5.2.1.1.2 Channel spacing. FM radio equipment shall have a channel spacing of 25 kHz, within the allocated frequency band for the equipment. (See 4.1.1.)

5.2.1.2 FM (VF) transmitter parameters.

5.2.1.2.1 Amplitude frequency response. The amplitude frequency response of FM transmitters over the frequency band from 300 Hz to 3000 Hz shall be within the limits of ±2 dB.

5.2.1.2.2 Envelope delay. The absolute envelope delay of FM transmitters over the frequency band from 300 Hz to 3000 Hz shall not exceed 2.5 ms.

5.2.1.2.3 Carrier noise level. The carrier noise level of FM transmitters shall be at a level which is at least 50 dB (Design Objective 60 dB) below the unmodulated carrier level at full rated rf output power, measured at any frequency within the limits from 0.95 f to 1.05 f, where f is the carrier frequency.

5.2.1.2.4 Total harmonic distortion. The total harmonic distortion of VF signals passing through the VF and rf circuits of an FM transmitter shall be at a level which is at least 33 dB below reference level (-33 dBm0), while the Design Objective should be -43 dBm0. The total harmonic distortion shall be measured using a single-frequency test signal with a frequency between 300 Hz and 3000 Hz and a level that produces a peak deviation in accordance with 5.2.1.2.10 at full rated rf power.

5.2.1.2.5 Intermodulation distortion. The intermodulation distortion of VF signals passing through the VF and rf circuits of FM transmitters shall be at a level which is at least 30 dB below reference level (-30 dBm0), while the Design Objective should be -40 dBm0. The intermodulation distortion shall be measured using any two equal level single-frequency test signals between 300 Hz and 3000 Hz and a level that produces a peak deviation in accordance with 5.2.1.2.10 at full rated rf output power.

NOTE: The frequencies of the two equal level signals should be selected so that at least the third order harmonic product falls within the specified frequency band.

5.2.1.2.6 Occupied bandwidth. The occupied bandwidth of FM transmitters shall be less than 25 kHz.

5.2.1.2.7 Rf output impedance. The rf output impedance of FM transmitters shall be nominal 50 ohms, unbalanced to ground.

5.2.1.2.8 Modulator input impedance. The modulator input impedance of FM transmitters shall be 150 ohms, unbalanced to ground, with a minimum return loss of 20 dB against a 150-ohm resistance over the frequency band from 300 Hz to 3000 Hz. As a Design Objective, the modulator input impedance should be 600 ohms, balanced to ground, with a minimum return loss of 26 dB against a 600-ohm resistance over the frequency band from 300 Hz to 3000 Hz. (See note under 5.1.2.8.) The electrical symmetry should be sufficient to suppress longitudinal currents to a level which is at least 40 dB below reference level (-40 dBm0).

5.2.1.2.9 Modulator input signal level. Not standardized. (See note under 5.1.2.9.)

5.2.1.2.10 Peak deviation. The peak deviation of FM transmitters for signals shall be 6.5 kHz, ±1 kHz.

5.2.1.2.11 Squelch. FM transmitters operating in the narrowband mode shall superimpose on the transmitted signal a tone modulation with a frequency of 150 Hz, ±4 Hz and a peak deviation of 1600 Hz, ±350 Hz.

NOTE: The 150 Hz squelch tone is needed only for interoperation with older FM receivers and will not be used to operate the squelch circuitry of new receivers. (See 5.2.1.3.11.)

5.2.1.2.12 Pre-emphasis. Not standardized.

NOTE: Tests have shown that the influence of pre-emphasis/de-emphasis on intelligibility is insignificant and that pre-emphasis/de-emphasis characteristics have to be tailored specifically for a language or a dialect to be effective.

5.2.1.3 FM (VF) receiver parameters.

5.2.1.3.1 Amplitude frequency response. The amplitude frequency response of FM receivers over the frequency band from 300 Hz to 3000 Hz shall be within the limits of ±2 dB.

5.2.1.3.2 Envelope delay. The absolute envelope delay of FM receivers over the frequency band from 300 Hz to 3000 Hz shall not exceed 2.5 ms.

5.2.1.3.3 Total harmonic distortion. The total harmonic distortion of VF signals passing through an FM receiver shall be at a level which is at least 23 dB below reference level (-23 dBm0), while the Design Objective should be -33 dBm0. The total harmonic distortion shall be measured with a single-frequency test signal with a frequency between 300 Hz and 3000 Hz and a level that produces a peak deviation in accordance with 5.2.1.2.10 at full rated VF output power.

5.2.1.3.4 Intermodulation distortion. The intermodulation distortion of VF signals passing through an FM receiver shall be at a level which is at least 20 dB below reference level (-20 dBm0), while the Design Objective should be -30 dBm0. The intermodulation distortion shall be measured using any two equal level single-frequency test signals between 300 Hz and 3000 Hz and a level that produces a peak deviation in accordance with 5.2.1.2.10 at full rated VF output power.

NOTE: The frequencies of the two equal level signals should be selected so that at least the third order harmonic product falls within the specified frequency band.

5.2.1.3.5 Rf input impedance. The rf input impedance of FM receivers shall be nominal 50 ohms, unbalanced to ground.

5.2.1.3.6 VF output impedance. The VF output impedance of FM receivers shall be 600 ohms, balanced to ground, with a minimum return loss of 26 dB against a 600-ohm resistance over the frequency band from 300 Hz to 3000 Hz. The electrical symmetry shall be sufficient to suppress longitudinal currents to a level which is at least 40 dB below reference level (-40 dBm0).

5.2.1.3.7 VF output signal level. The VF output signal level of FM receivers shall be continuously variable between at least -20 dBm and 0 dBm. See note under 5.1.3.7.

5.2.1.3.8 Internally generated spurious signals. Not standardized.

NOTE: Spurious signals at the VF output of FM receivers, produced in the absence of rf signals by mixing of signals that are generated internally in the receiver, will have sufficiently low levels to allow unrestricted tuning and the reception of wanted signals in any channel. Detailed requirements will be stated in the applicable equipment specifications.

5.2.1.3.9 Hum and noise level. Hum and noise measured at the VF output of FM receivers shall be at a level which is at least 40 dB below reference level (-40 dBm0), while the Design Objective should be -50 dBm0.

5.2.1.3.10 Adjacent channel rejection. The adjacent channel rejection of FM receivers shall be at least 60 dB.

5.2.1.3.11 Squelch and retransmission. The receiver squelch circuit shall control the switching of other radios for retransmission by signal energy in the receiver passband, by noise quieting, or by a combination of both; (and not by the 150 Hz squelch tone in accordance with 5.2.1.2.11). FM receivers operating in the narrowband mode shall provide adequate suppression of the 150 Hz, ±4 Hz squelch tone (see 5.2.1.2.11) received from FM transmitters.

5.2.1.3.12 De-emphasis. Not standardized. See note under 5.2.1.2.12.

5.2.2 Wideband (digital) channel.

5.2.2.1 Equipment parameters. The parameters listed under this heading are those that are common to both FM transmitters and FM receivers.

5.2.2.1.1 Rf accuracy. The rf accuracy of FM radio equipment, including tolerance and long-term stability but not any effect due to the doppler frequency shift, shall be such that the measured operating frequency does not differ from the designated frequency by more than ±500 Hz under all operational conditions.

5.2.2.1.2 Channel spacing. FM radio equipment shall have a channel spacing of 25 kHz, within the allocated band for the equipment. (See 4.1.1.)

5.2.2.1.3 Bit error rate (BER). As a Design Objective, the BER of a back-to-back FM transmitter/receiver combination should not exceed 1 erroneous bit in 10,000,000 information bits, when measured with a polar non-return-to-zero signal of 16 kb/s.

NOTE: More detailed requirements for BER measurements, such as signal levels, will be stated in the applicable equipment specifications.

5.2.2.1.4 Character-count and bit-count integrity. No extraneous characters or bits (see note) shall be inserted or deleted by a back-to-back FM transmitter/receiver combination in bit streams representing digitized voice or message texts. As a Design Objective, the mean-time-between-losses of character-count and bit-count integrity should be 24 hours or longer.

NOTE: Extraneous characters or bits include time differential blanks associated with asynchronous/synchronous transmission equipment. These characters or bits are permissible in the transmission subsystem if they can be recovered at the receiving terminal equipment prior to forwarding the signal to the user.

5.2.2.1.5 Protection of signal sense. All single channel FM radio equipment shall be designed in such a manner that neither an FM transmitter nor an FM receiver inverts the logic and signal sense of the data stream.

NOTE: A possible method of meeting the requirement of 5.2.2.1.5 is the use of differential coding techniques which includes conditioning of baseband signals.

5.2.2.1.6 Clock modulation rate stability. The stability of synchronizing or clock timing supplied to all synchronous digital FM radio transmission equipment shall be sufficient to ensure that synchronism is maintained between received and transmitted signals within ±25 percent of the unit interval for a given time period.

NOTE: The time period, expected to be less than 100,000 seconds for single channel FM radio equipment, is under consideration.

5.2.2.1.7 Electrical characteristics of digital interface. The electrical characteristics for polar non-return-to-zero signals at the digital interfaces of the wideband modulator input and the wideband VF output shall comply with the applicable requirements of the current edition of MIL-STD-188-114.

5.2.2.1.8 Equipment time delays. As a Design Objective, the receive-after-transmit time delay should not exceed 60 ms and the transmit-after-receive time delay should not exceed 70 ms.

5.2.2.2 FM (digital) transmitter parameters.

5.2.2.2.1 Amplitude frequency response. The amplitude frequency response of FM transmitters over the frequency band from 20 Hz to 11 kHz shall be within the limits of ±3 dB, with a roll-off of 6 dB/octave above and below the passband.

5.2.2.2.2 Envelope delay. Under consideration.

5.2.2.2.3 Carrier noise level. The carrier noise level of FM transmitters shall be at a level which is at least 40 dB (Design Objective 50 dB) below the unmodulated carrier level at full rated rf output power, measured at any frequency within the limits from 0.95 f to 1.05 f where f is the carrier frequency.

5.2.2.2.4 Occupied bandwidth. The occupied bandwidth of FM transmitters shall be less than 25 kHz.

5.2.2.2.5 Rf output impedance. The rf output impedance of FM transmitters shall be nominal 50 ohms, unbalanced to ground.

5.2.2.2.6 Peak deviation. The peak deviation of FM transmitters shall be 5 kHz, ±1 kHz. The polarity of the deviation shall be such that the frequency representing a binary 1 (Mark) shall be below the center frequency and the frequency representing a binary 0 (Space) shall be above the center frequency.

5.2.2.2.7 Premodulation filtering and waveshaping. Not standardized.

NOTE: Shaping and filtering of the digital signal will be required in order to contain the transmitted signal spectrum within the minimum necessary bandwidth, reduce inter-symbol interference, and preserve waveform symmetry. These requirements will be determined in the applicable equipment specifications.

5.2.2.2.8 Transmitter time delays. As a Design Objective, the transmitter attack-time delay should not exceed 25 ms and the transmitter release-time delay should not exceed 10 ms.

5.2.2.3 FM (digital) receiver parameters.

5.2.2.3.1 Amplitude frequency response. The amplitude frequency response of FM receivers over the frequency band from 20 Hz to 11 kHz shall be within the limits of ±3 dB, with a roll-off of 6 dB/octave above and below the passband.

5.2.2.3.2 Envelope delay. Under consideration.

5.2.2.3.3 Rf input impedance. The rf input impedance of FM receivers shall be nominal 50 ohms, unbalanced to ground.

5.2.2.3.4 Internally generated spurious signals. Not standardized.

NOTE: Spurious signals at the wideband VF output of FM receivers, produced in the absence of rf signals by mixing of signals that are generated internally in the receiver, will have sufficiently low levels to allow unrestricted tuning and the reception of wanted signals in any channel. Detailed requirements will be stated in the applicable equipment specifications.

ment forms a part of this appendix to the extent

5.2.2.3.5 Hum and noise level. Hum and noise measured at the wideband VF output of FM receivers shall be at a level which is at least 40 dB below reference level (-40 dBm0), while the Design Objective should be -50 dBm0.

5.2.2.3.6 Adjacent channel rejection. The adjacent channel rejection of FM receivers shall be at least 60 dB.

5.2.2.3.7 Receiver time delays. As a Design Objective, the receiver attack-time delay should not exceed 40 ms and the receiver release-time delay should not exceed 60 ms.

Custodians:

Army - CR
Navy - EC
Air Force - 90

Preparing activity:

Army - CR
(Project TCTS - 2420)

Review activities:

Army - SC
Navy - EC, MC
Air Force - 90
DCA - DC
NSA - NS

User activities:

Army
Navy
Air Force

International interest:

NATO
ABCA Armies

APPENDIX A

MEMORANDUM FROM THE UNDER SECRETARY OF DEFENSE FOR RESEARCH AND ENGINEERING, 16 AUGUST 1983, SUBJECT: MANDATORY USE OF MILITARY TELECOMMUNICATIONS STANDARDS IN THE MIL-STD-188 SERIES.

This Appendix contains information related to MIL-STD-188-242. Appendix A is a mandatory part of this standard.

THE UNDER SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301

RESEARCH AND
ENGINEERING

16 AUG 1983

MEMORANDUM FOR ASSISTANT SECRETARY OF THE ARMY (INSTALLATIONS, LOGISTICS & FINANCIAL MANAGEMENT)
ASSISTANT SECRETARY OF THE NAVY (SHIPBUILDING & LOGISTICS)
ASSISTANT SECRETARY OF THE AIR FORCE (RESEARCH DEVELOPMENT & LOGISTICS)
COMMANDANT OF THE MARINE CORPS
DIRECTOR, DEFENSE COMMUNICATIONS AGENCY
DIRECTOR, NATIONAL SECURITY AGENCY

SUBJECT: Mandatory Use of Military Telecommunications Standards in the MIL-STD-188 Series

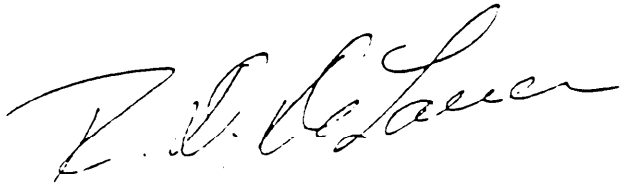
On May 10, 1977, Dr. Gerald Dinneen, then Assistant Secretary of Defense(C^3I), issued the following policy statement regarding the mandatory nature of the MIL-STD-188 series telecommunications standards:

"...standards as a general rule are now cited as 'approved for use' rather than 'mandatory for use' in the Department of Defense.

This deference to the judgment of the designing and procuring agencies is clearly appropriate to standards dealing with process, component ruggedness and reliability, paint finishes, and the like. It is clearly not appropriate to standards such as those in the MIL-STD-188 series which address telecommunication design parameters. These influence the functional integrity of telecommunication systems and their ability to efficiently interoperate with other functionally similar Government and commercial systems. Therefore, relevant military standards in the 188 series will continue to be mandatory for use within the Department of Defense.

To minimize the probability of misapplication of these standards, it is incumbent upon the developers of the MIL-STD-188 series to insure that each standard is not only essential but of uniformly high quality, clear and concise as to application, and wherever possible compatible with existing or proposed national, international and Federal telecommunication standards. It is also incumbent upon the users of these standards to cite in their procurement specifications only those standards which are clearly necessary to the proper functioning of the device or systems over its projected lifetime."

This statement has been reviewed by this office and continues to be the policy of the Department of Defense.



APPENDIX B

ABBREVIATIONS AND ACRONYMS

20. GENERAL

20.1 Scope. This appendix contains a list of abbreviations and acronyms used in MIL-STD-188-242.

20.2 Application. This appendix is a non-mandatory part of MIL-STD-188-242.

ABCA	American-British-Canadian-Australian
AM	amplitude modulation
b/s	bit(s) per second
BER	bit error rate
bit	binary digit
dB	decibel
dBm	dB, referred to 1 mW
dBm0	dBm, referenced to zero transmission level point(s)
DCA	Defense Communications Agency
DCS	Defense Communications System
DoD	Department of Defense
DoDD	DoD directive
ECCM	electronic counter-countermeasure
EMC	electromagnetic compatibility
EMI	electromagnetic interference
EMP	electromagnetic pulse
EW	electronic warfare
FM	frequency modulation
FED-STD	Federal Standard
Hz	hertz, (1 Hz = 1 cycle per second)
ICAO	International Civil Aviation Organization
IRAC	Interdepartment Radio Advisory Committee
ITU	International Telecommunication Union
JCS	Joint Chiefs of Staff
kb/s	kilobit(s) per second, (1 kb/s = 1000 b/s)
kHz	kilohertz, (1 kHz = 1000 Hz)
MCEB	Military Communications-Electronics Board
MHz	megahertz, (1 MHz = 1000 kHz)
MIL-STD	military standard
modem	modulator/demodulator
ms	millisecond(s), (1 ms = 1/1000 s)
NACSIM	National COMSEC Information Memorandum
NATO	North Atlantic Treaty Organization
NMCS	National Military Command System
QSTAG	Quadripartite Standardization Agreement (of the ABCA Armies)

rf	radio frequency
STANAG	standardization agreement (of the NATO)
TEMPEST	(see FED-STD-1037)
UHF	ultra high frequency, (300 MHz to 3000 MHz)
VF	voice frequency
VHF	very high frequency, (30 MHz to 300 MHz)
WARC	World Administrative Radio Conference

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-STD-188-242	Interoperability and Performance Standards for Tactical Single Channel Very High Frequency (VHF)Radio Equip

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ USER
	☐ MANUFACTURER
	☐ OTHER *(Specify)*: _____

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

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