EUROPEAN TELECOMMUNICATION STANDARD

ETS 300 457

November 1995

Source: ETSI TC-SES

Reference: DE/SES-04011

ICS: 33.060.30

Key words: TVRO, testing

Satellite Earth Stations and Systems (SES); Test methods for Television Receive Only (TVRO) operating in the 11/12 GHz frequency bands

ETSI

European Telecommunications Standards Institute

ETSI Secretariat

Postal address: F-06921 Sophia Antipolis CEDEX - FRANCE
Office address: 650 Route des Lucioles - Sophia Antipolis - Valbonne - FRANCE
X.400: c=fr, a=atlas, p=etsi, s=secretariat - **Internet:** secretariat@etsi.fr

Tel.: +33 92 94 42 00 - Fax: +33 93 65 47 16

New presentation - see History box

Contents

Foreword 7

1 Scope 9

2 Normative references 9

3 Definitions and abbreviations 10
3.1 Definitions 10
3.2 Abbreviations 10

4 General test arrangements 11
4.1 General 11
4.2 Outdoor far-field test site 11
4.2.1 General 11
4.2.2 Description 11
4.3 Anechoic chamber 12
4.3.1 General 12
4.3.2 Description 12
4.3.3 Parasitic reflections 14
4.4 Reverberating chamber 15
4.4.1 General 15
4.4.2 Description 15
4.5 Open area test site 15
4.5.1 General 15
4.5.2 Description 16
4.6 Compact antenna test range 16
4.6.1 General 16
4.6.2 Description 17
4.7 Semi-anechoic chamber 18
4.8 TEM cell 18
4.9 Power supplies 18
4.9.1 Test power supplies 18
4.9.2 LNB power supply 18
4.10 Test equipment 18
4.10.1 General 18
4.10.2 Substitution antenna 19
4.10.3 Measuring and test antenna 19
4.10.4 Measuring receiver/Spectrum analyser 19
4.10.5 Screening 19
4.11 Environmental conditions 20
4.11.1 General 20
4.11.2 Standard conditions for measurement 20
4.11.3 Non-standard conditions for measurement 20
4.12 Test results and test report 20
4.12.1 Test results 20
4.12.2 Test report 20

5 Safety 21
5.1 Mechanical safety 21
5.1.1 Specification 21
5.1.2 Test method 21
5.2 Mechanical construction - wind speed 21
5.2.1 Specification 21
5.2.2 Test methods 21
5.2.2.1 General 21
5.2.2.2 Wind tunnel 22
5.2.2.3 Numerical analysis and load applications 22

5.3 Mechanical construction - interface loads 23
5.3.1 Specification 23
5.3.2 Test method 23
5.4 Mechanical construction - adverse conditions 24
5.4.1 General 24
5.4.2 Corrosion resistance 24
5.4.2.1 Specification 24
5.4.2.2 Test method 24
5.5 Fire hazard 24
5.5.1 Specification 24
5.5.2 Test method 24
5.6 Electrical shock by access 24
5.6.1 Specification 24
5.6.2 Test method 24
5.7 Lightning protection 24
5.7.1 Specification 24
5.7.2 Test method 24

6 Radio frequency 25
6.1 LNB downconverter 25
6.1.1 Definition 25
6.1.2 Test site 25
6.1.3 Power supply 25
6.1.3.1 General 25
6.1.3.2 Specification 25
6.1.3.3 Method of measurement 25
6.1.4 Input range 26
6.1.4.1 Specification 26
6.1.4.2 Method of measurement 26
6.1.5 Local oscillator frequency 26
6.1.5.1 Frequency spectrum 26
6.1.5.1.1 Specification 26
6.1.5.1.2 Method of verification 26
6.1.5.2 Frequency conversion 26
6.1.5.2.1 Specification 26
6.1.5.2.2 Method of measurement 27
6.1.6 Output range 27
6.1.6.1 Specification 27
6.1.6.2 Method of measurement 27
6.1.7 Noise figure (noise temperature) 28
6.1.7.1 Specification 28
6.1.7.2 Method of measurement 28
6.1.8 Image frequency rejection 28
6.1.8.1 General 28
6.1.8.2 Specification 29
6.1.8.3 Method of measurement 29
6.1.9 Unwanted signals immunity 30
6.1.9.1 Specification 30
6.1.9.2 Method of measurement 30
6.1.10 Small signal gain 31
6.1.10.1 Specification 31
6.1.10.2 Method of measurement 31
6.1.11 Linearity 32
6.1.11.1 Amplitude-frequency characteristic 32
6.1.11.1.1 Specification 32
6.1.11.1.2 Method of measurement 32
6.1.11.2 Group delay characteristic 33
6.1.11.2.1 Specification 33
6.1.11.2.2 Method of measurement 33
6.1.11.3 Output level (multicarrier intermodulation ratio test) 34
6.1.11.3.1 General 34
6.1.11.3.2 Specification 34
6.1.11.3.3 Method of measurement 34

6.1.12 LNB interfaces 35
6.1.12.1 Input 35
6.1.12.1.1 Specification 35
6.1.12.1.2 Method of measurement 35
6.1.12.2 Output impedance 35
6.1.12.2.1 Specification 35
6.1.12.2.2 Method of measurement 35
6.1.12.3 Output connector 36
6.1.12.3.1 Specification 36
6.1.12.3.2 Method of verification 36
6.1.12.4 Output return loss 36
6.1.12.4.1 Matched load 36
6.1.12.4.2 Specification 36
6.1.12.4.3 Method of measurement 36
6.2 On-axis spurious radiation 37
6.2.1 Definition 37
6.2.2 Specification 37
6.2.3 Method of measurement 37
6.2.3.1 General 37
6.2.3.2 Test site 37
6.2.3.3 Method of measurement 38
6.2.3.3.1 Conducting method 38
6.2.3.3.2 Reverberating chamber method 39
6.3 Spurious radiation 40
6.3.1 General 40
6.3.2 Specification 40
6.3.3 Method of measurement 40
6.3.3.1 Test method 40
6.3.3.2 Identification of frequencies of spurious radiation 40
6.3.3.2.1 Test site 40
6.3.3.2.2 Procedure 40
6.3.3.3 Measurement of power levels of identified spurious radiation 41
6.3.3.3.1 Test site 41
6.3.3.3.2 Procedure 41
6.3.3.4 Measurement of spurious radiation radiated through the antenna 42
6.3.3.4.1 Test site 42
6.3.3.4.2 Procedure (antenna flange) 42
6.3.3.4.3 Procedure (primary feed) 43
6.4 Immunity 44
6.4.1 General 44
6.4.2 Test site 44
6.4.3 Definition 44
6.4.4 Ambient fields 44
6.4.4.1 Specification 44
6.4.4.2 Method of measurement 44
6.4.5 Currents 45
6.4.5.1 Specification 45
6.4.5.2 Method of measurement 46
6.5 Antenna sub-system 46
6.5.1 Co-polar on-axis gain 46
6.5.1.1 Definition 46
6.5.1.2 Specification 46
6.5.1.3 Test site 46
6.5.1.4 Method of measurement 46
6.5.2 Antenna receive radiation patterns 47
6.5.2.1 General 47
6.5.2.2 Specification 47
6.5.2.3 Design objectives 48
6.5.2.4 Test site 48
6.5.2.5 Method of measurement 48
6.5.2.6 Computation of results 49

6.5.3 Cross-polarisation discrimination ... 49
6.5.3.1 General ... 49
6.5.3.2 Specification ... 49
6.5.3.3 Design objective ... 49
6.5.3.4 Test site ... 49
6.5.3.5 Method of measurement ... 49
6.5.4 Pointing accuracy ... 50
6.5.4.1 Specification ... 50
6.5.4.2 Test site ... 50
6.5.4.3 Method of verification ... 50
6.5.5 Polarisation plane alignment ... 50
6.5.5.1 General ... 50
6.5.5.2 Specification ... 50
6.5.5.3 Test site ... 50
6.5.5.4 Method of verification ... 50
6.5.6 Mechanical stability ... 51
6.5.6.1 Specification ... 51
6.5.6.2 Method of measurement ... 51
6.5.7 Output interface and impedance matching ... 51
6.5.7.1 Test site ... 51
6.5.7.2 Interface ... 51
6.5.7.2.1 Specification ... 51
6.5.7.2.2 Method of measurement ... 51
6.5.7.3 Impedance matching ... 51
6.5.7.3.1 Specification ... 51
6.5.7.3.2 Method of measurement ... 52
6.6 Figure of merit ... 52
6.6.1 General ... 52
6.6.2 Specification ... 52
6.6.3 Test site ... 52
6.6.4 Method of measurement ... 53
6.7 Supplementary requirements ... 54
6.7.1 General ... 54
6.7.2 Commands ... 54
6.7.2.1 Specification ... 54
6.7.2.2 Test site ... 54
6.7.2.3 Method of measurement ... 55

7 Documentation ... 57
7.1 Basic specification ... 57
7.2 Information leaflet ... 57
7.3 Method of verification ... 59

Annex A (normative): Test report summary ... 60

Annex B (normative): Test report result forms ... 64

Annex C (normative): Waveguide flanges ... 103

C.1 Rectangular waveguide flange dimensions ... 103

C.2 Circular waveguide flange dimensions ... 103

History ... 104

Foreword

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

Transposition dates	
Date of adoption of this ETS:	15 September 1995
Date of latest announcement of this ETS (doa):	28 February 1996
Date of latest publication of new National Standard or endorsement of this ETS (dop/e):	31 August 1996
Date of withdrawal of any conflicting National Standard (dow):	31 August 1996

Blank page

1 Scope

This European Telecommunication Standard (ETS) covers the test methods for TeleVision Receive Only (TVRO) outdoor units used for reception of audio-visual signals from satellites within the 11/12 GHz frequency bands. These TVROs are defined and their characteristics are specified in the reference ETSs, ETS 300 158 [1] or ETS 300 249 [2]. This ETS specifies the test methods for demonstration of compliance with the specifications of the reference ETS, and also with those for which the reference ETS allows verification at the manufacturers' discretion.

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

- Type A for collective reception;
- Type B for individual reception.

2 Normative references

This European Telecommunication Standard (ETS) incorporates by dated or undated reference, 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] ETS 300 158: "Satellite Earth Stations (SES); Television Receive Only (TVRO-FSS) Satellite Earth Stations operating in the 11/12 GHz FSS bands".

[2] ETS 300 249: "Satellite Earth Stations (SES); "Television Receive-Only (TVRO) equipment used in the Broadcasting Satellite Service (BSS)".

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

[4] IEC 1079-2 (1992): "Methods of measurement on receivers for satellite broadcast transmissions in the 12 GHz band; Part 1: Electrical measurements on DBS tuner units".

[5] CISPR 16-1 (1993): "Specification for radio disturbance and immunity measuring apparatus and methods: Part 1: Radio disturbance and immunity measuring apparatus".

[6] ETS 300 019: "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment".

[7] HD 444.2 (1983): "Fire hazard testing: Part 2: Test methods".

[8] EN 60950 (1992): "Safety of information technology equipment including electrical business equipment".

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

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

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

[12] EN 50140: "Electromagnetic compatibility - Basic immunity standard - Radiated, radio-frequency electromagnetic field - Immunity test".

[13] EN 50141: "Electromagnetic compatibility - Basic immunity standard - Conducted disturbances induced by radio-frequency fields - Immunity test".

[14] EN 55020 (1994): "Electromagnetic immunity of broadcast receivers and associated equipment".

[15] EN 55022 (1994): "Limits and methods of measurement of radio interference characteristics of information technology equipment".

3 Definitions and abbreviations

3.1 Definitions

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

open air: Transparent to electromagnetic waves at the frequencies under consideration. Any covering or environmental protection used must therefore also be transparent to electromagnetic waves at the frequencies under consideration.

outdoor unit: That part of the TVRO installed in a position within line of sight to the satellite(s) to be received. This normally comprises the antenna, LNB(s) and the LNB mounting.

Type A equipment: For collective reception, in particular:

Community Antenna TeleVision (CATV) equipment;
Master Antenna TeleVision (MATV) equipment.

Type B equipment: For individual reception, that is:

Direct To Home (DTH) equipment.

Other definitions are generally included in the subclause in which they occur. The definitions have been taken, where possible, from "International Electrotechnical Vocabulary (2nd Edition), Group 60, Radiocommunications" published by the International Electrotechnical Commission. Other sources include, but are not limited to, documentation produced by IEC, ETSI and CISPR.

3.2 Abbreviations

For the purposes of this ETS the following abbreviations apply:

ac	alternating current
BSS	Broadcast Satellite Service
CATV	Community Antenna TeleVision
MATV	Master Antenna TeleVision
DBS	Direct Broadcast by Satellite
dc	direct current
EIRP	Equivalent Isotropically Radiated Power
emf	electro-motive force
EUT	Equipment Under Test
FSS	Fixed Satellite Service
IF	Intermediate Frequency
LNB	Low Noise Block downconverter
LO	Local Oscillator
RF	Radio Frequency
TEM	Transverse ElectroMagnetic
VSWR	Voltage Standing Wave Ratio

4 General test arrangements

4.1 General

Seven possible test sites are described in this clause: outdoor far-field test sites, anechoic chambers, reverberating chambers, open area test sites, compact antenna test ranges, semi-anechoic chamber and a TEM cell. The test sites used for the measurements shall be validated and, where appropriate, calibrated, so as to reduce measurement uncertainty and the probability of measurement error. Other test sites may be used provided that they are proven to produce results consistent with those produced by the appropriate test site described in this clause.

Any measurement involving either antenna gain patterns or polarisation measurements shall be performed in the far field obtainable on an outdoor far-field test site, through a compact antenna test range or any other recognised method that can be proved to give the same results over the concerned frequency range.

An open air test site shall be on a reasonable level surface or ground and it shall be free from reflecting objects so that the measurement results are not unduly affected. Sufficient precautions shall be taken to ensure that reflections from objects adjacent to the test site do not degrade the measurement methods.

The ambient noise of the test site shall be at least 6 dB lower than the lowest limit to which the measurements need to be compared. All test cables shall be as short as possible and shall be adequately screened.

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 tests to verify compliance with the specifications. In this case the manufacturer shall provide suitable fixtures.

4.2 Outdoor far-field test site

4.2.1 General

This test site shall be such that any covering or environmental protection as well as the site itself shall be transparent to electromagnetic waves at the frequencies under consideration. The distance between the measuring and measured antennas shall be such that they are each in the far-field region of the other antenna. Reflections from both natural and artificial objects shall be at a minimum and of known amplitude and effect.

4.2.2 Description

The far-field distance of an antenna is defined as:

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

where:

R is the distance;
D is the largest dimension of the antenna under test;
λ is the free space wavelength at the test frequency.

Even at this minimum distance, the path difference between the ray from the source to the centre of the aperture and the ray from the source to the edge of the aperture is $\lambda/16$ and the resulting phase deviation of the incident wave-front is 22,5° which corresponds to an error of about 0,1 dB in antenna gain.

The structure supporting the EUT shall have means of adjustment in polarisation, elevation angle and azimuth angle so that the received signal can be maximised.

If the near-field scanner technology to convert near-field measurements to far-field results is proven to be accurate by reference to tests taken in both regions, then antenna measurements may be taken in the near-field.

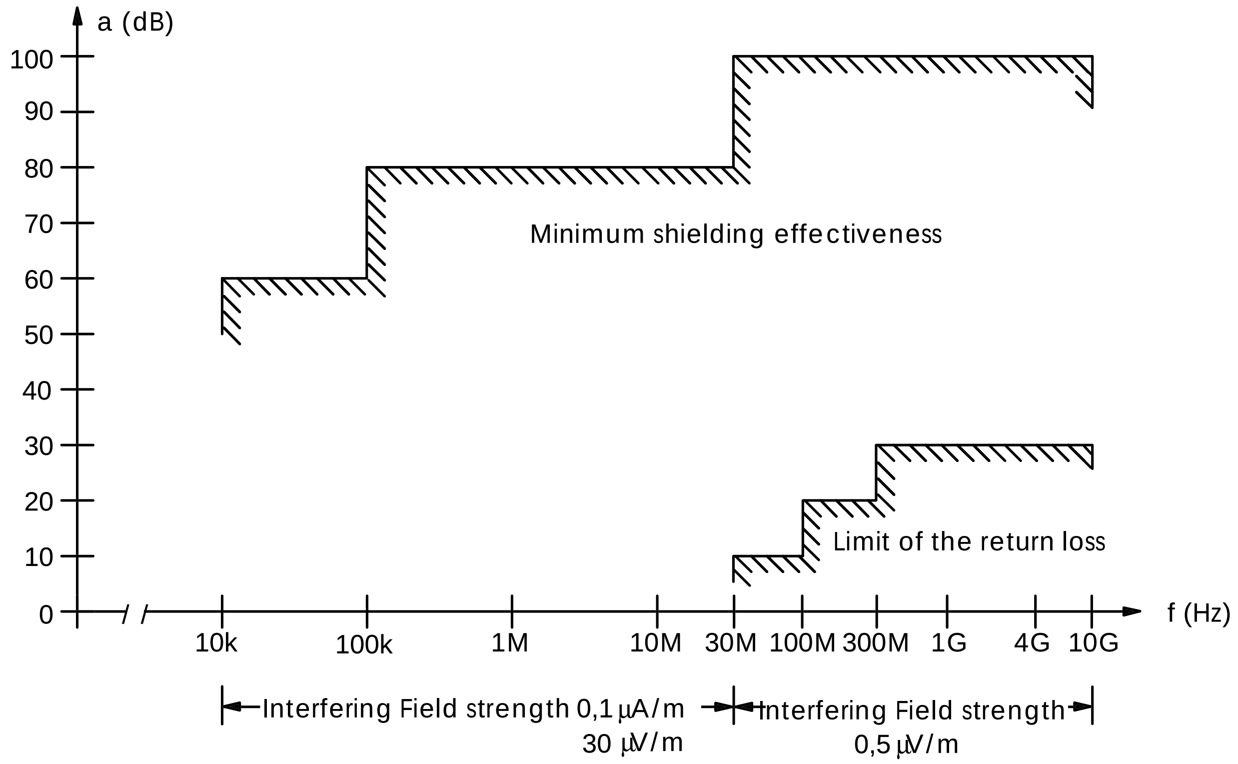
4.3 Anechoic chamber

4.3.1 General

An anechoic chamber is a well shielded chamber covered inside with radio frequency absorbing material and simulating a free space environment. Absolute or relative measurements can be performed, absolute measurements of field strength require the anechoic chamber to be calibrated. This is the type of chamber often used for immunity measurements.

4.3.2 Description

An anechoic chamber shall meet appropriate requirements for shielding effectiveness and wall return loss. Figure 1 shows an example of such requirements. Figure 2 shows an example of the construction of an anechoic chamber having a base area of 5 m by 10 m and a height of 5 m, usually used for EMC measurements. The ceiling and walls are coated with pyramidal-formed absorbers approximately 1 m high. The base is covered with special absorbers which form the floor. The available internal dimensions of the chamber are 3 m by 8 m by 3 m, so that a maximum measuring distance of 5 m in the middle axis of this chamber is available. The floor absorbers reject floor reflections so that the measuring antenna height need not be changed during the calibration procedures. Figure 3 shows an example of a chamber that can be used for higher frequencies. Anechoic chambers of other dimensions may be used.



where: a is attenuation;
f is frequency.

Figure 1: Example of an anechoic shielded chamber for simulated free-space measurements

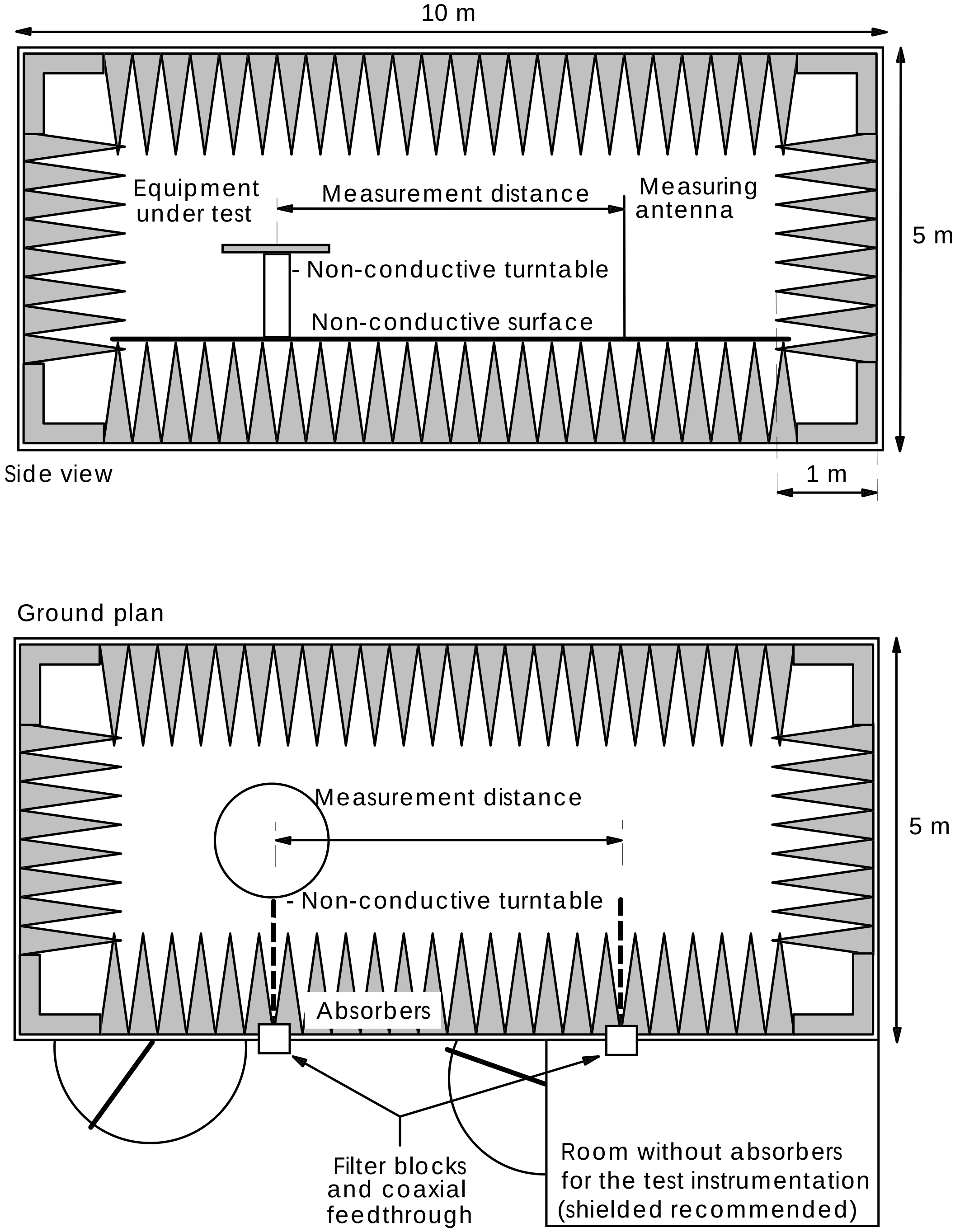


Figure 2: Example of an anechoic shielded chamber for simulated free-space measurements below 3 GHz

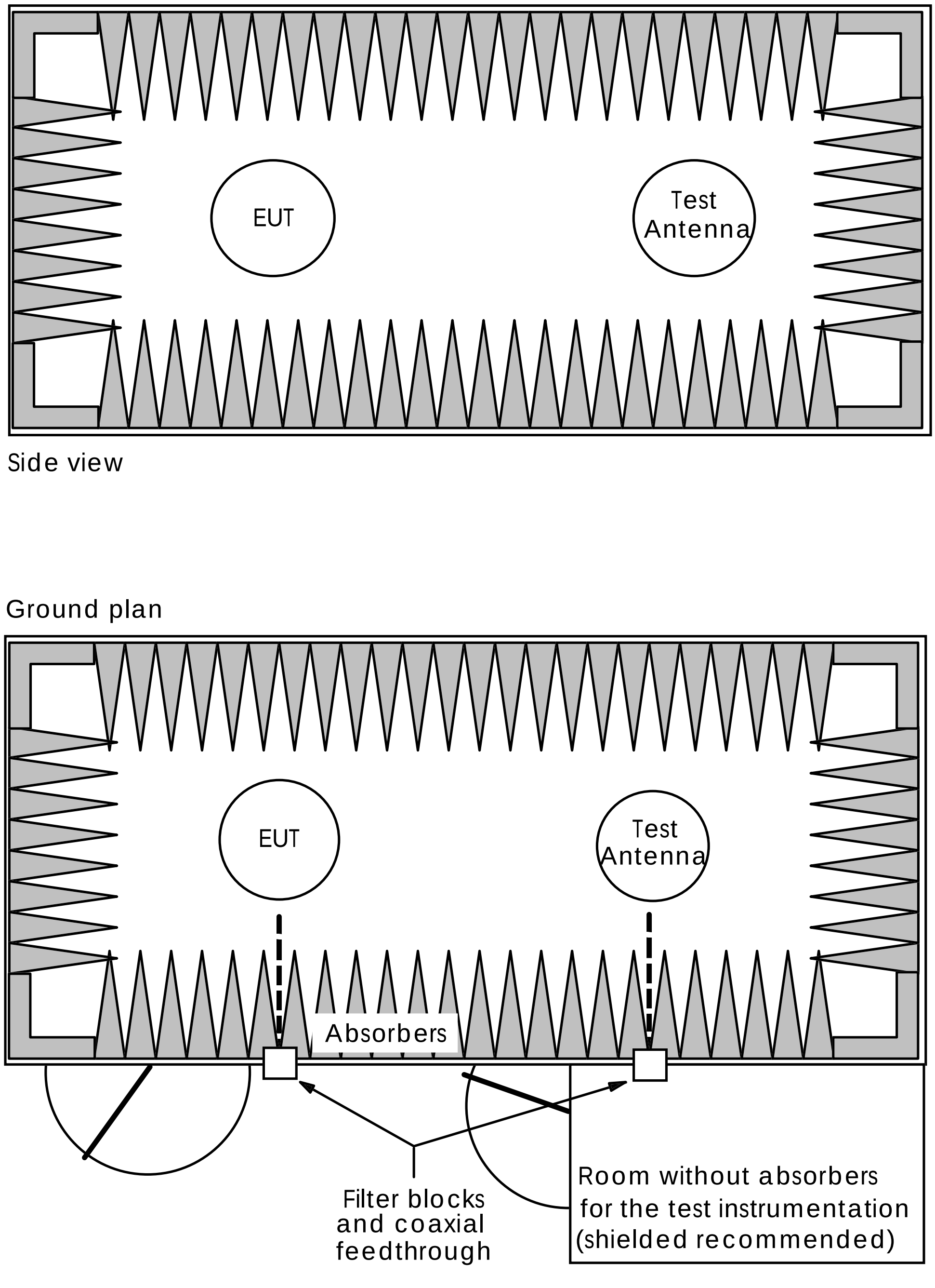


Figure 3: Example of an anechoic shielded chamber for simulated free-space measurements above 3 GHz

4.3.3 Parasitic reflections

For free-space propagation in the far-field the relationship between the field strength and the distance is given by:

$$X = X_o \text{ x } (R_o/R),$$

where:

- X is the field strength;
- X_o is the reference field strength;
- R_o is the reference distance;
- R is the distance.

This relationship allows relative measurements to be made as all constants are eliminated within the ratio and neither cable attenuation nor antenna mismatch or antenna dimensions are of importance.

If the logarithm of the foregoing equation is used, the deviation from the ideal curve can be easily seen because the ideal correlation of field strength and distance appears as a straight line. The deviations occurring in practice are then clearly visible. This indirect method shows quickly and easily any disturbances due to reflections and is far less difficult than the direct measurement of reflection attenuation.

With an anechoic chamber of the dimensions given above at frequencies below 100 MHz there are no far field conditions, but the wall reflections are stronger, so that careful calibration is necessary. In the frequency range from 100 MHz to 1 GHz the dependence of the field strength to the distance meets the expectations very well. Above 1 GHz, because more reflections will occur, the dependence of the field strength to the distance will not correlate so closely.

It is for this reason that the size of the anechoic chamber in relation to the required frequency range and the physical size of the equipment to be tested are of importance.

4.4 Reverberating chamber

4.4.1 General

The reverberating chamber is a small screened room or aluminium chamber (a reflecting chamber) with mechanical stirrers driven by electric motors. This test site can be used for radiation measurements where the antenna is of integral construction and where it is not possible to measure at the antenna flange but it is either possible to remove the reflector or there is no reflector. The EUT would, in this case, include the primary antenna.

4.4.2 Description

Uncertainties increase below a certain frequency thus setting a minimum usable frequency (maximum wavelength). The maximum usable wavelength is one tenth (1/10th) of the chamber's smallest physical dimension. There is no advantage in using a chamber which is much larger, and in fact greater sensitivity would be required in the receiver in such case.

Two stirrers are necessary to achieve an uniform electric field of ± 1 dB with a level of confidence of 95 %. The stirrers should have as large a surface area as possible with no gaps or holes, but should have irregularities with dimensions of at least one wavelength.

To maximise stirring the measuring antenna shall point to one stirrer and the EUT and substitution antenna towards the other. The antennas and EUT should be close to a stirrer but not less than 0,1 m from the walls or stirrers.

4.5 Open area test site

4.5.1 General

This test site shall be such that any covering or environmental protection as well as the site itself shall be transparent to electromagnetic waves at the frequencies under consideration. Absolute or relative measurements can be performed, absolute measurements of field strength require the open area test site to be calibrated.

4.5.2 Description

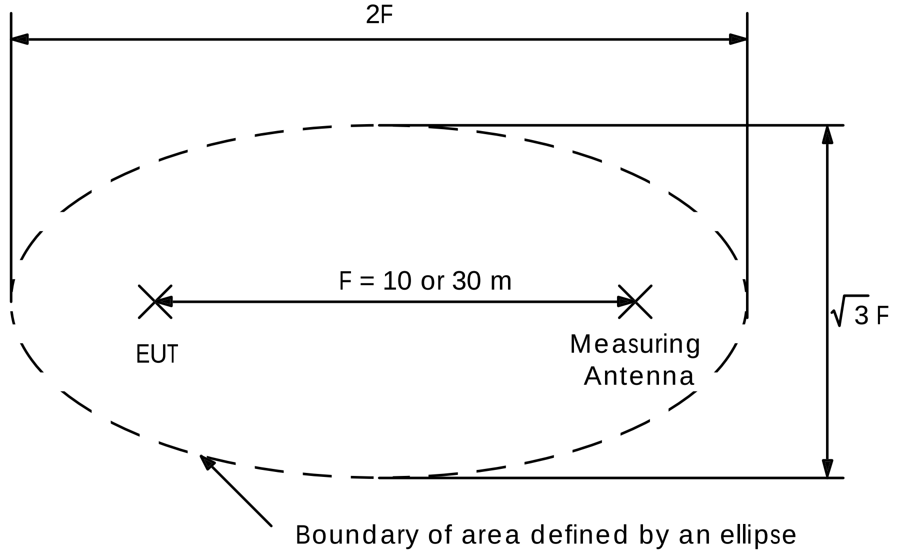


Figure 4: Open area test site arrangement

Figure 4 shows the arrangement of the test site which shall be void of buildings, electric lines, fences, trees etc. and be level. A reflecting ground plane shall be installed, if required to assist the reflectivity of the natural terrain and to avoid reflectivity changes due to environmental conditions or time. If an open area test site is constructed of wire mesh or aluminium mesh then a solid metal ground plane of total width at least 3 m and length 6 m towards the measuring antenna shall be placed from the centre of the turntable for the measurement of frequencies above 1 GHz. The site shall have an obstruction-free area surrounding it. This obstruction-free area shall be large enough so that scatterers from outside the obstruction-free area will have little effect on the fields measured by the measuring antenna.

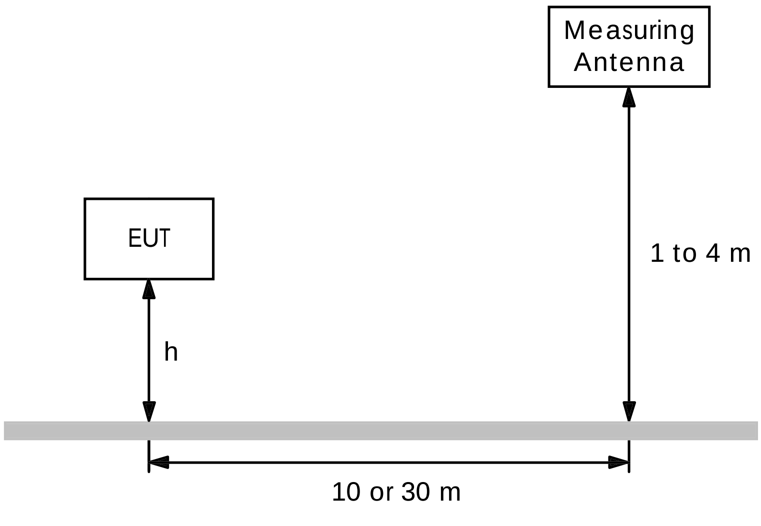


Figure 5: Schematic of equipment in relation to ground plane

Figure 5 shows the location of the equipment and ground plane. The height of the EUT (h) shall be as specified for each test. The height of the measuring antenna can be changed to allow both the direct and reflected waves to be combined.

4.6 Compact antenna test range

4.6.1 General

A compact test range is a large anechoic chamber in which, with the use of reflectors, it is possible to simulate the far-field obtainable on an open air test site. These reflectors are very accurately profiled large metal plates which are optically aligned with each other.

4.6.2 Description

Figure 6 shows the general arrangement of the test range which is one in which the receiving antenna is illuminated by the collimated energy in the aperture of a larger point or line focus antenna. The linear dimensions of the reflectors are usually chosen to be at least three times that of the antenna that they are illuminating, or are being illuminated by, so that the illumination sufficiently approximates a plane wave. To suppress any direct radiation from the feed antenna in the direction of the test region the reflectors are designed with long focal lengths. The use of relatively long focal-length reflectors has the additional advantage that for a given size reflector the depolarisation effect associated with curved reflectors is reduced. Diffraction from the edges of the reflectors is reduced by designing the reflectors with serration around the edges. High-quality absorbing material is placed between the two antennas to absorb the unwanted radiation. The structure holding the measuring antenna can be moved both sideways and forwards and backwards in order to further reduce any direct coupling between the antennas.

In order to obtain good results with a compact range the reflectors should be constructed with sufficient accuracy. Small deviations in the fabricated reflector surface can result in significant variations in the amplitude and phase distribution of the incident field at the receiving antenna. To assess the effect of surface deviations not only their shapes and maximum deviations should be noted but, also very importantly, their areas. For example, if the reflector has small deviations that do not exceed $\lambda/100$ and their individual sizes are also small (less than one square wavelength), then the integrated effect of all the deviations over the entire reflector will be quite small, and hence a fairly uniform amplitude distribution of the incident field over the receiving antenna will be obtained. On the other hand, suppose that a reflector had a single surface deviation near the centre of the reflector, extending over an area comparable to 1 Fresnel zone. In this case a very significant change in the incident field would occur. It is obvious therefore that the reflectors should be fabricated with great care.

The compact test range can be evaluated in the same manner as conventional ranges by the use of field-probing techniques. Since the illuminating field is obtained by the reflection from curved surfaces some depolarisation is to be expected. The field-probing shall, therefore, include measurements of polarisation as well as amplitude and phase, especially if the measurements to be made depend upon the polarisation characteristics of the illuminating field.

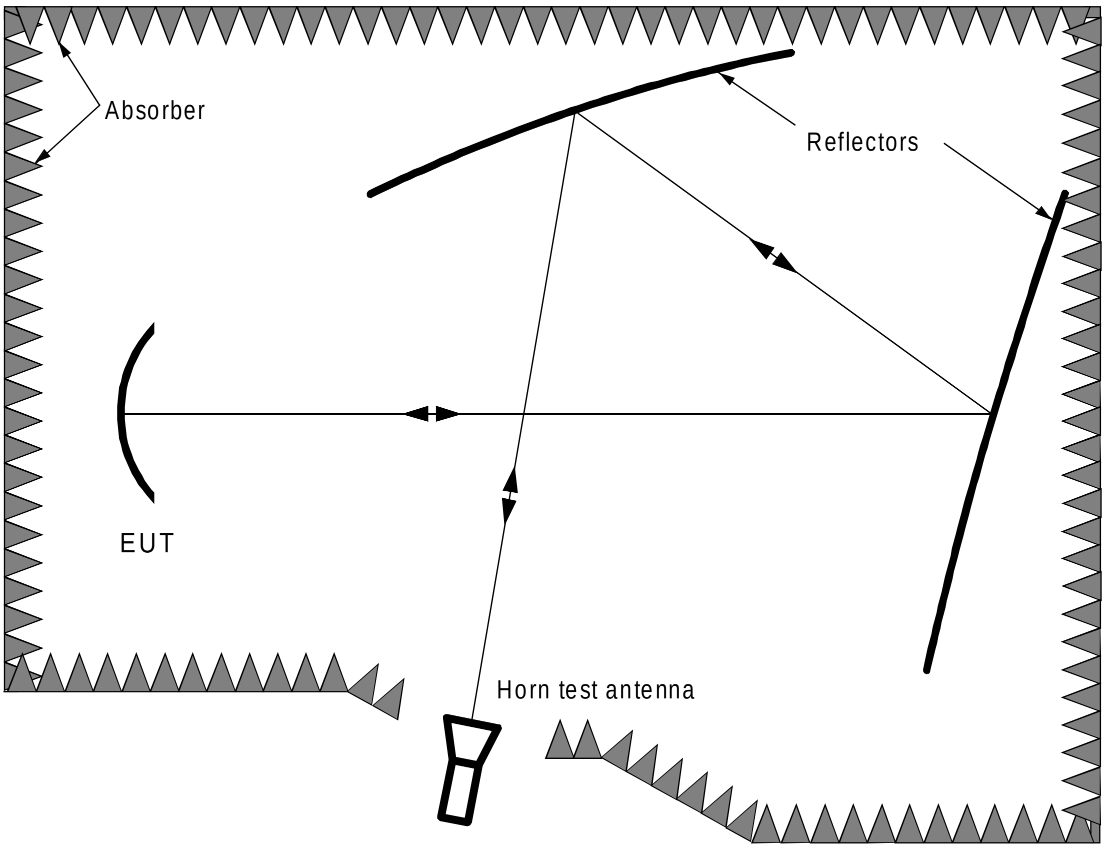
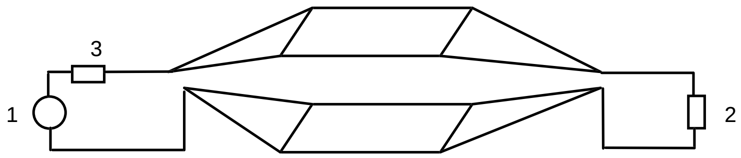


Figure 6: Compact antenna test range

4.7 Semi-anechoic chamber

A semi-anechoic chamber has one difference to an anechoic chamber as described in subclause 4.3. This difference is that the absorbers and any non-conductive surfaces are removed from the floor. The floor of a semi-anechoic chamber shall consist of a reflective ground plane.

4.8 TEM cell



1 = Signal generator

2 = Terminating impedance

3 = Matching impedance

Figure 7: TEM stripline device - schematic

A homogeneous, electromagnetic wave under free space conditions can be simulated by a guided wave of the TEM mode travelling between two flat horizontal conducting surfaces. In this case the electric field component is perpendicular to the conductors and the magnetic field horizontal. The open TEM stripline is the device that is specified in this ETS.

An open TEM stripline can be used within another test site for the testing of small items, typically up to 0,7 m high. The usable frequency range is up to 150 MHz and the characteristic impedance of the device is 150 Ω. Full construction details are contained in EN 55020 [14].

4.9 Power supplies

4.9.1 Test power supplies

During the test period the power supplies used shall not exceed the limits stated in table 1 (see also IEC 510-1 [3] clauses 5 and 6). The harmonic components are those components that deviate from the instantaneous value of the fundamental wave. The limit quoted is in respect of the difference in the amplitude of those components and the amplitude of the fundamental wave.

Table 1: Power supply limits

Parameter	Limit
Voltage	± 2 %
Frequency	± 2 %
Harmonic components	5 %

4.9.2 LNB power supply

If the LNB is powered directly from a satellite receiver then the requirements of IEC 1079-2 [4] apply additionally to that receiver.

4.10 Test equipment

4.10.1 General

All equipment used for any test shall be within its stated calibration period and shall be operated within the test equipment manufacturer's declared operating conditions and procedures.

4.10.2 Substitution antenna

The substitution antenna is used to replace the EUT when called for in the relevant test method. For measurements below 1 GHz the substitution antenna shall be a half wavelength dipole resonant at the frequency under consideration, or a shortened dipole, calibrated to the half wavelength dipole. For measurements above 1 GHz a calibrated horn radiator shall be used. The centre of this antenna shall coincide with the volumetric centre of the EUT it has replaced.

4.10.3 Measuring and test antenna

When the test site is used for radiation measurements the measuring antenna is used to detect the field from both the EUT and the substitution antenna when called for in the relevant test method.

When the test site is used for the measurement of receiver characteristics and, possibly, antenna measurements, the test antenna is used for transmission.

For frequencies between 80 MHz and 1 GHz the measuring antenna shall be a balanced dipole which shall be resonant in length. For frequencies below 80 MHz it shall have a length equal to the 80 MHz resonant length and shall be tuned and matched to the feeder by a suitable transforming device. For frequencies above 1 GHz the antenna shall be a horn radiator of known gain/frequency characteristics. When used for reception the antenna and any associated amplification system shall have an amplitude/frequency response within ± 2 dB of the combined calibration curves across the measurement frequency range considered for the antenna. The antenna is mounted on a support capable of allowing the antenna to be used in either horizontal or vertical polarisation and at the specified height.

4.10.4 Measuring receiver/Spectrum analyser

For measurements below 1 GHz the measuring receiver shall conform to the following characteristics:

- the response to a constant amplitude sine wave signal shall remain within ± 1 dB across the frequency range of interest;
- quasi-peak detection shall be used in a 6 dB bandwidth of 120 kHz;
- the receiver shall be operated at more than 1 dB below the compression point during tests/measurements.

For measurements above 1 GHz the spectrum analyser shall conform to the following characteristics:

- the response to a constant amplitude sine wave signal shall remain within ± 4 dB across the frequency range of interest;

The spectrum analyser shall conform to the following characteristics:

- the sweep time shall be capable of variation between 0,1 s and 10 s;
- a resolution filter with a - 3 dB bandwidth of 100 kHz and a - 60 dB/- 3 dB shape factor of ≤ 15:1 shall be used;
- the screening effectiveness shall be at least 60 dB;
- the spectrum analyser shall be operated at more than 1 dB below the compression point during tests/measurements.

4.10.5 Screening

The screening performance of all measuring equipment and interconnecting cables shall be in conformity with CISPR 16-1 [5], section one, clause 2.8 over the frequency range of operation of that piece of test equipment.

4.11 Environmental conditions

4.11.1 General

All tests shall be performed under environmental conditions within those for which the EUT is designed to operate.

4.11.2 Standard conditions for measurement

Unless otherwise stated for specific tests the normal environmental conditions shall be taken to be within those ranges shown in table 2.

Table 2: Standard environmental conditions

Condition	Permissible range
Temperature	+15°C to +35°C
Relative Humidity	20 % to 75 %
Air pressure	86 kPa to 106 kPa (860 mbar to 1 060 mbar)

4.11.3 Non-standard conditions for measurement

Where standard environmental conditions are not met then the measurements described in this ETS may be made under other environmental conditions within limits agreed between the parties concerned. These limits may affect one or more of the following:

- wind velocity;
- hail;
- ice;
- rain;
- snow;
- solar radiation;
- temperature range.

4.12 Test results and test report

4.12.1 Test results

The test results shall be classified on the basis of the specification for the equipment under test as either:

a) normal performance within the specified limits;
b) temporary degradation or loss of function or performance which is self-recoverable;
c) temporary degradation or loss of function or performance which requires operator intervention or system reset;
d) degradation or loss of function which is not recoverable due to damage to equipment or software, or loss of data.

The measurement value related to the corresponding limit shall be used to decide whether an equipment meets the requirements of the relevant standard.

4.12.2 Test report

A test report containing details of the environmental and test conditions and the test results shall be produced.

The measurement uncertainty value for the measurement of each parameter shall be included in the test report.

A test report summary as presented in annex A shall be incorporated into the test report.

Annex B is composed of Test report result forms which shall be used in the test report. These forms contain the minimum amount of information that is required to show compliance with the specification. Any graphically presented results shall be included in the test report following the appropriate test result.

These forms and pro forma cover tests which, if performed, shall be included in the report.

The test results shall be presented in the manner described in this ETS, whatever method of measurement is used.

5 Safety

5.1 Mechanical safety

5.1.1 Specification

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.

5.1.2 Test method

The test method to be used shall be a careful visual inspection of the unit whilst taking great care when moving the unit around.

Any edge or area considered suspect is to be entered on the test report.

5.2 Mechanical construction - wind speed

5.2.1 Specification

As specified in ETS 300 158 [1] or ETS 300 249 [2] the outdoor unit, including mounted structural components (but excluding the means of attachment), shall be designed to support the following main loads due to:

- the weight of the antenna and structural components;
- the wind speed.

Loading due to snow and ice is not considered.

At the maximum applicable wind speed quoted in ETS 300 158 [1] or ETS 300 249 [2] none of the components shall be torn away.

The maximum installation height of the antenna and the maximum wind speed to be tested to shall be those declared by the manufacturer. These limits shall be indicated in the data sheet of the test report.

5.2.2 Test methods

5.2.2.1 General

Two methods of testing are described in this subclause, wind tunnel and numerical analysis. The numerical analysis and load application are performed in two stages.

In the first stage the effects of maximum wind speed 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. In the second stage the computed loads shall be applied to the structure.

The purpose of the numerical analysis is twofold:

1) to show that the fields of force and torque 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;
- LNB - struts.

5.2.2.2 Wind tunnel

a) The outdoor unit (EUT) shall be mounted in the wind tunnel in such a way that wind load can be applied from all horizontal directions in steps of 45°.

b) The EUT shall be set to the minimum elevation angle.

c) The wind shall be applied gradually in steps up to the maximum speed declared by the manufacturer.

d) At each step a pause lasting approximately 1 minute shall be made during which time the EUT shall be observed for any signs of distortion.

e) Any signs of distortion or fractures observed shall be recorded.

f) The test shall be repeated with the wind direction changed by 45°, i.e. a total of 8 different directions.

g) The tests shall be repeated with the EUT set to the maximum elevation angle.

h) If appropriate the results obtained with the scale model shall be computed to obtain the true size data.

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

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

where:

V_T is the wind velocity under test;
V_S is the wind velocity under standard conditions;
P_T is the air pressure, in Pascal, at the test site;
T_T is the temperature, in Kelvin, at the EUT.

The test report shall contain the following information:

- description of the test equipment;
- description of the tests performed;
- any signs of distortion or fractures observed.

When the test detailed in subclause 6.5.6 is carried out then the test report shall contain the following additional information:

- results of the measurements of the deviation of the antenna position;
- component deviation with respect to each other.

5.2.2.3 Numerical analysis and load applications

a) The air related parameters, namely the kinematic viscosity used to calculate drags at the rims of the structure shall be calculated with the standard atmospheric environmental conditions (temperature = 293 K, air pressure = $1{,}013 \times 10^5$ Pascal).

b) The computations needed to derive the fields of force and torque and the equivalent static stresses shall be carried out for each of the following variables:

- elevation angle: maximum and minimum;
- wind direction: in steps of 45° around the outdoor unit;

- wind speed: as declared by the manufacturer.

c) It shall be verified with the simulated results that break point limits are not exceeded for any self-contained element.

d) The calculated equivalent static loads shall be applied at any critical fixing point of the assembly.

e) Whilst the loads are applied the outdoor unit shall be observed and any distortion noted.

f) The test report shall contain the following information:

  - the computation method used;
  - description of the test equipment;
  - description of the tests performed;
  - results of the safety margin test;
  - any signs of distortion or fracture observed.

  When the test detailed in subclause 6.5.6 is tested then the test report shall contain the following additional information:

  - results of the measurements of the deviation of the antenna position;
  - component deviation with respect to each other.

5.3 Mechanical construction - interface loads

5.3.1 Specification

The mechanical loads at the interface with the attachment device shall be calculated or measured and entered as values in the data sheet of the test report.

5.3.2 Test method

This test shall be performed in conjunction with that detailed in subclause 5.2.

The wind load (W) is given by the formula:

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

where:

W is the wind load in Newton (N);
c is the area correction coefficient and is equal to 1,2;
p is the wind pressure (Pa);
A is the component area (m^2).

For the purposes of establishing outdoor unit loading, the following wind pressure value corresponding to the required wind speed shall be used:

- a wind pressure of 800 Pa, corresponding to a wind speed of 130 km/h;
- a wind pressure of 1 100 Pa corresponding to a wind speed of 150 km/h;
- 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.

The test report shall contain the following information:

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

5.4 Mechanical construction - adverse conditions

5.4.1 General

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.

5.4.2 Corrosion resistance

5.4.2.1 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.

5.4.2.2 Test method

This shall be in conformance with the appropriate part of ETS 300 019 [6] for the environmental class in use; stationary use; non-weather protected locations - extended (Class 4.1E).

5.5 Fire hazard

5.5.1 Specification

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

5.5.2 Test method

The test method shall be in accordance with CENELEC HD 444.2 [7].

5.6 Electrical shock by access

5.6.1 Specification

The electrical safety of the equipment shall be in accordance with the introduction and clauses 1 to 3 of EN 60950 [8]. These clauses deal with fundamental design requirements, wiring, connections and supply.

5.6.2 Test method

The test method to be used shall be in conformance with EN 60950 [8] verification procedures.

5.7 Lightning protection

5.7.1 Specification

Means shall be provided to permit the attachment of bonding conductors of dimensions indicated in EN 50083-1 [9], clause 10 as stated in ETS 300 158 [1] or ETS 300 249 [2].

5.7.2 Test method

a) The dimensions of the attachment point shall be measured.

b) The dimensions of any restrictive area shall be measured.

c) The measurements obtained in a) and b) above shall be compared to the specification to ascertain compliance.

6 Radio frequency

6.1 LNB downconverter

6.1.1 Definition

For the purposes of this subclause the EUT is defined as the LNB only, properly powered.

6.1.2 Test site

There is no requirement to define the test site to be used for these tests.

6.1.3 Power supply

6.1.3.1 General

The test in this subclause may be performed if required by the manufacturer.

6.1.3.2 Specification

The LNB shall have a dc power supply. Its characteristics shall be as specified in ETS 300 158 [1] or ETS 300 249 [2] (Power supply for LNB).

6.1.3.3 Method of measurement

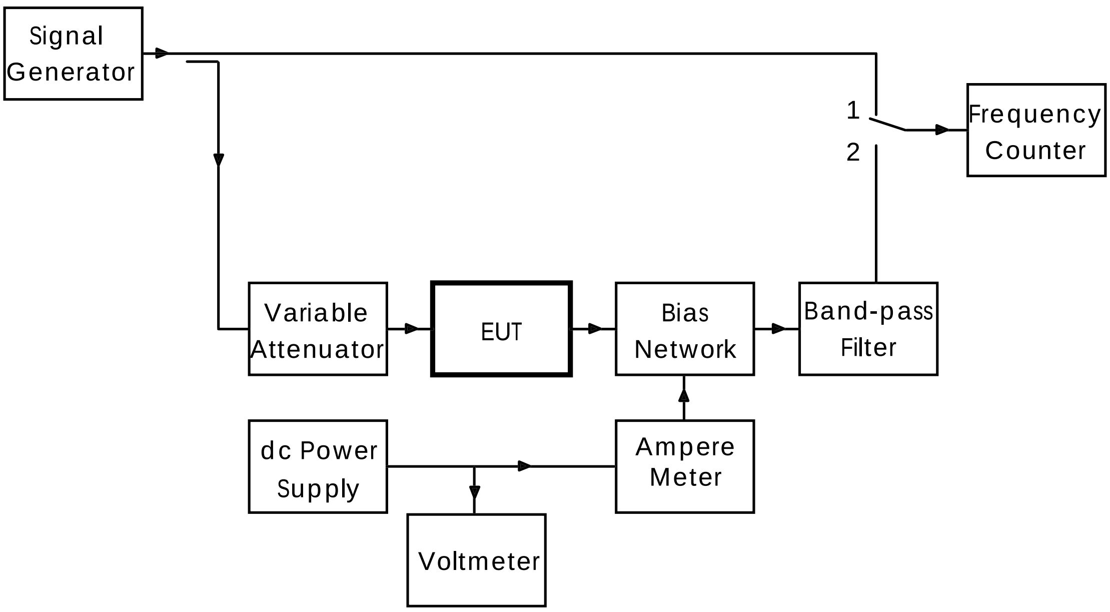


Figure 8: Test arrangement - LNB power supply

a) The test arrangement shall be as shown in figure 8 with the dc power supply set to approximately 15 V.

b) The signal generator shall be set to a frequency in the middle of the manufacturer's declared input range.

c) The frequency shall be measured by the frequency counter.

d) The frequency counter shall be switched to input line 2.

e) The output level of the signal generator shall be adjusted for a minimum stable signal at the output of the EUT.

f) The frequency counter shall measure the EUT output frequency.

g) The voltage and current shall be recorded.

h) The dc power supply shall be varied between the limits 11,5 V and 19 V.

j) Any change in the output frequency shall be investigated to ascertain whether it is due to the EUT failing to operate, the EUT LO switching, possibly including an instantaneous change of current, or the signal generator failing.

k) Whilst the voltage is being varied the current shall also be monitored to ascertain the maximum value.

6.1.4 Input range

6.1.4.1 Specification

The outdoor unit shall be able to receive simultaneously signals in the frequency ranges specified in ETS 300 158 [1] or ETS 300 249 [2] (Radio Frequency (RF) input range).

6.1.4.2 Method of measurement

This requirement is verified during the test described in subclause 6.1.5.2.2 steps b), g) and h).

6.1.5 Local oscillator frequency

6.1.5.1 Frequency spectrum

6.1.5.1.1 Specification

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

6.1.5.1.2 Method of verification

This requirement is verified during the test described in subclause 6.1.5.2.2 step f).

6.1.5.2 Frequency conversion

6.1.5.2.1 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 the deviation specified in ETS 300 158 [1] or ETS 300 249 [2] from its nominal value with the factors specified within those ETSs being taken into account.

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

6.1.5.2.2 Method of measurement

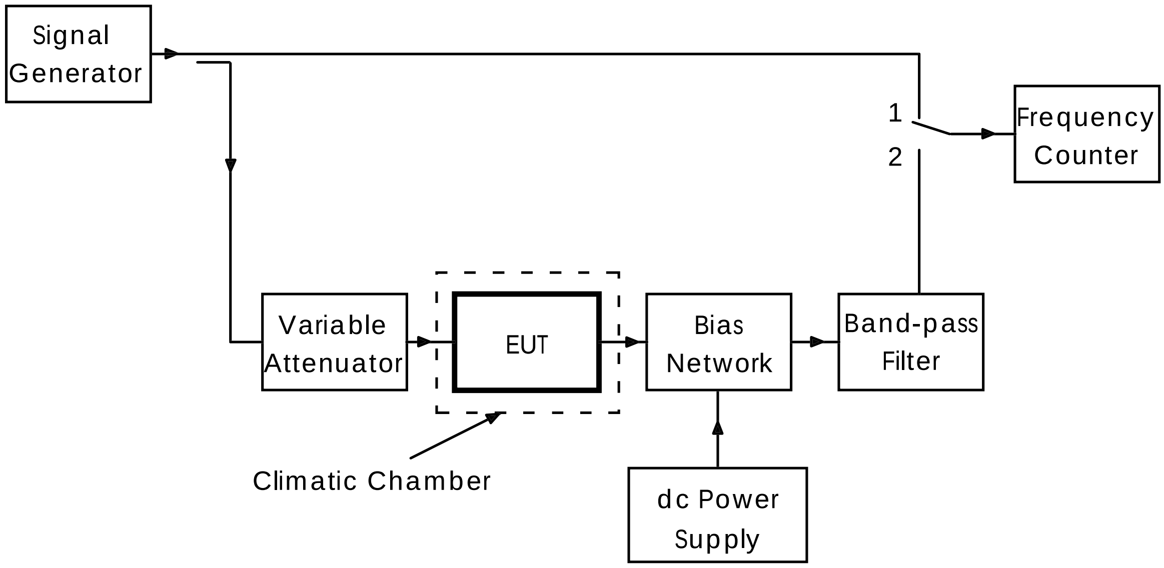


Figure 9: Test arrangement - conversion frequency measurement

a) The test configuration shall be as shown in figure 9.

b) The signal generator shall be set to a frequency at the bottom of the appropriate band (FSS or BSS) with an output level in the order of - 60 dBm.

c) The frequency shall be recorded.

d) The frequency counter shall be switched to input line 2.

e) The output level of the signal generator shall be adjusted for a minimum stable signal at the output of the EUT.

f) The output signal frequency shall be measured, recorded and compared to the input frequency.

g) The conversion frequency i.e. the difference between the frequencies on lines 1 and 2 shall be noted.

h) The test shall be repeated at two other frequencies, one mid band and the other near the top of the band, and in each case the results similarly noted.

j) If the frequency measured on line 2 follows the direction of the frequencies on line 1 the spectrum sense of modulation has not been inverted. The spectrum sense observed shall be noted.

k) The tests shall be repeated at temperatures of - 20° C, 0° C, + 25° C and + 55° C.

l) The tests shall be repeated with supply voltage variations of - 12 % and + 10 % of nominal or as stated by the manufacturer.

6.1.6 Output range

6.1.6.1 Specification

The IF at the LNB output shall be in the range stated in ETS 300 158 [1] or ETS 300 249 [2].

6.1.6.2 Method of measurement

This parameter is measured during the test described in subclause 6.1.5.2.2 step f).

6.1.7 Noise figure (noise temperature)

6.1.7.1 Specification

As specified in ETS 300 158 [1] or ETS 300 249 [2] the worst case value of the LNB noise temperature, or noise figure, over the RF input frequency range(s) shall be determined.

6.1.7.2 Method of measurement

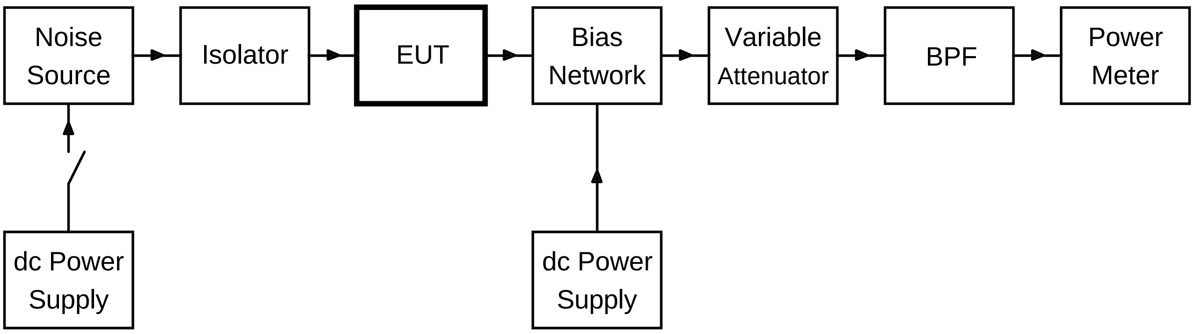


Figure 10: Test arrangement - noise temperature measurement

a) The test arrangement shall be as shown in figure 10.

b) The isolator shall have a VSWR of less than 1,05 and the variable attenuator shall have a VSWR of less than 1,05 and an attenuation of between 6 dB and 10 dB.

c) The Band Pass Filter (BPF) shall be tuneable over the output range of the EUT and have a passband of approximately 20 MHz.

d) At each of the test frequencies within the input range of the LNB, commencing 10 MHz from the bottom of the range with incremental steps of 20 MHz, the noise power, Po, shall be measured (dBm) with the noise generator switched off.

e) The noise generator shall be activated and the noise power level, P, shall be measured (dBm) at the same frequencies.

f) The noise figure shall be calculated using the following formula:

$$NF = (E_N - L) - 10 \log (Y - 1)$$

where:

NF is Noise Figure in dB;
E_N is Excess Noise Ratio (ENR) of the noise source in dB;
L is insertion loss of the isolator in dB;
Y is $10^{0,1(P - Po)}$.

g) The noise figure to be recorded shall be the worst result obtained from the tests above.

6.1.8 Image frequency rejection

6.1.8.1 General

In view of the note attached to the basic specification the actual rejection obtained shall be recorded in the test report.

6.1.8.2 Specification

The LNB shall suppress the image frequencies of the received channel by at least 40 dB as specified in ETS 300 158 [1] or ETS 300 249 [2].

6.1.8.3 Method of measurement

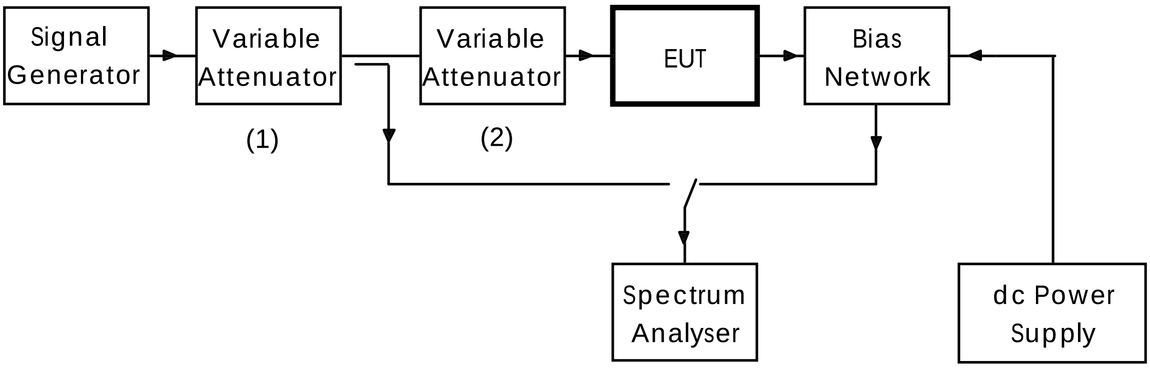


Figure 11: Test arrangement - image frequency rejection

a) The test arrangement shall be as shown in figure 11 with the directional coupler being suitable for signals between 9 GHz and 22 GHz and with both variable attenuators set to maximum attenuation.

b) The signal generator shall be adjusted to a frequency in the centre of the input range of the EUT.

c) The spectrum analyser shall be switched to the directional coupler and tuned to the signal generator frequency.

d) Variable attenuator (1) shall be adjusted to give an input level to variable attenuator (2) of - 35 dBm as measured with the spectrum analyser.

e) The frequency shall be measured using the spectrum analyser and recorded.

f) The spectrum analyser shall be switched to the EUT output and adjusted to the output frequency.

g) Variable attenuator (2) shall be adjusted to give a test signal level of - 70 dBm at the EUT input.

h) The output level (L_{Po}) of the EUT shall be measured and recorded in conjunction with the input level.

j) The signal generator frequency shall be adjusted to the image frequency where:

$$f_{image} = 2 \cdot f_{local\ oscillator} - f_{desired\ signal}$$

k) The signal applied to the EUT input shall be increased by 30 dB.

l) Without retuning the spectrum analyser the EUT output level (L_P) shall be measured and recorded.

m) The image rejection shall be calculated from the formula:

$$(L_{Po} - L_P + 30)\ dB.$$

n) The tests in steps c) to m) shall be repeated with the original generator frequency in step b) being at the top and then at the bottom of the input range of the EUT.

6.1.9 Unwanted signals immunity

6.1.9.1 Specification

The distortion components at the output of the LNB, caused by wanted and unwanted signals applied at its input, that fall within the IF frequency range shall be as specified in ETS 300 158 [1] or ETS 300 249 [2] (Internal immunity of the outdoor unit to unwanted signals).

6.1.9.2 Method of measurement

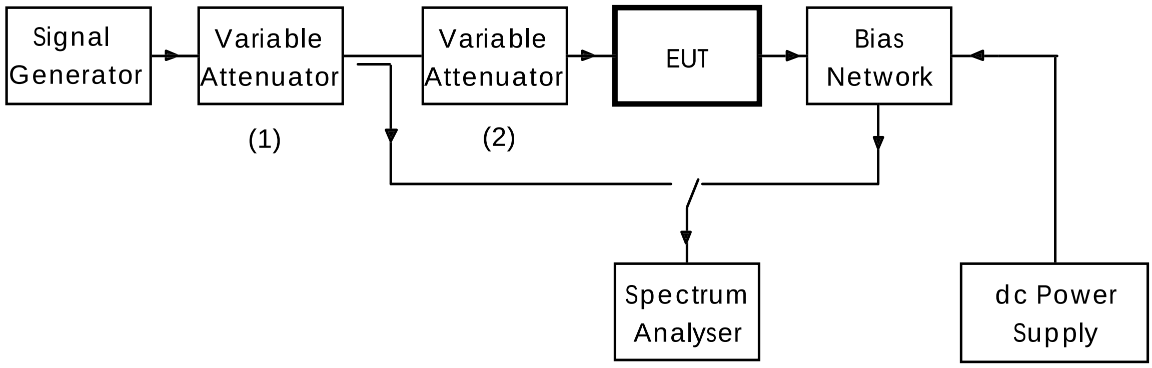


Figure 12: Test arrangement - unwanted signals immunity

a) The test arrangement shall be as shown in figure 12 with the directional coupler being suitable for signals between 7,8 GHz and 15 GHz and with both variable attenuators set to maximum attenuation.

b) The signal generator shall be adjusted to a frequency in the centre of the input range of the EUT.

c) The spectrum analyser shall be switched to the directional coupler and tuned to the signal generator frequency.

d) Variable attenuator (1) shall be adjusted to give an input level to variable attenuator (2) of - 35 dBm as measured with the spectrum analyser.

e) The frequency shall be measured using the spectrum analyser and recorded.

f) The spectrum analyser shall be switched to the EUT output and adjusted to the output frequency.

g) Variable attenuator (2) shall be adjusted to give a test signal level of - 70 dBm at the EUT input.

h) The output level (L_{Po}) of the EUT shall be measured and recorded in conjunction with the input level.

j) The signal generator frequency shall slowly be adjusted over the frequency range 7,8 GHz to 15 GHz and stopped when any output appears at the output termination of the EUT.

k) The signal generator frequency shall be finely tuned for a maximum reading on the spectrum analyser.

l) The output level (L_P) of the EUT shall be measured and recorded in conjunction with the input frequency.

m) The unwanted signal immunity shall be calculated from the formula:

$$(L_{Po} - L_P) \text{ dB.}$$

n) Continue with step j) repeating steps k) to m) inclusive if necessary.

p) Repeat the test with the signal generator frequency in step b) being firstly adjusted to a frequency 20 MHz above the bottom of the input range and secondly adjusted to a frequency 20 MHz below the top of the input range.

6.1.10 Small signal gain

6.1.10.1 Specification

The small signal gain of the LNB at any frequency within its RF input frequency range(s) should be as specified in ETS 300 158 [1] or ETS 300 249 [2].

6.1.10.2 Method of measurement

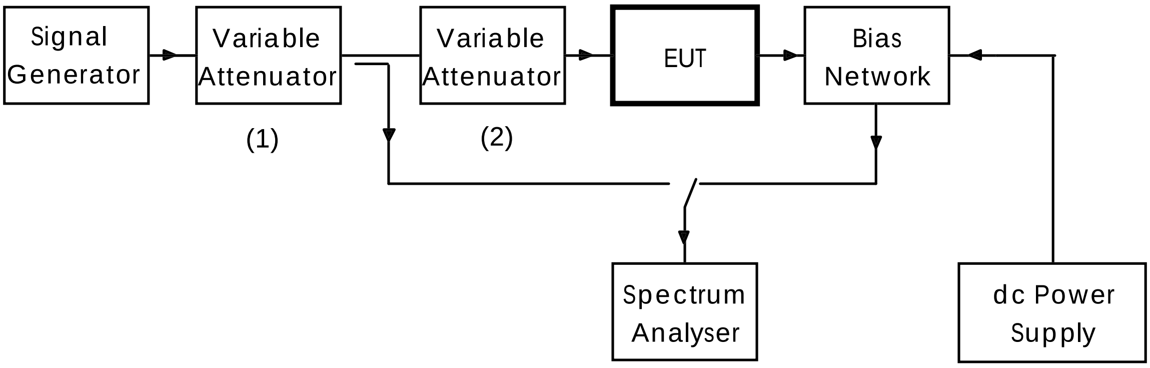


Figure 13: Test arrangement - small signal gain

a) The test arrangement shall be as shown in figure 13 with both variable attenuators set to maximum attenuation.

b) The signal generator shall be set to a frequency 5 MHz above the bottom of the EUT input band.

c) The spectrum analyser shall be switched to the directional coupler and tuned to the signal generator frequency.

d) Variable attenuator (1) shall be adjusted to give an input level to variable attenuator (2) of - 10 dBm (L_{Po}) as measured with the spectrum analyser.

e) The frequency and level shall be measured using the spectrum analyser and recorded.

f) The spectrum analyser shall be switched to the EUT output and adjusted to the output frequency.

g) Variable attenuator (2) shall be adjusted to produce a reading as close as possible to that recorded in e) above, the attenuation setting (L_R) shall be recorded.

h) The output level (L_P) of the EUT shall be measured and recorded.

j) The small signal gain shall be calculated from the formula:

$$Gain = L_P - L_{Po} + L_R - L_S + L_B$$

where:
L_R = attenuation of the second variable attenuator;
L_S = coupling factor of the directional coupler;
L_B = insertion loss of the bias network.

k) The tests in steps c) to j) shall be repeated at 5 MHz intervals throughout the EUT input range.

l) The test results shall be presented in the form of a graph.

6.1.11 Linearity

6.1.11.1 Amplitude-frequency characteristic

6.1.11.1.1 Specification

The amplitude-frequency characteristic over the IF range should be such that the maximum amplitude variation does not exceed the limits specified in ETS 300 158 [1] or ETS 300 249 [2] (Linear distortion: amplitude-frequency characteristic).

6.1.11.1.2 Method of measurement

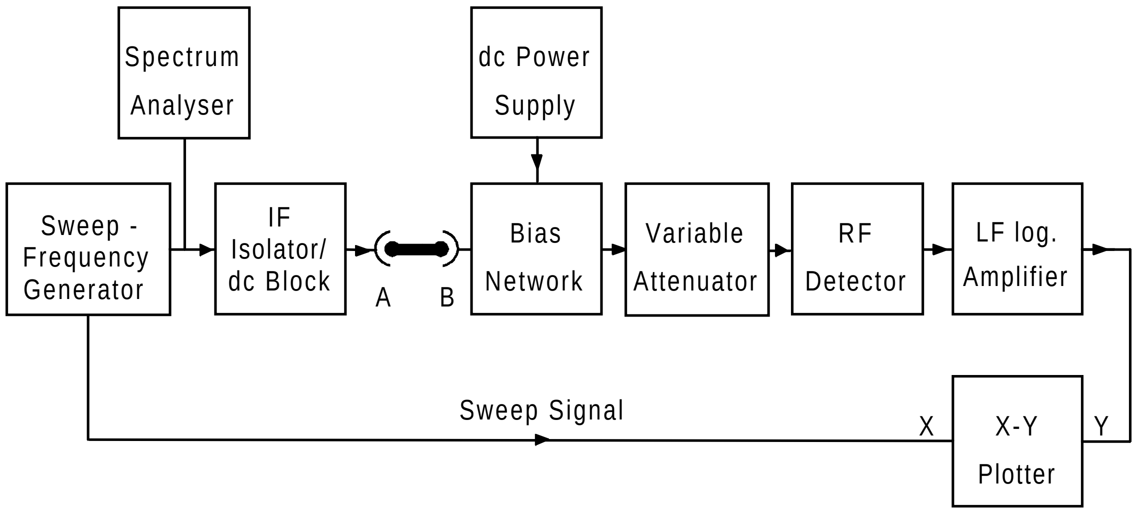


Figure 14: Test arrangement - equipment calibration

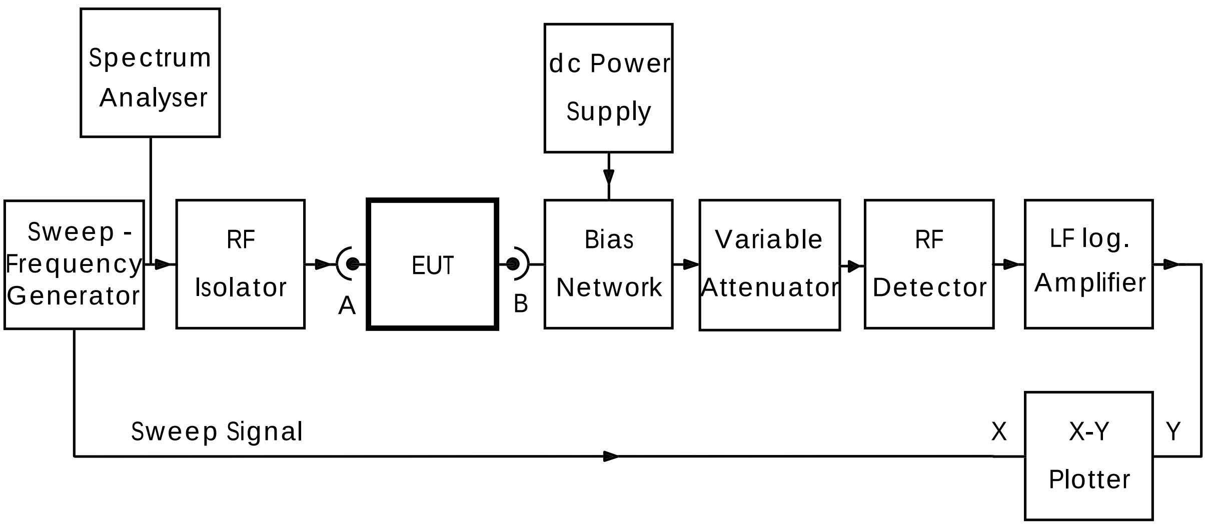


Figure 15: Test arrangement - amplitude/frequency characteristic

a) For calibration purposes the test equipment shall be as shown in figure 14 with points A and B connected.

b) The sweep generator shall sweep across the output frequency band of the EUT and the response on both the spectrum analyser and X-Y plotter checked for flatness.

c) The test arrangement shall be as shown in figure 15 with the EUT connected between points A and B.

d) The sweep-frequency generator shall be set to known fixed frequencies within the input range of the EUT and the variable attenuator adjusted in order to apply calibration points of both level and frequency to the X-Y Plotter. The spectrum analyser shall be used as a monitor of the flatness of the output of the signal generator.

e) The attenuator shall be set to the lowest value used in the calibration procedure.

f) The sweep generator shall sweep the input range of the EUT. The spectrum analyser shall be used as a monitor of the flatness of the output of the signal generator.

g) The amplitude/frequency characteristic of the EUT shall be plotted.

h) The plot obtained shall be presented as the result of the test.

6.1.11.2 Group delay characteristic

6.1.11.2.1 Specification

The maximum permitted group-delay variation over the IF frequency range should not exceed the limits specified in ETS 300 158 [1] or ETS 300 249 [2] (Linear distortion: group-delay characteristics).

6.1.11.2.2 Method of measurement

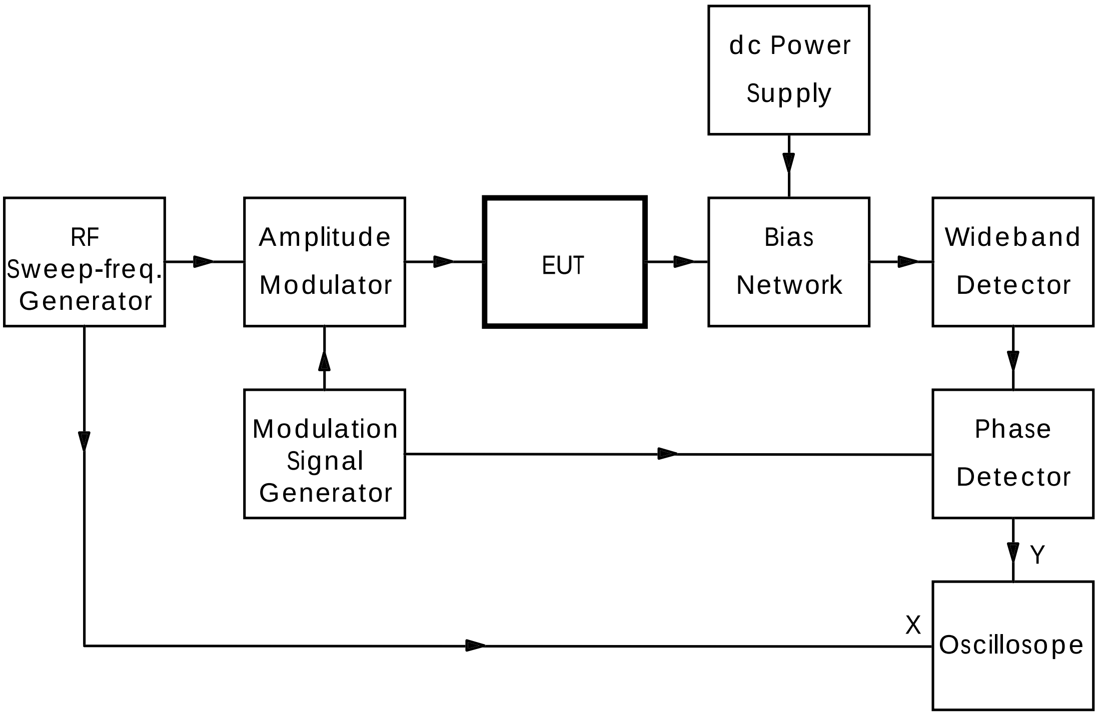


Figure 16: Test arrangement - Group delay characteristic

a) The test arrangement shall be as shown in figure 16.

b) The RF Sweep-frequency Generator shall be set to cover the input frequency range of the EUT.

c) The output level of the Sweep-frequency Generator shall be held constant over this frequency range.

d) The Modulation Signal Generator shall be set to a frequency between 100 kHz and 2 MHz.

e) The results shall be presented as a reproduction of the oscilloscope display with frequency as the abscissa.

6.1.11.3 Output level (multicarrier intermodulation ratio test)

6.1.11.3.1 General

Multicarrier intermodulation ratio is defined as when two or more signals of specified frequency traverse a non-linear network to produce a specified common level at the output port, the multicarrier intermodulation ratio for each intermodulation product is the ratio of the level of that product to the specified common output level.

6.1.11.3.2 Specification

The maximum permissible output voltage shall be as specified in ETS 300 158 [1] or ETS 300 249 [2] (Output level).

At the LNB output the level of any of the intermodulation products generated by two signals at the nominal output level shall be as specified in ETS 300 158 [1] or ETS 300 249 [2].

6.1.11.3.3 Method of measurement

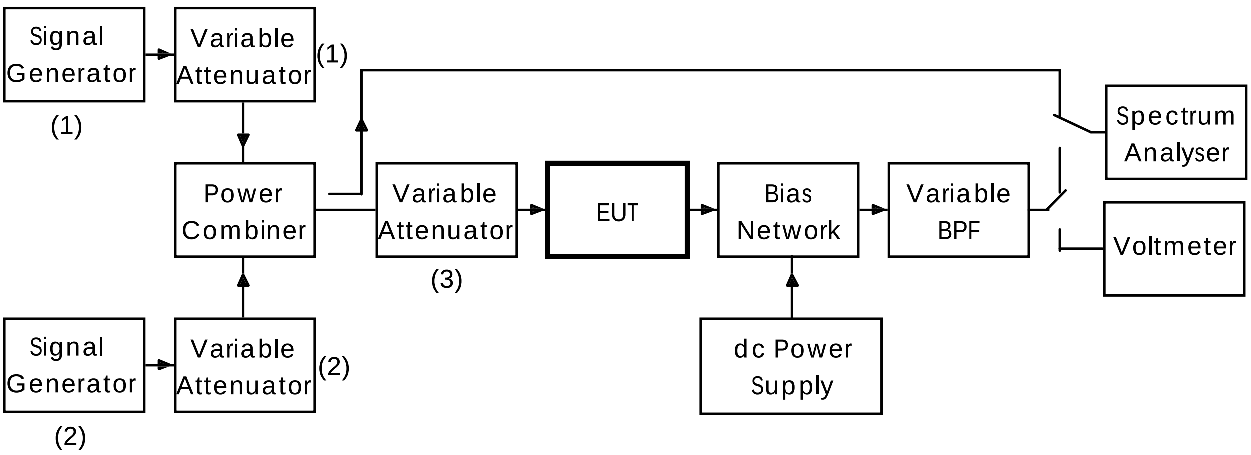


Figure 17: Test arrangement - multicarrier intermodulation ratio

a) The test arrangement shall be as shown in figure 17 with the variable attenuators set to 40 dB attenuation.

b) Signal generator (1) shall be set to a frequency 40 MHz above the bottom of the input range of the EUT.

c) Signal generator (1) and variable attenuator (1) shall be set to give a level of - 40 dBm at the input to variable attenuator (3).

d) The spectrum analyser shall be set to the output of the Band Pass Filter (BPF) which shall be tuned to obtain the maximum signal level on the spectrum analyser.

e) Variable attenuator (3) shall be adjusted to give the nominal EUT output level at the spectrum analyser. This level (L_{Po}) and the corresponding frequency shall be measured and recorded.

f) Signal generator (1) frequency shall be reduced by 36 MHz.

g) Signal generator (2) shall be tuned to a frequency 72 MHz above that set in step f).

h) The spectrum analyser shall be set to the directional coupler.

j) The signal generators and associated variable attenuators shall be set to give equal levels at the output of the power combiner of - 40 dBm.

k) The spectrum analyser shall be switched to the BPF output.

l) The signal level (L_P), at the frequency established in step d), shall be measured and recorded.

m) The intermodulation ratio shall be calculated from the formula:
$(L_{Po} - L_P)$ dB

n) Adjust the variable attenuators until the intermodulation ratio is 35 dB. Measure the output voltage.

p) Signal generator (1) shall be set to a frequency in the mid point of the input range and steps c) to n) repeated.

r) Signal generator (1) shall be set to a frequency 40 MHz below the top of the input frequency range and steps c) to n) repeated.

6.1.12 LNB interfaces

6.1.12.1 Input

6.1.12.1.1 Specification

As specified in ETS 300 158 [1] or ETS 300 249 [2] if a physical interface exists between the antenna subsystem and the LNB and if waveguide is employed, then the input flange should be either type PBR 120 (rectangular) or C 120 with gasket groove (circular).

6.1.12.1.2 Method of measurement

a) The waveguide flange shall be inspected to determine whether rectangular or circular waveguide is employed.

b) The flange shall be inspected to ascertain that a 1,5 mm circular groove is present.

c) The various dimensions shall be measured, in millimetres, and the measurements recorded.

d) The recorded measurements shall be compared to the appropriate schematic shown in annex C.

6.1.12.2 Output impedance

6.1.12.2.1 Specification

The value of the nominal output impedance shall be as specified in ETS 300 158 [1] or ETS 300 249 [2] (LNB output interface; Impedance).

6.1.12.2.2 Method of measurement

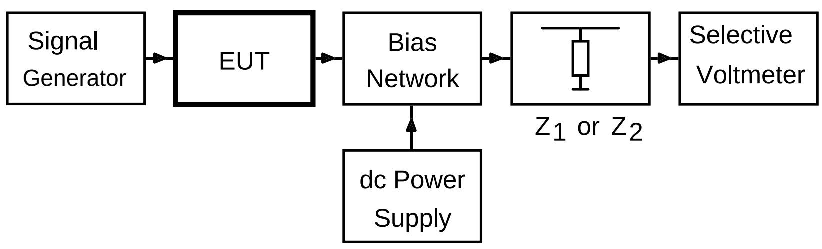


Figure 18: Test arrangement - Output impedance

a) The test arrangement shall be as shown in figure 18 with the interconnections between the EUT and selective voltmeter inclusive being as short as possible.

b) Z_1 and Z_2 are feed through termination of 50 Ω and 75 Ω respectively.

c) The signal generator shall be set to a frequency such that the output frequency is approximately 1 GHz.

d) The signal generator output power shall be such that the EUT has a stable output.

e) With Z_1 in circuit the output voltage, U_1, shall be measured and recorded.

f) With Z_2 in circuit the output voltage, U_2, shall be measured and recorded.

g) The output impedance Z_x of the EUT shall be calculated from the formula:

$$Z_x = \frac{Z_1 \cdot Z_2 \cdot (U_2 - U_1)}{(Z_2 \cdot U_1) - (Z_1 \cdot U_2)}$$

6.1.12.3 Output connector

6.1.12.3.1 Specification

The type of connector shall be as specified in ETS 300 158 [1] or ETS 300 249 [2] (LNB output interface; Type of connector).

6.1.12.3.2 Method of verification

The output connector shall be visually inspected for compliance with the specification.

6.1.12.4 Output return loss

6.1.12.4.1 Matched load

Matched load is defined as a load whose output impedance is the same as the input impedance of the EUT or an antenna designed to work with the EUT.

6.1.12.4.2 Specification

The output return loss ratio over the IF frequency range employed shall be as specified in ETS 300 158 [1] or ETS 300 249 [2] (LNB output interface; Impedance matching at the output terminal).

6.1.12.4.3 Method of measurement

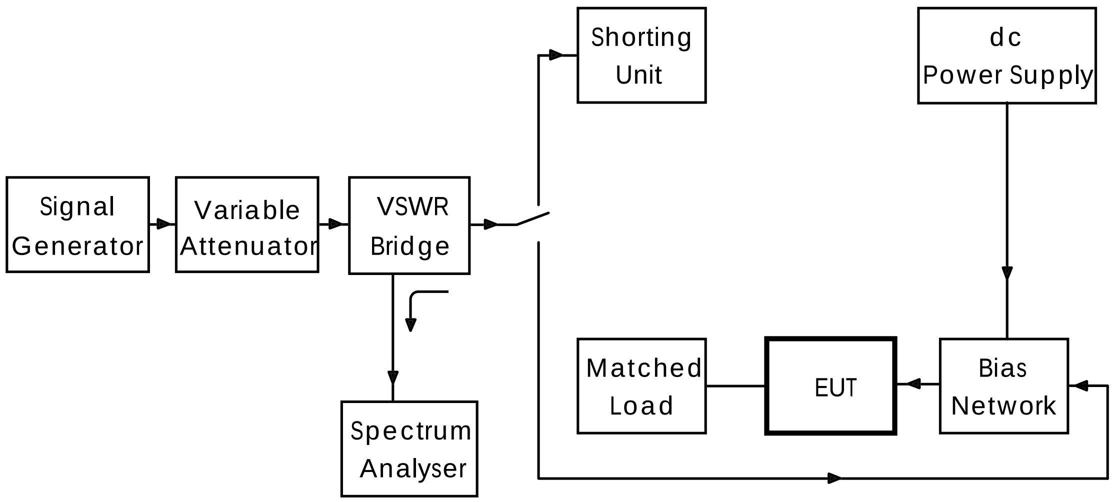


Figure 19: Test arrangement - output return loss measurement

a) The test arrangement shall be as shown in figure 19.

b) The signal generator is set to a frequency at the low end of the IF output range of the EUT.

c) The shorting unit is connected to the output termination of the VSWR bridge, a continuous wave signal at - 30 dBm is applied and the output signal level of the VSWR bridge, L_{Po}, measured.

d) The shorting unit is replaced by the output terminal of the EUT and the output signal level L_P similarly measured.

e) The return loss is expressed as the difference:
$(L_{Po} - L_P)$ dB.

f) The insertion loss and VSWR of the bias network shall be taken into account in the measurement result.

g) The test shall be repeated at frequencies at the middle and top of the output frequency range.

6.2 On-axis spurious radiation

6.2.1 Definition

For the purposes of this subclause the EUT is defined as either:

a) that part of the outdoor unit which excludes the antenna, separated at the antenna flange; or
b) the outdoor unit including the antenna, in cases where the antenna is an integral part which cannot be detached.

On-axis spurious radiation is defined as unwanted radiation occurring within ± 7° of the main beam axis of the receiving antenna.

6.2.2 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) and the applicable frequency range shall be as specified in ETS 300 158 [1] or ETS 300 249 [2] (Unwanted radiation including LO leakage radiated from the antenna).

6.2.3 Method of measurement

6.2.3.1 General

Measurements may be carried out by selecting one of the following methods depending upon how the (primary feed) antenna is attached to the outdoor unit:

a) The conducting method (TE_{10}), which is given in subclause 6.2.3.3.1, shall be used for an EUT defined as in subclause 6.2.1 a);

b) The reverberating chamber method, which is given in subclause 6.2.3.3.2, shall be used for an EUT defined as in subclause 6.2.1 b).

6.2.3.2 Test site

There is no requirement to define the test site to be used for the conducted method test. The reverberating method requires a suitable chamber in order to conduct the test.

6.2.3.3 Method of measurement

6.2.3.3.1 Conducting method

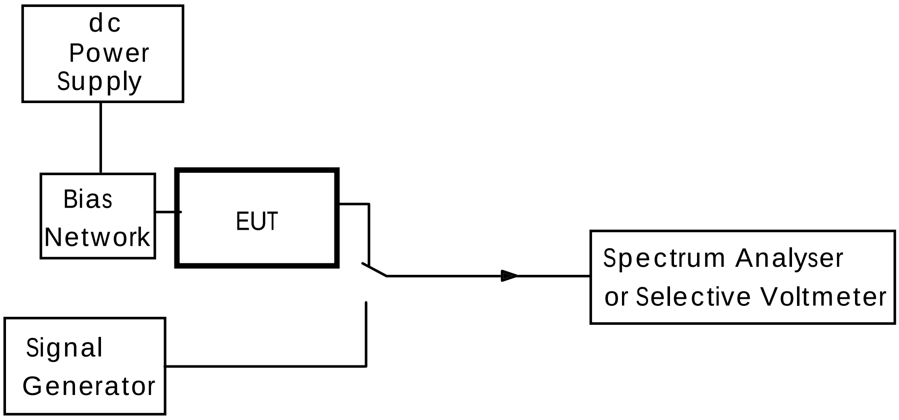


Figure 20: Test arrangement - conducted method

a) The test arrangement shall be as shown in figure 20. In some cases it may be necessary to use appropriate waveguide transitions and/or transducers to connect the measuring equipment with this interface point. In such a case, the performance of such transitions and/or transducers shall be investigated/calibrated.

b) With power supplied to the EUT investigate the frequency band from 2,5 GHz to 40 GHz for unwanted radiation.

c) The signal generator shall be used as a substitute for the EUT to ascertain the power levels of unwanted radiation found in step b).

6.2.3.3.2 Reverberating chamber method

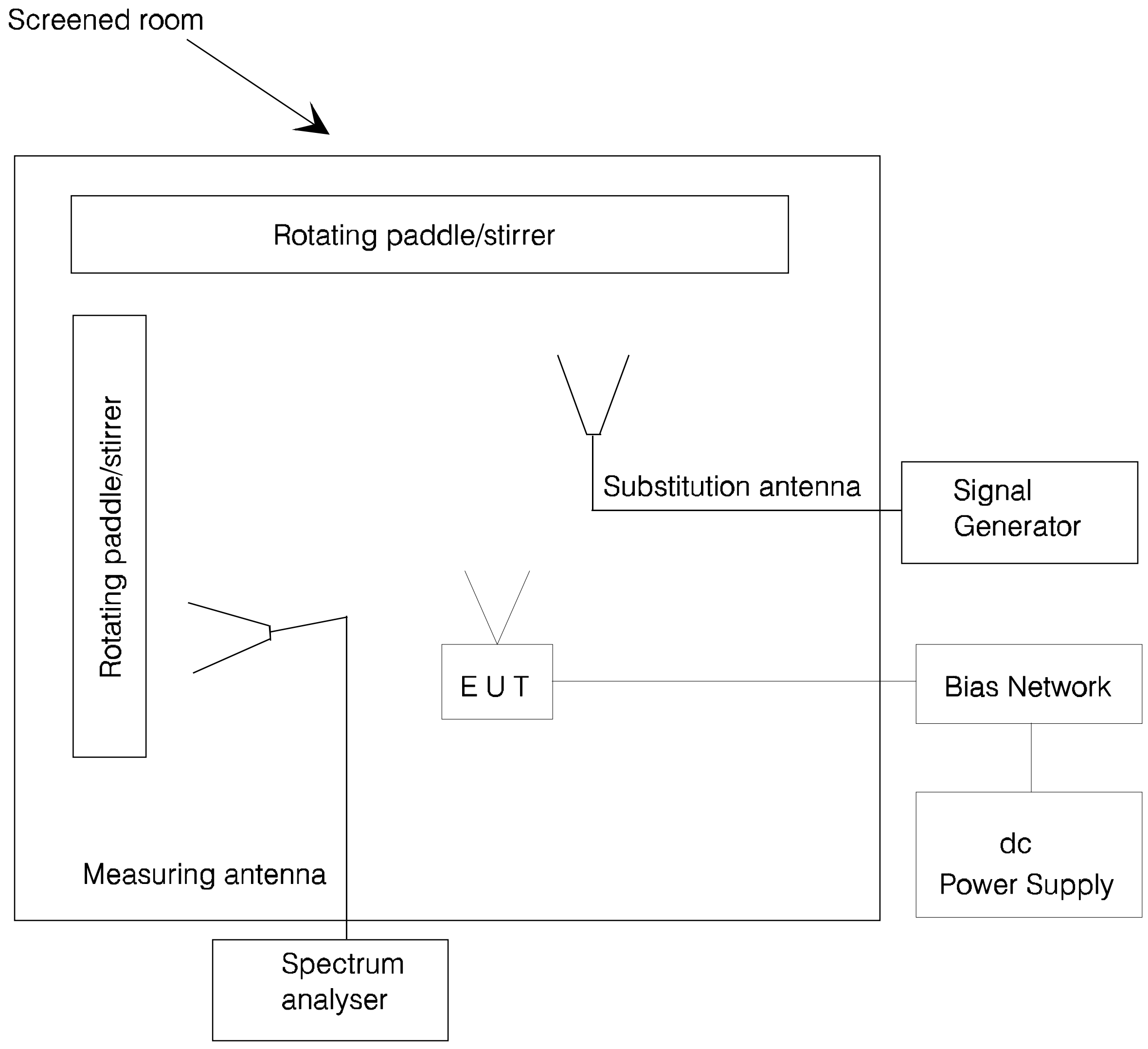


Figure 21: Test arrangement - reverberating chamber method

a) The test arrangement shall be as shown in figure 21 with the test antenna pointing to one stirrer and the EUT and substitution antenna pointing to the other stirrer.

b) The EUT shall be in the normal operating condition.

c) The frequency range shall be investigated for spurious radiation, excluding intermodulation products.

d) The spectrum analyser resolution bandwidth shall be set to the specified measuring bandwidth or as close as possible. If the resolution bandwidth is different from the specified measuring bandwidth, bandwidth correction shall be performed for the noise-like wide-band spurious emissions.

e) The EUT shall be switched off and the signal generator switched on.

f) For each frequency identified in step c) the signal generator power shall be adjusted for the same reading on the spectrum analyser.

g) For each of these frequencies the source power shall be measured at the signal generator output port.

6.3 Spurious radiation

6.3.1 General

A general emission standard for EMC has been produced in EN 50081-1 [10].

Until such time as a specific product or family ETS is produced covering EMC requirements for TVRO equipment the contents of this ETS shall be used.

For the purposes of this subclause the EUT for the test method in subclause 6.3.3.1 shall be defined as:

Stage A and B: the complete outdoor unit, or, if the antenna is large for the test site it is defined as the LNB(s) and connecting primary feed;

Stage C: that part of the outdoor unit which excludes the antenna, separated at the antenna flange, or alternatively, that part of the outdoor unit which excludes the reflector but does include the primary feed.

Off-axis spurious radiation is defined as unwanted radiation occurring in all directions except within ± 7° of the main beam axis of the receiving antenna.

6.3.2 Specification

The TVRO shall satisfy the limits for radiated interference field strength over the applicable frequency ranges specified in ETS 300 158 [1] or ETS 300 249 [2].

6.3.3 Method of measurement

6.3.3.1 Test method

The test shall be performed in three stages:

Stage A: Identification of frequencies of spurious radiation (subclause 6.3.3.2);

Stage B: Measurement of level of identified spurious radiation (subclause 6.3.3.3);

Stage C: Measurement of spurious radiation radiated through the antenna. Alternative test methods are stated that depend upon the EUT as defined in subclause 6.3.1 above (subclause 6.3.3.4).

6.3.3.2 Identification of frequencies of spurious radiation

6.3.3.2.1 Test site

The identification of frequencies emitting from the EUT shall be performed in a shielded chamber with the measuring antenna close to the EUT and at the same height as the volume centre of the EUT.

6.3.3.2.2 Procedure

a) The EUT shall be in the normal operating condition and the main beam of the antenna shall have an angle of elevation of 7°.

b) The receivers shall scan the frequency band whilst the EUT revolves.

c) The EUT shall be rotated through 360° and the frequency of any spurious radiation noted for further investigation.

d) The test shall be repeated in each LNB configuration with all LNBs properly powered.

e) The test shall be repeated with the measuring antenna being in the opposite polarisation.

6.3.3.3 Measurement of power levels of identified spurious radiation

6.3.3.3.1 Test site

The measurement of each spurious radiation noted during the first part of the test shall be performed on a test site that is free from reflecting objects, i.e. either an open-area test site or a semi-anechoic chamber.

6.3.3.3.2 Procedure

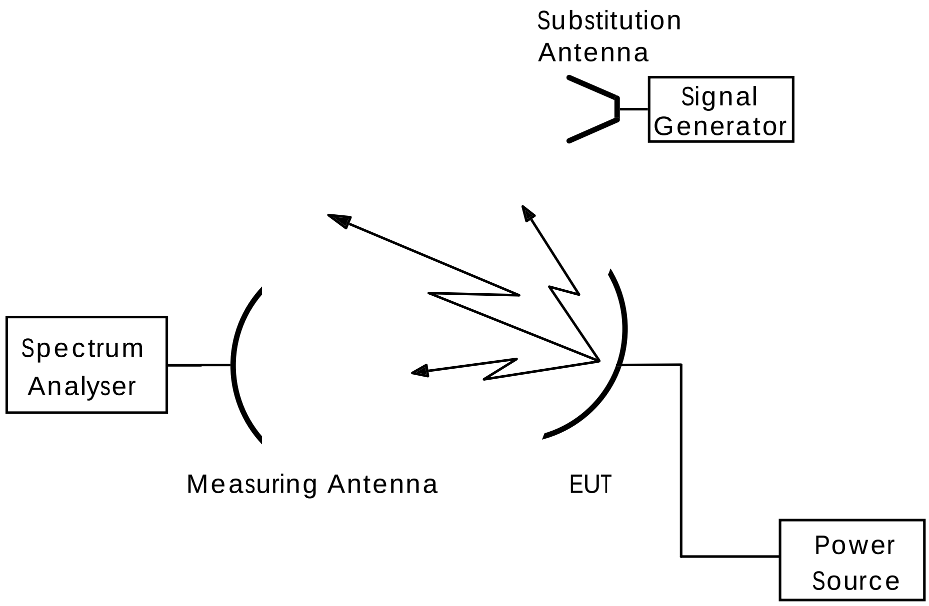


Figure 22: Test arrangement - Spurious radiation measurement method

a) The test arrangement shall be as shown in figure 22.

b) The EUT shall be installed such that the main beam of the antenna shall have an angle of elevation of 7°.

c) The measuring antenna shall be positioned at a distance of 3 m from the EUT for frequencies below 1 GHz and at frequencies above 1 GHz the position of the antenna shall be 10 m from the EUT. This distance is the minimal distance between the measuring antenna and the vertical cylinder encompassing the EUT. The section of this cylinder in the horizontal plane shall be convex, with straight lines from edges to edges. The EUT shall be rotated through 360° and the measuring antenna shall be adjusted in height and rotated for a maximum response on the associated spectrum analyser at each spurious frequency previously identified. The response level shall be noted in each case. The measuring antenna shall never enter the 7° off-axis cone around the main beam direction.

d) The investigation shall be repeated with the measuring antenna in the opposite polarisation and the response level similarly noted.

e) The EUT shall be replaced by the substitution antenna to which is connected a signal generator. The main beam axes of the measurement and substitution antennas shall be aligned and the distance between the two antennas shall be 10 m for frequencies above 1 GHz or 3 m for frequencies below 1 GHz.

f) The substitution and measuring antennas shall be aligned in the polarisation which produced the larger response between the EUT and the measuring antenna.

g) The output of the generator shall be adjusted so that the received level is identical to that of the previously noted largest spurious radiation.

h) The output level of the signal generator shall be noted. The EIRP of the spurious radiation is the sum in dB of the signal generator output plus the substitution antenna isotropic gain minus the interconnection cable loss.

6.3.3.4 Measurement of spurious radiation radiated through the antenna

6.3.3.4.1 Test site

There is no requirement to define the test site to be used for this test unless the alternative method including the prime focus feed is employed in which case the test site shall be a reverberating chamber.

6.3.3.4.2 Procedure (antenna flange)

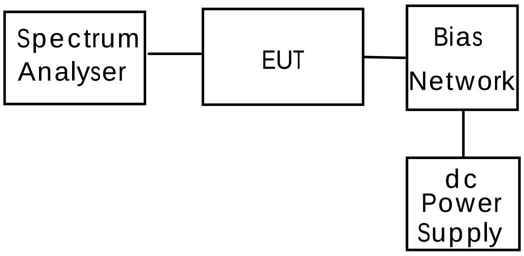


Figure 23: Test arrangement - radiated spurious radiation

a) The test arrangement shall be as shown in figure 23.

b) The EUT shall be in the normal operating condition.

c) The frequency range 1 GHz to 40 GHz shall be investigated for spurious radiation, excluding intermodulation products.

d) The spectrum analyser resolution bandwidth shall be set to the specified measuring bandwidth or as close as possible. If the resolution bandwidth is different from the specified measuring bandwidth, bandwidth correction shall be performed for the noise-like wide-band spurious emissions.

e) To obtain the off-axis spurious power level that would be transmitted, the maximum antenna transmit gain for off-axis angles greater than 7° shall be added to any figure obtained in the above measurement and any correction or calibration factor summated with the result.

6.3.3.4.3 Procedure (primary feed)

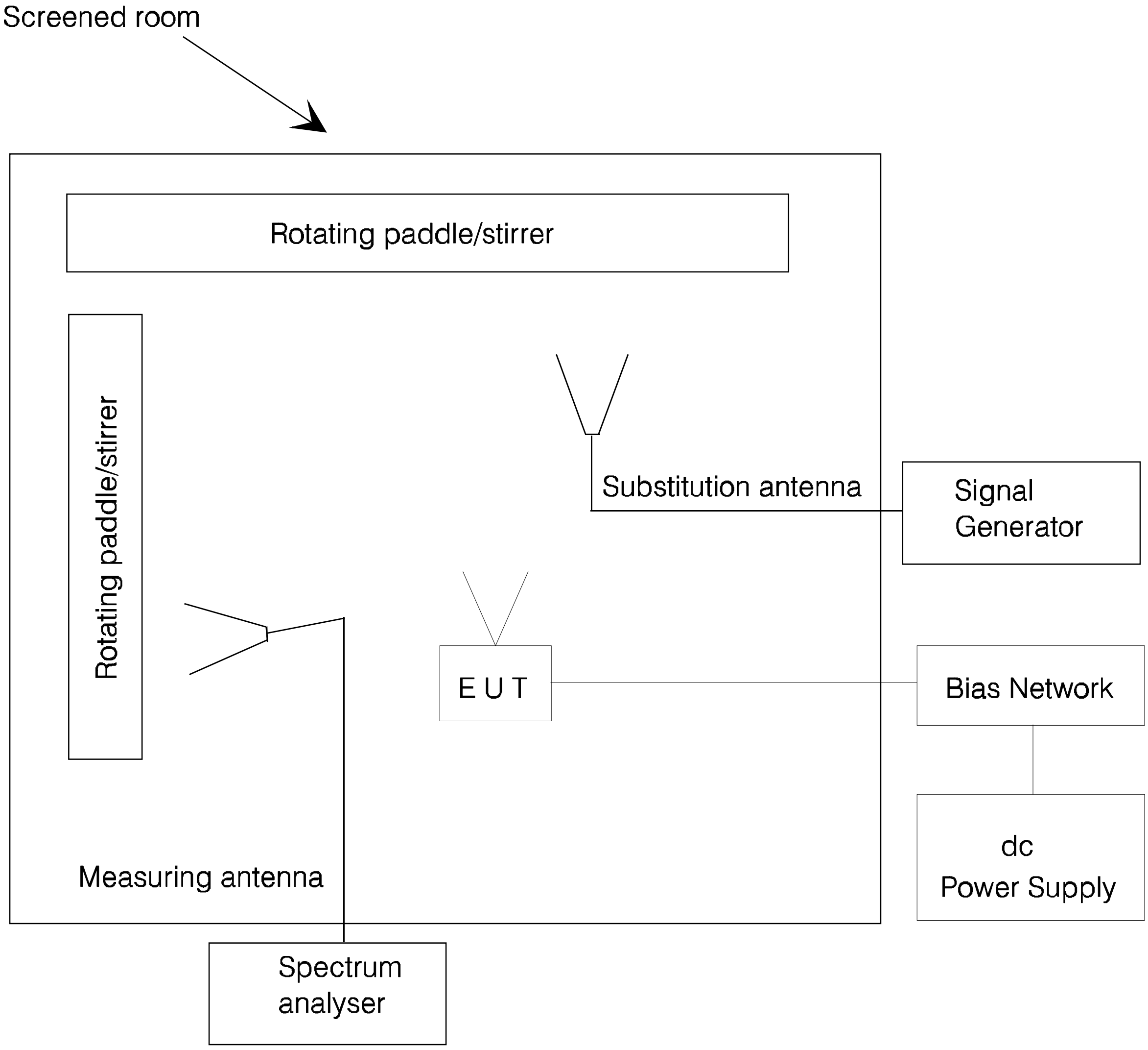


Figure 24: Test arrangement - reverberating chamber method

a) The test arrangement shall be as shown in figure 24 with the test antenna pointing to one stirrer and the EUT and substitution antenna pointing to the other stirrer.

b) The EUT shall be in the normal operating condition.

c) The frequency range shall be investigated for spurious radiation, excluding intermodulation products.

d) The spectrum analyser resolution bandwidth shall be set to the specified measuring bandwidth or as close as possible. If the resolution bandwidth is different from the specified measuring bandwidth, bandwidth correction shall be performed for the noise-like wide-band spurious emissions.

e) The EUT shall be switched off and the signal generator switched on.

f) For each frequency identified in step c) the signal generator power shall be adjusted for the same reading on the spectrum analyser.

g) For each of these frequencies the source power shall be measured at the signal generator output port.

h) The off-axis spurious power level that would be transmitted is obtained by adding the level obtained in step g) to the gain of the test antenna to produce the power transmitted from the EUT. To this figure is added the gain of the reflector.

6.4 Immunity

6.4.1 General

A general immunity standard for all radio equipment has been produced in EN 50082-1 [11].

Until such time as a specific product or family ETS is produced covering immunity requirements the contents of this ETS shall be used.

For the purposes of this subclause the EUT is defined as the outdoor unit.

6.4.2 Test site

These tests shall be performed in a screened room.

6.4.3 Definition

For the purposes of this ETS, electromagnetic immunity is defined as the ability of equipment to operate unimpaired whilst in an electromagnetic field.

A just perceptible disturbance is assumed to correspond to an RF wanted to unwanted signal ratio of 35 dB in the RF or IF band.

6.4.4 Ambient fields

6.4.4.1 Specification

The TVRO shall have an adequate level of intrinsic immunity to enable it to operate as intended, without any just perceptible disturbances, when it is exposed to the electrical field strengths specified in ETS 300 158 [1] or ETS 300 249 [2] (External immunity of the outdoor unit to ambient fields).

6.4.4.2 Method of measurement

Type A equipment:

There are two possible methods of measurement dependant upon the size of the TVRO. If the TVRO antenna is large in comparison to the test site then a Transverse ElectroMagnetic (TEM) cell may be used to test the LNB only, as described for Type B equipment.

For ambient fields below 80 MHz the test shall be performed by current clamp injection. This test shall be in accordance with EN 50141 [13], where applicable, except that the interfering signal shall be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1 kHz. The frequencies selected during the test shall be recorded in the test report.

For ambient fields above 80 MHz the test method shall be in accordance with EN 50140 [12], where applicable, except that the test level shall be as stated in the specification. The interfering signal shall be amplitude modulated to a depth of 80 % by a 1 kHz sinusoidal audio tone. The frequencies selected during the test shall be recorded in the test report.

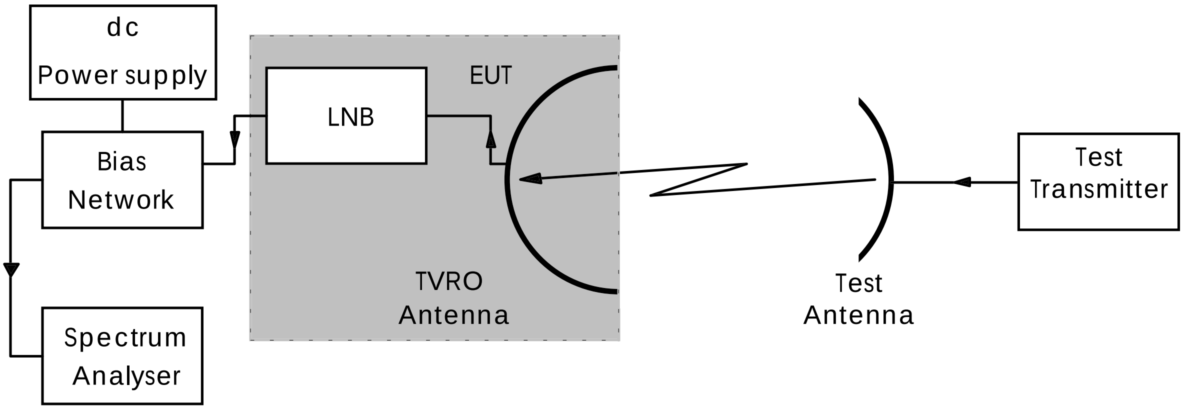


Figure 25: Test arrangement - immunity to ambient fields above 80 MHz (full assembly)

a) The test arrangement shall be as shown in figure 25. The spectrum analyser shall be adjusted so that a total bandwidth of 100 MHz is available on the screen.

b) The test transmitter shall transmit an unmodulated carrier. The spectrum analyser shall be adjusted to display this carrier in the centre of the screen.

c) The ambient field shall be applied in accordance with the specification.

d) Any degradation of the signal observed on the spectrum analyser, including unwanted carriers appearing, shall be noted in the test report.

e) For equipment which is too large for a screened room the LNB shall be placed in a TEM cell with the appropriate input and output signal connections as required by the full test.

f) The test shall be repeated for all LNBs with all LNBs properly powered at all times.

Type B equipment:

There are two possible methods of measurement dependant upon the size of the TVRO. If the TVRO antenna is large in comparison to the test site then a TEM cell can be used to test the LNB only, otherwise the tests for Type A equipment shall be performed.

The TEM test method shall be in accordance with EN 55020 [14], clause 19 where applicable. A suitable means of inducing the wanted signal into the LNB whilst not obstructing the ambient field from that port shall be provided by the manufacturer.

6.4.5 Currents

6.4.5.1 Specification

Type A:

At each interference frequency the immunity, expressed as the electro-motive 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 as specified in ETS 300 158 [1] or ETS 300 249 [2] (External immunity of the outdoor unit to currents conducted via connected cables), when the minimum level of the wanted signal is applied to its input.

Type B:

The immunity, expressed as the electro-motive 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 as specified in ETS 300 158 [1] or ETS 300 249 [2] (External immunity of the outdoor unit to currents conducted via connected cables), when the minimum level of the wanted signal is applied to its input.

The interfering signal shall be as specified in ETS 300 158 [1] or ETS 300 249 [2].

6.4.5.2 Method of measurement

This shall be in accordance with EN 55020 [14], clause 15 where applicable.

6.5 Antenna sub-system

6.5.1 Co-polar on-axis gain

6.5.1.1 Definition

For the purposes of this test the EUT is defined as that part of the outdoor unit which comprises the antenna and its flange. The antenna includes the parabolic reflector, feed, support struts and an enclosure of equal weight/distribution to any electrical equipment normally housed with the feed at the antenna focal point.

Co-polar on-axis gain is defined as the ratio, expressed in decibels, of the power that would have to be supplied to the reference antenna, an isotropic radiator isolated in space, to the power supplied to the antenna being considered, so that they produce the same signal level from the same distance in the same direction.

6.5.1.2 Specification

The antenna co-polar on-axis gain, expressed in dB relative to an isotropic source (dBi), for the specified range(s) of frequency and for the two orthogonal polarisation, if dual polarisation is available, should be as specified in ETS 300 158 [1] or ETS 300 249 [2].

6.5.1.3 Test site

This test shall be performed on either an outdoor far-field test site or compact test range (however see the last paragraph of subclause 4.2.2).

6.5.1.4 Method of measurement

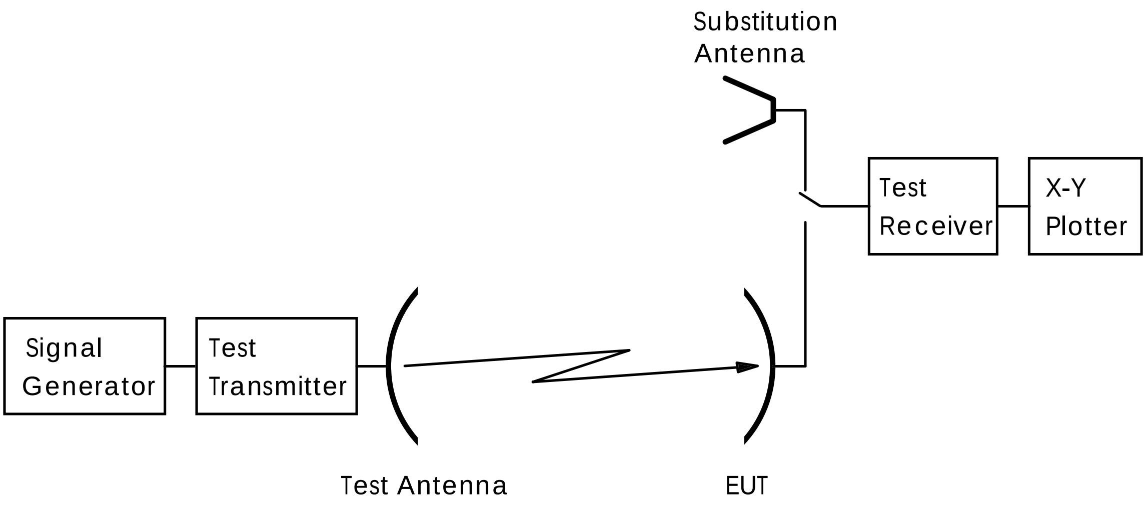


Figure 26: Test arrangement - antenna gain measurement

a) The test arrangement shall be as shown in figure 26 with the EUT connected to the test receiver. A signal proportional to the angular position from the servo mechanism shall be applied to the X-axis and the signal level from the test receiver shall be applied to the Y-axis of the plotter.

b) The test frequencies shall be the centre frequency of each applicable frequency range. The E-plane shall be vertical.

c) The EUT shall be aligned so that maximum deflection is obtained on the X-Y Plotter.

d) This deflection shall be adjusted to the maximum reading on the chart.

e) The EUT shall be driven in azimuth in one direction through 10°.

f) The pattern measurement is then obtained by driving the EUT in azimuth back through boresight to 10° the other side with the plotter recording the results.

g) The EUT shall be replaced by the substitution antenna and the received signal level maximised.

h) This level shall be recorded on the X-Y Plotter.

j) The substitution antenna shall be driven in azimuth as in e) and f).

k) The gain of the EUT is calculated from:

$$G_{EUT} = L_1 - L_2 + C$$

where:

G_{EUT} is the gain of the EUT (dBi);
L_1 is the level obtained with the EUT (dB);
L_2 is the level obtained with the substitution antenna (dB);
C is the calibrated gain of the substitution antenna at the test frequency (dBi).

l) The tests in b) to k) shall be repeated with the frequency changed to the lower limit of the applicable band as declared by the manufacturer.

m) The tests in b) to k) shall be repeated with the frequency changed to the upper limit of the applicable band as declared by the manufacturer.

n) The tests in b) to m) shall be repeated with the frequencies changed to the others specified if the design of the equipment is such that operation is possible, but not necessarily simultaneously, in all bands.

p) The tests in b) to n) shall be repeated with the test signal being transmitted in the H-plane instead of the E-plane.

6.5.2 Antenna receive radiation patterns

6.5.2.1 General

The basic specification contained in this subclause refers to Type A equipment only, with the applicable specification for Type B equipment being under consideration. The design objectives however, are given for both Type A and Type B equipment.

The basic ETSs give a design objective, therefore the actual results obtained shall be given in the test report.

For the purposes of this test, the EUT is defined as that part of the outdoor unit which comprises the antenna and its flange. The antenna includes the parabolic reflector, feed, support struts and an enclosure of equal weight/distribution to any electrical equipment normally housed with the feed at the antenna focal point.

Antenna receive radiation patterns are diagrams relating received signal strength to direction relative to the pointing angle of the antenna, at a constant large distance from the antenna.

6.5.2.2 Specification

At any frequency within the antenna sub-system receive frequency range(s) the co-polar gain G (ϕ) in dB relative to an isotropic antenna shall be as specified in ETS 300 158 [1] or ETS 300 249 [2] (Antenna gain pattern; Specification 1).

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 shall be as specified in ETS 300 158 [1] or ETS 300 249 [2] (Antenna gain pattern; Specification 2).

6.5.2.3 Design objectives

These objectives are specified in ETS 300 158 [1] (Antenna gain pattern; Design objectives) and in ETS 300 249 [2] (Antenna gain pattern; Design objectives; Antenna discrimination and Antenna gain pattern; Design objectives; Antenna gain pattern).

6.5.2.4 Test site

This test shall be performed on either an outdoor far-field test site or compact test range (however see the last paragraph of subclause 4.2.2).

6.5.2.5 Method of measurement

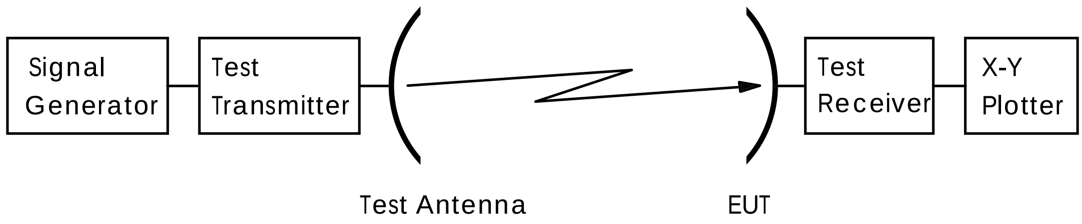


Figure 27: Test arrangement - antenna radiation pattern measurement

a) The test arrangement shall be as shown in figure 27 with the EUT connected to the test receiver. A signal proportional to the angular position from the servo mechanism shall be applied to the X-axis and the signal level from the test receiver shall be applied to the Y-axis of the plotter.

b) The test frequencies shall be the centre frequency of each applicable frequency range. The E-plane shall be vertical.

c) The EUT shall be aligned to maximise the received signal level and the X-Y plotter shall be adjusted to give the maximum reading on the chart.

d) The EUT shall be driven in azimuth through 180°.

e) The pattern measurement is then obtained by driving the EUT in azimuth through 360° with the plotter recording the results.

f) The tests in b) to e) shall be repeated with the frequency changed to the lower limit of the applicable band as declared by the manufacturer.

g) The tests in b) to e) shall be repeated with the frequency changed to the upper limit of the applicable band as declared by the manufacturer.

h) The tests in b) to g) shall be repeated with the frequencies changed to the others specified if the design of the equipment is such that operation is possible, but not necessarily simultaneously, in all bands.

j) The tests in b) to h) shall be repeated with the test signal being transmitted in the H-plane instead of the E-plane.

k) The tests in b) to h) shall be repeated with the test signal being transmitted in a plane at 45° to the H-plane.

l) The tests in b) to h) shall be repeated with the test signal being transmitted in a plane at 90° to that in k).

m) The tests in b) to l) shall be repeated between the angles of 2,5° and 9,2° with the EUT rotated through 90°, or the test antenna or the polarisation subsystem of the EUT rotated by 90°, to give the cross-polar measurement.

6.5.2.6 Computation of results

The computation of results shall be carried out by producing a "mask" to the specified limits with the reference level being equal to the gain of the antenna. This reference shall then be placed on the maximum point of the plot obtained from the pattern measurements.

6.5.3 Cross-polarisation discrimination

6.5.3.1 General

The basic ETSs give a design objective, therefore the actual results obtained shall be given in the test report.

For the purposes of this test the EUT is defined as that part of the outdoor unit which comprises the antenna and its flange. The antenna includes the parabolic reflector, feed, support struts and an enclosure of equal weight/distribution to any electrical equipment normally housed with the feed at the antenna focal point.

Cross-polarisation discrimination is the ratio of the power received by the antenna from a given direction in the polarisation of intended maximum power transfer (co-polarisation) to the power received from the same direction from an identical far-field source of equal power but of orthogonal polarisation.

6.5.3.2 Specification

At any frequency within the antenna sub-system receive bandwidth the receive cross-polarisation discrimination anywhere within the main beam shall be as specified in ETS 300 158 [1] or ETS 300 249 [2] (Cross polarisation discrimination; Specification).

6.5.3.3 Design objective

These objectives are specified in ETS 300 158 [1] or ETS 300 249 [2].

6.5.3.4 Test site

This test shall be performed on either an outdoor far-field test site or compact test range (however see the last paragraph of subclause 4.2.2).

6.5.3.5 Method of measurement

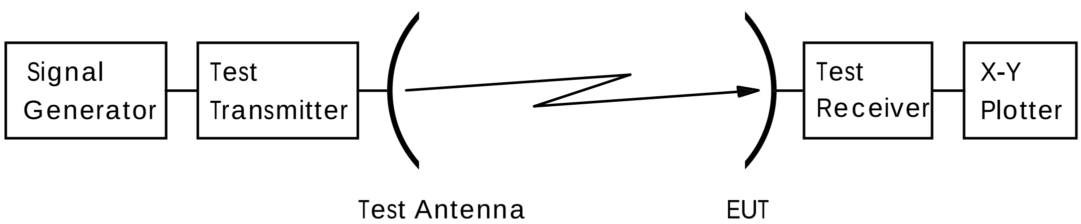


Figure 28: Test arrangement - receive polarisation discrimination

a) The test arrangement shall be as shown in figure 28.

b) The EUT shall be aligned to maximise the co-polar received signal and the X-Y Plotter adjusted to give maximum reading.

c) The EUT shall be driven in azimuth until the level has dropped by 1 dB or the appropriate angular offset.

d) The EUT shall then be driven in azimuth through boresight to a corresponding offset on the other side.

e) At boresight the EUT shall be rotated by 90°, or the test antenna or the polarisation subsystem of the EUT rotated by 90°, to the cross-polar position, rotated slightly to minimise the received signal level and the test repeated between the same two angles used for the co-polar trace.

f) The plot obtained shall show both co-polar and cross-polar traces.

g) The test shall be repeated at all frequencies specified in the basic ETS and again with the orthogonal polarisation to that originally used.

6.5.4 Pointing accuracy

6.5.4.1 Specification

The antenna sub-system alignment facilities should enable the main beam axis to be adjusted and fixed with an accuracy as specified in ETS 300 158 [1] or ETS 300 249 [2].

6.5.4.2 Test site

There is no requirement to define the test site to be used for this test.

6.5.4.3 Method of verification

a) The EUT shall be inspected to ascertain whether adjustment facilities are available for the azimuth axis (course adjustment is usually provided by the positioning of the means of attachment).

b) The adjustment facilities shall be examined to determine both the angular movement possible and the means of arresting that movement.

c) The arresting facility shall be examined to determine its permanency.

d) The test shall be repeated for the elevation axis.

6.5.5 Polarisation plane alignment

6.5.5.1 General

This requirement only applies to linear polarised antennas.

6.5.5.2 Specification

The receive polarisation plane of the antenna system shall be adjustable and it shall be possible to fix the receive polarisation plane of the antenna system as specified in ETS 300 158 [1] or ETS 300 249 [2].

6.5.5.3 Test site

There is no requirement to define the test site to be used for this test.

6.5.5.4 Method of verification

a) The adjustment facilities shall be examined to determine both the angular movement possible and the means of arresting that movement.

b) The arresting facility shall be examined to determine its permanency.

6.5.6 Mechanical stability

6.5.6.1 Specification

After application of a maximum wind speed, with gusts, as specified in ETS 300 158 [1] or ETS 300 249 [2] (Antenna pointing and efficiency stability under severe environmental conditions) 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 6.5.4.

6.5.6.2 Method of measurement

This test shall be performed in conjunction with the tests described in subclause 5.2.

6.5.7 Output interface and impedance matching

6.5.7.1 Test site

There is no requirement to define the test site to be used for these tests.

For the purposes of this test the EUT is defined as that part of the outdoor unit which comprises the antenna and its flange. The antenna includes the parabolic reflector, feed, support struts and an enclosure of equal weight/distribution to any electrical equipment normally housed with the feed at the antenna focal point.

6.5.7.2 Interface

6.5.7.2.1 Specification

As specified in ETS 300 158 [1] or ETS 300 249 [2] if a physical interface exists between the antenna subsystem and the LNB and if waveguide is employed, then the output flange should be either type UBR 120 (rectangular) or C 120 without gasket groove (circular).

6.5.7.2.2 Method of measurement

a) The waveguide flange shall be inspected to determine whether rectangular or circular waveguide is employed.

b) The flange shall be inspected to ascertain that a 1,5 mm circular groove is not present.

c) The various dimensions shall be measured, in millimetres, and the measurements recorded.

d) The recorded measurements shall be compared to the appropriate schematic shown in annex C.

6.5.7.3 Impedance matching

6.5.7.3.1 Specification

The impedance matching of the antenna sub-system, expressed in terms of Return Loss Ratio (RLR) (L in dB) shall be as specified in ETS 300 249 [2] (Output interface of antenna sub-system; Impedance matching).

6.5.7.3.2 Method of measurement

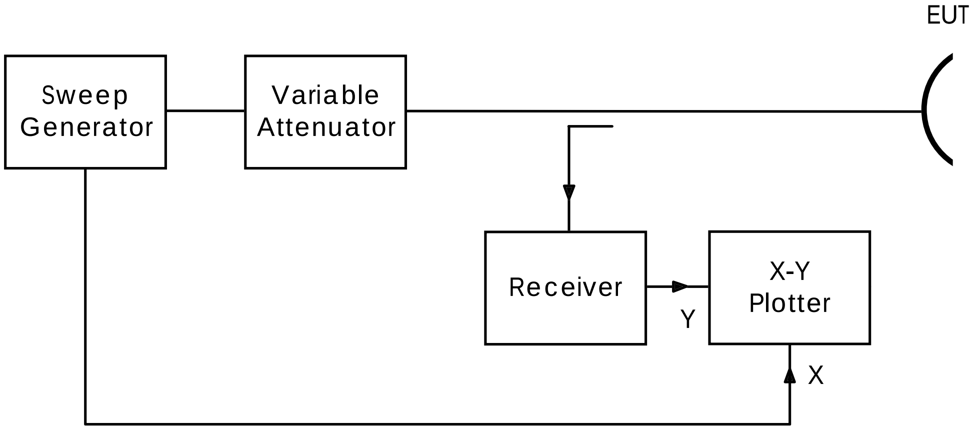


Figure 29: Test arrangement - output impedance matching

a) The X axis of the X-Y plotter shall be calibrated for the EUT input frequency range by use of a sweep signal generator and the receiver.

b) The test arrangement shall be as shown in figure 29.

c) With the EUT replaced by a short circuit termination the output level of the coupling port by the receiver shall be measured and set as 0 dB.

d) The sweep generator shall be used to sweep the required frequency band and the Y axis of the X-Y plotter calibrated for the output level in the range of 0 dB to - 30 dB with the aid of the variable attenuator.

e) The short circuit terminator shall be replaced by the EUT.

f) The sweep generator shall be used to sweep the required frequency band and the Y axis of the X-Y plotter shall record the return loss ratio (L) in dB.

g) When the impedance matching is required to be expressed in terms of VSWR this shall be calculated from the following formula:

$$VSWR = (1 + 10^{-L/20}) / (1 - 10^{-L/20})$$

6.6 Figure of merit

6.6.1 General

For the purposes of this subclause the EUT shall be defined as the complete outdoor unit.

6.6.2 Specification

The worst case value across the frequency band (see subclause 6.1.4) of the outdoor unit figure of merit, for 10° and 30° elevation angles, should be as specified in ETS 300 158 [1] or ETS 300 249 [2].

6.6.3 Test site

The test shall be performed on an outdoor far-field test site.

6.6.4 Method of measurement

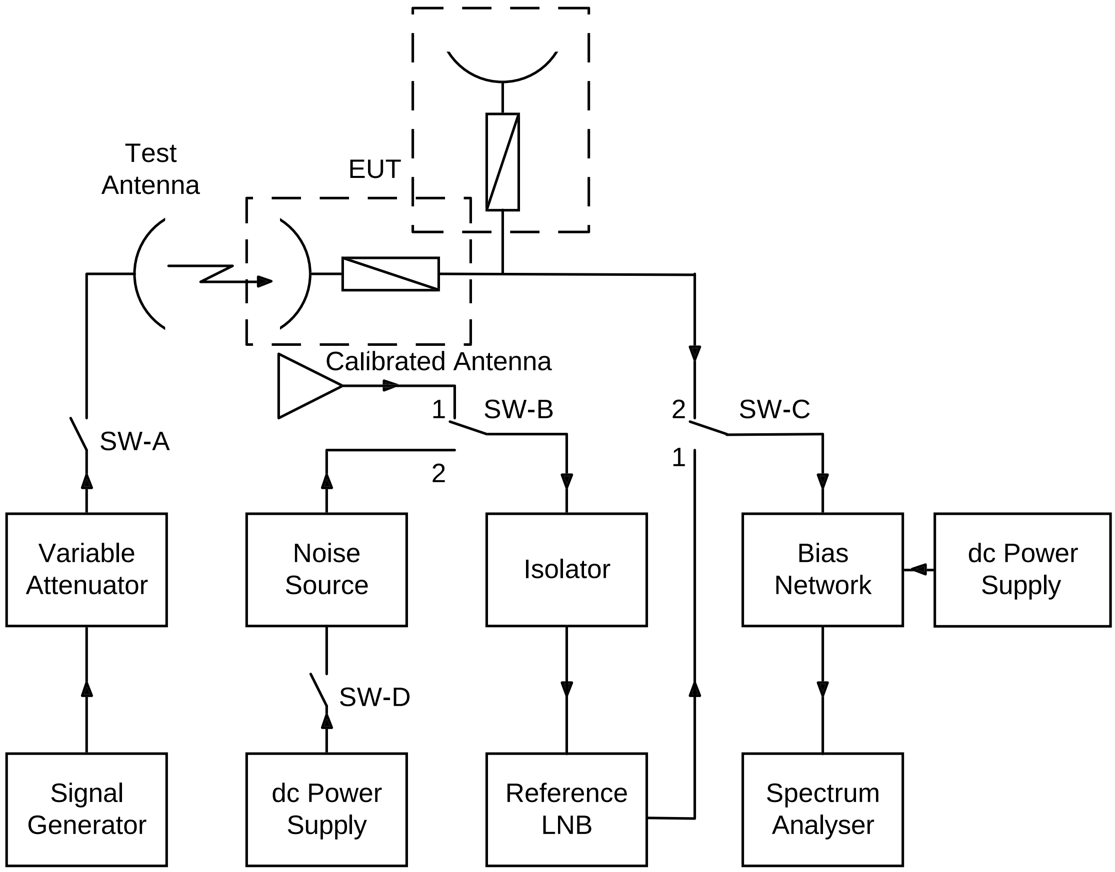


Figure 30: Test arrangement - figure of merit

a) The test arrangement shall be as shown in figure 30. The noise power measurements shall be corrected taking into account the bandwidth of the spectrum analyser.

b) The test antenna and EUT antenna shall have coincidental polarisation.

c) The signal generator shall be set to a frequency 20 MHz above the bottom of the receive band, switch A shall be closed.

d) The EUT shall be aligned to the test antenna.

e) Switch C shall be placed in position 2 and the power, P_1, shall be measured and recorded in Watts.

f) Switch A shall be opened and the power, P_2, shall be measured and recorded in Watts.

g) The EUT shall be turned to an elevation angle of 10° and the power, P_3, shall be measured and recorded in Watts.

h) Switch A shall be closed, switches B and C shall be placed in position 1.

j) The calibrated antenna shall be moved in the plane where the EUT is located to measure the spatial power flux density distribution of the wave coming from the test antenna and the mean output power, P_m, of the reference LNB shall be measured and recorded in Watts.

k) The calibrated antenna shall be placed near to the aperture plane of the EUT and the output power, P_4, of the reference outdoor unit shall be measured and recorded in Watts.

l) The ratio $\beta = P_m / P_4$ shall be calculated and recorded.

m) Switch A shall be opened and the power, P_5 shall be measured and recorded in Watts.

n) Switch B shall be placed in position 2 and switch D closed and the power, P_6 shall be measured and recorded in Watts.

p) Switch D shall be opened and the power, P_7 shall be measured and recorded in Watts.

q) The figure of merit G/T shall be calculated from the appropriate formula for an elevation angle of 10°:

Linear polarisation

$$G/T = 10 \log \frac{G_S (P_1 - P_2)(P_6 - P_7)}{T_o E_N \beta P_3 (P_4 - P_5)}$$

Circular polarisation

$$G/T = 10 \log \frac{G_S (P_1 - P_2)(P_6 - P_7)}{2 T_o E_N \beta P_3 (P_4 - P_5)}$$

where:

G_S = the gain of the calibrated antenna expressed as a ratio (not in dBi).
E_N = the excess noise ratio of the noise source expressed as a ratio (not in dB).
T_o = 290 K.

r) The test shall be repeated with the elevation angle in step g) being 30° and the calculation in step q) being valid for 30°.

s) The tests shall be repeated with the signal generator set to a frequency 20 MHz below the top of the receive band.

t) The worst result at each elevation angle shall be entered in the test summary.

6.7 Supplementary requirements

6.7.1 General

For the purposes of this subclause the EUT shall be defined as the complete outdoor unit.

6.7.2 Commands

6.7.2.1 Specification

The command signals, if required, shall be as specified in ETS 300 158 [1] or ETS 300 249 [2].

6.7.2.2 Test site

The test can be performed either on an outdoor far-field test site or by utilising an appropriate orbital satellite in place of the signal generator, test transmitter and measuring antenna.

6.7.2.3 Method of measurement

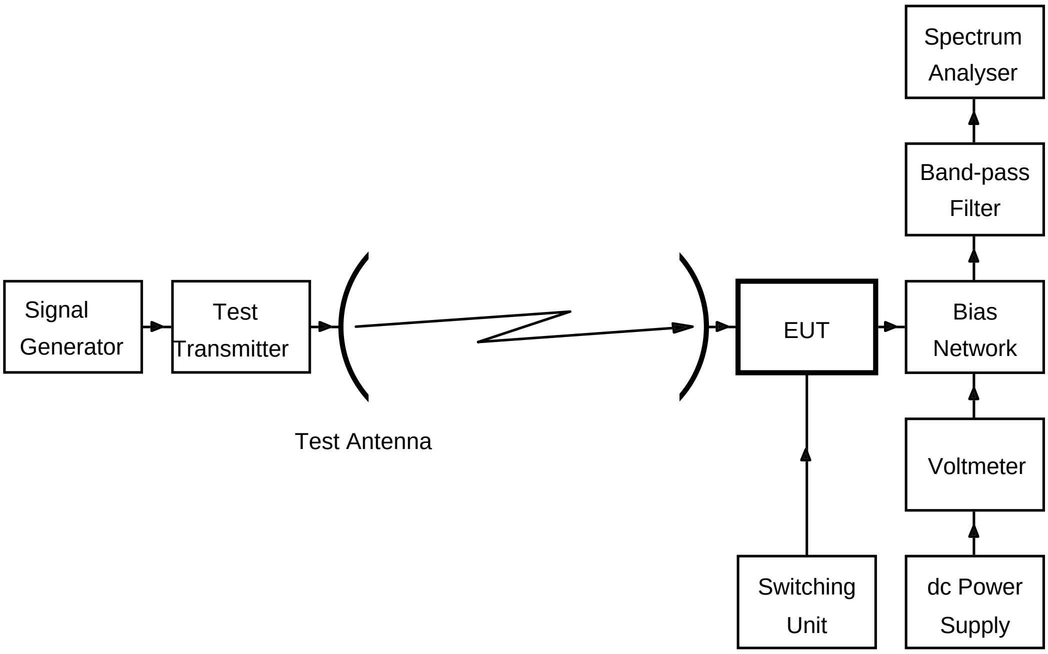


Figure 31: Test arrangement - commands

a) The test arrangement shall be as shown in figure 31 with the power supply set to 15 V.

b) In the case of a dual band LNB with a polar switch a low frequency signal is superimposed on the centre conductor of the IF cable at a convenient point.

c) The signal generator shall be set to a frequency in the middle of the manufacturers declared input range.

d) The output level shall be adjusted for a minimum stable signal at the output of the EUT.

e) The EUT polarisation shall be adjusted for maximum output signal.

f) The frequency counter shall measure the EUT output frequency.

g) The test for LO switching by IF cable, if pertinent, shall be as follows:

   1) The power supply voltage shall be reduced to below 14 V;

   2) Any change in output frequency shall be noted;

   3) The signal generator shall be adjusted to give the same output frequency;

   4) The change in frequency shall be noted;

   5) Increase the power supply voltage to above 16 V;

   6) The change in output frequency shall be noted;

   7) Repeat steps 1) to 4) above.

h) The test for polarisation switching by IF cable, if pertinent, shall be as follows:

   1) The power supply voltage shall be reduced to below 14 V;

   2) Any change in output shall be noted;

   3) The test antenna polarisation shall be adjusted to the same polarisation as the EUT antenna;

4) The change in polarisation shall be noted;

5) Increase the power supply voltage to above 16 V;

6) The change in output shall be noted;

7) The test antenna polarisation shall be readjusted to the same polarisation as the EUT antenna;

8) Repeat steps 1) to 4) above.

j) The test for polarisation switching by transistor logic levels applied through a separate cable, if pertinent, shall be as follows:

1) The switching unit shall be activated to choose a polarisation;

2) Any change in output shall be noted;

3) The test antenna polarisation shall be adjusted to the same polarisation as the EUT antenna;

4) The change in polarisation shall be noted;

5) The switching unit shall be activated to choose the opposite polarisation;

6) The change in output shall be noted;

7) The test antenna polarisation shall be readjusted to the same polarisation as the EUT antenna;

8) Repeat steps 1) to 4) above.

k) The test for polarisation changes by current supplied through a separate cable, if pertinent, shall be as follows:

1) For the purposes of this test the switching unit shall have an ammeter incorporated within;

2) The switching unit shall be activated to choose a polarisation;

3) The current drawn shall be noted;

4) The test antenna polarisation shall be adjusted to the same polarisation as the EUT antenna;

5) The switching unit shall be activated to choose the opposite polarisation;

6) The current drawn shall be noted;

7) The test antenna polarisation shall be readjusted to the same polarisation as the EUT antenna;

8) Repeat steps 5) and 6) above.

l) The test for LO frequency changes by low frequency switching shall be as follows:

1) The low frequency switching command shall be switched off;

2) The signal generator and output frequencies shall be noted;

3) The low frequency switching command shall be switched on;

4) Any change in output frequency shall be noted;

5) The signal generator shall be adjusted to give the same output frequency;

6) The change in frequency shall be noted;

7) The low frequency switching command shall be switched off.

8) Repeat steps 4) to 6) above.

7 Documentation

7.1 Basic specification

The manufacturer shall supply an information leaflet with each equipment. This leaflet shall contain at least the information listed in ETS 300 158 [1] or ETS 300 249 [2].

7.2 Information leaflet

A specimen information leaflet is shown in table 3.

Table 3: Information leaflet

Characteristic	Information
Radio frequency bands	
Antenna impedance matching	
LNB Input	
Type of waveguide flange	
Radio frequency input range	
Local oscillator frequency	
Polarisation type	
Polarisation switching possible	
Intermediate frequency range	
LNB Output	
Connector type	
Impedance and return loss	
Spectrum Inversion	
LNB power requirement	
Voltage	
Polarity	
Current	
Auxiliary power requirement	
Voltage	
Polarity	
Current	
Supplementary control	
TTL interface	
Power interface	
Voltage	
Polarity	
Current	
Maximum installation height above ground	
Survival wind speed	
Installation instructions	
Mechanical	
Electrical	
Operating environmental conditions	
Solar radiation warning	
Attachment load	
Wind speed rating	
Antenna pointing accuracy	
Polarisation matching capability	
Antenna stability	
Frequency conversion tolerance	
LNB	
Output maximum level	
Small signal gain	
Image frequency rejection	
Amplitude/frequency response	
Group delay response	
Multicarrier inter-modulation ratio	
Return loss	
Figure of merit	
LNB noise figure	
Antenna	
Receive gain pattern	
Cross-polarisation discrimination	
Co-polar on-axis gain	
Internal interface (if it can be reached)	
Types of waveguide flanges	

7.3 Method of verification

Comparison of the specified requirements and the printed documentation which shall indicate the manufacturer's guaranteed parameters.

Annex A (normative): Test report summary

Table A.1: Test report summary

Test number	Specification title	Status Mandatory or Optional	Test conducted Y/N	Pass or Fail	Comments and/or measured value
5.1	Mechanical safety				
5.2	Mechanical construction - wind speed				
5.3	Mechanical construction - interface loads				
5.4	Mechanical construction - adverse conditions				
5.5	Fire hazard				
5.6	Electrical shock				
5.7	Lightning				
6.1.3	LNB: Power supply				
6.1.4	Radio frequency input range(s)				
6.1.5.1	LO: Frequency spectrum				
6.1.5.2	LO: Frequency conversion				
6.1.6	Intermediate frequency output range				
6.1.7	LNB: Noise figure				
6.1.8	LNB: Image frequency rejection				
6.1.9	Unwanted signals immunity				

(continued)

Table A.1 (continued): Test report summary

Test number	Specification title	Status	Test conducted Y/N	Pass or Fail	Comments and/or measured value
6.1.10	LNB: Small signal gain				
6.1.11.1	LNB: Amplitude-frequency characteristic				
6.1.11.2	LNB: Group-delay characteristic				
6.1.11.3	LNB: Output level (Multicarrier intermodulation ratio)				
6.1.12.1	LNB: Input interface				
6.1.12.2	LNB: Output impedance				
6.1.12.3	LNB: Output connector				
6.1.12.4	LNB: Output return loss				
6.2	On-axis spurious radiation				
6.3	Spurious radiation				
6.4.4	Immunity: Ambient fields				
6.4.5	Immunity: Currents				
6.5.1	Co-polar on-axis gain				
6.5.2	Antenna receive radiation patterns				

(continued)

Table A.1 (concluded): Test report summary

Test number	Specification title	Status Mandatory or Optional	Test conducted Y/N	Pass or Fail	Comments and/or measured value
6.5.3	Cross-polarisation discrimination				
6.5.4	Pointing accuracy				
6.5.5	Polarisation plane alignment				
6.5.6	Mechanical stability				
6.5.7.2	Output interface				
6.5.7.3	Impedance matching				
6.6	Figure of merit				
6.7.2	Commands				
7	Documentation				

Annex B (normative): Test report result forms

The following forms shall be used as a minimum requirement to record the results of the tests carried out. Where a graphical representation is required the graph shall be included immediately after the test result.

TEST REPORT REFERENCE

MECHANICAL SAFETY SUBCLAUSE 5.1

Danger of physical injury

Comments:
....
....
....
....
....
....
....
....

SPECIFICATION: Subclause 5.1.1

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.

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

MECHANICAL CONSTRUCTION - WIND SPEED SUBCLAUSE 5.2

Maximum installation height of the antenna .... m

Maximum wind speed tested .... km/h

Test results:

Safety margin test (if applicable):
....
....

	Yes	No
Any signs of distortion observed	☐	☐

Comments:
....
....
....
....
....
....
....
....

SPECIFICATION: Subclause 5.2.1

As specified in ETS 300 158 [1] or ETS 300 249 [2] the outdoor unit, including mounted structural components (but excluding the means of attachment), shall be designed to support the following main loads due to:

- the weight of the antenna and structural components;
- the wind speed.

Loading due to snow and ice is not considered.

At the maximum applicable wind speed quoted in ETS 300 158 [1] or ETS 300 249 [2] none of the components shall be torn away:

TEST EQUIPMENT USED:

....

....

NOTE: Indicate computation method used.

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

MECHANICAL CONSTRUCTION - INTERFACE LOADS SUBCLAUSE 5.3

Interface description	Wind Speed	Load value (N)	Measurement uncertainty

Wind speed as declared by manufacturer: ....

Comments:
....
....
....
....
....
....
....
....

SPECIFICATION: Subclause 5.3.1

The mechanical loads at the interface with the attachment device shall be calculated or measured and entered as values in the data sheet of the test report.

TEST EQUIPMENT USED:

....

....

NOTE: Indicate computation method used.

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

MECHANICAL CONSTRUCTION - ADVERSE CONDITIONS SUBCLAUSE 5.4

Corrosion resistance

Comments:
....
....
....
....
....
....
....
....

SPECIFICATION: Subclause 5.4.2.1

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.

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

FIRE HAZARD SUBCLAUSE 5.5

Outdoor unit made of material with limited ignitability

Comments:
....
....
....
....
....
....
....
....

SPECIFICATION: Subclause 5.5.1

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

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

ELECTRICAL SHOCK SUBCLAUSE 5.6

Danger of electrical shock

Comments:
....
....
....
....
....
....
....
....

SPECIFICATION: Subclause 5.6.1

The electrical safety of the equipment shall be in accordance with the introduction and clauses 1 to 3 of EN 60950 [8]. These clauses deal with fundamental design requirements, wiring, connections and supply.

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

LIGHTNING PROTECTION SUBCLAUSE 5.7

Dimensions of the attachment point: ....

Dimensions of restrictive area: ....

Attachment suitable for conductor made of:	Cu	☐
	Al	☐
	Fe	☐
	None	☐

Comments:
....
....
....
....
....
....
....
....

SPECIFICATION: Subclause 5.7.1

Means shall be provided to permit the attachment of bonding conductors of dimensions indicated in EN 50083-1 [9] as stated in ETS 300 158 [1] or ETS 300 249 [2].

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

LNB: POWER SUPPLY SUBCLAUSE 6.1.3

Polarity: ....

	Yes	No
EUT operates properly for power supply specified	☐	☐

Maximum value of the current: .... mA

Comments:
....
....
....
....
....
....
....
....

SPECIFICATION: Subclause 6.1.3.2

The LNB shall have a dc power supply. Its characteristics shall be as specified in ETS 300 158 [1] or ETS 300 249 [2] (Power supply for LNB).

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

RADIO FREQUENCY INPUT RANGE(S) SUBCLAUSE 6.1.4

Frequency range number	**Bottom frequency (GHz)**	**Upper frequency (GHz)**	**Measurement uncertainty**

SPECIFICATION Subclause 6.1.4.1

The outdoor unit shall be able to receive simultaneously signals in the frequency ranges specified in ETS 300 158 [1] or ETS 300 249 [2] (Radio Frequency (RF) input range).

TEST EQUIPMENT USED:

....

....

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

LOCAL OSCILLATOR FREQUENCY SPECTRUM SUBCLAUSE 6.1.5.1

Measurement point	**Bottom frequency (GHz)**	**Upper frequency (GHz)**
Before conversion		
After conversion		

SPECIFICATION Subclause 6.1.5.1.1

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

TEST EQUIPMENT USED:

....

....

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

LOCAL OSCILLATOR FREQUENCY CONVERSION SUBCLAUSE 6.1.5.2

Nominal frequency difference between input and output of LNB (d_n): ....

Nominal supply voltage: ....

LO setting error (e_s): ....

Ageing (e_a): ....

Test frequency, f: .... GHz

Measurement temperature (°C)	**Supply voltage**	**Frequency after conversion f_a (GHz)**	**Measurement uncertainty**	**$d=f - f_a$**	**$e=d-d_n$**	**$e+e_s+e_a$**
-20	Nominal					
	1)					
	2)					
0	Nominal					
	1)					
	2)					
+25	Nominal					
	1)					
	2)					
+55	Nominal					
	1)					
	2)					

SPECIFICATION Subclause 6.1.5.2.1

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 the deviation specified in ETS 300 158 [1] or ETS 300 249 [2] from its nominal value with the factors specified within those ETSs being taken into account.

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

TEST EQUIPMENT USED:

....

....

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

INTERMEDIATE FREQUENCY OUTPUT RANGE(S) SUBCLAUSE 6.1.6

Measurement point	**Bottom frequency (GHz)**	**Upper frequency (GHz)**	**Measurement uncertainty**
Before conversion			
After conversion			

SPECIFICATION Subclause 6.1.6.1

The IF at the LNB output shall be in the range stated in ETS 300 158 [1] or ETS 300 249 [2].

TEST EQUIPMENT USED:

....

....

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

LNB: NOISE FIGURE SUBCLAUSE 6.1.7

Ambient temperature ....°C Relative humidity .... %
(to one significant place of decimals)

Test frequency (GHz)	Noise figure (dB)	Measurement uncertainty

SPECIFICATION Subclause 6.1.7.1

As specified in ETS 300 158 [1] or ETS 300 249 [2] the worst case value of the LNB noise temperature, or noise figure, over the RF input frequency range(s) shall be determined.

TEST EQUIPMENT USED:

....

....

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

LNB: IMAGE FREQUENCY REJECTION SUBCLAUSE 6.1.8

Test frequency (GHz)	Image rejection (dB)	Measurement uncertainty

Signal level used:.....................................

SPECIFICATION Subclause 6.1.8.2

The LNB shall suppress the image frequencies of the received channel by at least 40 dB as specified in ETS 300 158 [1] or ETS 300 249 [2].

TEST EQUIPMENT USED:

....

....

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

UNWANTED SIGNALS IMMUNITY SUBCLAUSE 6.1.9

Test frequency: .... GHz

Noticed unwanted signal frequency (GHz)	**Signal rejection (dB)**	**Measurement uncertainty**

Signal level used:.....................................

SPECIFICATION Subclause 6.1.9.1

The distortion components at the output of the LNB, caused by wanted and unwanted signals applied at its input, that fall within the IF frequency range shall be as specified in ETS 300 158 [1] or ETS 300 249 [2] (Internal immunity of the outdoor unit to unwanted signals).

TEST EQUIPMENT USED:

....

....

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

LNB: SMALL SIGNAL GAIN SUBCLAUSE 6.1.10

Test frequency range (GHz)	Gain (dB)	Measurement uncertainty
	See Graphs	

NOTE: Measurement results are presented in a graphic form following this result sheet.

Signal gain declared by manufacturer:...............................

Signal level used:...

SPECIFICATION Subclause 6.1.10.1

The small signal gain of the LNB at any frequency within its RF input frequency range(s) should be as specified in ETS 300 158 [1] or ETS 300 249 [2].

TEST EQUIPMENT USED:

....

....

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

LNB: AMPLITUDE-FREQUENCY CHARACTERISTIC SUBCLAUSE 6.1.11.1

Results are presented in a graphic form following this result sheet.

SPECIFICATION Subclause 6.1.11.1.1

The amplitude-frequency characteristic over the IF range should be such that the maximum amplitude variation does not exceed the limits specified in ETS 300 158 [1] or ETS 300 249 [2] (Linear distortion: amplitude-frequency characteristic).

TEST EQUIPMENT USED:

....

....

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

LNB: GROUP-DELAY CHARACTERISTIC SUBCLAUSE 6.1.11.2

Results are presented in a graphic form following this result sheet.

SPECIFICATION Subclause 6.1.11.2.1

The maximum permitted group-delay variation over the IF frequency range should not exceed the limits specified in ETS 300 158 [1] or ETS 300 249 [2] (Linear distortion: group-delay characteristics).

TEST EQUIPMENT USED:

....

....

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

LNB: MULTICARRIER INTERMODULATION RATIO SUBCLAUSE 6.1.11.3

Test centre frequency (GHz)	Intermodulation ratio (dB)	Output Voltage	Measurement uncertainty

Signal level used:...................................

SPECIFICATION Subclause 6.1.11.3.2

The maximum permissible output voltage shall be as specified in ETS 300 158 [1] or ETS 300 249 [2] (Output level).

At the LNB output the level of any of the intermodulation products generated by two signals at the nominal output level shall be as specified in ETS 300 158 [1] or ETS 300 249 [2].

TEST EQUIPMENT USED:

....

....

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

LNB: INPUT INTERFACE SUBCLAUSE 6.1.12.1

Type of interface: ....

Dimension	Standard value (mm)	Measured value (mm)	Measurement uncertainty

SPECIFICATION Subclause 6.1.12.1.1

As specified in ETS 300 158 [1] or ETS 300 249 [2] if a physical interface exists between the antenna subsystem and the LNB and if waveguide is employed, then the input flange should be either type PBR 120 (rectangular) or C 120 with gasket groove (circular).

TEST EQUIPMENT USED:

....

....

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

LNB: OUTPUT IMPEDANCE SUBCLAUSE 6.1.12.2

	A	B
Type of equipment:	☐	☐

Test frequency: .... GHz

LNB output impedance: .... Ω

Measurement uncertainty: ....

SPECIFICATION Subclause 6.1.12.2.1

The value of the nominal output impedance shall be as specified in ETS 300 158 [1] or ETS 300 249 [2] (LNB output interface; Impedance).

....

....

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

LNB: OUTPUT CONNECTOR SUBCLAUSE 6.1.12.3

Type of connector: ....

SPECIFICATION Subclause 6.1.12.3.1

The type of connector shall be as specified in ETS 300 158 [1] and ETS 300 249 [2] (LNB output interface; Type of connector).

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

LNB: OUTPUT RETURN LOSS SUBCLAUSE 6.1.12.4

Nominal impedance: ....

Test output frequency (GHz)	Return loss (dB)	Measurement uncertainty

SPECIFICATION Subclause 6.1.12.4.2

The output return loss ratio over the IF frequency range employed shall be as specified in ETS 300 158 [1] or ETS 300 249 [2] (LNB output interface; Impedance matching at the output terminal).

TEST EQUIPMENT USED:

....

....

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

ON-AXIS SPURIOUS RADIATION SUBCLAUSE 6.2

Frequency of spurious signal (GHz)	**Type of spurious signal**	**Level of spurious signal (dBm)**	**Measurement uncertainty**

SPECIFICATION Subclause 6.2.2

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) and the applicable frequency range shall be as specified in ETS 300 158 [1] and ETS 300 249 [2] (Unwanted radiation including LO leakage radiated from the antenna).

TEST EQUIPMENT USED:

....

....

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

SPURIOUS RADIATION SUBCLAUSE 6.3

Frequency of spurious signal (GHz)	Level of spurious signal (dBm)	Measurement uncertainty

SPECIFICATION Subclause 6.3.2

The TVRO shall satisfy the limits for radiated interference field strength over the applicable frequency ranges specified in ETS 300 158 [1] or ETS 300 249 [2].

TEST EQUIPMENT USED:

....

....

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

IMMUNITY: AMBIENT FIELDS SUBCLAUSE 6.4.4

A B

Type of equipment: ☐ ☐

Feature tested	Pass/Fail	Ratio of failures to test applications

SPECIFICATION Subclause 6.4.4.1

The TVRO shall have an adequate level of intrinsic immunity to enable it to operate as intended, without any just perceptible disturbances, when it is exposed to the electrical field strengths specified in ETS 300 158 [1] or ETS 300 249 [2] (External immunity of the outdoor unit to ambient fields).

TEST EQUIPMENT USED:

....

....

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

IMMUNITY: CURRENTS SUBCLAUSE 6.4.5

	A	B
Type of equipment:	☐	☐

Feature tested	Pass/Fail	Ratio of failures to test applications

SPECIFICATION Subclause 6.4.5.1

Type A:

At each interference frequency the immunity, expressed as the electro-motive 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 as specified in ETS 300 158 [1] or ETS 300 249 [2] (External immunity of the outdoor unit to currents conducted via connected cables), when the minimum level of the wanted signal is applied to its input.

Type B:

The immunity, expressed as the electro-motive 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 as specified in ETS 300 158 [1] or ETS 300 249 [2] (External immunity of the outdoor unit to currents conducted via connected cables), when the minimum level of the wanted signal is applied to its input.

The interfering signal shall be as specified in ETS 300 158 [1] or ETS 300 249 [2].

TEST EQUIPMENT USED:

....

....

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

CO-POLAR ON-AXIS GAIN SUBCLAUSE 6.5.1

Ambient temperature ....°C Relative humidity .... %

Test polarisation: ....

Feature tested	**Gain (dBi)**	**Measurement uncertainty**

NOTE: Measurement results are presented in a graphic form following this result sheet.

On-axis gain as declared by manufacturer:...............

SPECIFICATION Subclause 6.5.1.2

The antenna co-polar on-axis gain 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 orthogonal polarisation, if dual polarisation is available should be as specified in ETS 300 158 [1] or ETS 300 249 [2].

TEST EQUIPMENT USED:

....

....

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

ANTENNA RECEIVE RADIATION PATTERNS SUBCLAUSE 6.5.2

Test frequency: .... GHz

Test polarisation: ....

Test	Measured value	Unit of measurement	Measurement uncertainty
Antenna receive gain		dBi	
Antenna receive radiation pattern	See graph	dB	

NOTE: Measurement results are presented in a graphic form following this result sheet.

SPECIFICATION Subclause 6.5.2.2

At any frequency within the antenna sub-system receive frequency range(s) the co-polar gain G (ϕ) in dB relative to an isotropic antenna shall be as specified in ETS 300 158 [1] or ETS 300 249 [2] (Antenna gain pattern; Specification 1).

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 shall be as specified in ETS 300 158 [1] or ETS 300 249 [2] (Antenna gain pattern; Specification 2).

DESIGN OBJECTIVES Subclause 6.5.2.3

These objectives are specified in ETS 300 158 [1] (Antenna gain pattern; Design objectives) and in ETS 300 249 [2] (Antenna gain pattern; Design objectives; Antenna discrimination and Antenna gain pattern).

COMPUTATION OF RESULTS

As indicated in subclause 6.5.3.5.

Results are presented in a graphic form following this result sheet.

TEST EQUIPMENT USED:

....

....

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

CROSS-POLARISATION DISCRIMINATION SUBCLAUSE 6.5.3

Test frequency: .... GHz

Test polarisation: ....

Test	**Measured value**	**Unit of measurement**	**Measurement uncertainty**
Receive polarisation discrimination	See graph	dB	

NOTE: Measurement results are presented in a graphic form following this result sheet.

SPECIFICATION Subclause 6.5.3.2

At any frequency within the antenna sub-system receive bandwidth the receive cross-polarisation discrimination anywhere within the main beam shall be as specified in ETS 300 158 [1] and ETS 300 249 [2] (Cross polarisation discrimination; Specification).

DESIGN OBJECTIVE Subclause 6.5.3.3

These objectives are specified in ETS 300 158 [1] and ETS 300 249 [2].

TEST EQUIPMENT USED:

....

....

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

POINTING ACCURACY SUBCLAUSE 6.5.4

Pointing accuracy	Azimuth axis		Elevation axis	
	Yes	No	Yes	No
Adjustments available	☐	☐	☐	☐
Angular movement possible	☐	☐	☐	☐
Means of arresting available	☐	☐	☐	☐
Arresting facility permanence	☐	☐	☐	☐

Comments:
....
....
....
....
....
....
....
....

SPECIFICATION: Subclause 6.5.4.1

The antenna sub-system alignment facilities should enable the main beam axis to be adjusted and fixed with an accuracy as specified in ETS 300 158 [1] or ETS 300 249 [2].

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

POLARISATION PLANE ALIGNMENT SUBCLAUSE 6.5.5

Polarisation angle	Examination	
	Yes	No
Adjustments available	☐	☐
Angular movement possible	☐	☐
Means of arresting available	☐	☐
Arresting facility permanence	☐	☐

Comments:
....
....
....
....
....
....
....
....

SPECIFICATION: Subclause 6.5.5.2

The receive polarisation plane of the antenna system shall be adjustable and it shall be possible to fix the receive polarisation plane of the antenna system as specified in ETS 300 158 [1] or ETS 300 249 [2].

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

MECHANICAL STABILITY SUBCLAUSE 6.5.6

Test method used:

a) Wind tunnel testing ☐ Outdoor unit ☐

b) Numerical analysis and simplified tests ☐

Test results:

	Yes	No
Any signs of distortion observed	☐	☐
Repointing needed	☐	☐

Comments (include description of deviation of the antenna position and component deviation with respect to each other):
....
....
....
....
....
....
....
....

SPECIFICATION: Subclause 6.5.6.1

After application of a maximum wind speed, with gusts, as specified in ETS 300 158 [1] or ETS 300 249 [2] (Antenna pointing and efficiency stability under severe environmental conditions) 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 6.5.4.

TEST EQUIPMENT USED:

....

....

NOTE: In the case of numerical analysis indicate computation method used.

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

OUTPUT INTERFACE SUBCLAUSE 6.5.7.2

Type of interface: ....

Dimension	Standard value (mm)	Measured value (mm)	Measurement uncertainty

SPECIFICATION Subclause 6.5.7.2.1

As specified in ETS 300 158 [1] or ETS 300 249 [2] if a physical interface exists between the antenna subsystem and the LNB and if waveguide is employed, then the output flange should be either type UBR 120 (rectangular) or C 120 without gasket groove (circular).

TEST EQUIPMENT USED:

....

....

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

IMPEDANCE MATCHING SUBCLAUSE 6.5.7.3

Type of waveguide flange: ....

Return loss ratio value declared: .... dB

Return loss ratio: Results are presented in a graphic form following this result sheet.

SPECIFICATION Subclause 6.5.7.3.1

The impedance matching of the antenna sub-system, expressed in terms of Return Loss Ratio (RLR) (L in dB) shall be as specified in ETS 300 249 [2] (Output interface of antenna sub-system; Impedance matching).

TEST EQUIPMENT USED:

....

....

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

FIGURE OF MERIT SUBCLAUSE 6.6

Ambient temperature ....°C Relative humidity .... %

Test frequency (GHz)	**Figure of merit for elevation angle dB/K**		**Measurement uncertainty**
	10°	**30°**	

Value declared by manufacturer: ....

The worst case value of the figure of merit: .... dB/K

SPECIFICATION Subclause 6.6.2

The worst case value across the frequency band (see subclause 6.1.4) of the outdoor unit figure of merit, for 10° and 30° elevation angles, should be as specified in ETS 300 158 [1] or ETS 300 249 [2].

TEST EQUIPMENT USED:

....

....

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

COMMANDS SUBCLAUSE 6.7.2

Command	Present		Test	
	Yes	No	Pass	Fail
LO switching by IF cable	☐	☐	☐	☐
Electrical polarisation switching by IF cable:	☐	☐	☐	☐
Mechanical polarisation switching by IF cable:	☐	☐	☐	☐
Mechanical polarisation switching by separate cable:	☐	☐	☐	☐
Magnetic polarisation switching by separate cable:	☐	☐	☐	☐

SPECIFICATION Subclause 6.7.2.1

The command signals, if required, shall be as specified in ETS 300 158 [1] or ETS 300 249 [2].

COMMENTS:

....

....

....

....

TEST EQUIPMENT USED:

....

....

Test: Pass ☐ Fail ☐

TEST REPORT REFERENCE ....

DOCUMENTATION SUBCLAUSE 7

	Yes	No
Information leaflet present	☐	☐
Information leaflet contains proper information	☐	☐

Comments:
....
....
....
....
....
....
....
....

SPECIFICATION: Subclause 7.1

The manufacturer shall supply an information leaflet with each equipment. This leaflet shall contain at least the information listed in ETS 300 158 [1] or ETS 300 249 [2].

Test: Pass ☐ Fail ☐

Annex C (normative): Waveguide flanges

C.1 Rectangular waveguide flange dimensions

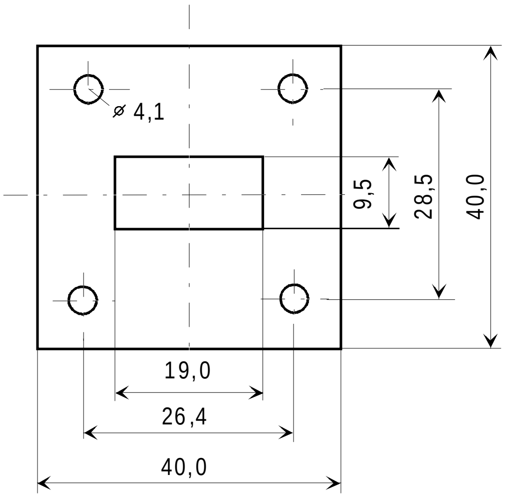


Figure C.1: UBR 120

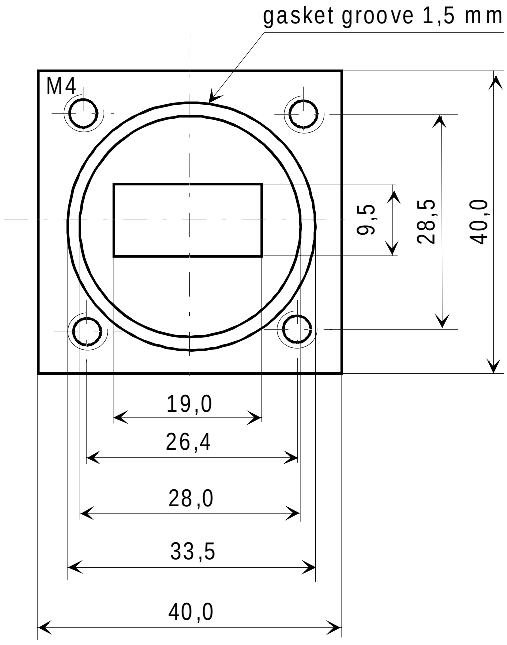


Figure C.2: PBR 120

C.2 Circular waveguide flange dimensions

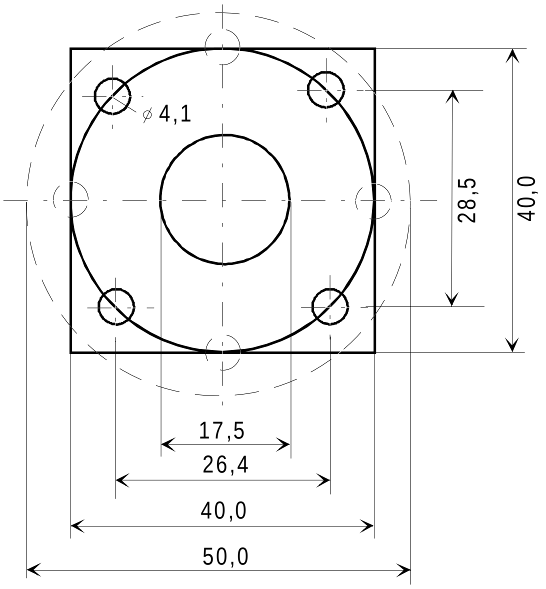


Figure C.3: C 120 without gasket groove

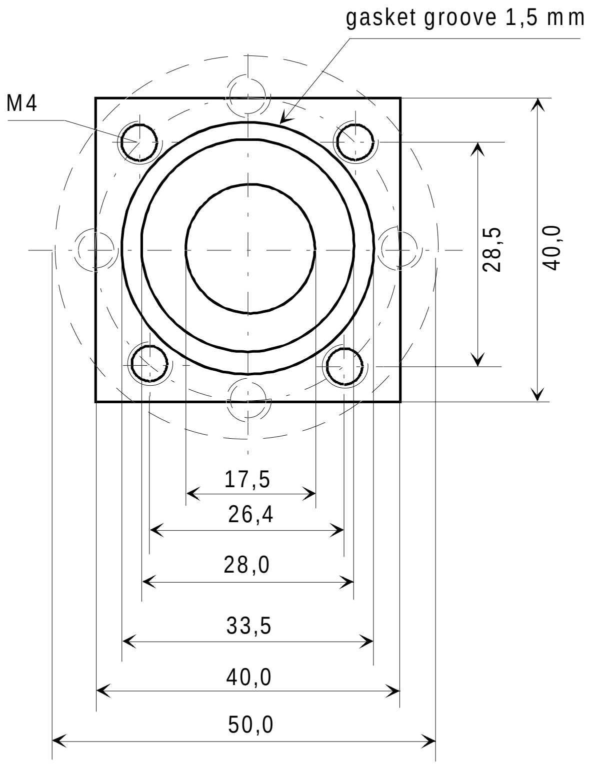


Figure C.4: C 120 with gasket groove

History

Document history			
September 1994	Public Enquiry	PE 71:	1994-09-19 to 1995-01-13
June 1995	Vote	V 82:	1995-06-26 to 1995-09-01
November 1995	First Edition		
March 1996	Converted into Adobe Acrobat Portable Document Format (PDF)		

ISBN 2-7437-0309-1
Dépôt légal : Novembre 1995