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Satellite Earth Stations and Systems (SES); Receive-only Very Small Aperture Terminals (VSATs) operating in the 4 GHz frequency band

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Foreword

This second edition European Telecommunication Standard (ETS) has been produced by the Satellite Earth Stations and Systems (SES) Technical Committee of the European Telecommunications Standards Institute (ETSI).

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1 Scope

This European Telecommunication Standard (ETS) provides specifications for the standardization of the characteristics of receive-only Very Small Aperture Terminals (VSATs) operating as part of a satellite network (e.g. star, meshed or point-to-point) used for the distribution of information.

These VSATs have the following characteristics:

- operating in the shared part of the C-band allocated to the Fixed Services (FS) and to the Fixed Satellite Services (FSS), 3,400 GHz to 4,200 GHz (space-to-earth);

- in this frequency band circular and linear polarization are used;

  the VSAT operates through geostationary satellites at least 3° away from any other geostationary satellite operating in the same frequency band and covering the same area;

- designed usually for unattended operation;

- antenna diameter not exceeding 7,3 m, or equivalent corresponding effective area.

The equipment considered in this ETS comprises both the "outdoor unit", usually composed of the antenna sub-system and associated Low Noise Block (LNB), and the "indoor unit" composed of the remaining part of the communication chain, including the cable between these two units.

This ETS applies to the VSAT with its ancillary equipment and its various terrestrial ports, and operated under the conditions which are within the ranges of humidity, temperature and supply voltage declared by the manufacturer.

There are no EMC specifications under this ETS, however ETS 300 673 [2] contains the EMC specifications for VSATs.

This ETS does not contain any specification or information on the installation of the VSATs.

The specifications have been selected to ensure an adequate level of compatibility for VSATs. The levels, however, do not cover extreme cases which may occur in any location but with a low probability of occurrence. 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.

This ETS deals with two types of specification:

- specifications defined in order to protect other users of the frequency spectrum, both satellite and terrestrial, from unacceptable interference. In addition, these specifications are specified for the purposes of structural safety and lightning protection as well as protection from harmful interference;

- specifications related to characteristics which contribute to the quality of reception by providing the VSAT with a minimum interference protection from other radio systems. These specifications apply if required by the manufacturer.

2 Normative references

This ETS incorporates, by dated or undated references, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] EN 50083-1 (1993): "Cabled distribution systems for television and sound signals - Part 1: Safety requirements".

[2] ETS 300 673 (1996): "Radio Equipment and Systems (RES); ElectroMagnetic Compatibility (EMC) standard for 4/6 GHz and 11/12/14 GHz Very Small Aperture Terminal (VSAT) equipment and 11/12/13/14 GHz Satellite News Gathering (SNG) Transportable Earth Station (TES) equipment".

[3] ETS 300 456: "Satellite Earth Stations and Systems (SES); Test methods for Very Small Aperture Terminals (VSATs) operating in the 11/12/14 GHz frequency bands".

[4] ITU-R Recommendation 732 (1992): "Method for statistical processing of Earth station antenna side-lobe peaks".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of this ETS, the following definitions apply:

ancillary equipment: Equipment used in connection with the VSAT is considered as ancillary if the following conditions are met:

a) the equipment is intended for use in conjunction with the VSAT 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 VSAT; and

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

cross-polarization discrimination: The ratio of the on-axis co-polar gain to the cross-polar gain in a given direction, at a receive frequency.

indoor unit: Is composed of that part of the VSAT which is not part of the outdoor unit. It is generally installed inside a building and is connected to the outdoor unit. The connection cable between the outdoor and indoor unit is considered part of the indoor unit.

outdoor unit: The part of the VSAT intended to be installed outdoor, as declared by the manufacturer or as indicated in the user documentation.

The outdoor unit usually comprises two main parts:

a) the antenna sub-system which converts the incident radiation field into a guided wave;

b) the Low Noise Block (LNB) down converter, which is a device that amplifies, with very low internal noise, the received signals in the Radio Frequency (RF) band and converts them to intermediate frequencies.

NOTE: The installation equipment (means of attachment) is outside the scope of this ETS. However, the antenna structures and other components directly mounted on the antenna and forming an integral part of it, are subject to the specifications of this ETS.

voltage axial ratio: The voltage axial ratio of an antenna at a transmit or a receive frequency is the ratio r equal to (x + 1)/(x - 1) where x is the square root of the cross-polarization discrimination (not expressed in dB).

3.2 Abbreviations

For the purposes of this ETS, the following abbreviations apply:

EIRP	Equivalent Isotropically Radiated Power
EMC	ElectroMagnetic Compatibility
FS	Fixed Service
FSS	Fixed Satellite Service
LNB	Low Noise Block (low noise amplifier and down converter)
RF	Radio Frequency
VSAT	Very Small Aperture Terminal

4 Test report

The test report shall be similar to the one specified in ETS 300 456 [3] and shall contain:

- the results of the tests;

- all operational conditions and parameters.

5 Safety

5.1 Mechanical construction

Purpose:

Protection of operating personnel, the public and goods from insecure structures of the VSAT itself.

Specification:

This specification applies to the outdoor unit only including mounted and structural components, and does not apply to the means of attachment.

The outdoor unit, shall be designed to support the following main loads due to:

- the weight of the antenna and structural components;

- the wind speed.

Loading due to snow and ice is not considered.

At wind speeds up to 180 km/h, referred to standard atmosphere temperature and pressure (293 K and $1{,}013 \times 10^5$ Pa (1 013 mbar)) none of the components shall be torn away.

Verification:

The test method specified in subclause 5.1 of ETS 300 456 [3] shall apply.

5.2 Lightning

Purpose:

To avoid dangerous potential differences between the outdoor unit and any other conductive structure.

Specification:

Means shall be provided to permit the attachment of bonding conductors of dimension indicated in EN 50083-1 [1], subclause 10.2.3.

Verification:

The test method specified in subclause 5.2 of ETS 300 456 [3] shall apply.

6 Radio Frequency (RF)

The test methods of ETS 300 456 [3] shall apply for verifications where applicable.

6.1 Spurious radiation

Purpose:

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

Specification:

a) The VSAT shall not exceed the limits for radiated interference field strength over the frequency range from 30 MHz to 1,0 GHz specified in table 1.

Table 1: Radiated field strength at a distance of 10 m

Frequency range MHz	Quasi-peak limits dB(µV/m)	
	Class A	Class B
30 to 230	40	30
230 to 1 000	47	37
NOTE: The lower limits shall apply at the transition frequency.		

The applicable class A or B limits shall be designated by the manufacturer and indicated in the data sheet of the test report.

b) The off-axis spurious Equivalent Isotropically Radiated Power (EIRP) from the VSAT, in any 100 kHz band, shall not exceed the limits in table 2, for all off-axis angles greater than 7°.

Table 2: Limits of spurious EIRP

Frequency band	EIRP limit (dBpW)
1,0 GHz to 10,7 GHz	48
10,7 GHz to 21,2 GHz	54
21,2 GHz to 40,0 GHz	60
NOTE: The lower limits shall apply at the transition frequency.	

c) These limits are applicable to the complete VSAT equipment, comprising of the indoor and outdoor units with at least 10 m of cable connecting them.

Verification:

The test method specified in subclause 6.6 of ETS 300 456 [3] shall apply.

6.2 Antenna receive gain pattern (co-polar and cross-polar)

Purpose:

Protection of the wanted signals from interference from terrestrial services, from the same satellite and from adjacent satellites.

Specification 1:

Protection from terrestrial services, mean values.

This specification applies if required by the manufacturer.

The gain G (Φ) in dB relative to an isotropic antenna of the main lobe and of at least 90 % of the side-lobe peaks shall not exceed the limits in table 3.

Table 3

Direction (Φ)	Receive gain (dBi)
2,5° ≤ Φ ≤ 7°	29 - 25 log Φ
7° < Φ ≤ 9,2°	8
9,2° < Φ ≤ 48°	32 - 25 log Φ
Φ > 48°	- 10

For Φ > 70° the values given above may be increased to 0 dBi over the range of angles for which the particular feed system may give rise to relatively high levels of spill-over.

Additionally, the cross-polar gain G(Φ) in dB relative to an isotropic antenna of at least 90 % of the peaks shall not exceed the limits in table 4.

Table 4

Direction (Φ)	Cross-polar gain (dBi)
2,5° ≤ Φ ≤ 7°	19 - 25 log Φ
7° < Φ ≤ 9,2°	- 2

Where Φ is the angle, in degrees, between the main beam axis and the direction considered.

The method of statistical processing of side-lobe peaks and the definition of a peak is dealt with in annex II of ITU-R Recommendation 732 [4].

Specification 2:

Protection from adjacent satellites, between 2,5° and 20°.

This specification applies if required by the manufacturer.

Specification 1 shall be met.

For antennas designed for minimum off-axis gain in the direction of the geostationary orbit, the specification for Φ between 2,5° and 20° need only be met within ±3° of a plane bisected by the main beam axis. This plane shall be marked and identified on the antenna in order to be able to align it tangentially to the geostationary orbit. There shall be an axis of rotation along or parallel to the main-beam axis, with adjustment capability to an accuracy of 0,5°. The antenna shall be capable of having the above plane aligned with the geostationary orbit plane.

Verification:

The test method specified in subclause 6.2.3 of ETS 300 456 [3] shall apply.

6.3 Receive polarization discrimination

Purpose:

To provide protection of the wanted signals from signals on the orthogonal polarization.

Specification:

This specification applies if required by the manufacturer.

When linear polarization is used, the polarization discrimination of the antenna system in the receive frequency band shall exceed the limits of table 5.

When circular polarization is used, the voltage axial ratio of the antenna in the receive frequency band shall be less than the limits of table 5.

Table 5

Antenna diameter D	Linear polarization	Circular polarization
	Cross-polarization discrimination limit	Voltage axial ratio limit
D ≤ 4,5 m	25 dB	1,3
D > 4,5 m	27 dB	1,09

The above specification applies to all off-axis angles of less than 0,1° plus the pointing accuracy (see subclause 7.2, specification 1).

NOTE: Some satellite operators may require a better performance.

Verification:

The test method specified in subclause 6.4 of ETS 300 456 [3] shall apply.

7 Mechanical

7.1 Pointing stability

Purpose:

To prevent interference from adjacent satellites during severe wind conditions.

Specification:

This specification applies if required by the manufacturer.

Under the condition of 100 km/h maximum wind speed, with gusts of 130 km/h lasting 3 seconds, the installation shall not show any sign of permanent distortion and shall not need re-pointing after the application of the wind load.

Verification:

The test method specified in subclause 7.4 of ETS 300 456 [3] shall apply.

7.2 Antenna pointing accuracy capability

Purpose:

To enable precise antenna pointing in order to avoid interference from adjacent satellites.

Specification 1:

Main beam pointing accuracy.

This specification applies if required by the manufacturer.

The antenna mount shall allow the position of the antenna main beam axis to be fixed with an accuracy of at least 0,1° along the geostationary orbit. A pointing accuracy of better than 0,1° if declared by the manufacturer shall be recorded in the test report.

Specification 2:

Non-symmetrical main beam orientation.

This specification applies to antennas designed for minimum off-axis gain in the direction of the geostationary orbit (e.g. elliptical antennas). The plane bisected by the main beam axis and where the off-axis gain is minimum shall be marked on the antenna. There shall be an axis of rotation along or parallel to the main beam axis, with adjustment capability to an accuracy of 0,5°. The antenna shall be capable of having the above plane aligned with the geostationary orbit plane.

Verification:

The test method specified in subclause 7.3 of ETS 300 456 [3] shall apply.

7.3 Linear polarization angle alignment capability

Purpose:

To enable precise antenna linear polarization alignment in order to avoid interference to and from the same satellite and also adjacent satellites.

Specification 1:

This specification applies if required by the manufacturer.

When linear polarization is used, the polarization angle shall be continuously adjustable in a range of at least 180°.

Specification 2:

This specification applies if required by the manufacturer.

When linear polarization is used, it shall be possible to fix the antenna polarization angle with an accuracy of at least 1°.

Verification:

The test method specified in subclause 7.5 of ETS 300 456 [3] shall apply.

8 Control and monitoring

A requirement for control and monitoring functions does not exist.

History

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