



EUROPEAN
TELECOMMUNICATION
STANDARD

DRAFT
pr **ETS 300 333**

June 1996

Second Edition

Source: ETSI TC-SES

Reference: RE/SES-00013

ICS: 33.060.30

Key words: satellite, earth station, VSAT, RO, radio

**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 draft 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), and is now submitted for the Public Enquiry phase of the ETSI standards approval procedure.

Proposed transposition dates	
Date of latest announcement of this ETS (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this ETS (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	6 months after doa

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1 Scope

This European Telecommunication Standard (ETS) provides specifications for the standardization of the characteristics of Receive-Only (RO) 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), 3,625 to 4,200 GHz (Space-Earth);
- in this frequency band circular and linear polarisation are used and the system operates through satellites at 3° spacing;
- designed usually for unattended operation;
- antenna diameter not exceeding 7,3 m, or equivalent corresponding aperture.

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.

EMC specifications are contained in ETS 300 673 [2].

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] prETS 300 673: "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:

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

It usually comprises two main parts:

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

indoor unit: Is composed of the remaining part of the VSAT. It is generally installed inside the buildings and is connected to the outdoor unit. The connection cable between the outdoor and indoor unit belongs to the indoor unit.

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

- the equipment cannot be used on a stand alone basis to provide user functions independently of a VSAT; and
- the absence of the equipment does not inhibit the operation of the VSAT.

cross-polarisation discrimination: The ratio of the on-axis co-polar gain to the cross-polar gain in a given direction, at a receive frequency. It is usually expressed in dB.

3.2 Abbreviations

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

EIRP	Equivalent Isotropically Radiated Power
FS	Fixed Service
FSS	Fixed Satellite Service
ITU	International Telecommunication Union
ITU-R	ITU Radiocommunication Sector
LNB	Low Noise Block (low noise amplifier and down converter)
RF	Radio Frequency
RO	Receive-Only
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.

Specification:

This specification applies to the outdoor unit only.

The outdoor unit, including mounted and structural components, (but excluding the means of attachment) 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 off-axis spurious Equivalent Isotropically Radiated Power (EIRP) from the VSAT, in any 100 kHz band, shall not exceed the limits in table 1, for all off-axis angles greater than 7°:

Table 1

Frequency band	EIRP limit (dBpW)
960,0 MHz 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.

- b) 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 and from the same and adjacent satellites.

Specification 1: Protection from terrestrial services, mean values:

This specification applies if required by the manufacturer.

The gain $G(\Phi)$ 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 2:

Table 2

Direction (Φ)	Receive gain (dBi)
$2,8^\circ \leq \Phi \leq 7^\circ$	$29 - 25 \log \Phi$
$7^\circ < \Phi \leq 9,2^\circ$	8
$9,2^\circ < \Phi \leq 48^\circ$	$32 - 25 \log \Phi$
$\Phi > 48^\circ$	- 10

For $\Phi > 70^\circ$ 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 $G(\Phi)$ in dB relative to an isotropic antenna of at least 90 % of the peaks shall not exceed the limits in table 3:

Table 3

Direction (Φ)	Cross-polar gain (dBi)
$2,8^\circ \leq \Phi \leq 7^\circ$	$19 - 25 \log \Phi$
$7^\circ < \Phi \leq 9,2^\circ$	- 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 $2,8^\circ$ 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 $2,8^\circ$ and 20° need only be met within $\pm 3^\circ$ of a plane bisected by the main beam axis. This plane shall be marked and identified 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 $0,5^\circ$. 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 polarisation discrimination

Purpose:

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

Specification:

This specification applies if required by the manufacturer.

When linear polarisation is used, the polarisation discrimination of the antenna system in the receive frequency band shall exceed 27 dB within the -1 dB contour of the main beam.

When circular polarisation is used, for antenna diameter larger than 2,5 meters, the axial ratio shall not exceed 1,09.

NOTE: Some satellite operators may require a higher ratio.

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 make possible precise antenna pointing in order to avoid interference from adjacent satellites.

Specification:

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 better than 0,3° along the geostationary orbit.

Verification:

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

7.3 Linear polarisation angle alignment capability

Purpose:

To make precise antenna linear polarisation 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 polarisation is used, the polarisation angle shall be continuously adjustable in a range of at least 180°.

Specification 2:

This specification applies if required by the manufacturer.

When linear polarisation is used, it shall be possible to fix the antenna polarisation 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

Document history	
December 1994	First Edition
June 1996	Public Enquiry PE 108: 1996-06-24 to 1996-10-18