EUROPEAN TELECOMMUNICATION STANDARD

ETS 300 249

December 1993

Source: ETSI TC-SES

Reference: DE/SES-4003

ICS: 33.160.20, 33.160.40

Key words: TVRO, BSS

Satellite Earth Stations (SES); Television Receive-Only (TVRO) equipment used in the Broadcasting Satellite Service (BSS)

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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).

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

This European Telecommunication Standard (ETS) gives minimum specifications for the standardisation of the technical characteristics of satellite receiving only earth stations, capable of receiving audio-visual signals and associated data. A specified quality of service is not a requirement of this ETS.

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

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 included in this ETS.

For the "indoor unit" the relevant standard is prEN 50083: "Cabled distribution systems for television and sound signals".

This ETS is applicable to Television Receive Only (TVROs) earth stations which receive audio-visual signals in the Broadcasting Satellite Service (BSS) Ku band frequency ranges from 11,70 GHz to 12,50 GHz.

The TVROs are classified into two different types according to the corresponding services:

Type A for collective reception, in particular:

- Community Antenna Television (CATV);
- 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 equipment in the various Clauses of this ETS.

The received television signals can be PAL, SECAM, 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 that those systems operate in the BSS Ku Band.

They could be:

- digital TV systems;
- MAC - packet family full channel digital mode.

Data may be present as coded signals inside television signals.

Encrypted signals may also be accommodated.

NOTE: This ETS takes as main references for radio frequency specifications the WARC '77 plan (see [1], Appendix 30), and the CCIR relevant Recommendations (see Annex G, informative), but different assumptions are made taking into account the general trend towards very small aperture terminals. Following the decision made during WARC '92 to revise the WARC '77 plan, further developments of Radio Frequency (RF) parameters are expected in the near future and will require further studies.

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 the 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] ITU (1990) Radio Regulations, Vol 1, 2, 3.

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

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

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

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

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

[5] 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".

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

[7] a) EN 50081-1 (1991): "Electromagnetic compatibility - Generic emission standard. Part 1: Residential, commercial and light industry".

b) EN 50082-1 (1991): "Electromagnetic compatibility - Generic immunity standard. Part 1: Residential, commercial and light industry".

[8] 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".

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

b) Draft prEN 55011 (1991): "Limits and methods of measurement of radio interference characteristics of industrial, scientific and medical (ISM) radio frequency equipment".

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

[11] prEN 61114-1/IEC 1114-1: "Methods of measurement on receiving antennas for satellite broadcast transmissions in the 12 GHz band. Part 1: Electrical measurements on DBS receiving antennas".

Amendment 1: "Alternative method for G/T ratio".

[12] 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".

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

[14] prEN 50083-5: "Cabled distribution systems for television and sound signals. Part 5: Headend".

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

[16] 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".

[17] 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".

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

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:

a) 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 includes a depolariser that converts circular to linear polarisation and an Optional orthoMode Transducer (OMT) which separates two incoming differently polarised signals into two independent Radio Frequency (RF) outputs.

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

NOTE: The relevant specifications of this ETS apply to systems using circular polarisation.

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

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 equipment for control of the antenna position.

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, see Annex A, Clause A.1.

For other conditions such as power supply, test site, accuracy of measuring instruments, stabilisation period, presentation of results, radio frequency input signals, see Annex A, Clauses A.2 to A.8.

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 Clause 3 for definitions).

NOTE 2: 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 the verification of some requirements. In this case the manufacturer shall provide suitable test 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 [2], 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 [2], 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

All parts of the outdoor unit, including structural and mounted components, (but excluding the means of attachment) shall be so designed that they withstand the following main loads due to:

- the weight of the antenna and structural components;

- the wind speed.

The wind load W is given by the formula:

$$W = c \times p \times A$$

where: W is in Newtons (N),

c = 1,2 is the area correction coefficient,

p is the wind pressure, in Pascals (Pa)

A is the component area (m2)

Loading due to snow and ice is not considered.

For the purpose of establishing outdoor unit loading, the following values for wind speed shall be assumed in accordance with prEN 50083-1 [2], subclause 11.3:

- 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 Pascals (Pa) corresponding to a wind speed of 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 corresponding to a wind speed of 150 km/h.

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

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

- a wind pressure of 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 noted in the data sheet of the test report and in the manufacturer's information leaflet (see subclause 5.6).

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 manufacturer's information leaflet (see subclause 5.6).

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 or alternatively on a scale model of 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 point;
- 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 the 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 applicable wind speed, each step with a duration of 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 Pascal), 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 is the wind velocity under test;
V_S is the wind velocity under standard conditions;
P_T is the air pressure at the test site, in Pascal;
T_T is the temperature at the item under test, in Kelvins (K).

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 safety margin test;
- results of the measurements or calculations on the mechanical loads transmitted at the interface of the outdoor unit and the attachment devices.

For the antenna pointing and efficiency stability verification, see subclause 6.6.8.2.

NOTE: See NOTE in subclause 5.2.3.2.1.

5.2.3.3.2 Numerical analysis procedure

The computations needed to derive the field of forces and torques and the equivalent static stresses shall be carried out for the same wind directions and antenna elevations as stated in the wind tunnel test procedure (see subclause 5.2.3.3.1 above). Only the maximum applicable wind speed 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 reference to the "standard reference atmosphere" (see IEC 68-1 [3a], subclause 5.1). It shall be verified with the simulated results that none of the components of the outdoor unit are torn away. Then, during the tests, 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 tests performed;
- results of the safety margin calculation;
- results of the measurements or calculations on the mechanical loads transmitted at the interface of the outdoor unit and the attachment devices.

For the antenna pointing and efficiency stability verification, see subclause 6.6.8.2.

NOTE: See NOTE in subclause 5.2.3.2.1.

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 [2]. The particular aspects of prEN 50083-1 [2] relevant to the outdoor unit are generally covered in subclause 5.2.4.2.

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 [2] shall be considered.

5.2.4.2 Specification

In accordance with prEN 50083-1 [2], 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 [2], 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 [2], 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 against burning if, in sunshine conditions, solar radiation is focused near the feed.

5.2.6.2 Specification

The reflecting surfaces of the antenna sub-system shall be treated to avoid burning, or the equipment shall be fitted with a warning notice in a clearly visible position.

5.2.6.3 Verification

Statement that the reflecting surfaces of the antenna sub-system has been treated to avoid burning, 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 [2], 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 and basic environmental testing procedures, see IEC 68-1 [3a] and IEC 68-2-52 [3b]. For fire hazard testing, see IEC 695-1-1 [4a] and HD 444.2 [4b].

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 (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 the 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 LO 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): by measurement, as indicated in IEC 1079 [5], subclause 3.1.2.

For c): by statement of the manufacturer.

For d): 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 [6], Clause 3.

The unwanted radiations are the following:

- LO leakage radiated from the receiving antenna within 7° of the main beam axis;

- 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 EN 50081-1 [7a].

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 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-sight radio-relay receivers.

The unwanted radiation at the second harmonic of the LO could interfere with line-of-sight radio-relay receivers working in the 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, the orthomode transducer, the band-pass filter and the RF waveguides) shall be as follows:

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

- 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 [8], subclause 5.2.2.

b) Indirect method.

Calculation of the level of the unwanted radiation at the antenna flange by measurement of the unwanted power radiated by the antenna and the knowledge of the antenna gain at that frequency. The unwanted radiation power of the antenna shall be measured as indicated in prEN 50083-2 [6], subclause 4.2.2.3, see Annex B.

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 [6], 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 CISPR No.16 [9a] and EN 50011 [9b]):

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 frequencies.

This specification applies to all directions except within 7 degrees of the antenna on-axis direction.

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 [6], subclauses 4.6 and 4.7, see Annex C.

For the frequency range from 1 GHz to 18 GHz, measurements shall be carried out as indicated in prEN 50083-2 [6], subclause 8.2, see Annex B.

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 [6], Clause 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" recommendation, see subclause 6.8.

NOTE: The immunity of the auxiliary devices shall also be considered. The relevant document is EN 50082-1 [7b].

5.5.2 External immunity of the outdoor unit to ambient fields

5.5.2.1 General

As stated in prEN 50083-2 [6], 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 RF or IF band.

5.5.2.2 Specification

Type A:

In accordance with prEN 50083-2 [6], subclause 8.2.1.1, the minimum ambient field that produces a just perceptible disturbance shall not be less than:

Frequency range (MHz)	Minimum field strength (dBµV/m)
>0,15 to 2 500	130

Type B:

In accordance with EN 55020 [10], Clause 7, the minimum ambient field that produces a just perceptible disturbance shall be defined by the following characteristics:

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

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 [6], subclause 6.2.

Type B: by measurement, as indicated in EN 55020 [10], subclause 6.2.

5.5.3 External immunity of the outdoor unit 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 [6], subclause 8.2.1.2, at each interference frequency the immunity, expressed as the electromotive force (emf) 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	u.c. (under consideration)
>1,5 to 230	125
>230 to 2 500	u.c.

Type B:

In accordance with EN 55020 [10], Clause 6, the immunity, expressed as the 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

By measurement, as indicated in prEN 50083-2 [6], subclause 6.3.

5.6 Documentation

5.6.1 Purpose

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

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.

5.6.2 Specification

The manufacturer shall supply an information leaflet with each equipment. This leaflet shall contain at least the information listed in table 1.

All the data shall be values declared and guaranteed by the manufacturer.

5.6.3 Verification

By documentary evidence provided by the manufacturer.

Table 1: Contents of the information leaflet

Characteristics	References
Antenna sub-system	
- Radio Frequency bands - Type of polarisation - Co-polar on axis-gain - Antenna receive gain pattern - Cross-polarisation discrimination	subclause 6.2.2 subclause 6.6.3.2 subclause 6.6.4.2 subclauses 6.6.5.3 & 6.6.5.4 subclauses 6.6.6.2 & 6.6.6.3

- Output interface (if existing)
  - Type of waveguide flange
  - Impedance matching
  - Power supply for auxiliary devices (voltage, polarity, current)
	
	subclause 6.6.9.1.3
	subclause 6.6.9.2.3
	subclause 6.9.2.2

- Mechanical characteristics
  - Installation instructions
  - Wind speed ratings (mandatory)
  - Mechanical loads transmitted from the outdoor unit to the attachment devices (mandatory) attachment plan
  - Antenna pointing accuracy and stability
	
	subclause 5.2.3.2.1
	
	subclause 5.2.3.2.2
	subclause 6.6.8.2

LNB sub-system	

- Input interface (if existing)
  - Type of waveguide flange
  - Radio Frequency input range(s)
  - Noise figure (temperature)
  - Image frequency rejection
	
	subclause 6.7.10.2
	subclause 6.2.2
	subclause 6.7.5.2
	subclause 6.7.6.2

- Transfer characteristics
  - LO Frequency
  - Frequency conversion tolerance
  - Small signal gain
  - Amplitude frequency characteristic
  - Group delay characteristics
	
	subclause 6.3.3
	subclause 5.3.2.4
	subclause 6.7.8.2
	subclause 6.7.9.3.1
	subclause 6.7.9.4.1

- Output interface
  - Intermediate frequency output range(s)
  - Output maximum level
  - Impedance
  - Type of connector
  - Return loss
  - Power supply for the LNB (voltage, polarity, current)
- Commands
	
	subclause 6.3.2
	subclause 6.7.7.4
	subclause 6.7.11.1.2
	subclause 6.7.11.2.2
	subclause 6.7.11.3.2
	subclause 6.9.1.2
	subclause 6.10.3

Outdoor unit	
- Figure of merit	subclause 6.4.4

6 Recommendations

6.1 Introduction

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, once installed, see also Annex F.

6.2 Radio Frequency (RF) input range

6.2.1 Purpose

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

6.2.2 Specification

The outdoor unit should be able to receive signals in the frequency range from 11,7 GHz to 12,5 GHz or parts thereof. For example, in the range from 11,7 GHz to 12,1 GHz, or in the range from 12,1 GHz to 12,5 GHz.

6.2.3 Verification

The frequency range 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.

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 a greater RF input range than that defined in subclause 6.2.

6.3.3 Verification

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

6.4 Figure of merit

6.4.1 General

The nominal 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), when referred to the same point of the antenna sub-system. The most appropriate G/T value depends on the received signal characteristics and on the required quality. See Annex G.

6.4.2 Purpose

To allow qualitative comparisons between different outdoor units.

6.4.3 Specification

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

6.4.4 Verification

- By the simplified direct measurement method indicated in prEN 61114-1/IEC 1114-1 [11], Amendment 1, see Annex D.

- By indirect measurement method, separately measuring the antenna sub-system noise temperature (see Annex E), the antenna sub-system gain (see subclause 6.6.5), the LNB noise figure (see subclause 6.7.5) and appropriate calculation (see Annex H).

6.5 Radiation from outdoor unit (EIRP)

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 [9a] and EN 50011 [9b]):

20 dBpW in the range 30 MHz to 960 MHz;

43 dBpW in the range > 960 MHz to 2,5 GHz;

45 dBpW in the range > 2,5 GHz to 10,7 GHz;

51 dBpW in the range > 10,7 GHz to 21,2 GHz;

57 dBpW in the range > 21,2 GHz to 40 GHz.

The lower limits apply at the transition frequencies.

This specification applies to all directions except within 7 degrees of the antenna on-axis direction.

6.5.2 Verification

For the frequency range from 30 MHz to 1 GHz, measurements shall be carried out as indicated in prEN 50083-2 [6], subclauses 4.6 and 4.7, see Annex C.

For the frequency range from 1 GHz to 18 GHz, measurements shall be carried out as indicated in prEN 50083-2 [6], subclause 8.2, see Annex B.

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 a).

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

See subclause 6.2.

6.6.3 Polarisation

6.6.3.1 Purpose

To enable the reception of signals transmitted by the BSS in Ku band satellites transmitting circularly polarised waves.

6.6.3.2 Specification

The antenna sub-system should be designed to receive a Right-Hand or Left-Hand Circularly Polarised (RHCP or LHCP) electromagnetic field. The two 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 circular polarisation is employed and if single or dual polarisation is employed. If single polarisation is employed, the sense of this polarisation should be declared.

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 gain should be indicated in the manufacturer's information leaflet, expressed in dB relative to an isotropic source (dBi), for the specified range of frequency, and for the two circular polarisations, if dual polarisation is available.

6.6.4.3 Verification

By measuring the antenna sub-system receive co-polar on-axis gain using the measurement method indicated in prEN 61114-1/IEC 1114-1 [11], subclause 5.2, taking also into account subclause 4.1.6.

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

6.6.5 Antenna gain pattern

6.6.5.1 General

The specifications in this subclause apply to Type A equipment only. The specifications for Type B equipment are under consideration.

Design objectives are also given for both Type A and Type B equipment.

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, the co-polar gain pattern G(Ò) expressed in dB relative to an isotropic antenna should not exceed the following limits:

29 - 25 log ϕ	for	$4{,}8° \le \phi \le 7°$
+ 8	for	$7° < \phi \le 9{,}2°$
32 - 25 log ϕ	for	$9{,}2° < \phi \le 30°$
- 5	for	$30° < \phi \le 70°$
0	for	$70° < \phi$

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

6.6.5.3.2 Specification 2

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

19 - 25 log ϕ	for	$4{,}8° \le \phi \le 7°$
- 2	for	$7° < \phi \le 9{,}2°$

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

6.6.5.4 Design objectives

6.6.5.4.1 Antenna discrimination

Type A equipment:

At any frequency within the antenna sub-system receive frequency range, the antenna discrimination, defined as the difference between the on-axis gain and the gain at an angular offset, ϕ, should be at least 27 dB for values of ø greater than or equal to 4,8°, see ITU [1].

6.6.5.4.2 Antenna gain pattern

Type B equipment:

a) Co-polar gain.

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

29 - 25 log ϕ	for	$4{,}8° < \phi \le 11°$
+ 3	for	$11° < \phi$

b) Cross-polar gain.

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

19 - 25 log ϕ	for	$4{,}8° < \phi \le 7°$

6.6.5.5 Verification

a) For co-polar gain pattern.

By measuring the antenna sub-system co-polar receive off-axis gain pattern, using the measurement method indicated in prEN 61114-1/IEC 1114-1 [11], subclause 5.2, taking also into account subclause 4.1.6, and calculation of the absolute gain.

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

b) For cross-polar gain pattern.

By measuring the antenna sub-system cross-polar receive off-axis gain pattern, using the measurement method indicated in prEN 61114-1/IEC 1114-1 [11], subclause 5.5, taking also into account subclause 4.1.6.

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

6.6.6 Cross-polarisation discrimination

6.6.6.1 Purpose

To give a certain degree of protection of the wanted signals from interference from cross-polarised signals transmitted from co-located satellites.

6.6.6.2 Specification

At any frequency within the antenna sub-system receive frequency range, 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.

6.6.6.3 Design objective

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

- 28 dB for Type A equipment;

- 25 dB for Type B equipment.

6.6.6.4 Verification

By measuring the antenna sub-system receive cross-polarisation discrimination using the measurement method indicated in prEN 641114-1/IEC 1114-1 [11], subclause 5.2, taking also into account subclause 4.1.6.

NOTE: Alternative recognised methods which may be demonstrated to give the same results can be used. The method used shall 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 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 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 manufacturer's information leaflet.

6.6.8 Antenna pointing and efficiency stability under severe environmental conditions

6.6.8.1 General

Under severe environmental conditions, the shape of the reflector and the pointing of the main lobe of the antenna 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 higher than the pointing accuracy capability as specified in subclause 6.6.7.2.

6.6.8.3 Verification

By carrying out the tests as described in subclauses 5.2.3.3.1 and 5.2.3.3.2 for the wind speed referred to in subclause 6.6.8.2.

The results of the measurements and calculations of any distortion observed shall be referred to the angular position of boresight and the pointing error thus obtained.

Any deviation of the antenna components from their normal alignment to each other should be used to calculate any change in antenna efficiency.

The full results should be included in the section of the test report containing the results of the tests performed as in subclauses 5.2.3.3.1 and 5.2.3.3.2.

The measured values should be indicated in the manufacturer's information leaflet.

6.6.9 Output interface of antenna sub-system

6.6.9.1 Physical interface

6.6.9.1.1 Purpose

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

6.6.9.1.2 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 [12a] and IEC 154-4 [12b], see Annex J.

6.6.9.1.3 Verification

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

6.6.9.2 Impedance matching

6.6.9.2.1 Purpose

To limit the mismatching between the antenna subsystem and the LNB and the resulting alterations of the frequency response (amplitude and group delay) at the user outlet.

6.6.9.2.2 Specification

The impedance matching of the antenna sub-system, expressed in terms of Return Loss Ratio (RLR) (L, in dB) should not be worse than the value declared by the manufacturer.

6.6.9.2.3 Verification

By the measurement method indicated in prEN 61114-1/IEC 1114-1 [11], subclause 5.3. The worst case value for the RF input frequency range should be entered in the manufacturer's information leaflet.

The impedance matching can be also expressed in terms of Voltage Standing Wave Ratio (VSWR), using the following equation:

$$VSWR = \frac{\left(1 + 10^{-\frac{L}{20}}\right)}{\left(1 - 10^{-\frac{L}{20}}\right)}$$

6.7 Low Noise Block (LNB) down-converter

6.7.1 General

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

6.7.2 Radio Frequency (RF) input range

See subclause 6.2.

6.7.3 Intermediate Frequency (IF) output range

See subclause 6.3.

6.7.4 Frequency conversion tolerance

See subclause 5.3.2.

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 figure of merit, G/T.

6.7.5.2 Specification

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

6.7.5.3 Verification

By measurements throughout the LNB input frequency range (see subclause 6.2), as indicated in IEC 1079 [5], subclause 3.7.

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 a suitable test fixture.

NOTE 2: Alternative recognised methods which may be demonstrated to give the same results can be used. The method used shall 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 radiolocation, radionavigation, aeronautical radionavigation, and maritime radionavigation services. 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: The image frequency rejection can be improved to at least 80 dB by means of an optional filter.

6.7.6.3 Verification

By measurement, as indicated in IEC 1079 [5], subclause 3.11.

6.7.7 Output level

6.7.7.1 General

The maximum output level of the outdoor unit is defined as the level when intermodulation products generated by two equal carriers at the output of the device are at a level 35 dB below the output of these carriers.

6.7.7.2 Purpose

To ensure a correct input level for the indoor unit.

6.7.7.3 Specification

The maximum output level should be indicated in the manufacturer's information leaflet.

6.7.7.4 Verification

By measurement, as indicated in IEC 1079 [5], 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 manufacturer's information leaflet.

6.7.8.3 Verification

By measurement, as indicated in IEC 510-2-4 [13], 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 range (see subclause 6.3) 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 range for Type A;
- 8 dB over the entire IF range for Type B.

6.7.9.3.2 Verification

By measurement, as indicated in IEC 1079 [5], subclause 3.4.

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 prEN 50083-5 [14], Annex I, figure 4.3.

In the indicated measurement set-up, the TV modulator and demodulator shall operate in a frequency modulation mode.

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

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 (rectangular), or C 120, with gasket groove (circular), as indicated in IEC 154-2 [12a] and IEC 154-4 [12b]. See Annex J.

6.7.10.3 Verification

The waveguide flange type 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 ratio 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 1079 [5], subclause 3.3.

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

6.8 Internal immunity of the outdoor unit to unwanted signals

6.8.1 General

As indicated in prEN 50083-2 [6], subclause 6.6.2, and Annex A, Clauses A.6 and A.7, TVROs receiving systems are likely to suffer interference from signals related to other radio services operating both outside their RF 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

In accordance with prEN 50083-2 [6], subclause 6.6.2, the distortion components at the output of the LNB, caused by wanted and unwanted signals applied at its input, and falling within the IF range (see subclause 6.3), should be at least 35 dB below the level of the wanted signal, as declared by the manufacturer.

The worst case value should be indicated in the manufacturer's information leaflet.

6.8.3 Verification

a) Type A equipment: by measurement, in accordance with prEN 50083-2 [6], Annex 7.

b) Type B equipment: by measurement, as indicated in IEC 1079 [5], subclause 3.10.

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 shall have a dc power supply. Its characteristics should be the following:

- voltage: from 11,5 to 19 V;
- polarity: ground negative;
- current: max. 250 mA per LNB, or max 300 mA for a switchable LNB.

6.9.1.3 Verification

The characteristics of the power supply for the LNB shall 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 [15], subclause 6.1.1.

For the 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 shall be indicated in the manufacturer's information leaflet.

6.10 Commands

6.10.1 General

To enable an outdoor unit to receive programmes transmitted with different polarisations, the capability to switch the polarisation should 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) Electrical polarisations switching, by IF cable:

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

b) Mechanical polarisations switching, by IF cable:

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

c) Mechanical polarisations switching by separate cable:

- pulses at Transistor Transistor Logic (TTL) levels.

d) Magnetic polarisations switching by separate cable:

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

6.10.4 Verification

The characteristics of the command signals shall be indicated in the manufacturer's information leaflet.

Annex A (normative): General conditions for measurement

A.1 Standard atmospheric conditions

The "standard atmospheric conditions" are defined in IEC 68-1 [3a], subclause 5.3 (see also subclause 10.2).

But for outdoor test sites, where it can be impracticable to carry out the measurements in standard atmospheric conditions, the actual values of temperature, relative humidity and air pressure during the measurements shall be entered in the data sheet and the results converted to standard atmospheric conditions.

A.2 Power supply

A.2.1 Standard conditions

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, see IEC 1079 [5], subclause 2.1.4.1.

As stated in IEC 510-1 [16], subclause 5.1:

"Measurements under standard power supply conditions are carried out at the nominal voltage (see NOTE) and the nominal frequency stated in the detailed equipment specification. During a series of measurements, 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: 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

The dc source may be, as stated in IEC 510-1 [16], 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 [16], subclause 6.1).

The source used to obtain the dc test voltage shall not be used to power other equipment during the test. Unless otherwise stated, the dc source shall 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 again prEN 50083-5 [14], subclause 6.2.2.

A.3 Test site

As indicated in IEC 1079 [5], subclause 2.1.2, measurements on the outdoor unit 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.

For the measurements to be carried out on the antenna sub-system only, the location shall not be subject to external radio interference and reflections due to ground and surrounding structures (see prEN 61114-1/IEC 1114-1 [11], subclause 4.1.2).

A.4 Accuracy of the measuring instruments

As indicated in IEC 1079 [5], subclause 2.1.5.1, the accuracy of the measuring instruments used shall either be stated as a percentage or in decibels, as appropriate.

Alternatively the accuracy class shall be quoted as laid down in the relevant publications.

A.5 Stabilisation period

As indicated in IEC 1079 [5], 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 [17] 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 [17], Clause 3:

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

A.8 Radio frequency input signals

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, see IEC 1079 [5], subclause 2.2.2, and prEN 61114-1/IEC 1114-1 [11], subclause 4.2.

A.8.3 Test frequencies

a) For the outdoor unit.

   Unless otherwise specified, test frequencies shall be selected near the nominal carrier frequency of each broadcast channel, see IEC 1079 [5], subclause 2.2.3.

b) For antenna subsystem.

   For the measurements to be carried out on the antenna sub-system only, test frequencies shall be the lowest, mid and highest frequencies in the 12 GHz band. If there is interference at these frequencies, the test frequency can be shifted slightly to avoid the disturbance. If the characteristics of the antenna are strongly frequency dependent, the measurements shall also be carried out at those frequencies where significant changes occur (see prEN 61114-1/IEC 1114-1 [11], subclause 4.2).

A.8.4 Radio frequency input arrangement (for the outdoor unit)

This is an extract from IEC 1079 [5], subclauses 2.2.4 and 2.2.5.

Depending on the input facilities of the equipment under test, the radio frequency input signal for the outdoor unit 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 source 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) 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.8.4.1 Input signal level

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

A.8.4.2 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. It can be expressed in milliwatts.

A.8.4.3 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:

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

where: P_A is the power delivered by the signal generator to the input of the transmitting antenna in watts;

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

d is the distance between the transmitting antenna and the receiving antenna in metres, measured between the electrical centres.

A.8.4.4 Siting and distance of the antennae

The antennae shall be placed at least four metres above the ground 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 (1966), pp. 658-659.

To avoid measurement errors caused by a non-uniform distribution of spherically propagated electromagnetic waves, the distance R between the aperture planes of the source antennae and the antenna under test shall satisfy the following equations (all the dimensions are in metres):

$$R > 2 D_1^2/\lambda$$

$$R > D_1 D_2/0{,}32\lambda$$

where: D_1 is the largest aperture diameter of the antenna under test;

D_2 is the largest aperture diameter of the source antenna;

λ is the free space wavelength at the test frequency.

The spatial variation of the field at the aperture plane of the antenna under test shall be minimised. The variation of the power received from the standard antenna shall be within ± 0,5 dB on the aperture plane of the antenna. The second method of measurement of the variation is described in prEN 61114-1/IEC 1114-1 [11], subclause 5.1.

If a larger variation is observed, the position and height of the antenna should be changed to obtain the value specified above.

NOTE: Alternative recognised methods which may be proved to give the same results can be used.

A.8.5 Other conditions for measurements on antenna sub-system

This is based on prEN 61114-1/IEC 1114-1 [11], Clause 3, and subclauses 4.3 and 4.5.

A.8.5.1 Standard antenna

A standard antenna is an antenna which is used as a gain reference for receiving antennae under test.

A right hand circularly polarised antenna and a left hand circularly polarised antenna which have an equal gain of more than 20 dB shall be provided as standard antennae.

An example of a suitable antenna is described in prEN 61114-1/IEC 1114-1 [11], Annex A.

The gain shall be calibrated at the test frequencies.

NOTE: A linearly polarised horn antenna can be used as the standard antenna. However, the accuracy of the gain measurement may be slightly reduced.

A.8.5.2 Source antenna

A source antenna is an antenna which is used as a transmitting antenna for measurements.

A right hand circularly polarised antenna and a left hand circularly polarised antenna shall be provided as the source antenna. These antennae shall have the same characteristics and a cross-polarisation discrimination of more than 35 dB.

These values can be confirmed by the standard antenna, see prEN 61114-1/IEC 1114-1 [11], Annex B.

A.8.5.3 Variable attenuator

A waveguide type precision attenuator having a variable range of 30 dB with an accuracy of better than ± 0,2 dB is required.

A.8.5.4 Directional coupler

The directional coupler shall have a VSWR of less than 1,05, a coupling factor of about 10 dB and a directivity of better than 36 dB.

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

B.1 Measurement equipment

A spectrum analyser shall be used with the characteristics stated in EN 50011 [9b], subclause 7.2.

B.2 Operating conditions

This is an extract from prEN 50083-2 [6], subclause 4.8.

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 output of the outdoor unit under test shall be terminated with its nominal impedance by means of a non-radiating load.

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 the use of a suitable horn antenna, which shall fulfil the "Fraunhofer conditions" for the measuring distance R:

$$R \geq 2D^2 / \lambda$$

where: D 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.

Care shall be taken to position the outdoor unit in such a way to put the measuring antenna outside ± 7° of the main beam direction.

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 antennae 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 turnable with the outdoor unit under test shall be rotated. Two tests shall be made for two elevation angles of the antenna: 7° and 30°. 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 MHz to 1 GHz

This is an extract from prEN 50083-2 [6], Clause 4.

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 GHz, 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 [6], subclause 4.6.

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

The measurements are carried out as indicated in prEN 50083-2 [6], subclause 4.7.

C.3.1 Equipment 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 lead correctly terminated, and the position of this connecting lead 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 antennae 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 antennae positions, supports, etc., shall all then be moved round in the horizontal plane by 90°, keeping the same precise spacing distance between the antennae. 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 is now rotated in all planes to obtain the maximum reading v_r, which is noted.

The transmitting antenna is substituted for the outdoor unit under test, and 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 is recorded.

This procedure is repeated for each of the test frequencies specified in subclause 5.5.

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 p_S" in dB pW.

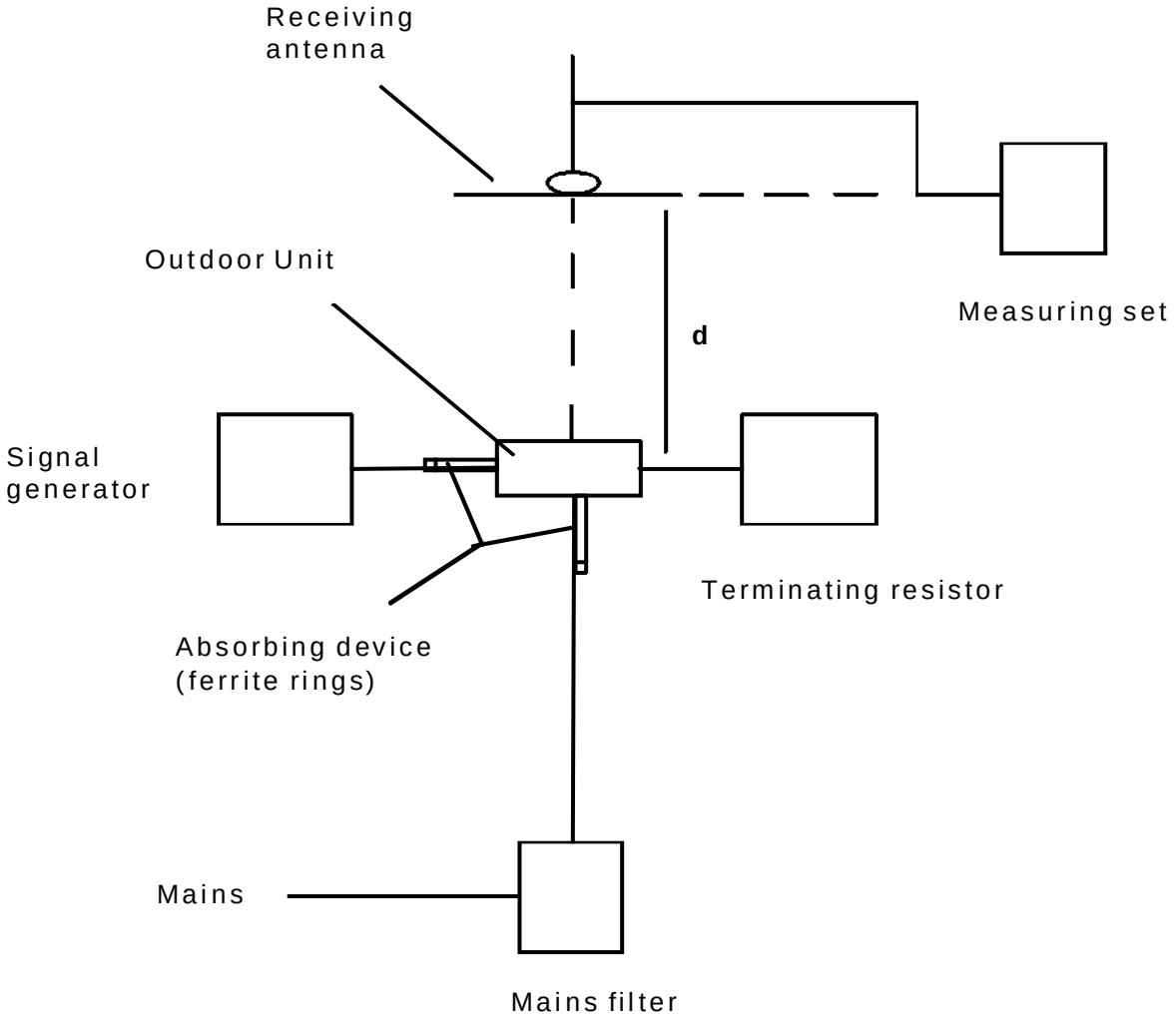


Figure C.1: Radiation method (from 300 MHz to 1 GHz) without measurement cable

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

This is an extract from prEN 61114-1/IEC 1114-1 [11].

D.1 Introduction

G/T is defined as the ratio of the antenna gain to the antenna-LNB noise temperature referred to the antenna terminal. G/T is measured as a parameter representing the total performance of the antenna under test with an LNB.

D.2 Environmental conditions for G/T measurement

The following conditions shall be maintained:

- the sky is clear;

- there are no noise sources such as the sun, a satellite, artificial constructions, and trees within 10 degrees around the beam axis of the antenna under test.

D.3 Methods of measurement

The measurement shall be normally carried out at elevation angles of 10 and 30 degrees.

The ambient temperature shall be measured.

The class of the test site ground (soil, grass, concrete or metal) and its conditions (dry or wet) shall be recorded.

D.4 Arrangement of test equipment

As presented in prEN 61114-1/IEC 1114-1 [11], Amendment 1, subclause 3.9.

D.5 Presentation of results

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

The elevation angle and the ambient temperature shall be presented.

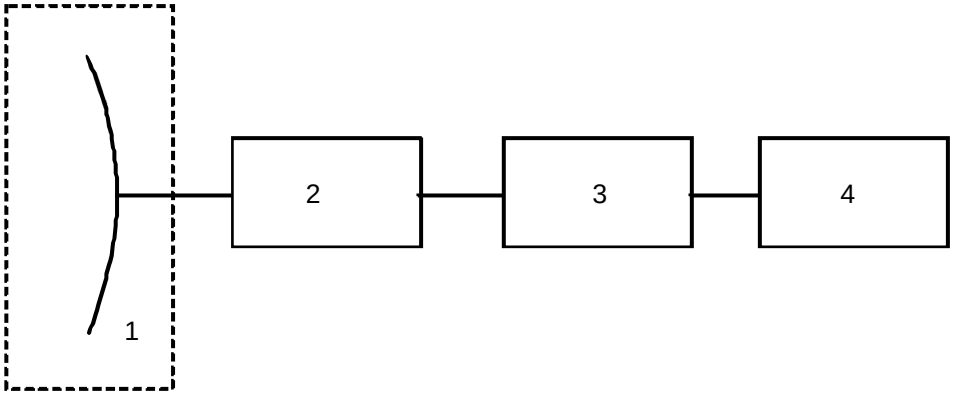
Annex E (normative): Antenna sub-system noise temperature measurement method

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 is measured as indicated in IEC 510-1-5 [18], 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" is replaced by the antenna sub-system plus the two position RF switch in position 2 (LNB terminated). The noise generator designated "cold" is 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:

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

T_{SW} 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: Antenna noise temperature measurement

Annex F (informative): Installation

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

In particular the site selected for the installation of the outdoor unit should ensure direct visibility of the satellite. Any obstacle that might even partially reduce the carrier-to-noise ratio at the input of the antenna should be avoided.

Annex G (informative): General characteristics of the Broadcasting Satellite Service (BSS) in the 12 GHz band

G.1 Background of the WARC '77

The BSS is defined by ITU [1] as follows:

"A radiocommunication service in which signals transmitted or retransmitted by space stations are intended for direct reception by the general public".

The general characteristics of the BSS for the three ITU Regions are derived from the Final Acts of the following Administrative Conferences:

- WARC '77 (down links for Regions 1 and 3);
- WARC '83 (up and down links for Region 2);
- WARC '88 (up links for Regions 1 and 3).

These Final Acts are inserted in the Radio Regulations (RR) as APPENDIX 30 (down-links) and 30A (feeder-links).

The duration of the Plan is foreseen as 15 years starting from the 1st of January 1979.

The most important technical parameters fixed during the WARC '77 for the Region 1 are the following:

- frequency bands:
  - * down-link 11,7 - 12,5 GHz
  - * up-link 17,3 - 18,1 GHz and 14,5 - 14,8 GHz
- channel spacing: 19,18 MHz
- channel bandwidth: 27 MHz
- number of channels: 40
- polarisation: circular
- global C/N: 14 dB at the edge of the service area and for the 99 % of the worst month
- energy dispersal: 600 kHz pp., with repetition frequency of 25 Hz

G.2 Up-link

The up-links for BSS are considered part of Fixed Satellite Service (FSS).

The up-links for Regions 1 and 3 have been planned for both the bands foreseen in Article 8 of the Radio Regulations [1] (18 GHz band and 14 GHz band).

All the European countries, except Malta, use the 18 GHz band.

The value of C/N is 24 dB for 99 % of the worst month at the edge of service area.

The protection ratios used for planning are 40 dB and 21 dB respectively for the co-channel and adjacent-channels.

G.3 Satellite

The satellites are designed to receive the carrier transmitted by the up-link stations in the 18 or 14 GHz bands.

The received signal is converted in the 12 GHz band, amplified and transmitted towards the earth, pointing the foreseen country.

The transmitted e.i.r.p. per channel lies between 61 and 67 dBW.

The transmitting antenna must have such a size and shape to cover the service area foreseen by the plan for each country.

Each service area is covered by means of one elliptic beam characterised by the values of three angles as seen from the satellite antenna, corresponding to the two axis of the ellipse and its orientation.

G.4 Earth reception

The Radio Regulations indicate, in the No.123 and 124, the two following types of reception:

a) No.123 INDIVIDUAL RECEPTION (in the Broadcasting Satellite Service (BSS)): the reception of emissions from a space station in the BSS by simple domestic installations and in particular those possessing small antennae;

b) No.124 COMMUNITY RECEPTION (in the Broadcasting Satellite Service (BSS)): the reception of emissions from a space station in the BSS by receiving equipments, which in some cases may be complex and have antennae larger than those used for individual reception, and intended for use:

   - by a group of general public at one location;

   - through a distribution system covering a limited area.

G.5 Down-link

The main parameters used for the down-link plan are:

- satellite EIRP value: 64 dBW (average);

- power flux density at the ground level for the 99 % of the worst month:

  - at the boresight: - 100 dBW/m^2;

  - at the edge of the service area: - 103 dBW/m^2;

  - co-channel protect. ratio: 31 dB;

  - adjacent-channel protect. ratio: 15 dB;

  - receiver G/T:

    * 6 dB/K (indiv. recep.);

    * 14 dB/K (comm. recep.);

  - receive antenna diam.:

    * 0,9 m (indiv. recep.);

    * 1,8 m (comm. recep.);

- C/N (99 % w.m.): 14 dB at the edge of the service area.

G.6 WARC '77 receiver

The planning of the BSS system for region 1 and 3 was based on the following characteristics of the earth receiver:

a)	figure of merit (G/T):	6 dB/K (indiv. recep.); 14 dB/K (comm. recep.);
b)	antenna main beamwidth at - 3 dB ($ø_0$):	2° (indiv. recep.); 1° (comm. recep.);
c)	antenna diameter:	0,9 m (indiv. recep.); 1,8 m (comm. recep.);
d)	antenna efficiency:	0,55;
e)	antenna diagram:	See Appendix of the Radio Regulations [1];
f)	bandwidth:	27 MHz.

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

H.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 overall noise factor (power ratio) of the LNB;

Gr is the effective receiving antenna gain (power ratio), taking account of illumination method of feeding and efficiency.

H.2 Example of G/T calculation

An example of a G/T calculation is presented here. In this example the Gr is calculated from:

$$Gr = \eta \times (\pi \times D / \lambda)^2$$

Assuming:

D = 0,9 m (antenna diameter);

η = 0,65 (antenna efficiency);

f = 12,1 GHz;

α = 0,89 (coupling losses: 0,5 dB);

Ta = 45 K (antenna noise temperature);

n = 1,4 (or 1,5 dB), (receiver noise figure);

the result is:

G/T = 14,9 dB/K

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

J.1 Dimensions of Type B flanges in millimetres for ordinary rectangular waveguides IEC 154-2 [12a]

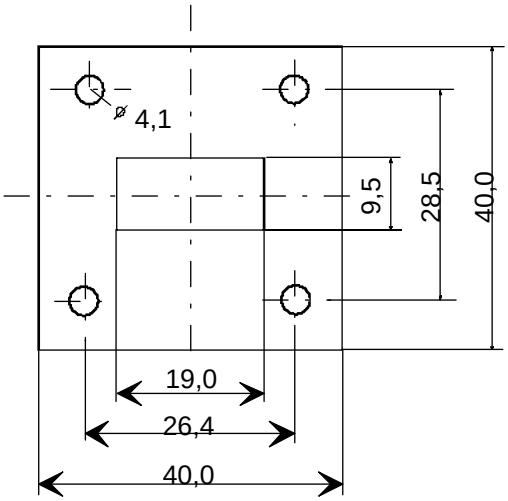


Figure J.1: UBR 120

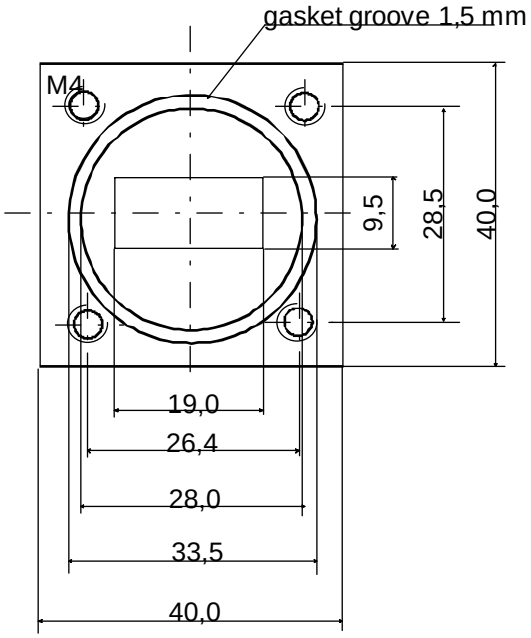


Figure J.2: PBR 120

J.2 Dimensions of flanges in millimetres for circular waveguides IEC 154-4 [12b]

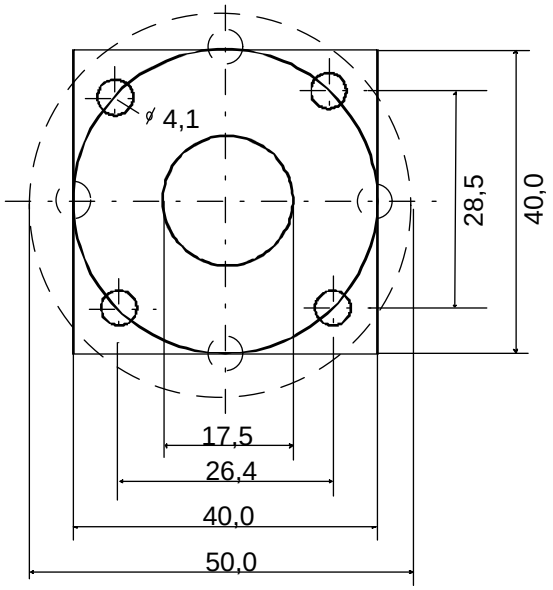


Figure J.3: C 120 without gasket groove

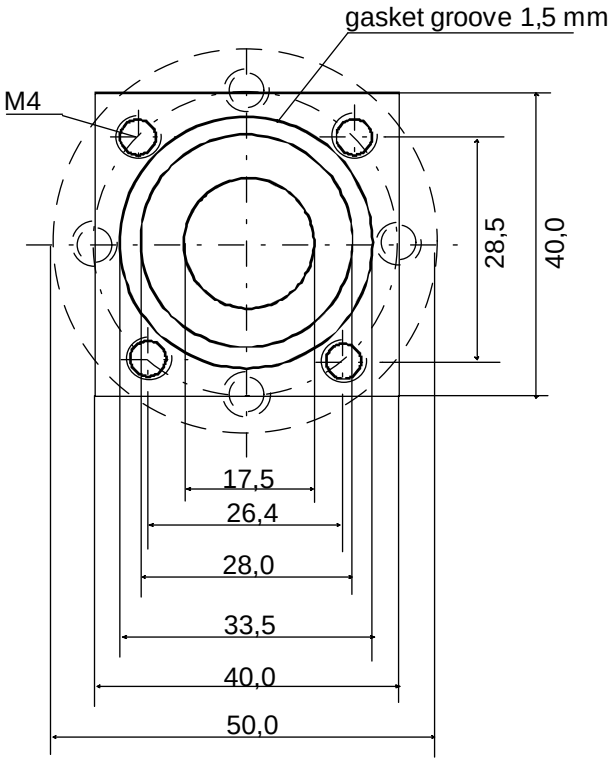


Figure J.4: C 120 with gasket groove

History

Document history	
December 1993	First Edition
March 1996	Converted into Adobe Acrobat Portable Document Format (PDF)