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Foreword

This European Telecommunication Standard (ETS) has been produced by the Satellite Earth Stations (SES) Technical Committee of the European Telecommunications Standards Institute (ETSI), and, has undergone the ETSI standards approval procedure in Public Enquiry 19 and Vote 25.

Every ETS prepared by ETSI is a voluntary standard. This ETS may contain text concerning type approval of the equipment to which it relates. This text should be considered only as guidance and does not make this ETS mandatory.

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1 Scope

The scope of this European Telecommunication Standard (ETS) is to give minimum specifications for the standardisation of the technical characteristics of satellite receiving earth stations, capable of receiving audiovisual signals and associated data.

The equipment considered in this ETS, is confined to the "outdoor unit" that consists of the antenna with the feed and the low-noise amplifier with its associated down-converter, referred to as Low-Noise Block converter (LNB).

The output interface towards the indoor unit is defined at the LNB output connector. Consequently the coaxial cable link to the "indoor unit", the intermediate frequency amplifier and the demodulator are not covered in this ETS.

Standards for the "indoor unit" are the responsibility of CENELEC.

This ETS is applicable to earth stations which receive audiovisual programmes in the Fixed Satellite Services (FSS) frequency ranges, from 10,70 GHz to 11,70 GHz and from 12,50 GHz to 12,75 GHz (Ku band).

The Television Receive Only (TVROs) are classified into two different types according to the corresponding services:

Type A for collective reception, in particular:

- cable distribution head ends (Community Antenna Television: CATV);
- community reception systems (Master Antenna Television: MATV).

Type B for individual reception, i.e. Direct-To-Home (DTH) equipment.

A clear distinction is made, wherever applicable between specifications for Type A and for Type B in the various Clauses of this ETS.

The received television signals can be PAL, SECAM, NTSC or the different MAC systems, all with the associated TV sound, and possibly other audio programmes.

Any other new TV systems (e.g. digital) may be received in the future, provided those systems operate with the FSS ku band.

Data may be present as coded signals inside television signals.

This ETS specifies:

a) Requirements (indicated in Clause 5)

The requirements cover mechanical, electrical safety and the interface with the indoor unit as well as some electromagnetic compatibility aspects.

The test and measurement procedures associated with the normative requirements detailed in Clause 5 of this ETS, shall be met in order to qualify compliance with this ETS.

b) Recommendations (indicated in Clause 6)

The recommendations are related to the quality of reception and are intended to assist manufacturers harmonise equipment design and to enable equipment distributors and end-users to better determine equipment performance.

The test and measurement procedures associated with the informative recommendations detailed in Clause 6 of this ETS, are given for verification purposes only. The compliance with the recommendations will not be taken as a condition to comply with the standard for TVRO equipment.

All the tests related to the requirements shall be performed and the results entered in the data sheet of the test report. The ability to comply with recommendations shall also be noted in the data sheet of the test report.

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] IEC 510-1 (1975): "Methods of measurement for radio equipment used in satellite earth stations. Part 1: General".

IEC 510-1-A (1980): "First supplement: d.c. source conditions".

[2] IEC 1079 (1992): "Recommended methods of measurement on receivers for satellite broadcast transmissions in the 12 GHz band. Part 1: Radio frequency measurements on the outdoor unit".

[3] IEC 107-1 (1977): "Recommended methods of measurement on receivers for television broadcast transmissions. Part 1: General considerations. Electrical measurements other than those at audio-frequencies".

[4] prEN 50083-1 (1991): "Cabled distribution systems for television and sound signals. Part 1: Safety requirements".

[5] a) IEC 68 - 1 (1988): "Environmental testing; Part 1: General and guidance".

b) IEC 68 - 2 - 52 (1984): "Test Kb: salt mist, cyclic (sodium chloride solution)".

[6] a) IEC 695-1-1 (1982): "Fire hazard testing; Part 1: General guidance".

b) CENELEC-HD 444.2 (1, 2, 3) S1: IEC 695-2 (1 (1980), 2 (1980), 3 (1984)) ed1: "Fire hazard testing. Part 2: test methods".

[7] IEC 510-1-2 (1984): "Part 1: Measurements common to sub-systems and combinations of sub-systems. Section 2 - Measurements in the R.F. range".

[8] prEN 50083-2 (1991): "Cabled distribution systems. Part 2: EMC for components and systems".

[9] CISPR No.16 (1987): "Specifications for radio interference measuring apparatus and measurements methods".

[10] CENELEC EN 55011 (1991): "Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio frequency equipment".

[11] IEC 510-2-1 (1978): "Part 2: Measurements for sub-systems. Section 1 - General. Section 2 - Antenna (including feed network)".

[12] IEC 510-1-5 (1988): "Part 1: Measurements common to sub-systems and combinations of sub-systems. Section 5: Noise temperature measurements".

[13] a) IEC 154-2 (1980): "Part 2: Relevant specifications for flanges for ordinary rectangular waveguides".

b) IEC 154-4 (1969): "Part 4: Relevant specifications for flanges for circular waveguides".

[14] IEC 510-2-4 (1988): "Part 2: Measurements for sub-systems; Section 4: Up-and-down-converters".

[15] CENELEC EN 50081-1 (1991): "Electromagnetic compatibility - Generic emission standard. Part 1: residential, commercial and light industry".

[16] CENELEC EN 50082-1 (1991): "Electromagnetic compatibility - Generic immunity standard. Part 1: residential, commercial and light industry".

[17] Draft IEC 933 Part X: "Audio, video and audio visual systems. Interconnections of satellite receiving equipment".

[18] CENELEC EN 55020 (1988): "Immunity from radio interference of broadcast receivers and associated equipment".

3 Definitions

For the purposes of this ETS, the following definition applies.

Outdoor unit: is the part of the TVRO installed in a position within line of sight to the satellite(s) to be received.

It normally comprises two main parts:

1) the antenna sub-system which converts the incident radiation field into a guided wave. The antenna sub-system consists of:

   - the main reflector, the secondary reflectors (if any) and the radiator;

   - the feed network; which may include optional polarising devices, to receive orthogonal linear polarisations, in a simultaneous or exclusive way.

   Instead of reflector(s) / feed network sub-system, other types of antennas may be used e.g. flat array antennas;

2) the LNB(s), which may include an optional filter, is a device with very low internal noise that amplifies the received signals in the Radio Frequency (RF) band and converts them to intermediate frequencies, (often called the 1st IF), for transmission to one or more indoor units where tuning, emodulation and decoding of the received signals are performed.

   NOTE: The installation equipment (means of attachment) is not included in this ETS. However, the antenna structures and other components directly mounted in the antenna and forming an integral part of it, are subject to the specifications of this ETS. These include, in particular, the antenna pointing facilities.

4 General conditions for measurement

4.1 General

The measurements shall be carried out under "standard atmospheric conditions" with respect to temperature, air pressure, humidity etc., as stated in IEC 68-1 [5a], subclauses 5.2, 6.1, and 6.2.

Other conditions such as power supply, output port load, test site, accuracy of measuring instruments, stabilisation period, presentation of results, radio frequency input signals, are also indicated in Annex A.

NOTE 1: Partial testing of the outdoor unit is permitted where it can be shown that relevant test evidence already exists for the component parts such as antenna sub-system and mount or the LNB (see subclause 3.1 for definitions).

NOTE 2: In the case where the outdoor unit is manufactured without an accessible interface between the antenna sub-system and the LNB, it is impossible to carry out the verification of some specifications. In this case, the manufacturer is required to provide suitable fixtures.

5 Requirements

5.1 General

The requirements specified in this ETS mainly concern the following:

- the inherent mechanical and electrical safety of the outdoor unit;
- radiation characteristics and immunity to electromagnetic disturbances of the outdoor unit;
- compatibility with the indoor unit.

5.2 Safety

5.2.1 Purpose

In accordance with prEN 50083-1 [4], Clause 3, the outdoor unit shall be so designed, constructed and installed as to present no danger, either in normal use or under any fault condition, to users, personnel working on or externally inspecting the equipment, or to any person or property, providing particularly:

- protection against electrical shock by access and lightning;
- protection against physical injury or property damage.

NOTE: The above does not apply to trained, authorised personnel working on the equipment, who may be exposed to live parts of the equipment by the removal of protective covers.

5.2.2 Mechanical safety

5.2.2.1 Specification

In accordance with prEN 50083-1 [4], subclause 3.1, all parts of the outdoor unit shall be so constructed that there is no danger of physical injury from contact with sharp edges or corners.

5.2.2.2 Verification

By physical inspection. Conformance shall be entered in the data sheet of the test report.

5.2.3 Mechanical construction

5.2.3.1 Purpose

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

5.2.3.2 Specifications

5.2.3.2.1 Specification 1: Outdoor unit test

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.

For the purpose of establishing outdoor unit loading (W), the following pressure values shall be used.

If the outdoor unit is installed up to 20 m above the ground level, the value of p (wind pressure) shall be assumed to be 800 Pa (wind speed 130 km/h).

If the outdoor unit is installed higher than 20 m above the ground level, the value of p (wind pressure) shall be assumed to be 1 100 Pa (wind speed 150 km/h). The coefficient c to be used in the formula "W = c x p x A", is 1,2. In this formula:

W is the wind load in Newtons (N)
c is the area correction coefficient (c = 1,2)
p is the wind pressure in Pascals (Pa)
A is the component area (m^2)

NOTE: Where adverse environmental conditions apply, a higher wind pressure value may need to be assumed, e.g.:

- a wind pressure shall be 1 250 Pa corresponding to a wind speed of 160 km/h;

- a wind pressure shall be 1 900 Pa corresponding to a wind speed of 200 km/h.

At the maximum applicable wind pressures none of the components shall be torn away. This condition is referred to as the "survival condition".

The maximum installation height of the antenna and the maximum wind speed shall be those declared by the manufacturer. These limits shall be indicated in the data sheet of the test report and in the manufacturers information leaflet (see subclause 6.1.2).

5.2.3.2.2 Specification 2: Mechanical loads at the interface of the attachment devices

The mechanical loads at the interface of the attachment device, shall be entered as values in the data sheet of the test report and in the manufacturers information leaflet (see subclause 6.1.2).

5.2.3.3 Verification

Two alternative methods are proposed for verification.

a) Wind tunnel testing.

A wind tunnel is used for the purpose of conformance testing. The wind tunnel tests shall be performed on the outdoor unit. The data obtained for the scale-model shall be computed in order to obtain data for the true antenna size.

b) Numerical analysis and simplified tests.

This method is to provide an alternative to the wind tunnel test.

In the first step the effects of maximum wind load shall be computed on the overall outdoor unit using a numerical analysis method (finite elements method by computer) taking into account the intrinsic properties of the materials.

The purpose of the numerical analysis is twofold:

1) to show that the fields of forces and torques applied to the outdoor unit structure under nominated conditions do not reach the breakpoint limit of any element of the structure;

2) to compute equivalent static loads (force and torque) applied to the critical attachment points of the structures, e.g:

- reflector - mounting legs fixing points;
- reflector - struts;
- struts - LNB.

In the second step, the computed loads shall be applied to the structure.

5.2.3.3.1 Wind tunnel test procedure

The test object shall be mounted in such a way that wind load can be applied from all horizontal directions in steps of 45°. The tests shall be carried out with the elevation angle of the antenna at its minimum and at its maximum in turn. The wind load shall be increased gradually in steps up to the maximum pressures defined in subclause 5.2.3.2, each step lasting approximately one minute.

The tests may be performed at any atmospheric temperature and air pressure. If the atmospheric conditions differ from standard reference conditions (temperature = 293 K, air pressure = 1,013 x 10^5 Pascals), then the test velocity shall be determined according to the formula:

$$V_T = V_S \times \sqrt{(1{,}013 \times 10^5 / P_T) \times (T_T / 293)}$$

where: V_T = wind velocity under test;
V_S = wind velocity under standard conditions;
P_T = air pressure at the test site in Pascals;
T_T = temperature at the item under test in Kelvins.

During the load conditions the test object shall be observed and the distortions recorded.

The test report shall contain:

- description of the test equipment;
- description of the tests performed;
- results of the measurements or calculations on the mechanical loads transmitted from the outdoor unit to the attachment devices.

For the antenna pointing and efficiency stability verification see subclause 6.6.8.3.

5.2.3.3.2 Numerical analysis procedure

The computations needed to derive the field of forces and torque and the equivalent static stresses shall be carried out for the same wind directions and elevations as specified in the wind tunnel test procedure (see subclause 5.2.3.3.1 above). Only the maximum pressures defined in subclause 5.2.3.2 shall be considered. The air related parameters, namely the kinematic viscosity used to calculate drags at the rims of the structure shall be calculated with the atmospheric environmental conditions given in subclause 5.2.3.2. It shall be specified with the simulated results that break point limits are not exceeded for any self-contained element. During the practical test the calculated equivalent static loads shall be applied at any critical fixing point of the assembly.

During the load conditions, the outdoor unit shall be observed, and any distortion recorded.

The test report shall contain:

- the computation method used;
- description of the test equipment;
- description of the test performed;
- results of the safety margin calculation;
- results of the measurements or calculations on the mechanical loads transmitted from the outdoor unit to the attachment devices.

For the antenna pointing and efficiency stability verification see subclause 6.6.8.3.

NOTE: Where adverse environmental conditions apply, a higher wind pressure value may need to be assumed, e.g.:

- a wind pressure shall be 1 250 Pa corresponding to a wind speed of 160 km/h;
- a wind pressure shall be 1 900 Pa corresponding to a wind speed of 200 km/h.

5.2.4 Electrical shock by access

5.2.4.1 General

The equipment covered by this ETS will be used as part of a system which shall comply with the requirements of prEN 50083-1 [4]. The particular aspects relevant to the outdoor unit are generally covered in this subclause 5.2.4.

Electrical shock is due to current passing through the human body. Currents of the order of a milliampere can cause a reaction in persons in good health and may cause indirect injury due to involuntary reaction. Higher currents can cause more serious injuries.

Voltages up to about 40 V peak, or 60 V dc, are not generally regarded as dangerous under dry conditions, but all accessible parts which have to be touched or handled should be at earth potential or properly insulated.

The LNB is fed from a low voltage dc source not exceeding 60 V, but higher voltages could be used for feeding auxiliary devices like a re-pointing motor or a de-icing system. Where voltages higher than 60 V are used, other requirements of prEN 50083-1 [4] shall be considered.

5.2.4.2 Specification

In accordance with prEN 50083-1 [4], subclause 3.2, a standard test finger shall not make contact with any live interior part or parts of the outdoor unit which are accessible to the general public without first removing a protection cover by the use of a tool.

5.2.4.3 Verification

Compliance shall be entered in the data sheet of the test report.

5.2.5 Lightning protection

5.2.5.1 General

In accordance with prEN 50083-1 [4], Clause 10, the lightning protection requirement is intended to protect only the outdoor unit, excluding the building and other structures. To avoid dangerous potential differences between the outdoor unit and any other conducting structure, it is necessary to connect a bonding conductor between the outdoor unit and the Lightning Protection System (LPS) of the building.

5.2.5.2 Specification

Means shall be provided to permit the attachment of bonding conductors of dimensions indicated in prEN 50083-1 [4], subclause 5.2.7.

5.2.5.3 Verification

Compliance shall be verified by inspection.

5.2.6 Solar radiation protection

5.2.6.1 Purpose

Protection of operating personnel and the public from solar radiation focusing effects.

5.2.6.2 Specification

If, in conditions of sunshine, solar radiation is focused near the feed such that burning may occur, the equipment must be fitted with a warning notice in a clearly visible position.

5.2.6.3 Verification

Statement that the surface of the antenna has been treated to avoid the situation, or visual inspection to confirm presence of warning notice.

5.2.7 Adverse conditions

5.2.7.1 General

In accordance with prEN 50083-1 [4], Clause 4, an outdoor unit, if exposed to weather, especially corrosive atmosphere, adverse temperature or other adverse conditions, shall be so constructed or protected as may be necessary to prevent danger to persons and property arising from such exposure. The sequence of failure due to structural corrosion or other adverse conditions shall be so designed to interrupt the satellite reception prior to a complete or partial break-away of the outdoor unit, thereby providing the user with a degree of warning of impending structural failure in the normal wind conditions.

For general guidance on environmental testing procedures, and for corrosion resistance testing see IEC 68-1 [5a] and IEC 68-2 [5b]. For fire hazard testing see IEC 695-1-1 [6a] and IEC 695-1-2 [6b].

5.2.7.2 Corrosion resistance

5.2.7.2.1 Specification

Materials and finishes used in manufacture of the outdoor unit shall be suitable for salt laden atmospheres and should provide a design life of at least 5 years at coastal sites.

5.2.7.2.2 Verification

By documentary evidence provided by the manufacturer.

5.2.7.3 Fire hazard

5.2.7.3.1 Specification

The outdoor unit shall be made of material with limited ignitability.

5.2.7.3.2 Verification

By documentary evidence provided by the manufacturer.

5.3 Local Oscillator(s) (LO) frequency

5.3.1 Frequency spectrum

5.3.1.1 Purpose

To ensure compatibility with the sense of modulation required by the indoor unit.

5.3.1.2 Specification

The RF spectrum of a signal received by the outdoor unit shall not be inverted at the outdoor unit output.

5.3.1.3 Verification

The nominal value of each LO frequency shall be indicated in the data sheet of the test report.

5.3.2 Frequency conversion tolerance

5.3.2.1 General

This parameter determines the acceptable variations (to ensure compatibility with the indoor unit) of the local oscillator frequency of the outdoor unit, due to:

- environmental temperature variations;
- power supply voltage variations;
- setting error;
- ageing.

5.3.2.2 Purpose

To allow the indoor unit to perform correct channel selection and automatic frequency control.

5.3.2.3 Specification

The conversion frequency (i.e. the difference between the frequency of an input signal and the output frequency of that signal) shall not deviate by more than ± 5 MHz from its nominal value with the following factors taken into account:

a) temperature variations in the range - 20° C to + 55° C;

b) supply voltage variations: as stated by the manufacturer;

c) LO setting error: as stated by the manufacturer;

d) ageing.

The deviation of the conversion frequency from the nominal value due to a) and b) above together shall not exceed ± 3 MHz.

The nominal frequency difference between the input and the output of the LNB and of its tolerance shall be entered in the data sheet of the test report.

5.3.2.4 Verification

For a) and b), in subclause 5.3.2.3: by measurement, as indicated in IEC 1079 [2], subclause 3.1.2.

For c), in subclause 5.3.2.3: by statement of the manufacturer.

For d), in subclause 5.3.2.3: by analysis based on manufacturers stated value for c).

NOTE: Alternative measurement methods which may be proven to give the same results can be used. The method used shall be indicated in the data sheet of the test report.

5.4 Radiation from the outdoor unit

5.4.1 General

For definition of radiation see prEN 50083-2 [8], Clause 3.

The unwanted radiations are the following:

- local oscillator leakage emitted on the main beam axis, ± 7°, of the receiving antenna;
- any other radiation from the outdoor unit in any other direction.

These radiations may produce interference to other services operating in the vicinity, either in the same or in other bands.

NOTE: Due attention shall be paid to radiations which may come from auxiliary devices. The relevant document is CENELEC EN 50081-1 [15].

5.4.2 Purpose

To limit the maximum permissible radiation level from the outdoor equipment in order to protect the radio electrical spectrum from uncontrolled pollution.

5.4.3 Unwanted radiation including Local Oscillator (LO) leakage radiated from the antenna

5.4.3.1 General

The power of the LO leakage and other unwanted radiation, after passing through the band-pass filter, the RF waveguides and the polariser, is radiated by the TVRO antenna.

The unwanted radiation at the LO frequency could possibly interfere with nearby TVROs receiving signals in different frequency ranges, as well as line of site radio-relay receivers.

The unwanted radiation at the second harmonic of the LO could interfere with line-of-site radio-relay receivers working in the region of 20 GHz band.

5.4.3.2 Specification

The maximum value of the unwanted radiation, including the LO frequency as well as its second and third harmonics, measured at the antenna flange (including the polariser, orthomode transducer, band-pass filter, RF waveguides) shall be as follows:

- the fundamental shall not exceed - 60 dBm in a 120 kHz bandwidth; and,

- the second and third harmonics shall not exceed - 50 dBm in a 120 kHz bandwidth.

This specification applies to the frequency range from 2,5 GHz to 40 GHz.

5.4.3.3 Verification

The value of the unwanted radiated power shall be measured in one of the two following ways:

a) Direct method

Measurement of the unwanted power at the antenna flange or at a similar interface between the antenna and the LNB e.g. the input to the LNB. Due allowance shall be made for the feed losses between the available interface and the antenna flange.
The measurement of the unwanted power level shall be performed as indicated in IEC 510-1-2 [7], subclause 5.2.2.

b) Indirect method

In case of unavailability of a suitable interface between the LNB and the antenna the level of the unwanted radiation at the antenna flange shall be calculated by measurement of the unwanted power radiated by the antenna and the knowledge of the antenna gain at that frequency. The unwanted radiation power shall be measured as indicated in prEN 50083-2 [8], subclause 4.8, (see Annex B (normative)).

NOTE: Measurement methods for the frequency range 18 GHz to 40 GHz are under consideration.

5.4.4 Radiation from outdoor unit (EIRP)

5.4.4.1 Specification

In accordance with the specification in prEN 50083-2 [8], subclause 8.1, the Equivalent Isotropically Radiated Power (EIRP) of each individual unwanted signal radiated by the outdoor unit within the band from 30 MHz to 40 GHz, shall not exceed the following values measured in a 120 kHz bandwidth (see [9]):

- 20 dBpW in the range 30 MHz to 960 MHz;
- 43 dBpW in the range > 960 MHz to 2,5 GHz;
- 57 dBpW in the range > 2,5 GHz to 40 GHz.

The lower limits apply at the transition frequency.

This specification applies to all directions except the antenna on-axis directions within the range ± 7°. Recommendation limits are given in subclause 6.5.

5.4.4.2 Verification

For the frequency range from 30 MHz to 1 GHz, measurements shall be carried out as indicated in prEN 50083-2 [8], subclauses 4.6 and 4.7, (see Annex C (normative)).

For the frequency range from 1 GHz to 18 GHz, measurements shall be carried out as indicated in prEN 50083-2 [8], subclause 8.2, (see Annex B (normative)).

NOTE: Measurement methods and bandwidths for the frequency range 18 GHz to 40 GHz are under consideration.

5.5 Immunity

5.5.1 Definitions

The following definitions apply, in accordance with prEN 50083-2 [8], subclause 3.

The "immunity" of a device is its ability to resist an electromagnetic disturbance.

a) The "internal immunity" of a device is its ability to resist an electromagnetic disturbance appearing at its normal input terminals or antenna.

b) The "external immunity" of a device is its ability to resist electromagnetic disturbance appearing other than at its normal input terminals or antenna.

c) The "immunity level" is the maximum value of a given electromagnetic disturbance incident on the device, equipment or system considered for which it remains capable of operating at a required degree of performance.

For internal immunity see subclause 6.8.

NOTE: The immunity of the auxiliary devices shall also be considered. The relevant document is CENELEC EN 55020 [18].

5.5.2 External immunity to ambient fields

5.5.2.1 General

As stated in prEN 50083-2 [8], subclause 6.1.4, the "external immunity level" to ambient fields corresponds to the value of the incident electromagnetic disturbance, which produces a just perceptible disturbance at the output of the LNB, when the minimum level of the wanted signal is applied to its input.

It is assumed that the just perceptible disturbance corresponds to an RF wanted to unwanted signal ratio of 35 dB in the FSS-RF or IF band.

5.5.2.2 Specification

Type A:

In accordance with prEN 50083-2 [8], subclause 8.2.1.1, the minimum ambient field that produces a just perceptible disturbance shall not be less than:

Frequency range	Minimum Field strength
> 0,15 MHz to 2 000 MHz	130 dBµV/m

Type B:

In accordance with CENELEC EN 55020 [18] Clause 7, the minimum ambient field that produces a just perceptible disturbance shall be defined by the following characteristics:

Frequency range	Minimum field strength
> 0,15 MHz to 150 MHz	125 dBµV/m

The interfering signal shall be Amplitude Modulated (AM) with a 1 kHz tone, depth 80 %.

5.5.2.3 Verification

Type A: by measurement, as indicated in prEN 50083-2 [8], subclause 6.2

Type B: by measurement, as indicated in CENELEC EN 55020 [18], subclause 9.2 and Clause 13.

5.5.3 External immunity to currents conducted via connected cables

5.5.3.1 General

Ambient RF radiation and induction fields can induce currents into the output cable. This is due mainly to its poor screening effectiveness. This does not apply to the mains lead connection.

5.5.3.2 Specification

Type A:

In accordance with prEN 50083-2 [8], subclause 8.2.1.2, at each interference frequency the immunity, expressed as the electro-motive force (e.m.f.) value of the 150 Ω interference source in dBµV which produces a just perceptible disturbance at the output of the LNB, shall have a value not less than the following, when the minimum level of the wanted signal is applied to its input:

Frequency range (MHz)	Level (dBµV)
0,15 to 1,5	under consideration (u.c)
> 1,5 to 230	125
> 230 to 2 500	u.c

Type B:

In accordance with CENELEC EN 55020 [18], Clause 6, the immunity, expressed as the electromotive force (e.m.f) value of the 150 Ω interference source in dBµV which produces a just perceptible disturbance at the output of the LNB, shall be defined by the following characteristics when the minimum level of the wanted signal is applied to the input of the LNB:

Frequency range (MHz)	Level (dBµV)
26 - 30	126

The interfering signal shall be Amplitude Modulated (AM) with a 1 kHz tone, depth 80 %.

5.5.3.3 Verification

Type A: by measurement, as indicated in prEN 50083-2 [8], subclause 6.3.

Type B: by measurement, as indicated in CENELEC EN 55020 [18], subclause 9.2 and Clause 12.

5.6 Documentation

5.6.1 Purpose

To give to the installers and end-users, the essential information for installation and safety.

5.6.2 Specification

The manufacturer shall supply an information leaflet with each equipment. This leaflet shall contain those items which are mentioned under Requirements in subclauses 5.2.3.2.1 and 5.2.3.2.2.

6 Recommendations

Recommendations are related to the quality of reception and harmonisation of basic parameters. They are intended to assist manufacturers to harmonise equipment design and to enable equipment distributors and end-users to better determine equipment performance.

6.1 Documentation

6.1.1 Purpose

To assist manufacturers to harmonise equipment design and to enable equipment distributors and end-users to better determine equipment performance and assist in the installation of the equipment.

6.1.2 Specification

The manufacturer should supply with each equipment, the information leaflet mentioned in subclause 5.6. This leaflet should contain the information listed in table 1. All the data should be values declared by the manufacturer.

6.1.3 Verification

By documentary evidence provided by the manufacturer.

Table 1: Contents of the information leaflet

	Reference for measurement
- Antenna sub-system	
- Mechanical characteristics	
- Antenna pointing accuracy and stability	see subclause 6.6.7.3
- Polarisation angle capability	see subclause 6.6.9.4
- Installation instructions	
- Wind speed ratings (mandatory)	see subclause 5.2.3.3
- Mechanical loads transmitted from the outdoor unit to the attachment devices (mandatory)	see subclause 5.2.3.3
- Attachment plan	
- Radio frequency interface	
- Radio frequency bands	see subclause 6.2.3
- Type of polarisation	see subclause 6.6.3.3
- Co-polar on-axis gain	see subclause 6.6.4.3
- Antenna receive gain pattern	see subclause 6.6.5.5
- Cross-polarisation discrimination	see subclause 6.6.6.3
- Output interface (if this interface can be reached) of waveguide flange	
- Type of waveguide flange	see subclause 6.6.10.3
- Power supply for auxiliary devices (actuator motor)	
- Voltage, polarity, current	see subclause 6.9.2.3
- LNB	
- Input interface (if this interface can be reached)	
- Type of waveguide flange	see subclause 6.7.10.3
- Radio frequency input range(s)	see subclause 6.2.3
- Noise figure (temperature)	see subclause 6.7.5.3
- Image frequency rejection	see subclause 6.7.6.3
- Transfer characteristics	
- L0 Frequency	see subclause 6.3.3
- Frequency conversion tolerance	see subclause 5.3.2.4
- Small signal gain	see subclause 6.7.8.3
- Amplitude - frequency characteristic	see subclause 6.7.9.3.2
- Group delay characteristic	see subclause 6.7.9.4.2
- Multicarrier intermodulation ratio	see subclause 6.7.9.5.2
- Intermediate frequency output interface	
- Intermediate frequency output range(s)	see subclause 6.3.3
- Output maximum level	see subclause 6.7.7.4
- Image frequency rejection	see subclause 6.7.6.3
- Type of connector	see subclause 6.7.11.2.3
- Impedance and return loss	see subclause 6.7.11.3.3
- Power supply for the LNB	
- Voltage, polarity, current	see subclause 6.9.1.3
- Power supply for commands (switching of LO, switching of polarisation...)	
- Voltage, polarity, current	see subclause 6.10.4
- Outdoor unit - Global quality	
- Figure of merit (G/T)	see subclause 6.4.4
- Environmental information	see IEC 68-1 [5a], subclause 4.3

6.2 Radio frequency input range(s)

6.2.1 Purpose

To enable reception of signals transmitted on the FSS Ku band.

6.2.2 Specification

The outdoor unit should be able to receive simultaneously signals in the frequency ranges from 10,70 GHz to 11,70 GHz, and from 12,50 GHz to 12,75 GHz, or parts thereof. For example, in the range from 10,95 GHz to 11,70 GHz, or in the range from 12,50 GHz to 12,75 GHz.

6.2.3 Verification

The frequency range(s) covered should be entered in the manufacturer's information leaflet.

6.3 Intermediate Frequency (IF) output range

6.3.1 Purpose

To ensure compatibility with the indoor unit input frequency range.

6.3.2 Specification

The IF at the LNB output should be in the range from 950 MHz to 1 750 MHz, or parts thereof.

NOTE: This recommendation is based on current technology and should not exclude improved equipment designs which allow a wider IF range, (e.g. from 950 MHz to 3 000 MHz) to facilitate simultaneous reception of the two RF input ranges, defined in subclause 6.2.

6.3.3 Verification

The IF frequency range(s) should be entered in the manufacturer's information leaflet.

6.4 Figure of merit

6.4.1 General

The figure of merit (G/T) of the outdoor unit is the ratio between the antenna sub-system on-axis gain (G) and the outdoor unit total equivalent noise temperature under clear sky conditions (T), referred to the same point of the antenna sub-system output. The required G/T value depends on the received signal characteristics and on the quality requirements.

6.4.2 Purpose

To allow qualitative comparisons between different outdoor units.

6.4.3 Specification

The value across the frequency band (see subclause 6.2) of the outdoor unit figure of merit should be entered in the manufacturer's information leaflet, for 10° and 30° elevation angles.

6.4.4 Verification

- By direct measurement method, indicated in IEC 1079 [2], subclause 3.8 (see Annex D (normative));

- a simplified direct measurement method is also permitted, which is indicated in IEC 1079 [2], Amendment 1;

- by indirect measurement method, by separately measuring the antenna sub-system noise temperature (see Annex E (normative)), the antenna sub-system gain (see subclause 6.6.4), the LNB noise figure (see subclause 6.7.5) and appropriate calculation (see Annex F (informative)).

6.5 Radiation from outdoor unit

6.5.1 Specification

The Equivalent Isotropically Radiated Power (EIRP) of each individual unwanted signal radiated by the outdoor unit within the band from 30 MHz to 40 GHz, should not exceed the following values measured in a 120 kHz bandwidth (see CISPR No.16 [9]):

- 20 dBpW in the range 30 MHz to 960 MHz;

- 43 dBpW in the range > 960 MHz to 2,50 GHz;

- 45 dBpW in the range > 2,50 GHz to 10,70 GHz;

- 51 dBpW in the range > 10,70 GHz to 21,20 GHz;

- 57 dBpW in the range > 21,20 GHz to 40 GHz.

The lower limits apply at the transition frequency.

This specification applies to all directions except the antenna on-axis direction ± 7°.

6.5.2 Verification

For the frequency range from 30 MHz to 1 GHz, measurements should be carried out as indicated in prEN 50083-2 [8], subclauses 4.5 and 4.7, (see Annex C (normative)).

For the frequency range from 1 GHz to 18 GHz, measurements should be carried out as indicated in prEN 50083-2 [8], subclause 8.2, (see Annex B (normative)).

NOTE: Measurement methods and bandwidths for the frequency range 18 GHz to 40 GHz are under consideration.

6.6 Antenna sub-system

6.6.1 General

The antenna sub-system is defined in Clause 3, 1).

The output of the antenna sub-system is the waveguide output flange(s) of its feed, or an equivalent point, for instance in the case of a flat-array antenna.

6.6.2 Frequency-band(s)

See subclause 6.2.

6.6.3 Polarisation

6.6.3.1 Purpose

To enable the reception of signals transmitted by the FSS Ku band satellites transmitting linearly polarised waves.

6.6.3.2 Specification

The antenna sub-system should be designed to receive a linearly polarised electromagnetic field. The two orthogonal polarisations should be received although simultaneous reception of both polarisations is not necessary.

6.6.3.3 Verification

The manufacturer's information leaflet should state that linear polarisation is employed and if single or dual polarisation in employed.

6.6.4 Co-polar on-axis gain

6.6.4.1 Purpose

To allow the choice of the antenna sub-system in accordance with the wanted signal level.

6.6.4.2 Specification

The antenna co-polar on-axis gains should be indicated in the information leaflet, expressed in dB relative to an isotropic source (dBi), for the specified range(s) of frequency, and for the two linear polarisation planes.

6.6.4.3 Verification

By measuring the antenna sub-system receive co-polar on-axis gain at frequencies close to the edge of its frequency range(s), using one of the measurement methods indicated in IEC 510-2-1 [11], Clause 8.

NOTE: Alternative recognised methods which may be proved to give the same results can be used. The method used should be indicated in the data sheet of the test report.

6.6.5 Antenna gain pattern

6.6.5.1 General

This subclause applies only to Type A equipment, the applicable specification for Type B equipment is under consideration.

6.6.5.2 Purpose

To give a certain degree of protection of the wanted signals from interference from terrestrial services and from other satellites.

6.6.5.3 Specifications

6.6.5.3.1 Specification 1

At any frequency within the antenna sub-system receive frequency range(s) the gain G (ϕ) in dB relative to an isotropic antenna should not exceed the following limits:

$29 - 25 \log \phi$ for $2{,}80° \leq \phi \leq 7°$

$+ 8$ for $7° < \phi \leq 9{,}20°$

$32 - 25 \log \phi$ for $9{,}20° < \phi \leq 30°$

$- 5$ for $30° < \phi < 70°$

0 for $70° < \phi$

6.6.5.3.2 Specification 2

At any frequency within the antenna sub-system receive frequency range(s) the cross-polar gain G (ϕ) expressed in dB relative to an isotropic antenna should not exceed:

$19 - 25 \log \phi$ for $2{,}80° \leq \phi \leq 7°$

$- 2$ for $7° < \phi \leq 9{,}20°$

where ϕ is the angle in degrees between the main beam axis and the direction considered.

6.6.5.4 Design objective

The antenna discrimination, defined as the difference between the on-axis gain and the gain at an angular offset, ϕ, should be at least 28 dB for values of ϕ greater than or equal to 2,80°, see Annex G.

6.6.5.5 Verification

By measuring the antenna sub-system co-polar and cross-polar receive off-axis gain pattern at the centre frequency of each of the frequency range(s), and at three planes, two of them orthogonal and the other at 45°, using one of the measurement methods indicated in IEC 510-2-1 [11], Clause 8.

NOTE: Alternative recognised methods which may be proved to give the same results can be used. The method used should be indicated in the data sheet of the test report.

6.6.6 Cross-polarisation discrimination

6.6.6.1 Purpose

Protection of the wanted signals from interference from signals transmitted on the orthogonal polarisation on the same or on a co-located satellite.

6.6.6.2 Specification

At any frequency within the antenna sub-system receive bandwidth, the receive cross-polarisation discrimination everywhere within the main beam down to -1 dB contour should be at least:

- 25 dB for Type A equipment;

- 22 dB for Type B equipment.

The design objective within the -1 dB contour should be a cross-polarisation discrimination of:

- 30 dB for Type A equipment;

- 27 dB for Type B equipment.

6.6.6.3 Verification

By measuring the antenna sub-system receive polarisation discrimination at frequencies close to the edge and at the centre of the RF input frequency range(s), using one of the measurement methods in IEC 510-2-1 [11], Clause 7, or any other recognised method that can be proved to give the same results. The method used should be indicated in the data sheet of the test report.

6.6.7 Pointing accuracy capability

6.6.7.1 Purpose

To enable an accurate pointing of the antenna to the wanted satellite at the installation in order to provide the best possible reception of the wanted signal and to better avoid interference from signals transmitted on other satellites.

6.6.7.2 Specification

The antenna sub-system alignment facilities should enable the main beam axis to be adjusted and fixed with an accuracy of 10 % of the antenna main beam minimum half power beamwidth.

6.6.7.3 Verification

By documentary evidence provided by the manufacturer (drawings, calculations, tests, etc.). The setting accuracy should be indicated in the information leaflet.

6.6.8 Antenna pointing and efficiency stability under severe environmental conditions

6.6.8.1 General

Under severe environmental conditions, the pointing of the main lobe of the antenna and the shape of the reflector can be temporarily modified. Consequently, limits should be given for the pointing and efficiency decrease of the antenna system.

6.6.8.2 Specification

After application of 100 km/h max. wind speed, with gusts of 130 km/h, the installation should not show any sign of permanent distortion or loss of components and should not suffer a de-pointing greater than the pointing accuracy, as specified in subclause 6.6.7.2.

6.6.8.3 Verification

The section of the test report containing the results of testing procedures given in subclauses 5.2.3.3.1 and 5.2.3.3.2 should also contain:

- results of measurements or calculations of the deviations of the antenna position and components with respect to each other. The measured values should be indicated in the manufacturers information leaflet.

6.6.9 Polarisation plane alignment capability

6.6.9.1 Purpose

To enable reception of signals with different polarisations an accurate match of the receive antenna polarisation plane to the wanted satellite transmit polarisation plane should be performed (in order to take advantage of the antenna system polarisation isolation so as to protect the wanted signals from interference of signals transmitted on the orthogonal polarisation on the same or on a co-located satellite).

6.6.9.2 Specification 1

The receive polarisation plane of the antenna system should at least be continuously adjustable in a range of 180°.

6.6.9.3 Specification 2

It should be possible to fix the receive polarisation plane of the antenna system with an error of less than 1°.

6.6.9.4 Verification

By documentary evidence to be provided by the manufacturer (drawings, calculations, tests).

6.6.10 Output interface of antenna sub-system

6.6.10.1 Purpose

Harmonisation of the antenna sub-system output interface with the LNB input.

6.6.10.2 Specification

If a physical interface exists between the antenna sub-system and the LNB, and if waveguide is employed, then the flange should be type UBR 120, (rectangular), or C 120 without gasket groove (circular) as indicated in IEC 154-2 and 154-4 [13] (see Annex H (informative)).

6.6.10.3 Verification

The type of flange used should be entered in the manufacturer's information leaflet.

6.7 Low-Noise Block (LNB) down-converter

6.7.1 General

The input of the LBN down-converter is connected to the output waveguide flange of the antenna feed or an equivalent point in the case of flat-array antennas.

6.7.2 Radio frequency input frequency range

See subclause 6.2.

6.7.3 Intermediate frequency output range

See subclause 6.3.

6.7.4 Frequency conversion tolerance

See subclause 6.3.2.

6.7.5 LNB noise temperature, or noise figure

6.7.5.1 Purpose

To allow the correct choice of the LNB, in accordance with the wanted G/T.

6.7.5.2 Specification

The worst case of the LNB noise temperature, or noise figure value over the RF input frequency range(s) should be entered in the manufacturer's information leaflet.

6.7.5.3 Verification

By measurements throughout the LNB input frequency range(s) (see subclause 6.2.2), as indicated in IEC 510-1-5 [12], subclause 5.1.2.

NOTE 1: In case the outdoor unit is manufactured without an accessible interface between the antenna sub-system and the LNB, it is impossible to carry out this verification. Subsequently the manufacturer is required to provide suitable test fixtures.

NOTE 2: Alternative recognised methods which may be proved to give the same results can be used. The method used should be indicated in the data sheet of the test report.

6.7.6 Image frequency rejection

6.7.6.1 General

With an LO frequency lower than the received frequency, the first image frequency lies in a spectrum region allocated to maritime radar and other high-power navigational systems. Protection is necessary against the resulting interference.

6.7.6.2 Specification

The LNB should suppress the image frequencies of the received channel by at least 40 dB.

NOTE: If an optional filter is included, the image frequency rejection should be at least 80 dB.

6.7.6.3 Verification

By measurement, as indicated in IEC 510-2-4 [14], Clause 11.

The input level of the wanted signal should be the level that gives the nominal output level. The input level of the unwanted signal should be 30 dB greater than the wanted signal.

The frequencies of measurement should be close to the edge(s) and at the centre of the input frequency range(s).

6.7.7 Output level

6.7.7.1 General

The maximum permissible voltage should be such that the signal-to-intermodulation ratio is at least 35 dB (see subclause 6.7.9.5.1).

6.7.7.2 Purpose

To ensure a correct input level for the indoor unit.

6.7.7.3 Specification

The maximum permissible voltage should be indicated in the manufacturer's information leaflet.

6.7.7.4 Verification

Verification should be made by measurement as indicated in IEC 1079 [2], subclause 3.6. However, this reference being related to BSS, the chosen values should be amended as follows to be applicable to the FSS cases:

- the wanted signals should be at the following frequencies:

    - close to the upper edge of the RF input frequency range(s);
    - close to the lower edge of the RF input frequency range(s);
    - at the centre of the RF input frequency range(s);
    - the unwanted (interference) signals should be at frequencies separated by a suitable difference from the wanted frequencies. Suitable frequency separations may be 36 MHz or 72 MHz;

- the levels of the wanted and unwanted signals should be -10 dB with respect to those indicated in IEC 1079 [2], subclause 3.6.

6.7.8 Small signal gain

6.7.8.1 Purpose

To provide enough signal gain in order to achieve a signal level appropriate to the input of the indoor unit.

6.7.8.2 Specification

The small signal gain of the LNB at any frequency within its RF input frequency range(s) (see subclause 6.2) should be in the range of 40 dB to 65 dB. The measured small signal gain range should be indicated in the manufacturers information leaflet.

6.7.8.3 Verification

By measurement, as indicated in IEC 510-2-4 [14], Clause 5.

6.7.9 Linearity

6.7.9.1 General

Two sources of distortion can be considered, linear and non-linear distortion. These two types of distortion should be limited.

6.7.9.2 Purpose

To ensure that the LNB is able to amplify and frequency down-convert simultaneously several signals, keeping signal distortion, cross-talk between signals, and degradation due to intermodulation products at acceptable levels.

6.7.9.3 Linear distortion: amplitude-frequency characteristic

6.7.9.3.1 Specification

The amplitude-frequency characteristic over the IF frequency range (see subclause 6.3.2) should be such that the maximum amplitude variation does not exceed:

- 1,5 dB within any 27 MHz bandwidth;

- 2 dB within any 36 MHz bandwidth;

- 5 dB over the entire IF frequency range for Type A;

- 8 dB over the entire IF frequency range for Type B.

6.7.9.3.2 Verification

By measurement, as indicated in IEC 510-2-4 [14], Clause 9.

6.7.9.4 Linear distortion: group-delay characteristic

6.7.9.4.1 Specification

The maximum permitted group-delay variation over the IF frequency range (see subclause 6.3) should not exceed:

- 20 ns within any 36 MHz bandwidth.

6.7.9.4.2 Verification

By measurement, as indicated in IEC 510-2-4 [14], Clause 10.

NOTE: Alternative recognised methods which may be proved to give the same results can be used. The method used should be indicated in the data sheet of the test report.

6.7.9.5 Non-linear distortion: multicarrier intermodulation ratio

6.7.9.5.1 Specification

At the LNB output, the level of any of the intermodulation products generated by two signals at the nominal output level should be more than 35 dB below the nominal output level.

6.7.9.5.2 Verification

Verification should be made by measurement as indicated in IEC 1079 [2], subclause 3.6. However, this reference being related to BSS, the chosen values should be amended as follows to be applicable to the FSS cases:

- the wanted signals should be at the following frequencies:
  - close to the upper edge(s) of the RF input frequency range(s);
  - close to the lower edge(s) of the RF input frequency range(s);
  - at the centre(s) of the RF input frequency range(s);
  - the unwanted (interference) signals should be at frequencies separated by a suitable difference from the wanted frequencies. Suitable frequency separations may be 36 MHz or 72 MHz;
- the levels of the wanted and unwanted signals should be -10 dB with respect to those indicated in IEC 1079 [2], subclause 3.6.

6.7.10 LNB input interface

6.7.10.1 Purpose

Harmonisation of the LNB input interface with antenna sub-system output.

6.7.10.2 Specification

If a physical interface exists between the antenna sub-system and the LNB and if waveguide is employed, then the flange should be type PBR 120 or C 120 with gasket groove, as indicated in IEC 154 [13]. (See Annex H (informative)).

6.7.10.3 Verification

The waveguide flange used should be entered in the manufacturer's information leaflet.

6.7.11 LNB output interface

6.7.11.1 Impedance

6.7.11.1.1 Purpose

To define the electrical interface between the outdoor unit and the cable connecting it to the indoor unit.

6.7.11.1.2 Specification

The value of the nominal output impedance should be 50 Ω or 75 Ω for Type A and 75 Ω for Type B.

6.7.11.1.3 Verification

The nominal output impedance value should be indicated in the manufacturer's information leaflet.

6.7.11.2 Type of connector

6.7.11.2.1 Purpose

To define the mechanical interface between the outdoor unit and the cable connecting it to the indoor unit.

6.7.11.2.2 Specification

The connector should be "N" female or "SMA" type for 50 Ω impedance, and "F" female for 75 Ω impedance.

6.7.11.2.3 Verification

The type of connector should be indicated in the manufacturer's information leaflet.

6.7.11.3 Impedance matching at the output terminal

6.7.11.3.1 General

This measurement determines the impedance matching at the output terminal of the outdoor unit.

6.7.11.3.2 Specification

The output return loss over the IF frequency range(s) employed should be as follows:

- better than 15 dB, for "N" or "SMA" connectors;
- better than 8 dB, for "F" connector.

6.7.11.3.3 Verification

With the measurement method indicated in IEC 510-2-4 [14], subclause 4.2.3.

NOTE: Alternative recognised methods which may be proved to give the same results can be used. The method used should be indicated in the data sheet of the test report.

6.8 Internal immunity to unwanted signals

6.8.1 General

As indicated in prEN 50083-2 [8], subclause 6.6.2, Annex A.6 and Annex A.7, TVROs receiving systems are likely to suffer interference from signals related to other radio services operating both outside their RF frequency range (out-of-band interference), or inside it (in-band interference).

Distortions arising from this fact are:

- intermodulation products of the wanted signal and/or unwanted signals due to non-linearities;

- harmonics generated by an unwanted signal;

- unwanted signals that have penetrated the operating frequency range;

- unwanted signals that have been converted to the frequency range to be protected.

6.8.2 Specification

The distortion components at the output of the LNB (arising when wanted and unwanted signals are applied at its input) that fall within the IF frequency range (see subclause 6.3), should be at least 35 dB down from the level of the wanted signal, in accordance with prEN 50083-2 [8], subclause 6.6.2.

The value should be entered in the manufacturer's information leaflet.

6.8.3 Verification

Type A: by measurement, in accordance with prEN 50083-2 [8], Annex 7.

Type B: by measurement, as indicated in IEC 1079 [2], subclause 3.10.

NOTE: Verification should be made by measurement as indicated in IEC 1079 [2]. However, this reference being related to BSS, the chosen values should be amended as follows to be applicable to the FSS cases:

- the wanted signals should be at the following frequencies:

  - close to the upper edge of the RF input frequency range(s);
  - close to the lower edge of the RF input frequency range(s);
  - at the centre of the RF input frequency range(s);

- the levels of the wanted and unwanted signals should be -10 dB with respect to those indicated in IEC 1079 [2], subclause 3.6.

6.9 Power supply

6.9.1 Power supply for LNB

6.9.1.1 Purpose

To define the characteristics of the power needed to supply the LNB.

This will be useful to interface outdoor units with indoor units coming from different manufacturers.

6.9.1.2 Specification

The LNB should have a dc supply. Its characteristic should be the following:

- voltage: positive, from 11,50 to 19 volts;
- polarity ground: negative;
- dc: current maximum 250 mA per LNB, or maximum 300 mA for a switchable LNB.

6.9.1.3 Verification

The characteristics of the power supply for the LNB should be indicated in the manufacturer's information leaflet.

6.9.2 Power supply for auxiliary devices

6.9.2.1 Purpose

The most important auxiliary device may be the actuator motor for a motorised antenna. In this case an external power supply and control unit for the actuator motor shall be considered.

6.9.2.2 Specification

The power supply for the actuator motor should comply with the characteristics stated in draft IEC 933 Part X [17].

For safety requirements on the power supply of the auxiliary devices, see subclause 5.2.4.1.

6.9.2.3 Verification

The characteristics of the power supply for the actuator motor control should be indicated in the manufacturer's information leaflet.

6.10 Commands

6.10.1 General

The outdoor unit may receive programmes transmitted within different frequency ranges and/or different polarisations. For that, the switching of LO and of polarisation may be foreseen.

6.10.2 Purpose

To define the characteristics of signals needed for the switching. This should be necessary to interface outdoor units and indoor units coming from different manufacturers.

6.10.3 Specification

The command signals should be for:

a) LO switching, by IF cable:

- a dc voltage in the + 11,5 V to + 14 V range for the lowest LO frequency;
- a dc voltage in the + 16 V to + 19 V range for the highest LO frequency.

b) Electrical polarisation switching, by IF cable:

- a dc voltage in the + 11,5 V to + 14 V range (e.g. for vertical polarisation);
- a dc voltage in the + 16 V to + 19 V range (e.g. for horizontal polarisation).

c) Mechanical polarisations switching, by IF cable:

- a dc voltage in the + 11,5 V to + 14 V range (e.g. for vertical polarisation);
- a dc voltage in the + 16 V to + 19 V range (e.g. for horizontal polarisation).

d) Mechanical polarisations switching by separate cable:

- TTL interface.

e) Magnetic polarisations switching by separate cable:

- a current in the - 50 mA to + 100 mA range.

6.10.4 Verification

The characteristics and values of the command signals should be indicated in the manufacturer's information leaflet.

Annex A (normative): General conditions for measurement

A.1 Standard atmospheric conditions

As stated in IEC 68-1 [5a], subclause 5.3 (see also subclause 10.2).

A.2 Power supply

A.2.1 Standard conditions

As stated in IEC 510-1 [1], subclause 5.1:

"Measurements under standard power supply conditions are carried out at the nominal voltage (NOTE 1) and the nominal frequency stated in the detailed equipment specification. The voltage shall be measured at the power supply terminals of the equipment under test. During a series of measurements carried out on a sub-system or a combination of sub-systems, the voltage and the frequency of the power supply shall not deviate from the nominal values by more than ± 2 %, unless otherwise specified".

Unless otherwise specified, standard power supply conditions include the supplementary conditions given in subclause A.2.2.

NOTE 1: Where only a range of voltages is specified, the nominal voltage shall be taken as the mean value of this range. Measurements shall be repeated at the limits of the specified range.

A.2.2 Supplementary conditions on dc source

When measuring the characteristics of an outdoor unit, it is necessary to supply a dc power to it, without influencing the output signal. For this purpose, a bias network can be used.

The dc may be, as stated in IEC 510-1 [1], subclause 6.2:

a) a battery which may or may not be used on a floating charge;

b) a rectifier supply fed from ac mains (see IEC 510-1 [1], subclause 6.1).

The source used to obtain the dc test voltage should not be used to power other equipment during the test. Unless otherwise stated, the dc source should have an internal impedance low enough to have negligible influence on the equipment under test.

One specified pole of the dc source should be earthed.

For noise superimposed on the dc test voltage, (see IEC 510-1 [1], subclause 6.2.2).

A.3 Test site

As indicated in IEC 1079 [2], subclause 2.1.2, measurements shall be carried out at a location that is not subject to external interferences from radio frequency energy. If interferences cannot be avoided, the measurements shall be carried out in a screened room.

A.4 Accuracy of the measuring instruments

As indicated in IEC 1079 [2], subclause 2.1.5.1, the accuracy of the measuring instruments used shall either be stated as a percentage or in decibels, as appropriate.

A.5 Stabilisation period

As indicated in IEC 1079 [2], subclause 2.5.1.2, the characteristics of an outdoor unit may change for some periods after the application of supply voltage. Unless otherwise specified, measurements should be started after the stabilisation of the characteristics is obtained.

A.6 Presentation of results

As stated in IEC 107-1 [3], Clause 3:

"If the results of measurements are presented graphically, the points which have been obtained experimentally shall always be indicated on the graph, together with other specifically required data of the measurements. If a continuous record has been made, this shall be stated".

A.7 Deviations

As stated in IEC 107-1 [3], Clause 3:

"If deviations from the recommended methods are adopted, they shall be explicitly stated with the results".

A.8 Radio-frequency input signals

This is an extract from IEC 1079 [2], subclause 2.2.

A.8.1 Introduction

The following input signals shall be used.

A.8.2 Test signals

Unless otherwise specified, continuous wave (c.w.) Radio Frequency (RF) signals shall be used.

A.8.3 Test frequencies

Unless otherwise specified, test frequencies shall be selected in such a manner to clearly express the value of the considered parameter in the frequency range of interest.

A.8.4 Radio-frequency input arrangement

Depending on the input facilities of the equipment under test, the radio-frequency input signal can be applied in three different ways:

a) by means of a waveguide, having a flange and a cross-section compatible with the input of the unit;

b) by means of a coaxial cable and a connector compatible with the input of the unit;

c) by means of a transmitting antenna generating a field at the receiving antenna, that provides the electrical input signal for the unit.

When two or more signals are to be applied (two or multi-signal measuring methods), suitable combining networks, such as hybrid networks or directional couplers with the specified characteristic impedance shall be used to connect the various signal generators. All used terminals shall be terminated with matched loads.

When the input arrangement indicated in c) of this subclause, is used, the signals of the various generators are combined before application to the transmitting antenna.

NOTE: Any type of hybrid such as magic tee, rat-race or hybrid-ring can be used.

A.8.5 Input signal level

The input signal level to an outdoor unit shall be expressed according to the input arrangement used (see subclause A.8.4).

A.8.5.1 Available power

With the input arrangement a) or b) of subclause A.8.4, the input signal level is expressed in terms of available power at the output of the signal generator, including its associated network.

The available power is the power delivered by the signal generator to a matched load.

A.8.5.2 Power flux density

With the input arrangement c) of subclause A.8.4, the input signal level is expressed in terms of Power Flux Density (PFD) at the aperture plane of the receiving antenna, calculated as follows:

$$PFD = \frac{P_A G}{4\pi d^2} \quad W / m^2$$

where: P_A = power delivered by the signal generator to the input of the transmitting antenna (W);

G = gain of the transmitting antenna in the direction towards the receiving antenna;

d = distance between the transmitting antenna and the receiving antenna (m), measured between the electrical centres.

A.8.5.3 Siting of the antennas

The antennas shall be placed at an appropriate high level, to lessen the interference by the reflected wave from the ground. When a slant antenna range setting is used, the transmitting antenna can be placed on the ground, while the receiving antenna is placed at the top of a tower.

NOTE: For a slant antenna range, reference should be made to the following: P.W. Arnold, "The slant antenna range", IEEE Transmitters, Antennas & Propagation, AP-14, 5, pp. 658-659 (1966).

To avoid measurement errors caused by a non-uniform distribution of spherically propagated electromagnetic waves, the distance between the transmitting and the receiving antennas should be larger than $2D_1^2/\lambda$ and $D_1D_2/0{,}32\ \lambda$, where D_1 and D_2 are the maximum diameters of the antenna under test and the transmitting antenna respectively, and lambda is the free space wavelength at the test frequency. If the electric field strength at the receiving point deviates more than ± 0,5 dB in the aperture plane, the height and the distance shall be rearranged to obtain a deviation smaller than ± 0,5 dB.

NOTE: Alternative recognised methods, which may be proved to give the same results, can be used. The used methods should be indicated in the information leaflet.

Annex B (normative): Radiation measurement in the frequency range from 1 GHz to 18 GHz

B.1 Measuring equipment

This is an extract from CENELEC EN 55011 [10], subclause 8.2.

The measuring equipment should comply with the following requirements:

a) a spectrum analyser to measure interference in the range 0,3 GHz to 18 GHz;

b) a filter shall be provided at the input of the spectrum analyser to give at least 30 dB of attenuation at the operating frequency of the outdoor unit under test, in order to protect the input circuits of the analyser from damage when measuring weak spurious signals in the presence of a strong fundamental. A number of such filters may be required to deal with different operating frequencies.

B.2 Measuring set-up

This is an extract from prEN 50083-2 [8], subclause 8.2

The outdoor unit under test shall be placed on a turnable support of non-metallic material, the height of which shall be 1 m above the ground.

The outdoor unit shall be connected to a suitable signal generator through a "well-screened" cable.

NOTE: A cable can be considered "well-screened" if its radiation level, when terminated with a matched load, is almost 10 dB below the expected radiation level of the component under test, the cable and the component being supplied with the same input signal level.

The unused outputs, if any, of the outdoor unit under test shall be terminated with their nominal impedance by means of non-radiating loads.

The mains lead, if any, shall be placed vertically and connected to the mains outlet through a suitable mains filter. Any excess length of the mains lead shall be made into a neat bundle at the filter end.

The mains lead and the signal generator coaxial cable shall be provided with suitable absorbing devices (e.g. ferrite rings), placed close to the outdoor unit under test, to avoid measurement errors.

The measurements shall be made with a directive receiving antenna of small aperture capable of making separate measurements of the vertically and horizontally polarised components of the radiated field. The height above the ground of the centre line of the antenna shall be the same as the height of the approximate radiation centre of the outdoor unit. In order to avoid the influence of the ground reflexion on the results, it is recommended that a suitable horn antenna is used, which shall fulfil the "Fraunhofer conditions" for the measuring distance d:

$$d \geq 2b^2/\lambda$$

where: b is the wider dimension of the horn mouth;

λ is the wavelength corresponding to the test frequency.

In that case, no metallic ground plane is needed.

B.3 Site checking and calibration

The calibration checking of the test site shall be made by a radiation-substitution method. This is carried out in two stages.

Firstly, the suitability of the site shall be determined as follows. A transmitting antenna shall be mounted at the position where the approximate centre (usually the volume centre) of the outdoor unit under test is intended to be placed. The transmitting antenna shall have the same radiation properties as a half-wave dipole. The receiving antenna shall be placed at the same position as chosen for the actual measurements. The two antennas shall be placed so that they have the same polarisation which shall be perpendicular to the imaginary line between them. Tests shall be made with the planes of polarisation horizontal and vertical.

The site shall be considered suitable for the purpose of measurement at a test frequency if the indication on the measuring set changes by no more than 1,5 dB when the centre of the transmitting antenna is moved up to 15 cm in any direction from its initial position.

Secondly, the actual calibration is made so that at each test frequency with the transmitting and receiving antenna in the same (initial) position as above, the transmitting antenna is fed by signal power to give a suitable reading on the measuring set. The relationship between the reading on the measuring set and the input power to the transmitting antenna under matched conditions gives a conversion factor. By means of this factor, any reading of the measuring set is converted to the substituted power.

B.4 Measurement procedure

Measurements shall be made with the antenna having both horizontal and vertical polarisation and the turn-table with the outdoor unit under test shall be rotated. The highest level of radiation measured shall be the characteristic level of the measuring frequency. It shall be ascertained that, when the outdoor unit under test is switched off, the level of background noise is at least 10 dB below the reference limit, otherwise the reading may be significantly affected.

B.5 Presentation of the results

The radiation level of the outdoor unit under test shall be expressed in terms of substituted power in dBpW.

Annex C (normative): Radiation measurements in the frequency range from 30 to 1 000 MHz

C.1 Introduction

In the frequency range 30 MHz to 300 MHz most of the radiation is from the output cable. Therefore, the "absorbing clamp method" is specified.

In the frequency range 300 MHz to 1 000 MHz, however, the equipment itself may radiate. A substitute "radiation" method without a connected output cable is specified. Both methods allow indoor measurements to be made providing that certain precautions are taken.

C.2 Measurements in the frequency range 30 MHz - 300 MHz

The measurements are carried out as indicated in prEN 50083-2 [8], subclause 4.6.

C.3 Measurements in the frequency range 300 - 1 000 MHz

The measurements are carried out as indicated in prEN 50083-2 [8], subclause 4.7.

C.3.1 Equipment required

The following equipment is required:

- a signal generator for the outdoor unit input;
- a test frequency generator covering the frequency range of interest and of sufficient output power;
- a transmitting dipole antenna of known radiation characteristics and suitable for the frequency range of interest;
- a receiving antenna of known characteristics and suitable for the frequency range of interest;
- a measuring set of appropriate impedance covering the frequency range of interest;
- shielded terminating loads of appropriate impedance and design;
- all necessary coupling devices of an appropriate design;
- a power supply filter able to remove extraneous noise from the power supply in the frequency range of interest;
- absorbing devices such as ferrite rings sufficient to suppress signals from the outdoor unit on its input power supply leads;
- a suitable calibrated attenuator of appropriate impedance.

C.3.2 General measurement requirements

The test cables, coupling devices and terminations shall all be well-matched and well-screened. Test equipment should normally be 75 Ω impedance.

Test site: an indoor or outdoor site may be used. When indoors, a room of sufficient size must be chosen.

Any reflecting and absorbing objects should be so positioned or sufficiently removed away from the measuring set-up that they do not influence the results.

C.3.3 Equipment layout and connection

The measurement set-up and equipment layout is shown in figure C.1.

The outdoor unit under test shall be placed at a height of approximately 1 m above the ground on a turnable support of non-metallic material.

The output of the outdoor unit under test shall be terminated with the nominal impedance by means of a non radiating load directly connected without any cabling.

C.3.4 Operating conditions

The outdoor unit under test shall be operated in accordance with the manufacturer's recommendations.

The outdoor unit under test shall be tested under conditions which maximize the radiation.

The supply voltage shall be set to a value within the specified rating.

Adjusting devices accessible to the user or installer shall be set so as to maximize radiation.

The signal generator at the input shall be adjusted so that the maximum rated output level within the operating range of the outdoor unit is used.

C.3.5 Measurement frequencies

Measurements shall be made at a reasonable number of frequencies within the range of interest.

C.3.6 Precautions

For sensibly consistent results, the residual radiation and pick-up of the test set at all test frequencies shall be at least 20 dB lower than the expected measurement value.

This shall be checked following the first outdoor unit radiation measurement and before the result is recorded. The outdoor unit under test is removed. With the input and output leads correctly terminated, and the position of these connecting leads and other test equipment otherwise unchanged, the residual radiation measured shall be at least 20 dB lower than that measured, or expected to be measured, with the outdoor unit connected. If this cannot be achieved, repositioning of the test equipment may be helpful.

The positioning of the transmitting and receiving antenna shall be carefully adjusted to ensure sensibly consistent results over the frequency range of interest.

This shall be checked with a transmitting antenna connected horizontally in place of, and in the same position as, the outdoor unit under test, and parallel with the receiving antenna not less than 1,3 m away. A test shall then be carried out to ensure that when the transmitting antenna is moved vertically, or laterally by ± 10 cm, the measuring set readings do not vary more than ± 1,5 dB. This shall be repeated at each test frequency and the distance d and height h adjusted until this requirement is met (see figure C.1).

The antenna positions, supports, etc., shall all then be moved round in the horizontal plane by 90°, keeping the same precise spacing distance between the antennas. The new reading obtained shall be noted.

If the readings vary by more than 3 dB, the following may be required:

- change the size of the room;

- add metallic layers or plates to improve reflection properties of the ground;

- use absorbing material to the walls.

C.3.7 Measurement procedure

With the equipment connected as in figure C.1, adjust the signal generator to the input frequency and to a level that will give the maximum rated output level from the outdoor unit under test. Tune the measuring set to the test frequency and adjust the controls to give a convenient reading. The outdoor unit shall now be rotated in all planes to obtain the maximum reading v_r, which is noted.

The transmitting antenna is then substituted for the outdoor unit under test, and shall be placed so that it is parallel with the receiving antenna and with its centre corresponding to that of the outdoor unit under test when in position. The output level of the signal generator is adjusted to give the same reading v_r on the measuring set. The available power from the generator to the transmitting antenna is the "substituted radiated power" from the component under test, and its value p_s shall be recorded.

This procedure shall be repeated for each of the test frequencies specified in subclause C.3.5.

The highest reading p_s obtained, at each frequency, in the preceding tests indicates the "radiation from the component" characteristic expressed as a "substituted radiated power".

C.3.8 Presentation of the results

The radiation level of the "outdoor unit" shall be expressed in terms of "substituted power" ps in dBpW.

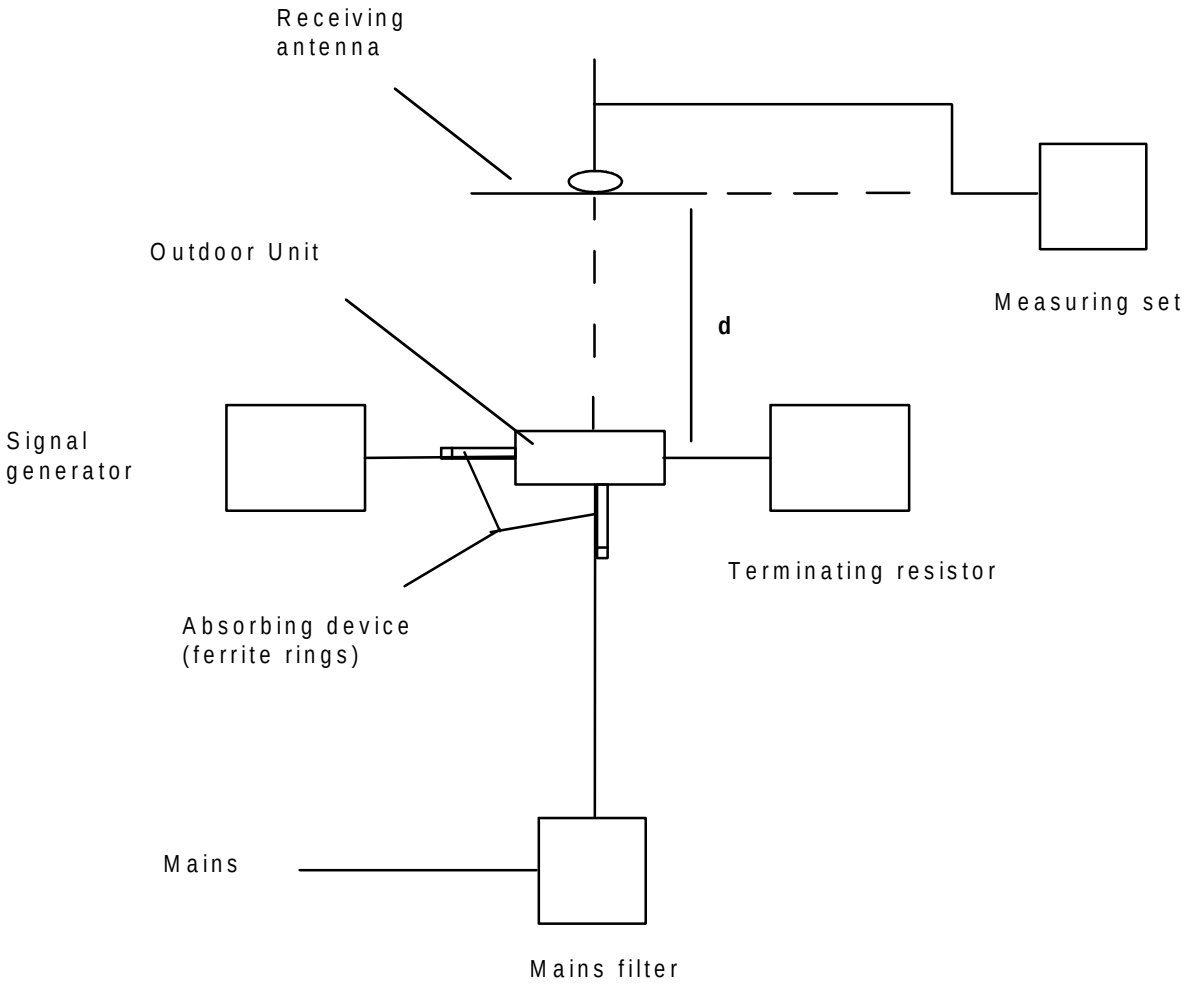

Figure C.1: Radiation method (from 300 MHz to 1 000 MHz) without measurement cable

Annex D (normative): Measurement of G/T ratio by direct method

This is an extract from IEC 1079 [2], subclause 3.8.

D.1 Introduction

This method of measurement determines the figure of merit of an outdoor unit. Therefore, this method of measurement applies only when the input arrangement c), (see subclause 8.4 of Annex A), is possible.

NOTE 1: Although the G/T ratio can be calculated from the antenna gain, the antenna noise temperature and the noise figure of the SHF converter, it is more practical and accurate to measure the G/T ratio directly. This is because the noise figure of an SHF converter depends on the impedance matching between the antenna and the SHF converter.

NOTE 2: The following paper is recommended as a reference: K. Ohmaru & Y. Mikuni, "Direct G/T measurement for satellite broadcasting receivers", IEEE Transmission & Broadcast, BC-30, 2, pp. 38-43 (1984).

D.2 Method of measurement

The arrangement of the test equipment is shown in figure D.1. After the position of the Outdoor Unit (OU) under test is determined, the standard horn shall be set near the aperture plane of OU: this is called the "specified position". The measurement shall be made under the following conditions and procedures.

D.2.1 Measuring conditions

a) Testing site: a location that does not give rise to radio wave reflections due to surrounding objects.

b) Test frequencies:

The test frequencies should be the following:

- close to the upper edge(s) of the RF input frequency range(s);
- close to the lower edge(s) of the RF input frequency range(s);
- at the centre(s) of the RF input frequency range(s).

c) Test signal level: the test signal level shall be high enough to provide a good signal to noise ratio as far as the amplitude linearity of the LNB is maintained. The linearity can be checked as indicated in IEC 1079 [2], subclause 3.5.

d) Setting of the antennas: see subclause A.8.5.3 (Annex A).

e) Sky conditions: when the sky is used to measure the antenna effective temperature, the antenna should be directed to the area which minimizes the output noise level of the outdoor unit, after confirming that there is no noise source like clouds, the sun, satellites, buildings and trees within 10° from the main beam of the antenna.

D.2.2 Measurement procedure

The procedure is composed of several measurements including the gain of OU (procedure a), b) and c)), the noise temperature of OU (procedure d)), the power flux density at OU aperture plane (procedure e) and f)) and calibration factors (procedure g), h) and i)).

a) The switch A shall be set to radiate a signal from the transmitting antenna. The polarisation direction of the signal shall coincide with that of the receiving antenna. The OU is directed towards the transmitting antenna (position 1).

b) OU shall be placed at the specified position and the switch-C is adjusted to position "2", and the output power P1 [W] of OU is measured.

c) The switch A shall be set to the "OFF" position and the output level P2 [W] is measured.

d) OU shall be directed to the sky (position 2) and the output power P3 [W] is measured.

e) The switch A shall be set to "ON" position again. The switch-B and switch-C are adjusted to position "1". The output level of the reference LNB shall be measured moving the standard horn in the plane where OU is located to get the spatial power flux density distribution of the wave coming from the transmitting antenna. The mean output power Pm [W] is calculated.

f) The standard horn shall be placed at the specified position near the aperture plane of OU. The output power of the reference LNB[1)] unit P4 [W] is measured. The ratio β = Pm/P4 is calculated.

g) The switch A shall be set to the "off" position and the output power P5 [W] is measured.

h) The switch B shall be set to "2" position and the switch-D to the "ON" position, and the output power P6 [W] is measured.

i) The switch D shall be set to the "OFF" position and the output power P7 [W] is measured.

j) The G/T ratio for a linear polarisation is calculated according to the following formula:

$$G/T = 10\log\frac{Gs(P1-P2)(P6-P7)}{\beta ToEN\,P3(P4-P5)}\ [dB/K]$$ [1)]

where: Gs = the gain of the linearly polarised standard horn with respect to an isotropic antenna, expressed as a ratio (not in dB);

EN = the excess noise ratio of the noise source, expressed as a ratio (not in dB);

To = 290 K.

k) The noise power measurements shall be corrected taking into account the bandwidth of the spectrum analyser.

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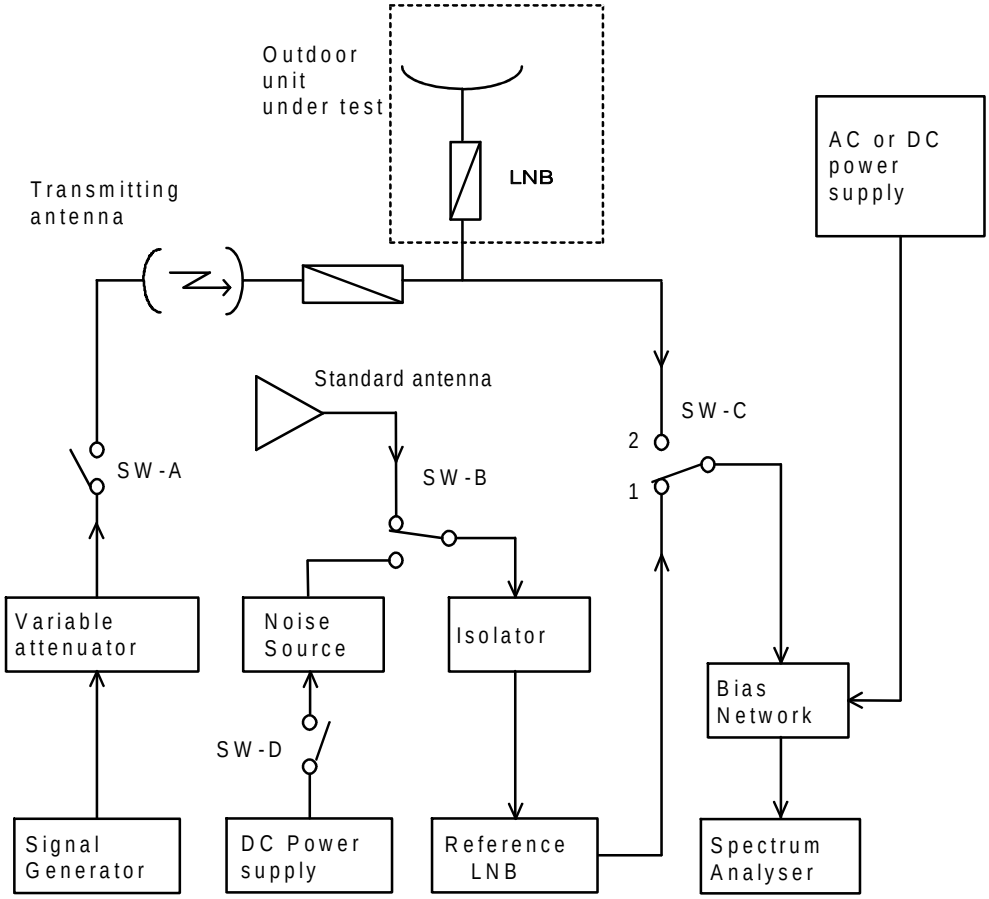
1) At these points above minor alterations have been made to the original IEC text.

D.3 Presentation of the results

The results shall be listed in a table and/or presented graphically.



NOTE 1: The isolator shall have a VSWR of less than 1,05:1.

NOTE 2: The standard antenna shall be a horn antenna which transmits/receives linearly polarised waves and has a gain of more than 20 dBi. It should be calibrated at test frequencies.

NOTE 3: The transmitting antenna shall have the same polarisation characteristics as the antenna under test.

Figure D.1: Arrangement for the measurement of G/T ratio

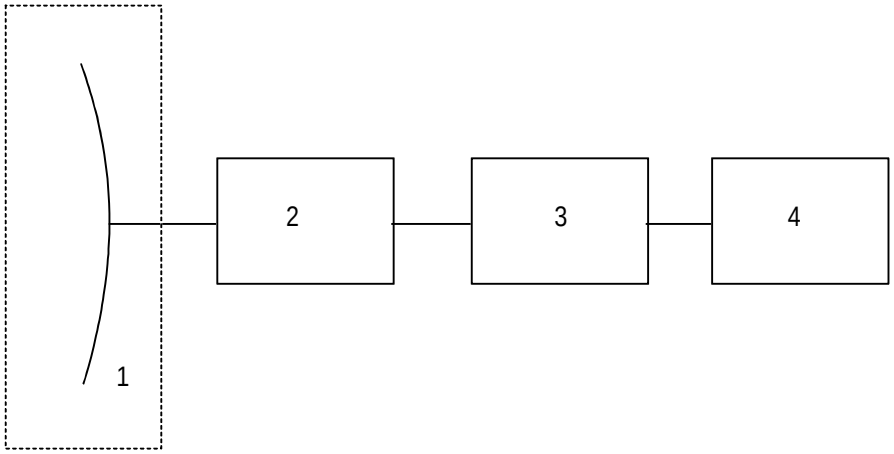
Annex E (normative): Antenna sub-system noise temperature measurement method

A two-position RF switch with a very low residual attenuation (L_{SW}) and an LNB of known noise temperature (T_{LNB}) are used as shown in figure E.1. The Y factor shall be measured as indicated in IEC 510-1-5 [12], subclause 5.1, replacing the random-noise generators by the antenna sub-system under test plus the two-position RF switch, and replacing the equipment under test by the LNB. The noise generator designated "hot" shall be replaced by the antenna sub-system plus the two-position RF switch in position 2 (LNB terminated). The noise generator designated "cold" shall be replaced by the antenna sub-system plus the two-position RF switch in position 1 (antenna connected to the LNB).

The antenna sub-system noise temperature T_A is calculated using the following formula:

$$T_A = \left(\frac{L_{SW}}{Y} + 1 - L_{SW} \right) T_{SW} + \left(\frac{L_{SW}}{Y} - L_{SW} \right) T_{LNB}$$

TSW is the measured thermodynamic temperature of the RF switch.



Key:

1 Antenna sub-system under test.

2 Two-position RF switch:

position 1: through;

position 2: terminated.

3 LNB of known noise temperature.

4 Y factor measurement test set.

Figure E.1: Arrangement for measuring antenna sub-system noise temperature

Annex F (informative): G/T ratio (clear sky conditions)

F.1 G/T ratio indirect measurement

The formula to calculate the "nominal G/T" ratio is:

$$G/T = \frac{\alpha.Gr}{\alpha Ta + (1-\alpha)To + (n-1)To}$$

where:

α - is the total coupling loss, in terms of the antenna/converter power ratio ($o<\alpha<1$);

Ta - is the "clear sky" antenna noise temperature;

To - is the reference temperature (To = 290 K);

n - is the noise figure (power ratio) of the LNB;

Gr - is the effective receiving antenna gain.

In the following example the Gr is calculated by the formula:

$$Gr = \eta\left(\frac{\pi D}{\lambda}\right)^2$$

F.2 G/T calculation for a particular antenna

Assuming:

f = 12,6 GHz;

α = 0,89 (coupling losses: 0,5 dB);

D = 0,9 m (antenna diameter);

η = 0,65 (antenna efficiency);

Ta = 45 K (antenna temperature);

n = 1,58 (or 2 dB), (LNB noise figure);

λ = wavelength.

we can find:

(G/T) = 15,3 dB/K.

Annex G (informative): Protection ratio

The protection ratio is defined as the minimum permissible power ratio of the wanted to unwanted signals, usually expressed in dB, available at the receiver input, required to produce a specified grade of picture (or sound) impairment.

The levels of the wanted and unwanted signals depend on the entire satellite system, but the characteristics of the outdoor receiving antenna usually constitute a major factor. The results of extensive measurements show that the protection ratio values considered acceptable in order to obtain an appropriate quality of picture and sound are as follows:

- for cable distribution and community reception: 23 dB (aggregate interferences);

- for individual reception: 20 dB (aggregate interferences).

These protection ratio limits determine the requirements on the antenna cross-polar performances (for the case of a cross-polar, frequency offset carrier transmitted from the same satellite), as well as the antenna co-polar off-axis gain (for the case of adjacent satellite interference).

The maximum single interference level should be 5 dB less than the aggregate interference level. This leads to the following level of protection ratio:

- for cable distribution: 28 dB (single interference);

- for individual reception: 25 dB (single interference).

The first value above determines the design objective given in subclause 6.6.5.4.

Annex H (informative): Dimensions in millimetres of waveguide flanges

H.1 Dimensions of Type B flanges in millimetres for ordinary rectangular waveguides [13a]

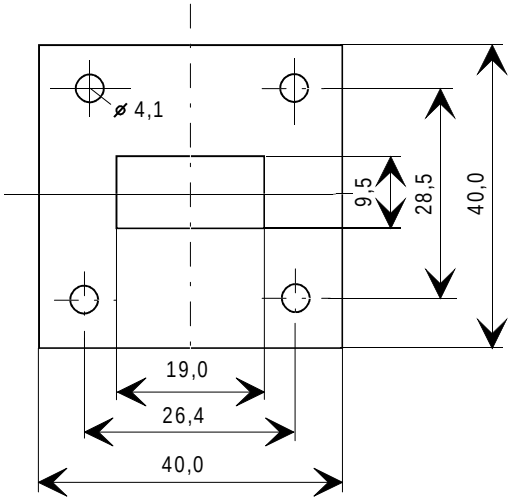


Figure H.1: UBR 120

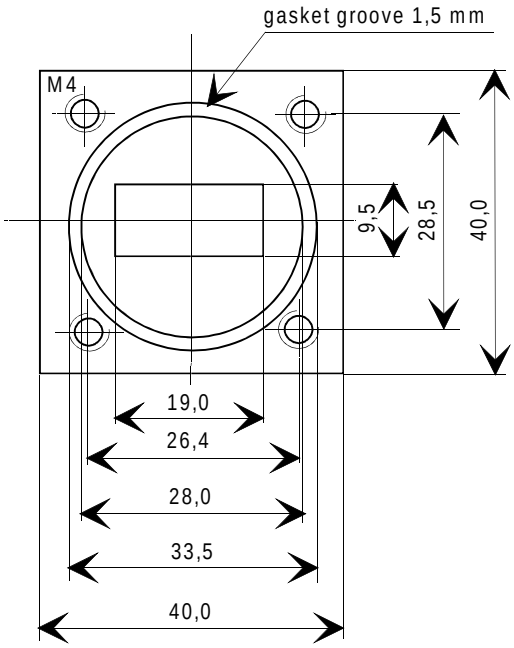


Figure H.2: PBR 120

H.2 Dimensions of flanges in millimetres for circular waveguides [13b]

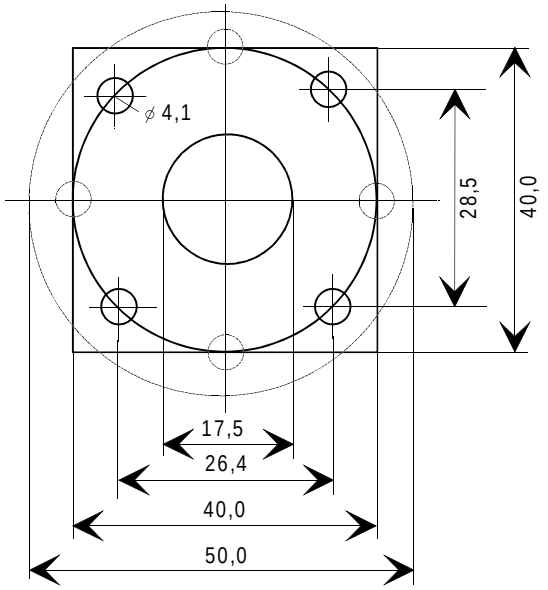


Figure H.3: C 120 without gasket groove

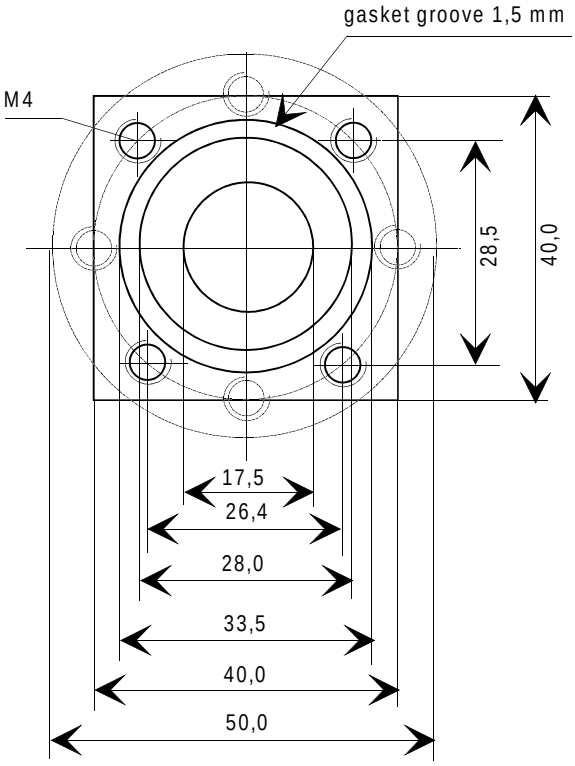


Figure H.4: C 120 with gasket groove

Annex J (informative): Installation

To obtain installations in line with the mechanical and radio-electrical requirements and recommendations given in Clauses 5 and 6, the following comment should be observed.

The outdoor unit should be installed in a safe, secure and stable manner, thus avoiding the possibility of injury to persons or damage to property.

The installation should be done according to good engineering practice, using appropriate material, all in accordance with the local laws.

The site selected for the installation of the outdoor unit must ensure direct visibility of the satellite. Any obstacle that might even partially reduce the received signal strength satellite should be avoided.

History

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