NOT MEASUREMENT SENSITIVE

MIL-STD-188-164C
16 November 2018

SUPERSEDING
MIL-STD-188-164B
CHANGE NOTICE 1
20 July 2016

DEPARTMENT OF DEFENSE INTERFACE STANDARD

INTEROPERABILITY OF SUPERHIGH FREQUENCY (SHF) SATELLITE COMMUNICATIONS TERMINALS

AMSC N/A **AREA TCSS**

FOREWORD

1. This standard is approved for use by all Departments and Agencies of the Department of Defense (DoD).

2. In accordance with DoD Instruction 8330.01, it is DoD policy that all IT used by DOD components must interoperate with equipment of joint, combined, and coalition forces, other U.S. Government departments and agencies, and non-governmental organizations to the maximum extent possible.

3. Military standards (MIL-STDs) in the 188 series (MIL-STD-188-*XXX*) address telecommunications design parameters and are to be used in all new DoD systems and equipment, or major upgrades thereto. 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. Emphasis is being placed on the development of common standards for tactical and long-haul communications (the MIL-STD-188-100 series). The MIL-STD-188 series may be based on, or make reference to, American National Standards Institute (ANSI) standards, International Telecommunications Union Radio Communication Sector (ITU-R) recommendations, International Organization for Standardization (ISO) standards, North Atlantic Treaty Organization (NATO) standardization agreements (STANAGs), and other standards, wherever applicable.

4. This standard establishes interoperability and performance requirements for satellite communications (SATCOM) earth terminals (ETs) operating with satellite transponders in the X-band, and military K_a-bands.

5. This revised standard was updated to improve the alignment with MIL-STD-188-165, to remove references to commercial frequency bands, to clarify numerous requirements, and to include requirements for variable performance terminals.

6. Comments, suggestions, and questions on this document should be addressed to DISA, 6910 Cooper Ave., ATTN: IE53, Fort Meade, MD 20755-5496, or emailed to henry.h.tran.civ@mail.mil. Because contact information can change, verify the currency of this address information by using the ASSIST Online database at https://assist.dla.mil.

CONTENTS

FIGURES

TABLES

1 SCOPE

1.1 Scope. This standard establishes mandatory radio frequency (RF)/IF and associated interface requirements applicable to SATCOM ETs operating over military X-band and K_a-band super high frequency (SHF) channels. Equipment developers may exceed the requirements herein to satisfy specific program requirements, provided that interoperability is maintained. Thus, incorporating additional standard and nonstandard capabilities and interfaces is not precluded. Existing certified SHF SATCOM ETs that predate this revision may not need to conform to this MIL-STD unless they undergo modernization or modifications that alter performance for requirements listed herein.

1.2 Applicability. The interface and performance specifications contained herein apply to SATCOM ETs used to communicate through transponders on the Defense Satellite Communications System (DSCS) and the Wideband Global SATCOM (WGS) system.

1.3 Certification authority. The U.S. Army Space and Missile Defense Command (USASMDC)/Army Forces Strategic Command (ARSTRAT) is the certification authority for the WGS communications system and the DSCS and may be contacted at the following address:

U.S. Army Space and Missile Defense Command
Army Forces Strategic Command G-6
Consolidated Wideband SATCOM System Expert (C-SSE)
350 Vandenberg Street
Peterson Air Force Base, CO 80914-2749
usarmy.peterson.smdc.list.wideband-engineering2@mail.mil

1.4 Additional requirements. USASMDC/ARSTRAT may levy certification requirements in addition to those listed herein. Modem designers/vendors will coordinate with the certification authority to obtain test requirements specific to their modem. Note that this document is not intended to provide information regarding how to achieve the requirements contained herein; modem designers/vendors should refer to applicable requirements and test procedures documents issued by USASMDC/ARSTRAT.

1.5 Deviation from the standard.

a. If an ET requires deviation from the specifications stated herein, the Government sponsor Program Manager (PM) should process a request to deviate from the standard through the certification authority, in accordance with DoD Manual (DoDM) 4120.24, Defense Standardization Program Procedures. The request should include the mission of the system, the rationale for deviating from the standard, and both the technical and cost impact if the program is not allowed to deviate from the standard. ETs that are accepted by the Government sponsor PM without first obtaining approval for deviation from the certification authority are acquired at program risk.

b. Throughout this document, requirements generally apply to every ET. Government sponsor PMs may, with approval from the certification authority as described in 1.5a, deviate from the requirements in section 4 or 5 of this document.

c. Special cases of general requirements are addressed in appendices for specific types of ETs, allowing the certification authority to issue a full ET certification for any ET that implements requirements as modified by that specific appendix. The program office, without approval from the certification authority, may instruct a manufacturer to replace a section 4 or section 5 paragraph with the appropriate appendix paragraph.

1.6 Document structure. The main body of this document addresses requirements applicable to all ETs, including stationary and mobile (OTM) ETs. Appendices addressing additional requirements, which replace specific requirements in the body of the document as described in 1.5c and are applicable to unique types of ETs, are categorized as follows:

a. Appendix A, Land-Based SATCOM OTM Earth Terminals;

b. Appendix B, Air-Based SATCOM OTM Earth Terminals;

c. Appendix C, Array-Based SATCOM OTM Earth Terminals.

2 APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, and 5 of this standard. This section does not include documents cited in other sections of this standard or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, and 5 of this standard, whether or not they are listed in section 2.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-188-165 - Interoperability of Super high Frequency (SHF) Satellite Communications Phase-Shift Keying (PSK) Modems

(Copies of these documents are available online at https://assist.dla.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

GLOBAL POSITIONING SYSTEM (GPS) JOINT PROGRAM OFFICE

ICD-GPS-060	-	GPS User Equipment (Phase III) Interface Control Document for the Precise Time and Time Interval (PTTI) Interface

(Copies of this document are available online at https://www.navcen.uscg.gov.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in solicitation or contract.

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)

ATIS-0100523	-	ATIS Telecom Glossary (American National Standard T1.523)

(Copies of this document are available online at https://www.atis.org/glossary/.)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 802.3	-	IEEE Standard for Ethernet

(Copies of this document are available online from https://www.ieee.org or from the IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854-4141.)

INTERNATIONAL TELECOMMUNICATIONS UNION (ITU)

Recommendation ITU-R S.580-6	-	Radiation diagrams for use as design objectives for antennas of earth stations operating with geostationary satellites
Recommendation ITU-R S.732-1	-	Method for statistical processing of earth station antenna side-lobe peaks to determine excess over antenna reference patterns and conditions for acceptability of any excess

(Copies of these documents are available online from https://www.itu.int/.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3 DEFINITIONS

3.1 Definitions of terms. Definitions of terms not listed in this section are as defined in the ATIS Telecom Glossary.

3.2 Abbreviations. The abbreviations used in this MIL-STD are defined as follows.

AC	alternating current
ANSI	American National Standards Institute
ARSTRAT	Army Forces Strategic Command
ATIS	Alliance for Telecommunications Industry Solutions
C-SSE	Consolidated Wideband SATCOM Systems Expert
CEVD	convolutional encoding and Viterbi decoding
CMA	control, monitor, and alarm
CW	continuous wave
C3I	command, control, communications, and intelligence
DAGR	Defense Advanced GPS Receiver
DISA	Defense Information Systems Agency
DoD	Department of Defense
DoDIN	Department of Defense Information Networks
DoDM	Department of Defense Manual
DSCS	Defense Satellite Communications System
EIRP	effective isotropically radiated power
ESD	EIRP spectral density
ET	earth terminal
GPS	Global Positioning System
GPSDO	Global Positioning System disciplined oscillator
GSO	geostationary orbit
HPA	high-power amplifier
IEEE	Institute of Electrical and Electronics Engineers
IF	intermediate frequency
ISO	International Organization for Standardization
ITU	International Telecommunications Union
ITU-R	International Telecommunications Union Radio communication Sector
LHCP	left-hand circular polarization
LNA	low-noise amplifier
MIL-STD	military standard
MILSATCOM	military satellite communications
NATO	North Atlantic Treaty Organization
OTM	on the move
PFD	power flux density
PM	Program Manager
PSD	power spectral density
PSK	phase-shift keying
PTTI	Precise Time and Time Interval
QPSK	quadrature phase-shift keying
RF	radio frequency
RHCP	right-hand circular polarization
RMS	root mean square
RSL	received signal level
RSS	root sum square
SAASM	Selective Availability Anti-Spoofing Module
SAE	Society of Automotive Engineers

SATCOM	satellite communications
SHF	Super high frequency
SNMP	Simple Network Management Protocol
SOW	statement of work
SSE	SATCOM Systems Expert
STANAG	standardization agreement
USASMDC	U.S. Army Space and Missile Defense Command
VSWR	voltage standing wave ratio
WGS	Wideband Global SATCOM

3.3 Antenna pointing. The action taken by the antenna control system to command the antenna's electrical boresight to a certain vector regardless of the antenna control system's method of determining the vector.

3.4 Antenna pointing loss. The antenna gain decrease due to the angular difference between the antenna boresight gain vector and the intended satellite target vector.

3.5 Antenna tracking. ET antenna tracking may be accomplished in either of two ways. In open-loop antenna tracking, the antenna is simply pointed in the direction of the satellite with the aid of positional, navigational, and perhaps platform motion data but without the aid of received signal level (RSL) data. Closed-loop antenna tracking may be accomplished with any of the aids used in open-loop antenna tracking, and with the addition of RSL data.

3.6 dBc. Ratio of a non-carrier power component to the total power in a carrier, expressed in decibels (dB).

3.7 dBi. Gain, in decibels, relative to an isotropic antenna.

3.8 dBm. Decibel relative to 1 mW.

3.9 dBW. Decibel relative to 1 W.

3.10 Earth terminal (ET). The portion of a satellite system that receives and transmits RF signals to and from a satellite. The ET is delimited by the IF interface to the modem and the RF interface including radome (if used). All ET and antenna specifications must be met with radome performance included. For some requirements, modem functionality is included.

3.11 Effective isotropically radiated power (EIRP). The product of the power accepted by an antenna and its gain relative to a hypothetical antenna that radiates or receives equally in all directions.

3.12 EIRP spectral density (ESD). ESD is calculated as EIRP/symbol rate (R_s).

3.13 Equivalent diameter. For non-circular apertures, the equivalent diameter (D_e), shown on FIGURE 1, may be computed by:

$$D_e = 2\sqrt{A/\pi}$$

Where:

A = aperture area.

For electronically scanned antennas, the equivalent diameter (D_e) may be computed by:

$$D_e = 2\sqrt{A/\pi}\cos\psi$$

Where:

A = aperture area.
ψ = the electronic scan angle

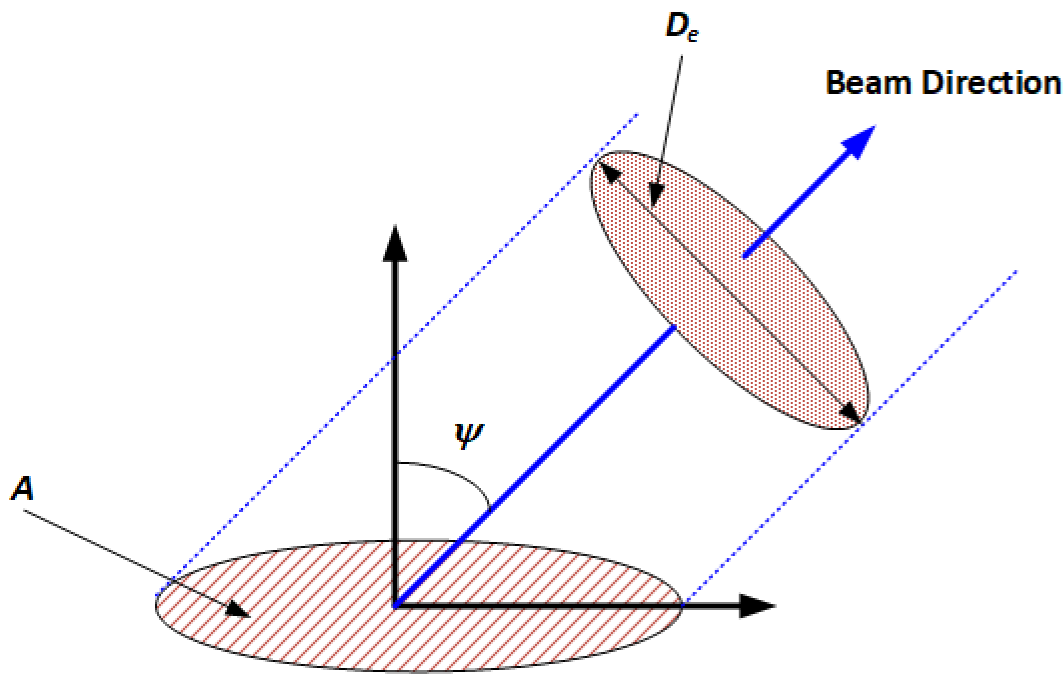


FIGURE 1. Equivalent diameter for electronically scanned antennas.

3.14 Extraneous emissions. Emissions that result from spurious tones, bands of noise, transmit (uplink) RF harmonics, or other undesirable signals; intermodulation products are excluded.

3.15 *G/T.* *G/T* is the receive antenna gain-to-noise temperature ratio in dBi/K. Minimum *G/T* is measured while operating with the transmitter on in a clear-sky condition, at the lowest frequency in the band, at a 10° elevation angle, and at 23 °C. G/T includes the entire reception function contributions.

3.16 Harmonics. A harmonic is a component frequency of the signal that is an integer multiple of the fundamental frequency.

3.17 Instantaneous bandwidth. The range over which a system's passband amplitude and phase response vs. frequency remain compliant without any tuning; compliance is governed by 4.2.7, 4.2.8, 4.3.6, and 4.3.7.

3.18 IF input. The first point of physical connection after the modulator output.

3.19 IF output. The last point of physical connection before the demodulator input.

3.20 Maximum linear power. For ETs with a single carrier, the definition is as stated in 3.20.1. For an ET capable of supporting multiple carriers, maximum linear power is defined as in 3.20.1 or 3.20.2, whichever yields the lesser value.

3.20.1 Single carrier maximum linear power. The carrier power where the first spectral regrowth side lobe (measured at 1.0 symbol rate, expressed in Hz from the carrier center frequency) of the modulated carrier is -30 dBc.

3.20.2 Two carrier maximum linear power. The maximum combined transmit power of two equal-amplitude continuous wave (CW) carriers, when any individual intermodulation product power is –25 dB relative to the combined power of the two CW carriers.

3.21 Reception function. The reception function receives RF signals from a satellite, provides low-noise amplification, and down-converts the RF signal to an IF signal. The reception function includes all of the equipment from the RF input (including radome, if used) to the IF output.

3.22 Satellite system. A communications system that includes two or more ETs, a communications satellite or a space platform, and a control system.

3.23 Saturated power. The single carrier output power level of an active device where the ratio of input power change to output power change is 10:1.

3.24 Transmission function. The transmission function up-converts the IF signal to a RF signal, amplifies the RF signal, and transmits the RF signal to a satellite. The transmission function includes all of the equipment from the IF input to the RF output, including radome (if used).

3.25 Variable Performance Terminal. Any terminal that exhibits variations in EIRP, G/T, off-axis ESD, or axial ratio as a function of its main beam pointing angle and are identified as terminals with non-symmetric radomes or electronically-steerable-beam antennas.

4 GENERAL REQUIREMENTS

4.1 General. Unless a specific band is identified in a paragraph, each paragraph in this section applies to all bands of operation.

4.2 Transmission function. The transmission function shall perform in accordance with 4.2.1–4.2.19.

4.2.1 Transmit chain alignment. Separate transmit alignment and power control functions shall be provided for the purpose of transmit chain gain alignment and operational EIRP control, respectively. These functions shall be independently controlled, either in hardware (physically separate functions) or in software (independent user inputs).

4.2.1.1 IF input level. With a single 0-dBm signal applied to any IF input, the transmit chain gain shall be sufficient to achieve maximum linear EIRP.

(NOTE: Government sponsor PMs for multi-carrier terminals may request deviation from this requirement from the certification authority.)

4.2.2 RF frequency bands. The transmission function shall be tunable in one or more of the SHF frequency bands listed in TABLE I.

TABLE I. Transmit allocated frequency ranges

SHF Frequency Band	Frequency (GHz)
X-band	7.900–8.400
Military K_a-band	30.000–31.000

4.2.3 Tuning. The up-conversion function shall be tunable in 1-kHz increments, in conjunction with the modem, starting at the lowest frequency for each band, as listed in TABLE I. The instantaneous bandwidth shall be available at any tuned uplink frequency in TABLE I, as long as the instantaneous bandwidth does not extend beyond the band edges.

4.2.4 EIRP stability. For any setting of the transmit gain (see 5.3.1) and a constant IF input level, the EIRP in the direction of the satellite shall not vary more than 2.5 dB peak to peak in any 24-h period. This tolerance, added on a root sum square (RSS) basis, includes all ET factors contributing to the EIRP variation, including output power level instability and power variations due to pointing losses. See 6.6–6.8 for RSS theory and determination of power variations due to pointing losses. The formula for RSS error is

$$\sqrt{P_1^2 + P_2^2}$$

Where:

P_1 = transmission function output power level instability in dB;
P_2 = uplink power variations, in dB, in the direction of the satellite caused by pointing losses as described in 4.3.12 and 6.8.

For multi-band simultaneous operation, the variable P_2 shall be evaluated in the highest operational RF band.

4.2.5 Carrier frequency accuracy and stability. The radiated carrier frequency accuracy shall be within 1 kHz of the intended value for all RF carriers. The radiated carrier frequency accuracy shall be maintained for a 90-day period or more without recalibration.

4.2.6 Carrier power control accuracy, step size, and range. The absolute accuracy of the carrier power control attenuator(s) shall be within 1 dB of the selected attenuator value. The relative accuracy associated with the smallest step increment shall be within 0.1 dB. The minimum step size shall not exceed 0.25 dB. The minimum carrier power control range shall be sufficient to attenuate the signal from maximum linear EIRP to 60 dBm EIRP as given by the following equation:

Minimum range (dB) = Maximum linear EIRP (dBm) − 60 (dBm)

The power control range can be met by using a combination of the ET and modem power adjustments. When a carrier power change is initiated, the controlled carrier's power shall transition monotonically and shall not induce burst errors into the controlled carrier's bit stream or into the adjacent carrier's bit stream (with the adjacent carrier spaced at 1.2 R_s).

4.2.7 Transmit phase linearity. Departure from phase linearity of the transmission function, when operating at any point up to the maximum linear power, shall not exceed the following:

a. ±0.2 radian or less over any 2 MHz of instantaneous bandwidth;

b. ±0.4 radian over any 36 MHz of instantaneous bandwidth;

c. ±0.5 radian over any 72 MHz of instantaneous bandwidth;

d. ±0.6 radian over any 90 MHz of instantaneous bandwidth;

e. ±0.7 radian over any 120 MHz of instantaneous bandwidth.

4.2.8 Transmit amplitude response. Amplitude variations of the transmit (uplink) function when operating at maximum linear power shall not exceed the following:

a. ±0.5 dB over any 10-MHz segment across the instantaneous bandwidth;

b. ±1.5 dB over any 120-MHz segment, or any smaller segment, across the instantaneous bandwidth (10 MHz < segment < 120 MHz);

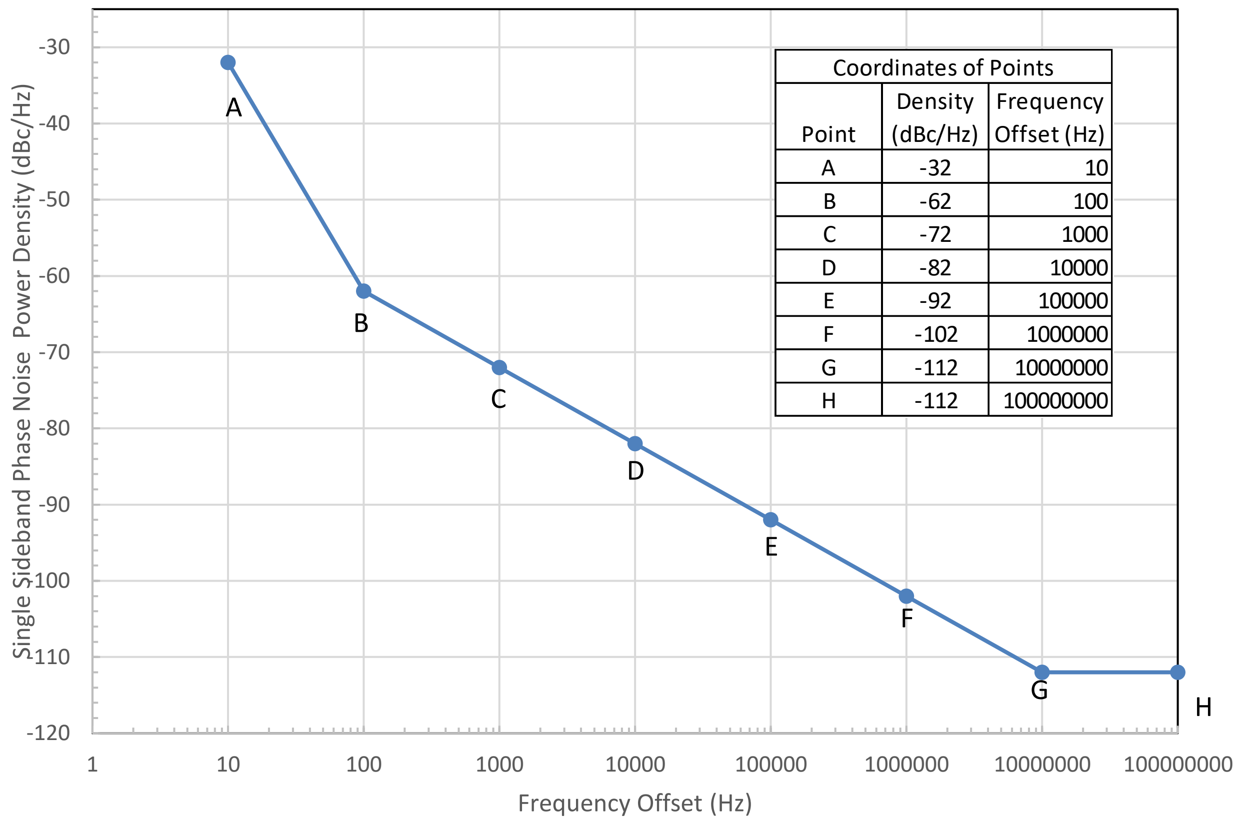
c. ±2.0 dB for each output frequency band listed in TABLE I.

4.2.9 Alternating current power line. The sum of the fundamental and all harmonic components of the alternating current (AC) line frequency shall not exceed −30 dBc.

4.2.10 Single sideband. The single sideband sum (added on a power basis) of all other individual spurious components shall not exceed −36 dBc.

4.2.11 Phase noise. The single sideband power spectral density (PSD) of the continuous phase noise component shall comply with the envelope defined in FIGURE 2. If specific points associated with the measured phase noise plot exceed the FIGURE 2 envelope, then the following two conditions shall be met:

a. The single sideband phase noise due to the continuous component, when integrated over the bandwidth from 10 Hz to 16 kHz relative to carrier center frequency, shall be less than 3.4° root mean square (RMS) (with a two-sided value of 4.8° RMS).



Point	Density (dBc/Hz)	Frequency Offset (Hz)
A	-32	10
B	-62	100
C	-72	1000
D	-82	10000
E	-92	100000
F	-102	1000000
G	-112	10000000
H	-112	100000000

FIGURE 2. ET phase noise

b. The single sideband phase noise due to the continuous component, when integrated over the bandwidth from 1 percent of the symbol rate (R_s) to R_s Hz relative to the carrier center frequency, shall be less than the value obtained when integrating the FIGURE 2 plot over the same limits. This requirement shall be verified at the lowest and highest symbol rates. This requirement applies to all operational R_s values.

4.2.12 Transmit thermal noise EIRP. With the IF input terminated, the transmission function aligned according to 4.2.1, and power control set to achieve maximum linear power, the transmit thermal noise spectral density shall not exceed −75 dBm/Hz when measured at the antenna feed.

4.2.13 Transmission function extraneous outputs. With the transmit equipment aligned and a CW signal applied to the IF input such that maximum linear power is achieved, or with the array configured to radiate maximum linear power and a CW signal applied to the IF input, extraneous emissions as measured over any 10-kHz bandwidth shall not exceed the following values:

a. Transmit band: −60 dBc when measured at the feed. This requirement excludes a 2-MHz band centered on the carrier.

b. Non-transmit band: −60 dBc, except for the band 31.0 GHz ≤ f ≤ 33.0 GHz, which shall not be greater than −45 dBc at 31.0 GHz and shall decrease linearly to −60 dBc by 33.0 GHz.

4.2.14 Harmonic emissions. The level of all harmonics of the transmit carriers shall not exceed −60 dBc when measured at maximum linear power.

4.2.15 Transmit-to-receive isolation. Transmit-to-receive isolation shall be such that there is less than a 0.1-dB increase, and no decrease, in receive noise density over the applicable frequency range shown in TABLE II with the transmitter operating at any EIRP level, compared to the receive performance with the transmitter turned off.

TABLE II. Receive allocated frequency ranges

SHF Frequency Band	Frequency (GHz)
X-band	7.250–7.750
Military K_a-band	20.200–21.200

4.2.16 Intermodulation products in the receive band. When transmitting two or more modulated carriers (in any bandwidth) with the aggregate at maximum linear power, the PSD of any intermodulation product at the IF output shall be at least 17 dB below the noise PSD.

4.2.17 Transmit spectrum inversion. No spectral inversion shall exist between any IF input and the antenna output for ETs operating with non-embedded modems. ETs with embedded modems shall be interoperable with ETs that do not have embedded modems.

4.2.18 Input impedance. The IF interfaces shall have a nominal impedance of 50 Ω. The voltage standing-wave ratio (VSWR) over the IF band shall be less than 1.5:1 for IF band centers below 1 GHz and 2.0:1 for IF band centers above 1 GHz.

4.2.19 Transmit IF frequency. The IF input interface shall support one or more of the following frequency ranges below. Phase linearity requirements in 4.2.7 and the amplitude response requirements in 4.2.8 shall be met across the bandwidths below.

a. 950 to 2000 MHz limited to the required bandwidth as listed in TABLE I.

b. 70 ± 18 MHz;

c. 140 ± 36 MHz;

d. 700 ± 62.5 MHz

4.3 Reception function. The reception function shall be in accordance with 4.3.1–4.3.13.

4.3.1 RF frequency bands. The down-conversion function shall be tunable in one or more of the SHF frequency bands listed in TABLE II.

4.3.2 Maximum power flux densities (PFDs). All reception functions shall be met with the maximum PFDs as follows:

4.3.2.1 X-band.

a. −142 dBW/m^2 in any 4-kHz band in any single carrier;

b. −95 dBW/m^2 across the entire 500-MHz band.

4.3.2.2 Military K_a-band.

a. −112 dBW/m^2 in any 1-MHz band in any single carrier;

b. −90 dBW/m^2 across the entire 1-GHz band.

4.3.3 Receive chain gain, linearity, and IF interface characteristics. The receive chain (antenna feed output interface to ET IF interface) shall exhibit the following characteristics:

4.3.3.1 Receive Chain Absolute Gain. When pointing to a cold sky at an elevation angle of not less than 30°, the receive chain absolute gain shall be sufficient to raise the IF output noise PSD to a minimum of −113 dBm/Hz.

4.3.3.2 Reception function Intermodulation Products. The PSD of any intermodulation product at the IF output shall be at least 17 dB below the noise PSD at any power and bandwidth combination equivalent to the antenna receiving the maximum power flux density per carrier bandwidth, and up to the maximum aggregate power flux density, both as given in 4.3.2.

4.3.3.3 IF Output Level Adjustment. When ET is pointed to an operational satellite, the receive chain absolute gain may be reduced to assist in complying with the linearity requirement described in 4.3.3.2, provided that the minimum IF output noise power spectral density described in 4.3.3.1 continues to be met. Any increase in system noise due to a reduction in receive chain absolute gain shall be incorporated into the terminal's G/T.

4.3.3.4 Output Impedance. The IF interfaces shall have a nominal impedance of 50 Ω. The voltage standing-wave ratio (VSWR) over the IF band shall be less than 1.5:1 for IF band centers below 1 GHz and 2.0:1 for IF band centers above 1 GHz.

4.3.4 Tuning. The down-conversion function shall be tunable in 1.0-kHz increments, in conjunction with the modem, starting at the lowest frequency for each band as listed in TABLE II. The instantaneous bandwidth shall be available at any tuned receive (downlink) frequency within the ranges listed in TABLE II.

4.3.5 Receive conversion frequency accuracy. The down-conversion frequency accuracy shall be within 1 kHz of the intended value for all received RF carriers. Down-conversion frequency accuracy shall be maintained for a 90-day period or more without recalibration.

4.3.6 Receive phase linearity. The RF-to-IF phase response of the reception function shall not deviate from linear by more than the following amounts:

a. ±0.2 radian over any 2-MHz segment across the instantaneous bandwidth;

b. ±0.4 radian over any 36-MHz segment across the instantaneous bandwidth;

c. ±0.5 radian over any 72-MHz segment across the instantaneous bandwidth;

d. ±0.6 radian over any 90-MHz segment across the instantaneous bandwidth;

e. ±0.7 radian over any 120-MHz segment across the instantaneous bandwidth.

4.3.7 Receive amplitude response. Amplitude variations as measured at the ET IF output (demodulator input) shall not exceed the following:

a. ±0.5 dB over any 10-MHz segment across the instantaneous bandwidth;

b. ±1.5 dB over any 120-MHz segment or smaller segment across the instantaneous bandwidth (10 MHz < segment < 120 MHz);

c. ±2.0 dB for each output frequency band listed in TABLE II.

4.3.8 Receive phase noise. The reception function shall meet phase noise requirements as defined in 4.2.11 and 4.3.9.

4.3.9 Receive spurious output.

4.3.9.1 Continuous component. The sum of all spurious signal power within the narrowest bandwidth of interest shall be at least 10 dB below the thermal noise power within the narrowest bandwidth of interest, when measured across the terminal IF output interface.

4.3.9.2 Discrete component. No one spurious signal shall exceed the level of 20 dB below the thermal noise power within the narrowest bandwidth of interest, when measured across the terminal IF output interface.

4.3.9.3 Component conditions. Both 4.3.9.1 and 4.3.9.2 above shall be met under the following simultaneous conditions:

a. Transmitting a single CW carrier at maximum-linear power.

b. Receiving one CW carrier at any frequency over the receive band, with a level equivalent to the antenna receiving the aggregate maximum power flux density given in 4.3.2.

The narrowest bandwidth of interest shall be 64kHz, unless ET procurement documents specify a bandwidth less than 64kHz.

4.3.10 Receive spectrum inversions. No spectral inversion shall exist between any RF input and the IF output of the ET.

4.3.11 Receive signal level stability. For any setting of the receive gain and for a constant PSD level, the reception function output level shall not vary more than ±2.0 dB in any 24-h period.

4.3.12 Antenna pointing loss. The downlink loss due to antenna pointing error shall not exceed 0.8 dB 99.7 percent of the time. The loss shall be translated to the appropriate uplink loss in accordance with 6.8 and shall be used as the P_2 RSS contribution to the EIRP stability and accuracy specification in 4.2.4; P_2 is defined as the power variation in the direction of the satellite caused by pointing loss. This requirement shall be met under operational conditions with no blockage or keyhole events.

4.3.13 Receive IF frequency. The IF output interface shall support one or more of the following frequency ranges below. Phase linearity requirements in 4.3.6 and the amplitude response requirements in 4.3.7 shall be met across the bandwidths below.

a. 950 to 2000 MHz limited to the required bandwidth as listed in TABLE II.

b. 70 ± 18 MHz;

c. 140 ± 36 MHz;

d. 700 ± 62.5 MHz

4.4 Military K_a-band antenna requirements.

4.4.1 Antenna side-lobe levels and transmit ESD. The antenna side-lobe and ESD requirements are described in 4.4.1.1 and 4.4.1.2.

4.4.1.1 $D_e/\lambda \geq 50$. The radiation pattern of the antenna while both transmitting and receiving, including radome effects, in the geostationary orbit (GSO) plane, shall be in accordance with Recommendation ITU-R S.580-6. Recommendation ITU-R S.732-1 shall be used for statistical processing of earth station antenna side-lobe peaks to determine excess over the antenna reference pattern and conditions for acceptability of any excess. Computation of λ will use 31.0 GHz and 21.2 GHz as the reference transmit and receive frequencies, respectively.

4.4.1.2 ESD. For all ETs, ESD in the GSO plane shall not exceed the following:

a. $ESD(\theta) = -6.4 - 25 \log_{10} \theta$ (dBW/Hz) for $2.0° \leq \theta < 20.0°$;

b. $ESD(\theta) = -38.9$ (dBW/Hz) for $20.0° \leq \theta \leq 26.3°$;

c. ESD(θ) = −3.4 − 25 $\log_{10}$ θ (dBW/Hz) for 26.3° < θ < 48.0°;

d. ESD(θ) = −45.4 (dBW/Hz) for 48° ≤ θ ≤ 180°;

Where
θ = the off-axis angle in the direction of the GSO plane referred to the main-lobe axis

The ESD requirement shall be met while incorporating transmit RMS pointing errors. FIGURE 3 illustrates the ESD mask defined by the above parameters.

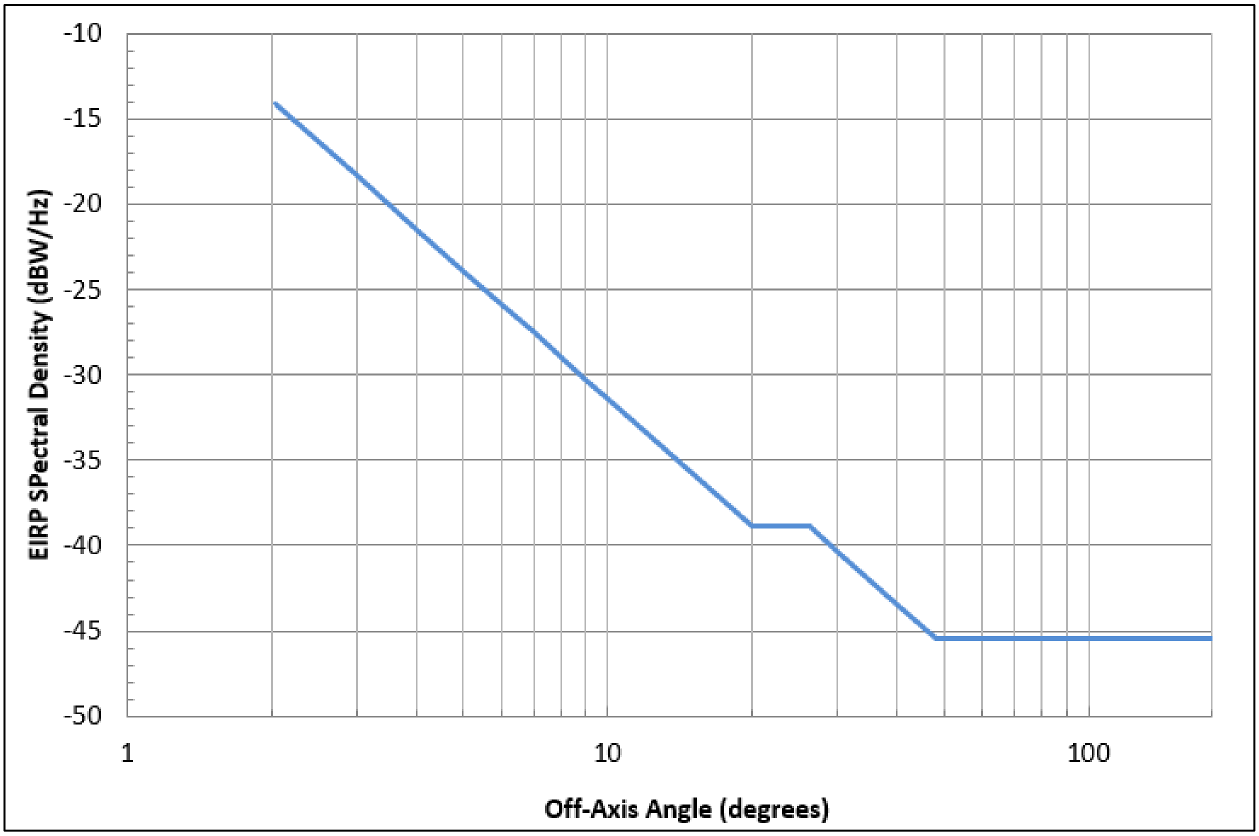


FIGURE 3. K_a-band EIRP spectral density mask

4.4.2 Transmit antenna polarization. The antenna shall be capable of transmitting right-hand circular polarization (RHCP) (clockwise) and left-hand circular polarization (LHCP) (counterclockwise). However, military K_a-band ETs do not have to operate with simultaneous RHCP and LHCP.

4.4.3 Transmit antenna axial ratio. The military K_a-band transmit axial ratio shall be no greater than 1.0 dB.

4.4.4 Receive antenna polarization. The antennas for military K_a-band ETs shall be capable of receiving LHCP and RHCP. However, military K_a-band ETs do not have to operate with simultaneous RHCP and LHCP.

4.4.5 Receive antenna axial ratio. The military K_a-band receive axial ratio shall be no greater than 1.5 dB.

4.5 Military X-band antenna requirements.

4.5.1 Antenna side-lobe levels and transmit ESD. The antenna side-lobe and ESD requirements are described in 4.5.1.1 and 4.5.1.2.

4.5.1.1 $D_e/\lambda \geq 50$. The radiation pattern of the antenna while both transmitting and receiving, including radome effects, in the GSO plane shall be in accordance with Recommendation ITU-R S.580-6. Recommendation ITU-R S.732-1 shall be used for statistical processing of earth station antenna side-lobe peaks to determine excess over the antenna reference pattern and conditions for acceptability of any excess. Computation of λ will use 8400 MHz and 7750 MHz as the reference transmit and receive frequencies, respectively.

4.5.1.2 ESD. For all ETs, ESD in the GSO plane shall not exceed the following:

a. $ESD(\theta) = 2.351 - 25 \log_{10} \theta$ (dBW/Hz) for $2.0° \leq \theta < 3.8°$;

b. $ESD(\theta) = -13.0$ (dBW/Hz) for $\theta = 3.8°$;

c. $ESD(\theta) = 1.49 - 25 \log_{10} \theta$ (dBW/Hz) for $3.8° < \theta < 5.0°$;

d. $ESD(\theta) = -3.97 - 25 \log_{10} \theta$ (dBW/Hz) for $5.0° \leq \theta < 6.94°$;

e. $ESD(\theta) = -25.0$ (dBW/Hz) for $6.94° \leq \theta \leq 12.42°$;

f. $ESD(\theta) = 2.35 - 25 \log_{10} \theta$ (dBW/Hz) for $12.42° < \theta < 48.0°$;

g. $ESD(\theta) = -39.65$ (dBW/Hz) for $48° \leq \theta \leq 180°$;

Where:
θ = the off-axis angle in the direction of the GSO plane referred to the main-lobe axis

The ESD requirement shall be met while incorporating transmit RMS pointing errors. FIGURE 4 illustrates the mask defined by the above parameters.

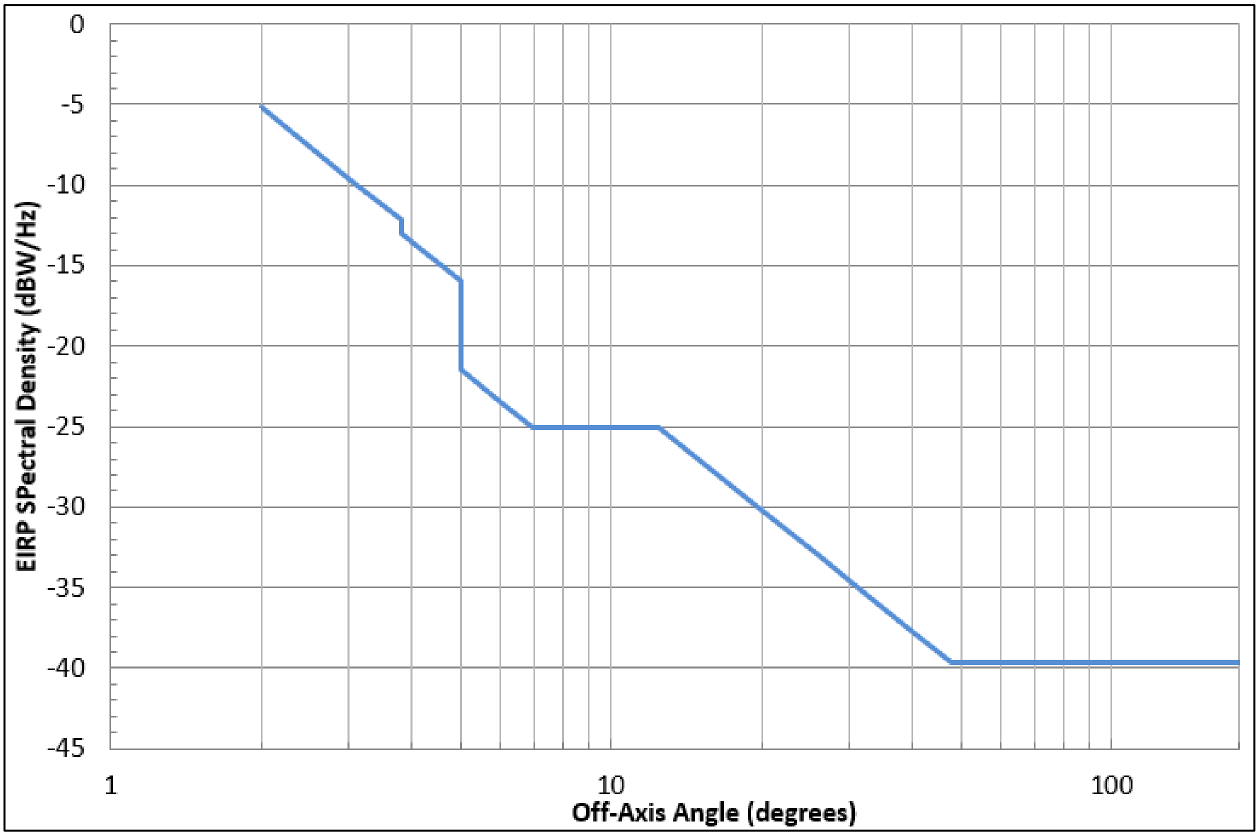


FIGURE 4. X-band EIRP spectral density mask

4.5.2 Transmit antenna polarization. The antenna shall be capable of transmitting RHCP.

4.5.3 Transmit antenna axial ratio. The axial ratio for X-band circularly polarized beams shall be no greater than 2.0 dB over the transmit band.

4.5.4 Receive antenna polarization. The antennas for all X-band ETs shall be capable of receiving LHCP.

4.5.5 Receive antenna axial ratio. The X-band receive axial ratio shall be no greater than 2.0 dB.

4.6 Frequency references. If an ET is capable of accepting an external frequency reference, the ET shall accept an external frequency reference signal as follows:

a. Signal type: sinusoidal.

b. Frequency: either 5 MHz or 10 MHz, at least one or the other.

c. Input impedance: 50 Ω (nominal).

d. Input signal level: +6 to +16 dBm.

e. Maximum VSWR: 1.5:1.

Terminals shall include an internal frequency reference for accuracy and stability when an external frequency reference signal is not present.

4.6.1 GPS disciplined oscillator (GPSDO). For an external frequency reference that is GPS dependent, such as a GPSDO, the following requirements shall apply.

4.6.1.1 External time code input. The GPSDO shall be an approved Selective Availability Anti-Spoofing Module (SAASM) receiver or shall have the ability to connect to an external time code input (i.e., a Defense Advanced GPS Receiver (DAGR)) in accordance with ICD-GPS-060, section "BCD Time Code". The external input shall include a 1 pulse per second (PPS) 40 bit serial 8421 BCD time code transmitted at 50 bps.

4.6.1.2 Frequency stability. The long-term final RF frequency stability drift when using a GPSDO shall not be greater than 1 kHz in a 90-day period without calibration and without a GPS-aided signal (with the GPS antenna disconnected). The long-term frequency stability drift shall not be greater than 1 kHz in a 90-day period when the GPS-aided signal is active.

4.6.1.3 Allan deviation. The stability of the 10- or 5-MHz reference source shall have the Allan deviations shown in TABLE III under the conditions listed in 4.6.1.3.1−4.6.1.3.3:

TABLE III. Allan deviation.

Time (s)	Allan Deviation
1	<1.5E−11
10	<1.5E−11
100	<1.5E−11
1000	<1.5E−11

4.6.1.3.1 GPS Conditions. These Allan deviation values shall be met with and without a GPS-aided signal.

4.6.1.3.2 GPS receiver cold start procedure. On initial GPS receiver turn-on (cold start) with the GPS antenna disconnected; then connect the antenna within one hour. Connect the antenna and allow the GPS receiver to warm up for at least one hour; then, remeasure the stability of the external frequency reference that is GPS dependent. The frequency stability shall be no worse than allowed in TABLE III.

4.6.1.3.3 Vibration and shock. Under full vibration, temperature shock, and shock as defined in 5.2, the frequency stability shall be no worse than allowed in TABLE III.

4.7 System implementation loss. Total implementation loss shall be less than 2.0 dB for all modem operational parameters measured when operating in satellite loop-back. The reference used to determine implementation loss is the theoretical modem E_b/N_0 performance using a MIL-STD-188-165-certified modem with quadrature phase-shift keying (QPSK) modulation, 1/2-rate convolutional encoding and Viterbi decoding (CEVD), randomizer on, and differential encoding/decoding on. Implementation loss includes the effects of traversing the ET uplink and downlink equipment, as well as the satellite. This shall be tested at low, middle, and high operational data rates.

4.8 Variable Performance Terminals. Variable performance terminals shall provide functionality to automatically control transmit power level and operation to limit the magnitude of variations in EIRP, G/T, off-axis ESD, and axial ratio, which are caused by beam pointing relative to the terminal platform. The ET PM should contact the certification authority to discuss how limiting the variation in terminal performance may improve the amount of satellite EIRP and allocated terminal G/T and thus overall SATCOM system throughput. Ultimately, it is the PM's decision whether to implement any functionality to automatically control transmit power level or operation for certification. The ET PM can contact the certification authority to request waiver from this requirement.

5 DETAILED REQUIREMENTS

5.1 General. Unless a specific band is identified in a paragraph, each paragraph in this section applies to all bands of operation.

5.2 Phase perturbation. The transmission function shall not change the linear phase of the output RF signal by more than 20° in 0.2 s, and the reception function shall not change the linear phase of the input RF signal by more than 20° in 0.2 s, over the range of environmental conditions over which the ET is required to operate. This shall include as a minimum:

a. Exposure to temperature deviation.

b. Exposure to vibration.

c. Exposure to shock on the outside surface of the ET, simulating maintenance, operator or other external action on the ET.

(NOTE: The ET procurement documents will provide guidance on the temperature range and rate of change, the vibration frequencies and accelerations, and any other expected environmental conditions over which the ET is required to operate.)

5.3 ET control and monitoring function. The ET shall meet the following requirements.

5.3.1 Control and monitoring parameters. As a minimum, remote and local control, monitor, and alarm (CMA) shall be provided in accordance with TABLE IV. For all ET types, the composite and individual transmit carrier power shall be measured at the antenna feed for monitoring and reporting antenna feed power and EIRP. Antenna feed power may be computed from measured high-power amplifier (HPA) output power.

5.3.1.1 Transmit gain. The transmit gain, as computed, shall be within 2 dB of actual gain, neglecting any frequency dependencies in accordance with 4.2.8. Transmit gain is computed by adding (1) the up-conversion function gain, (2) the gain/loss from the up-conversion function output to the power amplifier input, (3) the power amplifier gain, and (4) transmit loss to the antenna feed.

5.3.1.2 Receive gain. The receive gain, as computed, shall be within 5 dB of actual gain. Receive gain is computed by adding (1) the gain from the LNA input to the down-conversion function and (2) the down-conversion function gain.

5.3.2 Control response times. The ET shall meet a response time of 0.5 s for all parameters in TABLE IV.

5.3.3 ET remote control and monitoring interface. The ET remote control and monitoring interface shall be implemented as an IEEE 802.3-compliant Ethernet. The interface protocol shall be via the industry standard Simple Network Management Protocol (SNMP).

TABLE IV. ET control and monitoring parameters

Control	Monitoring
Transmit gain of each up-conversion function	Transmit gain setting of each up-conversion function
Frequency setting of each up-conversion function	Frequency setting of each up-conversion function
Frequency setting of each up-conversion function	Frequency setting of each down-conversion function
Auto-track source (frequency band)	Auto-track status
Total and individual carrier power level at antenna feed	Total and individual communications carrier power level at antenna feed
Antenna pointing angles (azimuth and elevation relative to true north)	Antenna pointing angles (azimuth and elevation relative to true north)
Signal path switches (redundant equipment and waveguide switches)	Equipment fault status
--	Total transmit power level at the power amplifier output
--	Transmit gain/loss setting from the output of each up-conversion function to the input of the HPA
--	Transmit gain setting of the power amplifier
--	Receive gain setting from LNA input to each down-conversion function output
--	Receive gain setting of each down-conversion function

6 NOTES

(This section contains information of a general or explanatory nature that may be helpful but is not mandatory.)

6.1 Intended use. This standard is intended to define the military SHF SATCOM ET interfaces in terms of physical and functional performance criteria necessary to support PMs and buying activities in the acquisition of interoperable and compatible ETs, which are vital for effective joint and combined forces communication.

6.2 Acquisition requirements. Acquisition documents should specify the title, number, and date of this standard. Because the United States ratifying official for NATO STANAG 4484, Overall Super High Frequency (SHF) Military Satellite Communications (MILSATCOM) Interoperability Standard, did not designate MIL-STD-188-164 as the form for implementing the STANAG in the ratification document. The title, edition, and date of ratification of STANAG 4484 should be directly cited in solicitations and contracts when the ETs will be used to communicate with NATO participating nations.

6.3 Tailoring guidance. To ensure proper application of this standard, invitations for bids, requests for proposals, and contractual statements of work (SOWs) can specify which of the requirements in section 5 of this standard apply, and should state exclusion to any non-applicable requirements (for example, environmental requirements). Specific values are modified in the appendices to this document to address specific ET types. It is highly recommended that any exclusions be coordinated with the appropriate certification authority to avoid any issues during ET performance certification.

6.4 Subject term (keyword) listing. The following keywords apply to this MIL-STD.

Defense Satellite Communications System (DSCS)
K_a-band, military
SATCOM
Wideband Global SATCOM (WGS)
X-band

6.5 International standardization agreement implementation. This standard implements STANAG 4484 (Edition 3), Overall Super High Frequency (SHF) Military Satellite Communications (MILSATCOM). When changes to, revision, or cancellation of this standard is proposed, the preparing activity must coordinate the action with the U.S. National Point of Contact for the international standardization agreement, as identified in the ASSIST database at https://assist.dla.mil.

6.6 RSS Theory. RSS is a method of determining the more likely overall variation of a sum $X = \sum x_k$ of components which each may vary. If each component x_k has a mean value m_k, then the mean $M = \sum m_k$ of the sum X and total deviation

$$X - M = \sum (x_k - m_k) = \sum \Delta x_k$$

Where:

$\Delta x_k = x_k - m_k$ denotes the deviation of the x_k component from its mean value.

If the component deviations take the values $\pm\Delta x_k$ with equal probability and they are mutually uncorrelated, the sum of squares $\sum(\Delta x_k)^2$ is the variance and the RSS $\sqrt{\sum(\Delta x_k)^2}$ is the standard deviation of the sum $X = \sum x_k$. Generally, since the various deviations seldom all add, or subtract, the RSS value represents a more likely and appropriate measure for the total variation of the sum, even if the RSS value cannot be justified on strict probabilistic arguments.

6.7 Antenna gain versus pointing variations. Since the degrees off beam of the uplink beam will degrade the EIRP in the direction of the satellite, this change is of concern for EIRP stability. The formula to approximate the reduction in gain of a circularly symmetric parabolic antenna due to pointing error is as follows:

$$A(dB) = 12\left(\frac{\beta}{\varphi}\right)^2$$

Where:

A = attenuation (dB);
β = uplink pointing error (degrees);
φ = 3-dB beam width (degrees).

6.7.1 Example. If the uplink beam is offset 0.01° from alignment, then, for a 38-ft (11.5824-m) antenna at 8.4 GHz with φ at 0.219089023°, the attenuation is 0.025 dB. If, because of pointing errors, the uplink beam is now offset by 0.03°, the attenuation is 0.225 dB. Thus, if the control system changes the pointing error from 0.01° to 0.03°, the EIRP will change by 0.2 dB. This change must be accounted for in the RSS equation.

6.7.2 Satellite motion. It is important to note that satellite motion also can impact this loss. ET design must account for EIRP errors due to satellite motion regardless of whether the ET has a pointing control system.

6.8 Accounting for pointing loss differences between uplink and downlink beams. Because beam width is a function of the frequency used, and because pointing loss is determined by measuring variations in the downlink satellite beacon, the actual uplink loss will differ from the downlink loss. At X-band frequencies, the frequency separation is relatively small, and the difference between uplink and downlink pointing losses is negligible. However, at K_a-band frequencies, the 10-GHz separation between the uplink and downlink can cause significant differences. For the purposes of EIRP stability, uplink pointing loss will be greater than downlink pointing loss and will therefore be used in the RSS equation in 4.2.4. Unless otherwise specified, the equation for calculating the uplink pointing loss based on the measured downlink loss is as follows:

$$L_{\text{up}} = L_{\text{down}} \left(\frac{F_{\text{up}}}{F_{\text{down}}}\right)^2$$

Where:

L_{up} = pointing loss on the uplink at the given frequency (dB);
L_{down} = pointing loss on the downlink at the given frequency (dB);
F_{up} = highest operational uplink frequency;
F_{down} = frequency of the downlink beacon.

Simultaneous multiband terminals are recommended to use the highest frequency beacon signal for tracking purposes.

6.8.1 Exceptions. Should the uplink and downlink beams be significantly misaligned, or should they originate from different apertures, the equation in 6.8 does not apply. In such cases, the individual beams will need to be compared to determine the uplink loss corresponding to a downlink loss due to mispointing. This will be accomplished by converting the downlink pointing loss from 4.3.12 into a pointing error based on the downlink beam pattern. Assuming the uplink and downlink beam pointing is coupled, this receive pointing error is then applied to the uplink beam to determine the transmit pointing loss to be used in 4.2.4. For ETs with asymmetric beam shapes, these calculations will be done at the lowest-performance operational orientation of the beams.

6.8.2 Example. On the WGS system, the downlink K_a-band beacon is at 20.7 GHz, while the uplink frequencies range between 30 and 31 GHz. Using these numbers, along with a hypothetical circular, center-fed ET having a measured downlink loss of 1.0 dB, gives an uplink loss of between 2.1 and 2.24 dB. In this case, the lowest-performance uplink frequency loss of 2.24 dB would be utilized as the P_2 loss component for calculating total EIRP stability (see 4.2.4).

6.9 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

APPENDIX A

LAND-BASED SATCOM OTM EARTH TERMINALS

A.1 Scope. This appendix applies to land-based SATCOM systems that operate while OTM. This appendix is a mandatory part of the standard. The information contained herein is intended for compliance and may replace specific requirements in the body of the standard (see 1.5c).

A.2 Uplink inhibit. OTM ETs shall immediately inhibit transmit upon loss of the downlink signal.

A.3 Antenna pointing loss. The following replaces the entire text of 4.3.12, Antenna Pointing Loss.

"4.3.12 **Antenna pointing loss.** The downlink loss due to antenna pointing error shall not exceed 0.8 dB 95.4 percent of the time. The loss shall be translated to the appropriate uplink loss in accordance with 6.8 and shall be used as the P_2 RSS contribution to the EIRP stability and accuracy specification in 4.2.4; P_2 is defined as the power variation in the direction of the satellite caused by pointing loss. The antenna pointing loss requirement is applicable to a blockage-free environment and does not include any time frame during which the antenna system supports a non-operating mode by design (for example, when not operating due to safety considerations)."

APPENDIX B

AIR-BASED SATCOM OTM EARTH TERMINALS

B.1 Scope. This appendix applies to air-based SATCOM systems that operate while OTM. This appendix is a mandatory part of the standard. The information contained herein is intended for compliance and may replace specific requirements in the body of the standard (see see 1.5c).

B.2 EIRP stability and accuracy. The following replaces 4.2.4, EIRP Stability, when an ET's modulated signal occupies the entire bandwidth of the transponder.

"**4.2.4 EIRP stability.** For any setting of the transmission gain and a constant IF input level, the EIRP in the direction of the satellite shall not vary more than 3.5 dB peak to peak in any 24-h period. This tolerance, added on an RSS basis, includes all ET factors contributing to the EIRP variation, including output power level instability (including radome insertion loss variations with look angle) and power variations due to pointing losses. See 6.6–6.8 for RSS theory and determination of power variations due to pointing losses. The formula for RSS error is

$$\sqrt{P_1^2 + P_2^2}$$

Where:

P_1 = transmission function output power level instability in dB;
P_2 = uplink power variations, in dB, in the direction of the satellite caused by pointing losses as described in 4.3.12 and 6.8.

For dual-band simultaneous operation, the variable P_2 shall be evaluated in the highest operational RF band."

B.3 Carrier frequency accuracy and stability. The following replaces 4.2.5, Carrier Frequency Accuracy and Stability.

"**4.2.5 Carrier frequency accuracy and stability.** The carrier frequency at the antenna feed shall be within 1 kHz of the intended value. The carrier frequency accuracy shall be maintained for the maximum mission duration without calibration."

B.4 Receive conversion frequency accuracy. The following replaces 4.3.5, Receive Conversion Frequency Accuracy.

"**4.3.5 Receive conversion frequency accuracy.** The down-conversion frequency accuracy shall be within 1 kHz of the intended value for all received carriers. Down-conversion frequency accuracy shall be maintained for the maximum mission duration without calibration.

B.5 Antenna pointing loss. The following replaces the entire text of 4.3.12, Antenna Pointing Loss.

"**4.3.12 Antenna pointing loss.** The downlink loss due to antenna pointing error shall not exceed 0.8 dB 95.4 percent of the time. The loss shall be translated to the appropriate uplink loss in accordance with 6.8 and used as the P_2 RSS contribution to the EIRP stability and accuracy specification in 4.2.4; P_2 is defined as the power variation in the direction of the satellite caused by pointing loss. This requirement shall be met under operational flight conditions with no airframe blockage or keyhole events. A mechanism shall be provided to inhibit transmit in the event that the antenna transmit pointing error causes the off-axis ESD limit to be exceeded."

APPENDIX C

ARRAY-BASED SATCOM OTM EARTH TERMINALS

C.1 Scope. This appendix applies to array-based SATCOM systems that operate while OTM. This appendix is a mandatory part of the standard. The information contained herein is intended for compliance and may replace specific requirements in the body of the standard (see 1.5c).

C.2 EIRP stability. The following replaces 4.2.4, EIRP Stability.

"**4.2.4 EIRP stability.** For any fixed scan angle, any setting of the electronic transmit gain, and a constant IF input level, the EIRP in the direction of the satellite shall not vary more than 2.5 dB peak to peak in any 24-h period."

C.3 Transmit-to-receive isolation. The following replaces 4.2.15, Transmit-to-receive isolation.

"**4.2.15 Transmit-to-receive isolation.** Transmit-to-receive isolation shall be such that there is less than a 0.5-dB increase, and no decrease, in receive noise density over the applicable frequency range shown in TABLE II with the transmitter operating at any EIRP level, compared to the receive performance with the transmitter turned off.

C.4 Receive signal level stability. The following replaces 4.3.11, Receive Signal Level Stability.

"**4.3.11 Receive signal level stability.** For a fixed scan angle, any setting of the receive gain, and a constant PSD level, the reception function output level shall not vary more than 2.0 dB in any 24-h period."

CONCLUDING MATERIAL

Custodians:
Army – CR
Navy – EC
Air Force – 02
NSA – NS

Preparing Activity:
DISA – DC1
TCSS-2018-005

Review Activities:
Army – AC, AV, CR2, MI, PT, TE, SPO
Navy – AS, CG, MC, OM
Air Force – 04, 11, 44, 49, 71, 93
DIA – DI
DISA – DC, DC5
NGA – MP
ODASD(SE) – SE

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, verify the currency of the information above using the ASSIST Online database at https://assist.dla.mil.