

ETSI EN 303 699 V1.1.1 (2021-02)



**Satellite Earth Stations and Systems (SES);
Fixed earth stations communicating with non-geostationary
satellite systems in the 20 GHz and 30 GHz FSS bands;
Harmonised Standard for access to radio spectrum**

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Contents

Intellectual Property Rights	7
Foreword.....	7
Modal verbs terminology.....	7
Introduction	8
1 Scope	9
2 References	10
2.1 Normative references	10
2.2 Informative references.....	10
3 Definition of terms, symbols and abbreviations.....	11
3.1 Terms.....	11
3.2 Symbols.....	13
3.3 Abbreviations	13
4 Technical requirements specifications	14
4.1 General	14
4.1.1 Environmental profile	14
4.1.2 Operational configurations	14
4.1.3 EIRP _{Aggregate} for networks of ESs	14
4.1.4 Presentation of equipment for testing purposes	15
4.1.5 Choice of model for testing	15
4.1.6 Void	15
4.1.7 Peak pointing accuracy	15
4.2 Conformance requirements	15
4.2.1 Off-axis spurious radiation	15
4.2.1.1 Justification	15
4.2.1.2 Specification	15
4.2.1.3 Conformance tests	16
4.2.2 On-axis spurious radiation	16
4.2.2.1 Justification	16
4.2.2.2 Specification.....	17
4.2.2.2.1 "Carrier-on" radio state.....	17
4.2.2.2.2 "Carrier-off" and "Emissions disabled" radio states	17
4.2.2.3 Conformance tests	17
4.2.3 Void	17
4.2.4 Void	17
4.2.5 Carrier suppression	17
4.2.5.1 Justification	17
4.2.5.2 Specification.....	18
4.2.5.3 Conformance tests.....	18
4.2.6 Antenna pointing accuracy	18
4.2.6.1 Purpose.....	18
4.2.6.2 Pointing accuracy specification.....	18
4.2.6.3 On-axis cross polarization isolation specification.....	18
4.2.6.4 Conformance tests	18
4.2.7 Cessation of emissions.....	18
4.2.7.1 Justification	18
4.2.7.2 Specification.....	18
4.2.7.2.1 Specification 1: Mode of cessation of emissions.....	18
4.2.7.2.2 Specification 2: Conditions under which the ES shall cease emissions.....	19
4.2.7.2.3 Specification 3: Cessation of emissions	19
4.2.7.2.4 Specification 4: Fault conditions	19
4.2.7.3 Conformance tests.....	20
4.2.8 Control and Monitoring Functions (CMFs).....	20
4.2.8.1 ES States	20
4.2.8.1.1 General	20

4.2.8.1.2	CMF state diagram	21
4.2.8.2	Processor monitoring	22
4.2.8.2.1	Justification	22
4.2.8.2.2	Specification	22
4.2.8.2.3	Conformance tests	22
4.2.8.3	Transmit subsystem monitoring	23
4.2.8.3.1	Justification	23
4.2.8.3.2	Specification	23
4.2.8.3.3	Conformance tests	23
4.2.8.4	Power-on/Reset	23
4.2.8.4.1	Justification	23
4.2.8.4.2	Specification	23
4.2.8.4.3	Conformance tests	23
4.2.8.5	Control Channel (CC) and Response Channel (RC)	23
4.2.8.5.1	Justification	23
4.2.8.5.2	Specification	23
4.2.8.5.3	Conformance tests	24
4.2.8.6	Network control commands	24
4.2.8.6.1	Justification	24
4.2.8.6.2	Specification	24
4.2.8.6.3	Conformance tests	25
4.2.8.7	Initial burst transmission	25
4.2.8.7.1	Justification	25
4.2.8.7.2	Specification	25
4.2.8.7.3	Conformance tests	25
4.2.8.8	Inhibition of transmissions	25
4.2.8.8.1	Justification	25
4.2.8.8.2	Specification	25
4.2.8.8.3	Conformance tests	26
4.2.9	Receive antenna off-axis gain pattern	26
4.2.9.1	Justification	26
4.2.9.2	Specification	26
4.2.9.3	Conformance tests	26
4.2.10	Blocking performance	26
4.2.10.1	Justification	26
4.2.10.2	Specification	27
4.2.10.3	Conformance tests	27
4.2.11	Adjacent Signal Selectivity	27
4.2.11.1	Justification	27
4.2.11.2	Specification	27
4.2.11.3	Conformance tests	27
4.2.12	Image frequency rejection	28
4.2.12.1	Justification	28
4.2.12.2	Specification	28
4.2.12.3	Conformance tests	28
5	Testing for compliance with technical requirements	28
5.1	Environmental conditions for testing	28
5.2	Ancillary Equipment	28
5.3	Nominated Bandwidth	28
5.4	Interpretation of the measurement results	29
6	Test methods for all aspects of the ES	29
6.1	General	29
6.1.1	General requirements	29
6.1.2	Special considerations for the interpretation of measurement results	29
6.1.3	Measuring receiver	30
6.2	Off-axis spurious radiation	31
6.2.1	General	31
6.2.2	Test method	31
6.2.2.1	General	31
6.2.2.2	Multi-carrier operation	31

6.2.3	Measurements up to 1 000 MHz	32
6.2.3.1	Test site	32
6.2.3.2	Measuring receivers	32
6.2.3.3	Procedure	32
6.2.4	Measurements above 1 000 MHz	32
6.2.4.1	General	32
6.2.4.2	Identification of the significant frequencies of spurious radiation	33
6.2.4.2.1	Test site.....	33
6.2.4.2.2	Procedure.....	33
6.2.4.3	Measurement of radiated power levels of identified spurious radiation.....	33
6.2.4.3.1	Test site.....	33
6.2.4.3.2	Procedure.....	34
6.2.4.4	Measurement of conducted spurious radiation at the antenna flange.....	35
6.2.4.4.1	Test site.....	35
6.2.4.4.2	Procedure.....	35
6.3	On-axis spurious radiation.....	36
6.3.1	Test method	36
6.3.1.1	General	36
6.3.1.2	Test site	36
6.3.1.3	Method of measurement.....	36
6.3.1.3.1	General	36
6.3.1.3.2	Method of measurement at the antenna flange	36
6.3.1.3.3	Method of measurement for an EUT with antenna.....	38
6.4	Void.....	39
6.5	Carrier suppression.....	39
6.5.1	General.....	39
6.5.2	Test method	39
6.6	Antenna pointing	40
6.6.1	General.....	40
6.6.2	Test method	40
6.7	Polarization angle alignment capability	41
6.7.1	General.....	41
6.7.2	Test site.....	41
6.7.3	Procedure.....	41
6.8	Cessation of emissions of the ES.....	42
6.8.1	General.....	42
6.8.2	Test Method.....	42
6.8.2.1	Required documentation	42
6.8.2.2	Cessation of emissions from the "Transmission enabled" state	42
6.8.2.3	Cessation of emission from the "Transmission disabled" state.....	42
6.8.2.4	Cessation of emission from the "Initial Phase" state	43
6.8.2.4.1	EUTs transmitting initial bursts.....	43
6.8.2.4.2	EUTs not transmitting initial bursts.....	43
6.8.2.5	"Single action" means of cessation of emissions.....	43
6.8.2.6	Fault conditions	44
6.9	Control and monitoring functions	44
6.9.1	General.....	44
6.9.2	Test arrangement	45
6.9.3	Processor monitoring- Test method	45
6.9.4	Transmit subsystem monitoring-Test method.....	45
6.9.5	Power-on/Reset-Test method.....	45
6.9.6	Control Channel and Response Channel -Test method.....	46
6.9.7	Network Control commands-Test method.....	46
6.9.8	Initial burst transmission-Test method.....	48
6.9.9	Inhibition of transmission-Test method	48
6.10	Receive antenna off-axis gain pattern	48
6.10.1	Test method	48
6.10.1.1	Test site	48
6.10.1.2	Method of measurement.....	48
6.10.1.3	Computation.....	49
6.11	Blocking performance	49
6.11.1	General.....	49

6.11.2	Test method	49
6.12	Adjacent Signal Selectivity	50
6.12.1	Test method	50
Annex A (informative):	Relationship between the present document and the essential requirements of Directive 2014/53/EU	52
Annex B (informative):	Linear Polarization Alignment Error Calculation	54
Annex C (normative):	Radiated measurement.....	55
C.1	Test sites and general arrangements for measurements involving the use of radiated fields	55
C.1.1	General	55
C.1.2	Anechoic Chamber	55
C.1.3	Anechoic Chamber with a conductive ground plane	56
C.1.4	Open Area Test Site (OATS)	57
C.1.5	Minimum requirements for test sites for measurements above 18 GHz.....	58
C.1.6	Test antenna.....	58
C.1.7	Substitution antenna	59
C.1.8	Measuring antenna	59
C.2	Guidance on the use of radiation test sites	59
C.2.1	General	59
C.2.2	Verification of the test site	59
C.2.3	Preparation of the EUT.....	59
C.2.4	Power supplies to the EUT	59
C.2.5	Range length.....	60
C.2.6	Site preparation	60
C.3	Coupling of signals.....	61
C.3.1	General	61
C.4	Standard test methods.....	61
C.4.1	General	61
C.4.2	Calibrated setup.....	61
C.4.3	Substitution method.....	62
Annex D (normative):	Conducted measurements	63
Annex E (informative):	General Requirements for RF Cables.....	64
Annex F (informative):	RF Waveguides	65
Annex G (informative):	Applicability of parameters given in ETSI EG 203 336	66
Annex H (informative):	Maximum Measurement Uncertainty.....	68
Annex I (informative):	Bibliography.....	69
Annex J (informative):	Change history	70
History		71

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ETSI EN 303 699 V1.1.1 (2021-02)

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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.1] 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.2].

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:	7 January 2021
Date of latest announcement of this EN (doa):	30 April 2021
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 October 2021
Date of withdrawal of any conflicting National Standard (dow):	31 October 2022

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).

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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.1]. The modular structure is shown in ETSI EG 201 399 [i.3].

The present document is largely based on ETSI EN 303 979 [i.4], for ESOMPs operating with NGSO satellites.

The present document may also be applicable to the frequency bands 30,0 GHz to 31,0 GHz (Earth-to-space) and 20,2 GHz to 21,2 GHz (space-to-Earth) subject to national regulation:

- Annex A (normative) provides HS Requirements specifications.
- Annex B (informative) provides information on Linear Polarization Alignment Error Calculation.
- Annex C (normative) provides specifications concerning radiated measurements.
- Annex D (normative) provides specifications concerning conducted measurements.
- Annex E (informative) provides general information concerning RF cables.
- Annex F (informative) provides information concerning RF waveguides.
- Annex G (informative) covers other supplementary information.
- Annex H (informative) provides information on measurement uncertainty.

The present document is intended to cover the provisions of Directive 2014/53/EU [i.1] (RE Directive) article 3.2 which states that "...radio equipment shall be so constructed that it both effectively uses and supports the efficient use of radio spectrum in order to avoid harmful interference" (standards.iteh.ai)

Recital 10 of Directive 2014/53/EU [i.1] states that "*in order to ensure that radio equipment uses the radio spectrum effectively and supports the efficient use of radio spectrum, radio equipment should be constructed so that: in the case of a transmitter, when the transmitter is properly installed, maintained and used for its intended purpose it generates radio waves emissions that do not create harmful interference, while unwanted radio waves emissions generated by the transmitter (e.g. in adjacent channels) with a potential negative impact on the goals of radio spectrum policy should be limited to such a level that, according to the state of the art, harmful interference is avoided; and, in the case of a receiver, it has a level of performance that allows it to operate as intended and protects it against the risk of harmful interference, in particular from shared or adjacent channels, and, in so doing, supports improvements in the efficient use of shared or adjacent channels*".

Recital 11 of Directive 2014/53/EU [i.1] states that "*although receivers do not themselves cause harmful interference, reception capabilities are an increasingly important factor in ensuring the efficient use of radio spectrum by way of an increased resilience of receivers against harmful interference and unwanted signals on the basis of the relevant essential requirements of Union harmonisation legislation*".

As a consequence, the present document includes both transmitting and receiving parameters aiming to maximize the efficient use of radio spectrum.

1 Scope

The present document covers requirements to demonstrate that radio equipment both effectively uses and supports the efficient use of radio spectrum in order to avoid harmful interference. The present document applies to satellite communications Earth Stations (ES) with the following characteristics:

- The ES is designed for stationary operation.
- The ES is operating as part of a satellite network (e.g. star, mesh or point to point) used for the distribution and/or exchange of information.
- The transmit and receive frequencies are shown in table 1.

Table 1: Frequency bands

	Frequency Bands/frequencies
Transmit (Earth-to-space) 1	27,5 GHz to 29,1 GHz
Transmit (Earth-to-space) 2	29,5 GHz to 30,0 GHz
Receive (space-to-Earth)	17,30 GHz to 20,20 GHz

- The ES transmits within the frequency range from 27,5 GHz to 29,1 GHz and 29,5 GHz to 30,0 GHz, which is a band allocated to the Fixed Satellite Services (FSS) (Earth-to-space) among other services. National regulations will specify the bands available for the operation of the ES. Such regulations may designate some parts of the frequency range 27,5 GHz to 29,1 GHz to terrestrial services such as the Fixed Service. However, the operation of the ES may be permitted under national regulations in the 29,50 GHz to 30,00 GHz band since this band is allocated on a primary basis to the Fixed Satellite Service.
- The ES receives in one or more frequencies within the range from 17,30 GHz to 20,20 GHz (FSS).
- The ES uses linear or circular polarization.
- The ES operates through non-geostationary satellites.
- The ES is designed for unattended operation.
- The ES is controlled and monitored by a Network Control Facility (NCF). This function may be performed centrally (e.g. for a network of ESs with a central hub) or it could be performed within the ES for autonomous control. The NCF is outside the scope of the present document.
- The ES operating in the 27,5 GHz to 28,6 GHz and 29,5 GHz to 30 GHz bands: epfd limits given in article 22 of the ITU Radio Regulations [i.5] apply for the ESs operating with the NGSO system for the protection of the GSO networks (see No. 22.5D of the ITU RR [i.5]).
- ES operating in the 28,6 GHz to 29,1 GHz band: No. 9.11A of the ITU RR [i.5] applies to the NGSO network of the ES, meaning that the NGSO will be required to coordinate with earlier filed GSO networks or NGSO systems (See No. 5.523A of the ITU RR [i.5]).
- The ES has one or more directive antennas that track satellites.

The present document applies to the ES with its ancillary equipment and its various telecommunication ports, and when operated within the boundary limits of the operational environmental profile as declared by the manufacturer and when installed as required by the manufacturer's declaration or in the user documentation.

NOTE 1: Operational requirements are defined by national administrations and by relevant ECC Decisions.

In addition to the present document, other ENs that specify technical requirements in respect of essential requirements under other parts of article 3 of the Directive 2014/53/EU [i.1] may apply to equipment within the scope of the present document.

NOTE 2: A list of such ENs is included on the web site <http://www.newapproach.org>.

NOTE 3: The relationship between the present document and essential requirements of article 3.2 of Directive 2014/53/EU [i.1] is given in annex A.

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] ANSI C63.5 (2006): "American National Standard for Electromagnetic Compatibility - Radiated Emission Measurements in Electromagnetic Interference (EMI) Control - Calibration of Antennas (9 kHz to 40 GHz)".
- [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] CISPR 16-1-4-2019: "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-4: Radio disturbance and immunity measuring apparatus - Antennas and test sites for radiated disturbance measurements".
- [4] 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] 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.2] 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.3] 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.4] ETSI EN 303 979 (V2.1.2): "Satellite Earth Stations and Systems (SES); Harmonised Standard for Earth Stations on Mobile Platforms (ESOMP) transmitting towards satellites in non-geostationary orbit, operating in the 27,5 GHz to 29,1 GHz and 29,5 GHz to 30,0 GHz frequency bands covering the essential requirements of article 3.2 of the Directive 2014/53/EU".
- [i.5] ITU Radio Regulations (2016).

- [i.6] ETSI TS 103 052: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Radiated measurement methods and general arrangements for test sites up to 100 GHz".
- [i.7] IEC 60153 (all parts): "Hollow metallic waveguides".
- [i.8] ETSI TR 100 028 (all parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".
- [i.9] ETSI TR 100 028-2: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 2".
- [i.10] ETSI EG 203 336 (V1.1.1): "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".
- [i.11] ETSI TR 102 273 (all parts) (V1.2.1) (12-2001): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site) and evaluation of the corresponding measurement uncertainties".

3 Definition of terms, symbols and abbreviations

3.1 Terms

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

ancillary equipment: equipment used in connection with an ES (see clause 5.2)

antenna controller: equipment used to maintain antenna stabilization and tracking accuracy based on inputs from the Control and Monitoring Function

bandwidth of the ideal signal: bandwidth of a theoretical signal that is defined by the modulation scheme of the actual signal and contains no unwanted signal components that would increase the bandwidth

NOTE: In case of amplitude or phase shift keying signals the bandwidth of an ideal signal is $B = R_s \times (1 + \alpha)$, where R_s is the symbol rate and α is the roll-off.

carrier-off radio state: radio state in which the ES may transmit and does not transmit any carrier (see clause 4.2.8.1.1)

carrier-on radio state: radio state in which the ES may transmit and transmits a carrier

Control Channel (CC): channel or channels by which ESs receive control information from the NCF

EIRP_{Aggregate}: sum of the EIRP (Watts) within the nominated bandwidth of the ES network

EIRP_{max}: maximum EIRP capability of the ES as declared by the manufacturer

emissions disabled radio state: radio state in which the ES is not emitting

NOTE: Examples of cases where the ES is in this radio state: before system monitoring pass, before the control channel is received, when a failure is detected, when an ES is commanded to disable, and when the ES is in a location requiring cessation of emissions.

equivalent power flux density: sum of the power flux densities produced at a receive station in the geostationary orbit by all the transmit stations within a non-geostationary satellite system

external control channel: control channel which is either:

- i) carried by the ES network via the same or another satellite, but not within the internal protocol of the ES system; or
- ii) carried by any other radio communication system

external response channel: response channel which is either:

- i) carried by the ES network via the same or another satellite, but not within the internal protocol of the ES system; or
- ii) carried by any other radio communication system

integral antenna: antenna which may not be removed during the tests according to the manufacturer's declaration

internal control channel: control channel which is carried by the ES network via the same satellite as used for transmission of user data and within the internal protocol structure of the ES system

internal response channel: response channel which is carried by the ES network via the same satellite as used for transmission of user data and within the internal protocol structure of the ES system

mobile platform: any non-stationary platform such as a train, a vessel, an aircraft or other vehicles

Network Control Facility (NCF): set of functional entities that, at system level, monitor and control the correct operation of the ES and, if appropriate, all of the ESs in a network

nominal antenna diameter: antenna diameter declared by the manufacturer that is a parameter in performance characteristics and that allows reference to a certain performance

NOTE 1: An antenna with circular aperture of diameter equal to the nominal diameter does typically have the performance specified.

NOTE 2: 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: bandwidth of the ES radio frequency transmission declared by the manufacturer (see clause 5.3)

off-axis angle: angle between the direction of the axis of the antenna main beam and the considered direction

peak pointing accuracy: angular error of antenna pointing that is not exceeded during intended use of the ES

removable antenna: antenna which may be removed during the tests according to the manufacturer's declaration

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

spurious radiation: any radiation outside the nominated bandwidth

transmission disabled state: radio state in which the ES is not authorized to transmit by the NCF

transmission enabled state: radio state in which the ES is authorized to transmit by the NCF

wanted signal occupied BandWidth (BW):

- for a digital modulation scheme: the width of the signal spectrum such that, at the lower and upper frequency limits, the power spectral density is 10 dB lower than the maximum;
- for an analogue modulation scheme: the width of a frequency band such that, below the lower and above the upper frequency limits, the mean power emitted is equal to 0,5 % of the total mean power of the emission.

3.2 Symbols

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

B	bandwidth
dBc	ratio expressed in decibels relative to the EIRP of the unmodulated carrier
dB _i	ratio of an antenna gain to the gain of an isotropic antenna, expressed in decibels
dBW	ratio of a power to 1 watt, expressed in decibels
dBpW	ratio of a power to 1 picowatt, expressed in decibels
dB μ V/m	ratio of an electric field to 1 μ V/m, expressed in decibels ($20 \log(\text{electric field} / 1 \mu\text{V/m})$)
$G(\varphi)$	antenna gain at off-axis angle
$G_x(\varphi)$	cross-polarized antenna gain at off-axis angle
φ	off-axis angle
IT_{\max}	maximum Inhibit Time
IT_{trans}	Inhibit Time to transition from "Carrier off" to "Carrier on" radio state
T_{trans}	Time to transition from "Carrier off" to "Carrier on" radio state

3.3 Abbreviations

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

BER	Bit Error Rate
BW	BandWidth
CC	Control Channel
CCF	Control Channel reception Failure
CCR	Control Channel correctly Received
CENR	Cessation of Emissions Not Required
CEPT	Conférence Européenne des Postes et Télécommunications (European Conference of Postal and Telecommunications)
CER	Cessation of Emissions Required
CISPR	Comité International Spécial des Perturbations Radioélectriques (International Special Committee on Radio Interference)
CMF	Control and Monitoring Functions
DC	Direct Current
ECC	Electronic Communications Committee (of CEPT)
EIA	Electronic Industries Alliance
EIRP	Equivalent Isotropically Radiated Power
EMC	Electro-Magnetic Compatibility
epfd	equivalent power flux-density
EN	European Norm
ES	Earth Station
ESOMP	Earth Station On Mobile Platform
EUT	Equipment Under Test
FEC	Forward Error Correction
FSS	Fixed Satellite Service
GEUT	Gain of EUT
GSO	Geostationary Satellite Orbit
HPA	High Power Amplifier
IDU	Indoor Unit
IEC	International Electrotechnical Commission
IPR	Intellectual Property Rights
LNB	Low Noise Block downconverter
LO	Local Oscillator
LV	Low Voltage
NCF	Network Control Facility
NGSO	Non Geostationary Satellite Orbit
OATS	Open Area Test Site
OFDM	Orthogonal Frequency Division Multiplexing
R&TTE	Radio and Telecommunications Terminal Equipment
RBW	Reference BandWidth
RC	Response Channel

RCSC	Radio Components Standardization Committee
RE	Radio Equipment
RED	Radio Equipment Directive
RF	Radio Frequency
RMS	Root Mean Square
RR	Radio Regulations
SMA	SubMiniature version A
SMF	System Monitoring Fail
SMP	System Monitoring Pass
STE	Special Test Equipment
TxD	Transmission Disable command
TxE	Transmission Enable command
VBW	Video BandWidth
VSWR	Voltage Standing Wave Ratio
WG	WaveGuide
WR	Waveguide Rectangular
XPD	Cross-Polarization Discrimination

4 Technical requirements specifications

4.1 General

4.1.1 Environmental profile

The technical requirements of the present document apply under the environmental profile for operation of the equipment, which shall be in accordance with its intended use. The equipment shall comply with all the technical requirements of the present document at all times when operating within the boundary limits of the operational environmental profile defined by its intended use.

The equipment shall comply with all the technical requirements of the present document which are identified as applicable in annex A.

4.1.2 Operational configurations

Under operational conditions an ES may dynamically change the occupied bandwidth and other transmission parameters (e.g. FEC, modulation, symbol rate) of the transmitted signal. For each declared occupied bandwidth an $EIRP_{max}$ and a nominated bandwidth shall be declared by the manufacturer. For the purposes of verifying that the ES complies with these specifications, the manufacturer may declare the worst case combination of transmission parameters. The following specifications apply to the ES for each occupied bandwidth and other transmission parameters.

In the present document, ESs that use OFDM modulation shall be considered as transmitting a single carrier.

The manufacturer shall declare all operational parameters including the EIRP, modulation and occupied bandwidth.

The manufacturer shall declare the number of emitters of the ES that may be used simultaneously. The specifications in clause 4 shall be applied to such configuration as declared by the manufacturer.

4.1.3 $EIRP_{Aggregate}$ for networks of ESs

For the case where several ESs are transmitting simultaneously on the same carrier frequency, the $EIRP_{Aggregate}$ is the sum of the EIRP (Watts) within the nominated bandwidth of the ES network.

For ESs designed to operate in an FSS network where the EIRP of each ES is determined by the NCF, the NCF shall ensure compliance with the EIRP density requirements in the present document. The manufacturer shall declare the method(s) used to maintain compliance.

4.1.4 Presentation of equipment for testing purposes

ES equipment submitted for testing, where applicable, shall fulfil the requirements of the present document on all frequencies over which it is intended to operate.

The manufacturer shall submit one or more samples of the equipment as appropriate for testing.

Additionally, technical documentation and operating manuals, sufficient to allow testing to be performed, shall be supplied.

The performance of the ES equipment submitted for testing shall be representative of the performance of the corresponding production model. The manufacturer shall offer equipment complete with any auxiliary equipment needed for testing.

The manufacturer shall declare the frequency range(s), the range of operation conditions and power requirements, as applicable, in order to establish the appropriate test conditions.

4.1.5 Choice of model for testing

If an ES equipment has several optional features, considered not to affect the RF parameters then the tests need only to be performed on one sample of the equipment configured with that combination of features considered to create the highest unintentional emissions.

In addition, when a device has the capability of using different dedicated antennas or other features that affect the RF parameters, at least the worst combination of features from an emission point of view as agreed between the manufacturer and the test laboratory shall be tested.

Where the transmitter is designed with adjustable output power, then all transmitter parameters shall be measured using the highest maximum mean power spectral density level, as declared by the manufacturer.

The choice of model(s) for testing shall be recorded in the test report.

4.1.6 Void [ETSI EN 303 699 V1.1.1 \(2021-02\)](https://standards.iteh.ai/catalog/standards/sist/ed35b3b9-3bc9-48b1-bdc9-749794783f2d/etsi-en-303-699-v1-1-1-2021-02)

4.1.7 Peak pointing accuracy

The manufacturer shall declare the peak pointing accuracy ($\delta\phi$) within which the antenna shall be maintained whilst transmissions are enabled.

4.2 Conformance requirements

4.2.1 Off-axis spurious radiation

4.2.1.1 Justification

To limit the level of interference to terrestrial and satellite radio services.

4.2.1.2 Specification

The following specifications apply to the ES transmitting at Equivalent Isotropically Radiated Power (EIRP) values up to and including $EIRP_{max}$:

- 1) The electric field strength level of any radiation from the ES in the frequency range from 30 MHz to 1 GHz shall not exceed the limits specified in table 2.