

# ETSI EN 303 981 V1.3.1 (2022-10)



**Satellite Earth Stations and Systems (SES);  
Fixed and in-motion Wide Band Earth Stations communicating  
with non-geostationary satellite systems (WBES)  
in the 11 GHz to 14 GHz frequency bands;  
Harmonised Standard for access to radio spectrum**

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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.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:	10 October 2022
Date of latest announcement of this EN (doa):	31 January 2023
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 July 2023
Date of withdrawal of any conflicting National Standard (dow):	31 July 2024

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# Modal verbs terminology

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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 and telecommunications terminal equipment within the scope of the RE Directive [i.1]. The modular structure is shown in ETSI EG 201 399 [i.2].

The present document is largely based on ETSI EN 303 979 [i.4], for ESOMPs operating with NGSO satellites, and ETSI EN 303 980 [i.5] for NEST operating with NGSO satellites.

The present document may also be applicable to the frequency band 14,0 GHz to 14,50 GHz (Earth-to-space) and 10,70 GHz to 12,75 GHz (space-to-Earth) subject to national regulation.

Annex A (informative) provides the relationship between the present document and the essential requirements of Directive 2014/53/EU [i.1].

Annex B (normative) describes methods of taking radiated measurements.

Annex C (normative) describes methods of taking conducted measurements.

Annex D (informative) describes requirements for RF measurement cables.

Annex E (informative) describes use of RF waveguides.

Annex F (informative) describes measurement equipment.

Annex G (informative) describes the applicability of parameters in ETSI EG 203 336 [i.8].

Annex H (informative) is the Bibliography.

Annex I (informative) is the Change history.

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

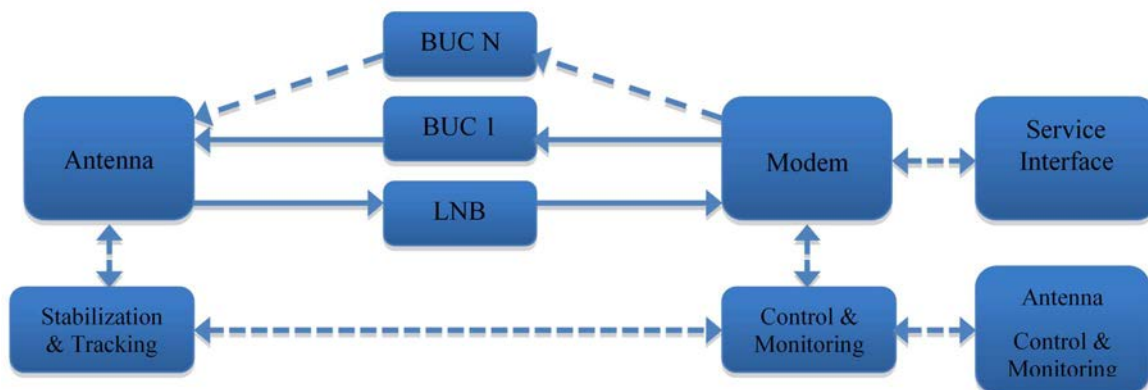
The present document specifies technical characteristics and methods of measurements for fixed and in-motion Earth Stations communicating with non-geostationary satellite systems (WBES) in the 11 GHz to 14 GHz FSS frequency bands, which have the following characteristics:

- The WBES is further defined as one of two classes of Earth stations, class A and class B. The clauses in the present document apply to both classes unless separately delineated.
- The WBES is designed for both in-motion and stationary operation.
- The WBES operates in-motion on various platforms such as trains, maritime vessels, aircraft and other vehicles and, therefore, may be subject to occasional disturbances and interruptions in the satellite link.
- The WBES is operating as part of a satellite system used for the provision of broadband communications.
- The WBES is comprised of all the equipment, electrical and mechanical, from the antenna itself to the interface with other communications equipment on a mobile platform.
- The WBES comprises one or more emitters and the system overview as given in figure 1 should be interpreted accordingly.
- The transmit and receive frequencies are shown in table 1.

**Table 1: Frequency bands**

	Frequency Bands
Transmit (Earth-to-space)	14,0 GHz to 14,50 GHz
Receive (space-to-Earth)	10,70 GHz to 12,75 GHz

- The WBES transmits within the frequency range from 14,0 GHz to 14,50 GHz.
- The WBES receives within the range from 10,70 GHz to 12,75 GHz.
- The Class A WBES transmits at elevation angles of 35° or greater, relative to the horizontal plane.
- The Class B WBES transmits at elevation angles of 25° or greater, relative to the horizontal plane.
- The WBES uses linear or circular polarization.
- The WBES communicates with non-geostationary satellites.
- The WBES is designed for unattended operation.
- The WBES is controlled and monitored by a Network Control Facility (NCF). The NCF is outside the scope of the present document.



**Figure 1: WBES System Overview**

The present document applies to the WBES with its ancillary equipment and its various telecommunication ports, and when operated within the boundary limits of the operational environmental profile as required by its intended use and when installed as required by the intended use or in the user documentation.

NOTE: 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.

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## 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] 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".
- [2] 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".
- [3] 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 04.08.2015 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] 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.3] 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.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] ETSI EN 303 980 (V1.1.1): "Satellite Earth Stations and Systems (SES); Harmonised Standard for fixed and in-motion Earth Stations communicating with non-geostationary satellite systems (NEST) in the 11 GHz to 14 GHz frequency bands covering essential requirements of article 3.2 of Directive 2014/53/EU".
- [i.6] ETSI TR 100 028 (all parts) (V1.4.1) (12-2001): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".
- [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.
- [i.8] ETSI EG 203 336 (V1.2.1): "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.9] IEC 60153 parts 1 to 7 (IEC 60153-1 to 60153-7): "Hollow metallic waveguides".
- [i.10] Recommendation ITU-R BO.1213: "Reference receiving earth station antenna pattern for the broadcasting-satellite service in the 11.7-12.75 GHz band".
- [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".
- [i.12] 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)".
- [i.13] 3GPP TR 37.842: "3<sup>rd</sup> Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA) and Universal Terrestrial Radio Access (UTRA); Radio Frequency (RF) requirement background for Active Antenna System (AAS) Base Station (BS)".

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## 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.1] and the following apply:

**ancillary equipment:** equipment used in connection with a WBES

NOTE: See clause 5.2.

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

**carrier-off radio state:** radio state in which the WBES may transmit and does not transmit any carrier

NOTE: See clause 4.2.7.

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

**Control Channel (CC):** channel or channels by which WBESs receive and send control information from and to the NCF

**desense:** reduction in the sensitivity of a receiver due to the presence of high power signals in the adjacent channel(s)

**EIRP<sub>max</sub>**: maximum EIRP capability of the WBES

**EIRP density<sub>max</sub>**: maximum EIRP in 1 MHz of the WBES taking into account the spectral distribution of that EIRP<sub>max</sub>

**emissions disabled radio state**: radio state in which the WBES may not emit

NOTE: Examples of cases where the WBES is in this radio state:

- before system monitoring pass, before the control channel is received;
- when a failure is detected;
- when an WBES is commanded to disable; and
- when the WBES is in a location requiring cessation of emissions.

**external control channel**: control channel which is either:

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

**external response channel**: response channel which is either:

- i) carried by the WBES network via the same or another satellite, but not within the internal protocol of the WBES 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 WBES network via the same satellite as used for transmission of user data and within the internal protocol structure of the WBES system

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

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

**nominated bandwidth**: bandwidth of the WBES radio frequency transmission

NOTE: See clause 5.3.

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

**removable antenna**: antenna which may be removed during the tests

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

**spurious radiation**: in the present document, any radiation outside the nominated bandwidth

**terrestrial port**: in the present document, RF port intended to feed an antenna connecting to terrestrial networks, using frequency bands that are outside of the scope of the present document

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

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

**Wanted signal occupied Bandwidth (BW)**: width of the signal spectrum 10 dB below the maximum in-band power density

## 3.2 Symbols

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

dB <sub>i</sub>	ratio of an antenna gain to the gain of an isotropic antenna, expressed in decibels
dB <sub>m</sub>	ratio of power to 1 mW, expressed in decibel
dB <sub>s</sub> d	ratio expressed in decibels relative to the spectral density
dBW	ratio of a power to 1 watt, expressed in decibels
dB <sub>p</sub> W	ratio of a power to 1 picowatt, expressed in decibels
dB <sub>μ</sub> V/m	ratio of an electric field to 1 μV/m, expressed in decibels (20 log(electric field / 1 μV/m))

## 3.3 Abbreviations

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

BW	Wanted signal occupied Bandwidth
CATR	Compact Antenna Test Range
CC	Control Channel
CCF	Control Channel reception Failure
CCR	Control Channel correctly Received
CENR	Cessation of Emissions Not Required
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
EFTA	European Free Trade Association
EIRP	Effective Isotropic Radiated Power
EIRP <sub>max</sub>	Maximum EIRP transmitted by the WBES
EMC	ElectroMagnetic Compatibility
EUT	Equipment Under Test
FEC	Forward Error Correction
FSS	Fixed Satellite Service
G <sub>EUT</sub>	Gain of EUT
GSO	Geostationary Satellite Orbit
HPA	High Power Amplifier
IFF	Indirect Far Field
IPR	Intellectual Property Rights
IT <sub>max</sub>	Maximum Inhibit Time
LNB	Low-Noise Block down converter
LO	Local Oscillator
LV	Low Voltage
NCF	Network Control Facility
NEST	Non-geostationary Earth Station Terminals
NFTF	Near Field To Far Field
NGSO	Non Geostationary Satellite Orbit
OATS	Open Area Test Site
R&TTE	Radio and Telecommunications Terminal Equipment
RBW	Reference BandWidth
RC	Response Channel
RE	Radio Equipment
RED	Radio Equipment Directive
RF	Radio Frequency
RMS	Root Mean Square
SMF	System Monitoring Fail
SMP	System Monitoring Pass
SNR	Signal to Noise Ratio
STE	Special Test Equipment
T <sub>trans</sub>	Time to transition from "Carrier off" to "Carrier on" radio state
TxD	Transmission Disable command

TxE	Transmission Enable command
VBW	Video BandWidth
VSWR	Voltage Standing Wave Ratio
WBES	Wide Band Earth Station communicating with NGSO satellite system

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## 4 Technical requirements specifications

### 4.1 General

#### 4.1.0 Target

This clause defines the specifications for each technical requirement and includes information for the test house to be able to conduct the tests.

#### 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.

#### 4.1.2 Operating configurations

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

All operational parameters including the maximum EIRP, EIRP densities in use, modulation, occupied bandwidth and polarization shall be provided for the EUT testing

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

#### 4.1.3 Presentation of equipment for testing purposes

WBES equipment submitted for testing shall fulfil the requirements of the present document on all frequencies over which it is intended to operate. When WBES operates with several combination of parameters (carrier, bandwidth, etc.) the WBES shall be provided with all necessary information.

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 WBES 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.

#### 4.1.4 Choice of model for testing

If an WBES 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 of EUT.

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

#### 4.1.5 Peak pointing accuracy

The manufacturer shall provide the maximum antenna beam pointing error  $\delta\phi_{\max}$ , beyond which transmissions shall be disabled.

#### 4.1.6 Location and Identification of the WBES

The manufacturer shall declare the means of determining, reporting and logging at appropriate update rates, the geographic location of the WBES within the accuracy and precision needed for the intended application such as vehicular or fixed.

The manufacturer shall be responsible for identifying and declaring at the time of test these location requirements and the method of test. In the case where an external system is required, the manufacturer shall declare which additional means are necessary for identification of the WBES.

#### 4.1.7 Operation of multiple WBES on a single frequency

The WBES under test shall be provided with all necessary information on the operation of the satellite network which permits more than one WBES on a given carrier frequency within a single spot beam of a satellite system.

The operational scenario of maximum number of WBES transmitting simultaneously is associated with the intended use, under the specific NGSO satellite system. The WBES having been built for specific intended use (for example, consistent with the characteristics of the NGSO system) will have to be provided with the information specifying whether the WBES is capable of transmitting multiple carriers at a given frequency.

### 4.2 Conformance requirements

#### 4.2.1 Antenna beam pointing

##### 4.2.1.1 Pointing accuracy

##### 4.2.1.1.1 Purpose

To validate that the antenna points correctly within the  $\delta\phi_{\max}$ .

##### 4.2.1.1.2 Antenna Beam Pointing error

The antenna beam pointing error is a difference between true azimuth and elevation position related to a given RF boresight of the WBES and the azimuth and elevation reported by the antenna control and tracking system.