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Satellite Earth Stations and Systems (SES);
Satellite mobile Aircraft Earth Stations (AESs) operating in the 11/12/14 GHz frequency bands;
Harmonised Standard for access to radio spectrum

Reference

REN/SES-00435

Keywords

aeronautical, air interface, AMSS, earth station, FSS, GSO, mobile, MSS, regulation, satellite

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Foreword

This Harmonised European Standard (EN) has been produced by ETSI Technical Committee Satellite Earth Stations and Systems (SES).

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.2] to provide one voluntary means of conforming to the essential requirements of Directive 2014/53/EU on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC [i.7].

Once the present document is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of the present document given in table A.1 confers, within the limits of the scope of the present document, a presumption of conformity with the corresponding essential requirements of that Directive, and associated EFTA regulations.

National transposition dates	
Date of adoption of this EN:	26 April 2021
Date of latest announcement of this EN (doa):	31 July 2021
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 January 2022
Date of withdrawal of any conflicting National Standard (dow):	31 January 2023

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Introduction

The present document is part of a set of standards developed by ETSI and is designed to fit in a modular structure to cover all radio equipment within the scope of the Directive 2014/53/EU [i.7]. Each standard is a module in the structure. The modular structure is shown in ETSI EG 201 399 [i.1].

The requirements have been selected to ensure an adequate level of compatibility with other radio services.

The present document may not cover those cases where a potential source of interference which is producing individually repeated transient phenomena or a continuous phenomenon is present, e.g. a radar or broadcast site in the near vicinity. In such a case it may be necessary to use special protection applied to either the source of interference, or the interfered part or both.

The present document does not contain any requirement, recommendation or information about the installation of the AES on aircraft.

The determination of the parameters of the AES using a given Geostationary Satellite Orbit (GSO) satellite for the protection of the spectrum allocated to that satellite, is considered to be under the responsibility of the satellite operator or the satellite network operators.

1 Scope

The present document specifies certain minimum technical performance requirements of Aircraft Earth Station (AES) equipment with both transmit and receive capabilities for provision of aeronautical mobile satellite service, in the frequency bands given in table 1.

Table 1: Frequency bands for the AES equipment specified in the present document

Mode of Operation	Frequency Band
AES transmit	14,00 GHz to 14,50 GHz
AES transmit	12,75 GHz to 13,25 GHz
AES receive	10,70 GHz to 12,75 GHz

The AES has the following characteristics:

- These AESs are equipment for installation on aircraft.
- The AESs transmit in the 14,00 GHz to 14,50 GHz band receive within the range from 10,70 GHz to 12,75 GHz ("14 GHz"), referred to as "14 GHz AES" in the present document, are operating in one or more frequency ranges of the Fixed-Satellite Service and Mobile-Satellite Service.
- The AESs transmit in the 12,75 GHz to 13,25 GHz band receive within the range from 10,70 GHz to 12,75 GHz ("13 GHz"), referred to as "13 GHz AES" in the present document, are operating in one or more frequency ranges of the Fixed-Satellite Service.

NOTE 1: When the term "AES" used in the present document without stating 13 GHz AES or 14 GHz AES, it is a reference to both 14 GHz AES and 13 GHz AES.

- The AES could consist of a number of modules from the antenna subsystem to the user interfaces.
- The AES uses linear polarization.

- The AES system uses digital modulation.
- The 14 GHz AES operates through a GSO satellite at least 3° away from any other geostationary satellite operating in the same frequency band and covering the same area.
- The 13 GHz AES operates with a GSO satellite network whose frequency assignments are from the List of Appendix 30B of the Radio Regulations.
- The antenna of the AES is directional, with means of tracking the satellites, which can be achieved by using either an active phase array or reflective type configuration.
- These AESs are operating as part of a satellite network used for the distribution and/or exchange of information between users.
- These AESs are controlled and monitored by a Network Control Facility (NCF). The NCF is outside the scope of the present document.
- When on the ground, the 14 GHz AES does not transmit at elevation angles below 7° with respect to the local horizontal plane, except at locations where transmissions below 7° are permitted by the local Administration; (the minimum elevation angle is also limited as per clause 4.2).

The technical requirements in the present document are in two major categories:

- **emission limits:** to protect other radio services and systems from harmful interference generated by the AES in normal use;
- **AES Control and Monitoring Functions (CMFs):** to protect other radio services and systems from unwanted transmissions from the AES. The CMF in each AES is capable of answering to commands from the Network Control Facility (NCF) for its supporting satellite network.

The present document applies to the AESs with their ancillary equipment and its various ports, and when operated within the boundary limits of the operational environmental profile specified by the manufacturer.

The technical requirements for the 14 GHz AES in regard to the Power Flux Density (PFD) limits to protect Fixed Service (FS) and Radio Astronomy Service (RAS) are based on annexes B and C of Recommendation ITU-R M.1643 [5] and ECC Report 26 [i.4]. Furthermore, in relation to the protection of the Fixed Satellite Service (FSS) the technical requirements of the AES take into account annex A of Recommendation ITU-R M.1643 [5].

The technical requirements for the 13 GHz AES in regards to the PFD limits on earth for the protection of FS are based on the ECC Decision (19)04 [6].

The present document is intended to cover the provisions of Directive 2014/53/EU [i.7] (RE Directive) article 3.2, which states that "*… radio equipment shall be so constructed that it both effectively and supports the use of radio spectrum allocated in order to avoid harmful interference*".

NOTE 2: The relationship between the present document and essential requirements of article 3.2 of Directive 2014/53/EU [i.7] is given in annex A.

In addition to the present document, other ENs that specify technical requirements in respect of essential requirements of other parts of article 3 of the RE Directive [i.7] may apply to equipment within the scope of the present document.

NOTE 3: A list of such ENs is included on the web site at: https://ec.europa.eu/growth/single-market/european-standards/harmonised-standards/red_en.

The present document does not cover equipment compliance with relevant civil aviation regulations. In this respect, an AES, for its installation and operation on board an aircraft is subject to additional national or international civil aviation airworthiness certification requirements, for example to EUROCAE ED-14 [4].

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] Void.

[2] CISPR 16-1-1:2019: "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-1: Radio disturbance and immunity measuring apparatus - Measuring apparatus".

[3] IEEE STD 149™-1979: "IEEE Standard Test Procedures for Antennas".

[4] EUROCAE ED-14 (2015) (Equivalent to RTCA DO-160D): "Environmental Conditions and Test Procedures for Airborne Equipment".

[5] Recommendation ITU-R M.1643 (06-2003): "Technical and operational requirements for aircraft earth stations of aeronautical mobile-satellite service including those using fixed-satellite service network transponders in the band 14-14.5 GHz (Earth-to-space)".

[6] CEPT ECC Decision (19)04 (03-2020): "The harmonised use of spectrum, free circulation and use of earth stations on-board aircraft operating with GSO FSS networks and NGSO FSS systems in the frequency bands 12.75-13.25 GHz (Earth-to-space) and 10.7-12.75 GHz (space-to-Earth)".

[7] ETSI ETS 300 457 (Edition 1) (11-1995): "Satellite Earth Stations and Systems (SES); Test methods for Television Receive Only (TVRO) operating in the 11/12 GHz frequency bands".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI EG 201 399: "Electromagnetic compatibility and Radio spectrum Matters (ERM); A guide to the production of Harmonized Standards for application under the Radio & Telecommunication Terminal Equipment Directive 1999/5/EC (R&TTE) and a first guide on the impact of the Radio Equipment Directive 2014/53/EU (RED) on Harmonized Standards".

[i.2] Commission Implementing Decision C(2015) 5376 final of 4.8.2015 on a standardisation request to the European Committee for Electrotechnical Standardisation and to the European Telecommunications Standards Institute as regards radio equipment in support of Directive 2014/53/EU of the European Parliament and of the Council.

[i.3] Recommendation ITU-R S.524-9: "Maximum permissible levels of off-axis e.i.r.p. density from earth stations in geostationary-satellite orbit networks operating in the fixed-satellite service transmitting in the 6 GHz, 13 GHz, 14 GHz and 30 GHz frequency bands".

[i.4] ECC Report 26 (02-2003): "The compatibility & sharing of the aeronautical mobile satellite service with existing services in the band 14,00 to 14,50 GHz Molde".

[i.5] ITU Radio Regulations 2020.

[i.6] ISO 7137 (1995): "Aircraft - Environmental conditions and test procedures for airborne equipment".

[i.7] Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC (RE Directive).

[i.8] Recommendation ITU-R S.728-1: "Maximum permissible level of off-axis e.i.r.p. density from very small aperture terminals (VSATs)".

[i.9] ETSI EG 203 336 (V1.2.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Guide for the selection of technical parameters for the production of Harmonised Standards covering article 3.1(b) and article 3.2 of Directive 2014/53/EU".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in Directive 2014/53/EU [i.7] and the following apply:

Figure 1a: Void

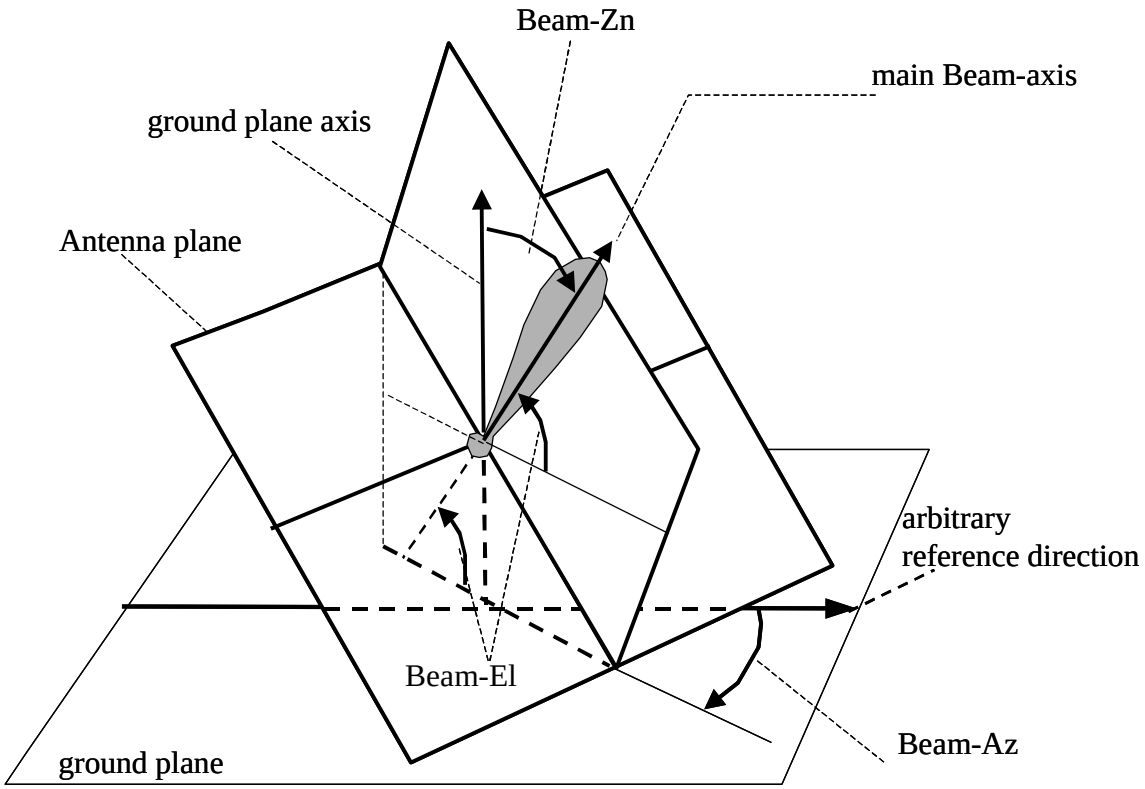

Figure 1b: Reference angles and planes for a passive (e.g. reflector) antenna

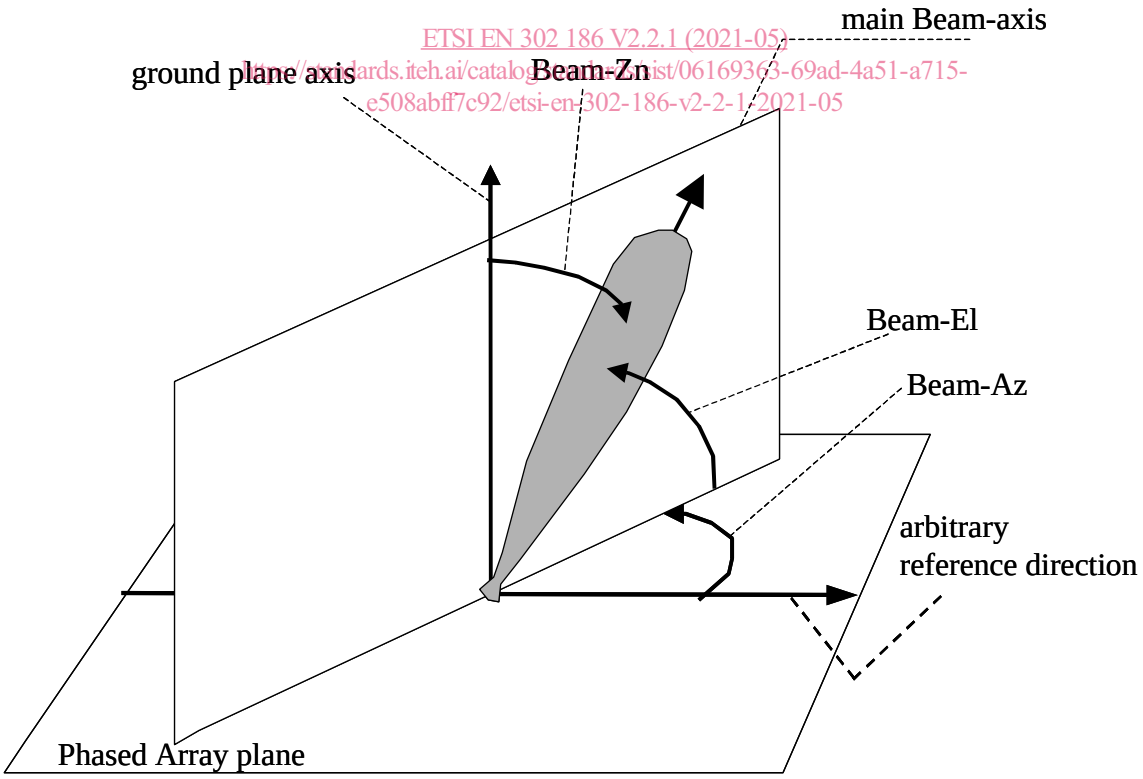

Figure 1c: Reference angles and planes for an active (e.g. phased array) antenna

AMSS network: comprises the 14 GHz AESs, geostationary satellite, LES and NCF

ancillary equipment: equipment used in connection with an AES is considered as ancillary if the three following conditions are met:

a) the equipment is intended for use in conjunction with the AES to provide additional operational and/or control features (e.g. to extend control to another position or location); and

b) the equipment cannot be used on a stand alone basis, to provide user functions independently of the AES; and

c) the absence of the equipment does not inhibit the operation of the AES.

antenna plane: for a passive antenna, plane orthogonal to the main beam axis direction. For a phased array antenna, the antenna plane is the phase array plane

NOTE: See figure 1b.

beam Az angle: angle between an arbitrary reference direction (specified by the manufacturer) within the ground plane and the orthogonal projection of the main beam axis within that plane

NOTE 1: See figures 1b and 1c.

NOTE 2: In case of a rectangular phased array antenna such reference direction may be taken, for example, as the direction parallel to the longer of the two sides.

NOTE 3: When the ground plane axis is vertical and the reference direction oriented towards the north or the south, then the beam Az angle is the main beam azimuth angle.

beam El angle: angle between the ground plane and the main beam axis

NOTE: See figures 1b and 1c.

beam Zn angle: angle between the ground plane axis and the antenna main beam axis

NOTE: See figures 1b and 1c.

carrier-off state: state in which AES is when either it is authorized by the Network Control Facility (NCF) to transmit but when it does not transmit any signal, or when it is not authorized by the NCF to transmit

carrier-on state: state in which AES is when it is authorized by the NCF to transmit and when it transmits a signal

Control Channel (CC): channel or channels by which AES receive control information from the NCF of their network

NOTE: The CCs are not necessarily on separate RF channels from the RF channels carrying the user data streams.

$EIRP_{max}$: maximum EIRP capability of the AES operating to the GSO Satellite Network

environmental profile: range of environmental conditions

Externally Mounted Equipment (EME): those of the modules of the Installable Equipment (IE) which are intended to be mounted externally to the aircraft as stated by the manufacturer

FSS network: comprises the 13 GHz AESs, geostationary satellite, LES and NCF

ground plane: for a passive antenna, the plane over which the antenna is mounted

NOTE: This plane can be specified by the manufacturer. For a phased array antenna, the ground plane is the phase array plane (see figure 1b).

ground plane axis: direction orthogonal to the ground plane

NOTE: See figures 1b and 1c.

GSO Satellite Network: the GSO satellite network the AES is designed to operate with

Installable Equipment (IE): equipment which is intended to be fitted to an aircraft

NOTE: An IE may consist of one or several interconnected modules.

integral antenna: antenna integrated into the AES which may not be removed during the tests

Internally Mounted Equipment (IME): those of the modules of the IE which are not specified by the manufacturer as EME are defined as IME

Land Earth Station (LES): earth station in the FSS or, in some cases, in the MSS, located at a specified fixed point or within a specified area on land to provide a feeder-link for the MSS or the FSS

main beam axis: direction where the antenna gain is maximum

NOTE: See figures 1b and 1c.

manufacturer: means any natural or legal person who manufactures radio equipment or has radio equipment designed or manufactured, and markets that equipment under his name or trademark

nominal antenna diameter: antenna diameter is a parameter in performance characteristics and that allows reference to a certain performance specified for the GSO Satellite Network

NOTE: An antenna with circular aperture of diameter equal to the nominal diameter does typically have the performance specified.

Network operators might request antennas of a certain diameter. Then an antenna that is compliant with the requirement for nominal antenna diameter equal to the requested antenna diameter can be used. Manufacturers can mark their equipment with antenna diameters used in the requirements during compliance test.

nominated Bandwidth (Bn): bandwidth of the AES radio frequency transmission declared by the manufacturer

NOTE: See clause 5.2.

occupied Bandwidth (Bo): for a digital modulation scheme-the width of the signal spectrum 10 dB below the maximum in-band density

phased array plane: for a phased array antenna, the plane containing the radiating elements, if it exists, otherwise the closest plane to the radiating elements

NOTE: This plane could be specified by the manufacturer (see figure 1c).

removable antenna: antenna which may be removed from the AES during the tests

Response Channel (RC): channel by which AES transmit monitoring information to the NCF

rms value: root mean square value of N measured values x_i is the square root of the sum of the square of the values x_i divided by N:

$$rms\ value = \sqrt{\frac{1}{N}\sum_{i=1}^{N} x_i^2}$$

spurious radiation: any radiation outside the nominated bandwidth

transmission disabled state: state in which AES is when it is not authorized to transmit by the NCF

transmission enabled state: state in which AES is when it is authorized to transmit by the NCF

3.2 Symbols

For the purposes of the present document, the following symbols apply:

dBc	ratio expressed in decibel relative to the absolute carrier EIRP
dBi	ratio of an antenna gain to the gain of an isotropic antenna, expressed in decibel
dBW	ratio of a power to 1 watt, expressed in decibel
dBpW	ratio of a power to 1 pico watt, expressed in decibel
dBµV/m	square of the ratio of an electric field to 1 µV/m, expressed in decibel 20 log (electric field /1 µV/m)
θ_{min}	minimum off-axis angle as defined in clause 4.2.2.2

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AES	Aircraft Earth Station
AMSS	Aeronautical Mobile Satellite Service
BER	Bit Error Rate
Bn	nominated Bandwidth
Bo	occupied Bandwidth
CC	Control Channel
CCF	Control Channel reception Failure
CCR	Control Channel correctly Received
CEPT	European Conference of Postal and Telecommunications administrations
CISPR	International SPecial Committee on Radio Interference
CMF	Control and Monitoring Function
EC	European Community
ECC	Electronic Communications Committee (of CEPT)
EFTA	European Free Trade Association
EIRP	Equivalent Isotropically Radiated Power
EIRPsd	EIRP spectral density
EMC	ElectroMagnetic Compatibility
EME	Externally Mounted Equipment
EN	European Norm
EUROCAE	EURopean Organization for Civil Aeronautical Electronics
EUT	Equipment Under Test
FEC	Forward Error Correction
FS	Fixed Service
FSS	Fixed-Satellite Service
GEUT	Gain of EUT
GSO	Geostationary Satellite Orbit
HPA	High Power Amplifier
HS	Harmonised Standard
IDU	InDoor Unit
IE	Installable Equipment
IEEE	Institute of Electrical and Electronic Engineers
IME	Internally Mounted Equipment
IPR	Intellectual Property Rights
ISO	International Organization for Standardization
ITU-R	International Telecommunication Union - Radiocommunication sector
LES	Land Earth Station
LNA	Low Noise Amplifier
LNA/D	Low Noise Amplifier/Diplexer
LNB	Low Noise Block
LO	Local Oscillator
LRU	Line Replaceable Unit
LV	Low Voltage
MSS	Mobile Satellite Service
NCF	Network Control Facility