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**Satellite Earth Stations and Systems (SES);
Satellite broadcast reception equipment;
~~Harmonised Standard covering the essential requirements
of article 3.2 of the Directive 2014/53/EU;~~
Part 1: Outdoor unit receiving in the
10,7 GHz to 12,75 GHz frequency band;
Harmonised Standard for access to radio spectrum**

Reference

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Foreword

This Harmonised European Standard (EN) has been produced by ETSI Technical Committee Satellite Earth Stations and Systems (SES).

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.1.9] to provide one voluntary means of conforming to the essential requirements of Directive 2014/53/EU on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC [i.1].

Once the present document is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of the present document given in table A.1 confers, within the limits of the scope of the present document, a presumption of conformity with the corresponding essential requirements of that Directive and associated EFTA regulations.

The present document is part 1 of a multi-part deliverable covering satellite broadcast reception equipment, as identified below:

Part 1: "Outdoor unit receiving in the 10,7 GHz to 12,75 GHz frequency band";

Part 2: "Indoor unit".

National transposition dates	
Date of adoption of this EN:	21 <u>June 2021</u>
Date of latest announcement of this EN (doa):	30 <u>September 2021</u>
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 <u>March 2022</u>
Date of withdrawal of any conflicting National Standard (dow):	31 <u>March 2023</u>

Modal verbs terminology

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Introduction

Today, satellite communications is an important means for broadcast distribution of television and radio programs to homes. Satellites transmit signals that can be received directly by mass deployed consumer electronics equipment. The present document concerns the performance of this kind of equipment with regard to harmful interference. The avoidance of receiving or transmitting interfering signals is considered in the present document, whereas reception of the wanted signals is not considered. Satellite operators or broadcasters may create specifications for the latter purpose.

The present document is intended to cover the provisions of Radio Equipment Directive [i.1] article 3.2, which states that "*Radio equipment shall be so constructed that it both effectively uses and supports the efficient use of radio spectrum in order to avoid harmful interference*". The directive requires that unwanted radio wave emissions of transmitters are limited in order to avoid harmful interference. It requires that receivers are resilient against harmful interference from radio waves in shared and adjacent frequency channels. In addition to the present document, other ENs that specify technical requirements in respect of essential requirements under other parts of article 3 of the Radio Equipment Directive [i.1] may apply to equipment within the scope of the present document.

The R&TTE Directive [i.3], which is the predecessor of the Radio Equipment Directive [i.1], contains no receiver requirements. Moreover, broadcast reception equipment is explicitly not covered. The present document becomes necessary with the adoption of the Radio Equipment Directive.

An overview of satellite broadcast reception equipment is given in the following. Typically, the equipment comprises an ~~outdoor unit~~ **Outdoor Unit** (ODU), and ~~indoor unit~~ **InDoor Unit** (IDU), an ~~inter-facility link~~ **Inter-Facility Link** (IFL) between these units, and optionally multi-switches for connecting multiple IDUs to an ODU. The ODU comprises an antenna and a ~~low noise block~~ **Low Noise Block** converter (LNB). The frequency down-conversion by the LNB enables transmission on a coaxial cable to the IDU. A frequency range that contains several modulated carriers is down-converted as one block. The most popular kind of antenna is a parabolic reflector antenna with offset feed. In that case the feed horn is often integrated with the LNB into one unit called ~~low noise block~~ **Low Noise Block** converter with ~~feed~~ **Feed** (LNBF). The IDU demodulates one of the carriers, de-multiplexes the retrieved bit stream and decodes digital audio video and audio for display on a TV screen. Common terms for the IDU are set-top box or satellite receiver. IDUs may contain a hard disk for recording programs. An IDU may be capable of processing multiple carriers for direct viewing and recording. The IDU functionality may be integrated into a TV set. Typically, the satellite transmits two electromagnetic waves with orthogonal polarization at the same time. In case the satellite transmits a large frequency band, it is divided up for frequency conversion with different local oscillator frequencies. The IDU selects by control signals which polarization and frequency band the ODU provides on the IFL. An ODU may work with multiple IDUs or IDUs with multiple tuners via separate IFLs. Multi-switches connected to an ODU allow connecting a large number of IDUs.

Frequency bands are re-used by satellites on different orbital positions of the Geostationary Orbit arc. Discrimination between signals from wanted and adjacent orbital positions is provided by the directivity of the ODU antenna. The actually required discrimination depends on the specific scenario of satellite spacing and Equivalent Isotropically Radiated Power (EIRP), as well as on the robustness of the wanted signals. Moreover, a certain on-axis gain is required for receiving the wanted signals with the target availability. In general, a larger antenna provides better discrimination and gain, but on the other hand small antennas are better accepted by users and the public. Requirements on the antenna are often given by means of the minimum antenna diameter. The meaning of such a requirement is "*that the antenna gain pattern shall be compliant with a reference pattern or mask that includes the nominal antenna diameter as a parameter*". The nominal diameter is a means for specifying and classifying antennas and in an easy way, but the actual antenna diameter may be different from it, or the antenna might not be circular. The concept of gain pattern definition with nominal antenna diameter is applied in the present document.

Besides the concept of ODU, IDU, IFL and optionally multi-switches, new concepts with different allocation of functionality exist. With channel stacking or SatCR, frequency channels are re-arranged by the ODU or an additional unit, so that all relevant channels can be carried on a single coaxial cable. IDUs or additional cables are connected by simple splitters. With Sat>IP, the ODU or an additional device performs demodulation and conversion to video over Internet Protocol. Common connected devices including tablet computers can be used to watch broadcast television inside a home network. Another concept applies optical fibre to carry signals between ODU and multi-switches. In conjunction with these and further concepts, the same requirements on the ODU characteristics exist.

The present document consists of multiple parts that apply to different kinds of equipment units, including ODUs for specific frequency bands and IDUs.

1 Scope

The present document applies to ODUs for satellite broadcast reception from geostationary satellites in the frequency band 10,7 GHz to 12,75 GHz. An ODU receives electromagnetic waves from a satellite. It amplifies the receive signal at low noise, converts it to a lower frequency band and makes it available to the IDU on an interface.

Part of the IDU functionality may be integrated with the ODU. In that case the present document applies only to the ~~conventional~~-ODU functionality that is defined above.

The present document contains requirements to demonstrate that radio equipment both effectively uses and supports the efficient use of radio spectrum in order to avoid harmful interference.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at <https://docbox.etsi.org/Reference/>.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

- [1] ETSI ETS 300 457 (Edition 1) (11-1995): "Satellite Earth Stations and Systems (SES); Test methods for Television Receive Only (TVRO) operating in the 11/12 GHz frequency bands".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC.
- [i.2] ETSI ETS 300 784: "Satellite Earth Stations and Systems (SES); Television Receive-Only (TVRO) satellite earth stations operating in the 11/12 GHz frequency bands".
- [i.3] ~~CENELEC EN 50083-2 (1995): "Cabled distribution systems for television and sound signals; Part 2: Electromagnetic compatibility for equipment".~~
- [i.4] ~~CISPR 16-1 (1993): "Specifications for radio interference measuring apparatus and measurements methods; Part 1: Radio disturbance and immunity measuring apparatus".~~
- [i.5] ~~Directive 1999/055/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity.~~

- [i.4] ETSI EG 203 336 (V1.4.1): "~~Electromagnetic compatibility and Radio spectrum Matters (ERM); 2.1): "Guide for the selection of technical parameters for the production of Harmonised Standards covering article 3.1(b) and article 3.2 of Directive 2014/53/EU".~~
- [i.5] ~~CENELEC~~ EN 50585:2014: "Communications protocol to transport satellite delivered signals over IP networks", produced by CENELEC.
- [i.6] Recommendation ITU-R BO.1213: "Reference receiving Earth station antenna pattern for the broadcasting-satellite service in the 11.7-12.75 GHz band".
- [i.7] ~~CENELEC~~ EN 61319-1:1996: "Interconnections of satellite receiving equipment - Part 1: Europe", produced by CENELEC.
- [i.8] ~~CENELEC~~ EN 50607:2015: "Satellite signal distribution over a single coaxial cable - second generation", produced by CENELEC.
- [i.9] Commission Implementing Decision C(2015) 5376 final of 4.8.2015 on a standardisation request to the European Committee for Electrotechnical Standardisation and to the European Telecommunications Standards Institute as regards radio equipment in support of Directive 2014/53 of the European Parliament and of the Council.
- [i.10] ~~CENELEC~~ EN 61319-1:1996/A11:1999: "Interconnections of satellite receiving equipment - Part_1: Europe", produced by CENELEC.

~~3~~ Definitions, symbols and abbreviations

~~3.1~~ Definitions

- [i.11] ~~ETSI EN 303 372-1 (V1.1.1) (08-2016): "Satellite Earth Stations and Systems (SES); Satellite broadcast reception equipment; Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU; Part 1: Outdoor unit receiving in the 10,7 GHz to 12.75 GHz frequency band".~~

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms ~~and definitions~~ apply:

LNB input level range: range of LNB input signal level with low end of the range equal to the level of LNB effective noise power and the high end of the range being the input level that causes 1 dB gain compression

nominal antenna diameter: antenna diameter ~~declared~~ specified by the manufacturer that is a parameter in performance characteristics and that allows reference to a certain performance

NOTE: An antenna with circular aperture of diameter equal to the nominal diameter does typically have the performance specified.

off-axis angle: angle between the antenna boresight axis and the direction of interest

taper: ratio of field strength in the center and at the edge of an antenna aperture expressed in dB

3.2 Symbols

For the purposes of the present document, the following symbols apply:

D nominal antenna diameter

F	focal length of the antenna reflector
λ	wave length

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

<u>DC</u>	<u>Direct Current</u>
<u>EIRP</u>	<u>Equivalent Isotropically Radiated Power</u>
<u>EUT</u>	<u>Equipment Under Test</u>
<u>IDU</u>	<u>InDoor Unit</u>
<u>IFL</u>	<u>InterFacility Link</u>
<u>IP</u>	<u>Internet Protocol</u>
<u>LNBS</u>	<u>Low Noise Block down-converter</u>
<u>LNBSF</u>	<u>Low Noise Block down-converter with Feed</u>
<u>LO</u>	<u>Local Oscillator</u>
<u>ODU</u>	<u>OutDoor Unit</u>
<u>RF</u>	<u>Radio Frequency</u>
<u>SAT>IP</u>	<u>SATellite over Internet Protocol</u>
<u>TV</u>	<u>TeleVision</u>

4 Technical requirements specifications

4.1 Environmental profile

The technical requirements of the present document apply under the environmental profile for operation of the equipment, which shall be ~~declared by the manufacturer. The equipment shall comply with all the technical requirements of the present document at all times when operating within the boundary limits of the declared operational environmental profile.~~

in accordance with its intended use. ~~4.2 Equipment capabilities~~

~~The technical requirements of the present document apply under the capabilities of the equipment, which shall be declared by the manufacturer. The equipment shall comply with all the technical requirements of the present document at all times when operating within the boundary limits of the operational environmental profile defined by its intended use.~~

4.2 Equipment capabilities

The technical requirements of the present document apply under the capabilities of the equipment, which shall be declared equipment capabilities.

specified by the manufacturer. The equipment shall comply with all the technical requirements of the present document at all times when operating within the boundary limits of the specified equipment capabilities.

Equipment capabilities comprise the following characteristics:

- Receive frequency band
- Polarization states
- Local oscillator frequency
- Nominal antenna diameter D
- Specific satellite network - if applicable

- LNB input level range

An ODU might be capable of receiving multiple frequency bands. The local oscillator frequency and the polarization states may be different in each frequency band. The declaration specification shall include all combinations of frequency band, polarization states and local oscillator frequency.

Polarization state can take the values horizontal linear, vertical linear, left hand circular and right hand circular. An ODU may receive multiple states in one frequency band.

If an ODU is designed for use in a specific satellite network only, then certain conformance requirements ~~do~~ are not apply-relevant with regard to harmful interference. Therefore, a conformance requirement in clause 4.3 may include a statement that the requirement is not applicable to such ODUs. (In the present document this is the case for clause 4.3.5.)

4.3 Conformance requirements

4.3.1 Radiation from the ODU

Specification 1: Unwanted radiation including Local Oscillator (LO) leakage radiated from the antenna

Purpose:

To limit the unwanted radiation level from the outdoor unit in order to protect adjacent satellites that use different frequency bands and are located near-by.

The EIRP power of the unwanted radiation, including the LO frequency as well as its second harmonic, ~~transmitted in the antenna axis (or boresight) direction, measured at the antenna flange (including the polarizer, ortho-mode transducer, band-pass filter, RF waveguides)~~ shall not exceed the following limits:

- ~~$-60 + G_{0u}$~~ -60 dBm in a 120 kHz bandwidth at the fundamental frequency of the LO
- ~~$-50 + G_{0u}$~~ -50 dBm in a 120 kHz bandwidth at the second harmonic of the LO
- ~~$-60 + G_{0u}$~~ -60 dBm in any other 120 kHz bandwidth

where ~~$G_{0u} = 20 \log \frac{\pi D}{\lambda}$~~ . D is the nominal antenna diameter, λ is the wave length.

This ~~specification~~ requirement applies to the frequency range from 2,5 GHz to 25 GHz.

~~NOTE 1: These limits are derived from those in ETSI ETS 300 784 [i.2]. Here EIRP is used instead of power at the antenna flange, because an antenna flange may not be present. G_{0u} is the upper bound for the antenna on-axis gain, which corresponds to 100 % efficiency.~~

Verification:

The test method specified in clause 6.2 in ETSI ETS 300 457 [1] shall apply.

NOTE 1: If LNB and feed horn of a reflector antenna are integrated, then no antenna flange exists. In that case the radiated signal may be accessed by a feed horn adaptor. The LNB manufacturer should supply the feed horn adaptor and characterization frequency and gain data. The data supplied should be used to correct the measurements taken.

NOTE 2: The specified test method in clause 6.2 of ETSI ETS 300 457 [1] includes provisions for the case that the antenna is an integral part which cannot be detached. In that case the specified test method defines that the reverberation chamber method of measurement is used.

NOTE 3: Version 1.1.1 of the present document [i.11] contained a requirement "Specification 2: Radiation from the outdoor unit (EIRP)

Purpose:

~~To limit unwanted radiation level from the outdoor unit in order to protect other systems.~~

~~The EIRP of unwanted signals radiated by the outdoor unit within the band from 30 MHz to 25 GHz, shall not exceed the following values measured). The requirement has been deleted because this kind of requirement is in any 120 kHz bandwidth (see CISPR No. 16-1 [i.4]); the scope of harmonised standards covering essential requirements on electromagnetic compatibility.~~

- ~~• 20 dBpW in the range 30 MHz to 960 MHz;~~
- ~~• 43 dBpW in the range from 960 MHz to 2,5 GHz;~~
- ~~• 57 dBpW in the range from 2,5 GHz to 25 GHz.~~

~~The lower limits apply at the transition frequency.~~

~~This specification applies for all off-axis angles greater than 7°.~~

~~NOTE 2: EIRP limits are in accordance with CENELEC EN 50083-2 [i.3].~~

4.3.2 Antenna gain pattern

Purpose:

To protect the wanted signals from interference from terrestrial services and from other satellites.

Specification:

The relative co-polar and cross-polar off-axis antenna gain shall comply with the following masks.

Variables:

- φ : off-axis angle of the antenna relative to boresight (degrees)
- $g_{co}(\varphi)$: Co-polar antenna gain at off-axis angle φ relative to co-polar on-axis gain (decibel)
- $g_{cross}(\varphi)$: Cross-polar antenna gain at off-axis angle φ relative to co-polar on-axis gain (decibel)

Parameters:

- D : nominal antenna diameter
- λ : wavelength expressed in the same unit as the diameter

Co-polar mask:

$$g_{co}(\varphi) \leq -2,5 \times 10^{-3} \left(\frac{D}{\lambda} \varphi\right)^2 \text{ for } 0 \leq \varphi < \varphi_m$$

$$g_{co}(\varphi) \leq g_1 \text{ for } \varphi_m \leq \varphi < \varphi_r$$

$$g_{co}(\varphi) \leq 29 - 25 \log \varphi - G_0 \text{ for } \varphi_r \leq \varphi < \varphi_b$$

$$g_{co}(\varphi) \leq -5 - G_0 \text{ for } \varphi_b \leq \varphi < 70^\circ$$

$$g_{co}(\varphi) \leq -G_0 \text{ for } 70^\circ \leq \varphi < 180^\circ$$

Where:

$$\varphi_r = 95 \frac{\lambda}{D}$$

$$G_0 = 8 + 20 \log \frac{D}{\lambda}$$

$$g_1 = 29 - 25 \log \varphi_r - G_0$$

$$\varphi_m = \frac{\lambda}{D} \sqrt{\frac{-g_1}{0,0025}}$$

$$\varphi_b = 10^{34/25}$$

NOTE 1: G_0 is the lowest expected on-axis gain. It corresponds to an antenna efficiency of 64 %.

Cross-polar mask:

$g_{\text{cross}}(\varphi) \leq -19$	for	$0 \leq \varphi < 0,25 \varphi_0$
$g_{\text{cross}}(\varphi) \leq -19 + 3 \left(\frac{\varphi - 0,25 \varphi_0}{0,19 \varphi_0} \right)$	for	$0,25 \varphi_0 \leq \varphi < 0,44 \varphi_0$
$g_{\text{cross}}(\varphi) \leq -16$	for	$0,44 \varphi_0 \leq \varphi < \varphi_0$
$g_{\text{cross}}(\varphi) \leq -16 + C \left \frac{\varphi - \varphi_0}{\varphi_1 - \varphi_0} \right $	for	$\varphi_0 \leq \varphi < \varphi_1$
$g_{\text{cross}}(\varphi) \leq 21 - 25 \log \varphi - G_0$	for	$\varphi_1 \leq \varphi < \varphi_2$
$g_{\text{cross}}(\varphi) \leq -5 - G_0$	for	$\varphi_2 \leq \varphi < 70^\circ$
$g_{\text{cross}}(\varphi) \leq -G_0$	for	$70^\circ \leq \varphi < 180^\circ$

Where:

$$\varphi_0 = 2 \frac{\lambda}{D} \sqrt{\frac{3}{0,0025}}$$

$$\varphi_1 = \frac{\varphi_0}{2} \sqrt{10,1875}$$

$$C = 21 - 25 \log \varphi_1 - (G_0 - 16)$$

$$\varphi_2 = 10^{26/25}$$

NOTE 2: Equations are not valid in the unlikely case where $\frac{D}{\lambda} > 15\,708$.

NOTE 3: ~~This specification~~ The present document is derived from Recommendation ITU-R BO.1213 [i.6]. The cross-polar mask takes into account degradation due to LNB cross-polar discrimination and cross talk of 20 dB.

Verification:

The test method specified in clause 6.5.2 of ETSI ETS 300 457 [1] shall apply.

The receive signal level may be measured at the output of the LNB.

NOTE 4: If the antenna feed or the complete antenna is integrated with the LNB, then measuring at the antenna flange is not possible. Measuring at the LNB output delivers valid results, since relative gain is specified.

4.3.3 Pointing accuracy capability

Purpose:

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

Specification:

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

Verification:

The test method specified in clause 6.1 shall apply.

4.3.4 Antenna pointing and efficiency stability under severe environmental conditions

Purpose:

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

Specification:

After application of the maximum 100 km/h wind speed, with gusts of 130 km/h defined by its intended use under clause 4.1, the installation shall not show any sign of permanent distortion or loss of components and ~~should~~shall not suffer a de-pointing greater than the pointing accuracy limit, as specified in clause 4.3.63.

Verification:

The test method specified in clause 6.5.6 ~~in~~of ETSI ETS 300 457 [1] shall apply.

NOTE: Although de-pointing limit is linked to clause 4.3, it is not required to test the pointing accuracy capability after application of wind speed. De-pointing may be obtained visibly by means of an angle metre.

4.3.5 Linear polarization plane alignment capability

Purpose:

To enable reception of signals with different linear polarization an accurate match of the receive antenna polarization plane to the wanted satellite transmit polarization plane shall be performed (in order to take advantage of the antenna system polarization isolation so as to protect the wanted signals from interference of signals transmitted on the orthogonal polarization on an adjacent satellite).

Applicability:

This requirement does not apply in case the ODU is designed for a specific satellite network that makes use of both polarizations.

NOTE: A satellite network may use only one polarization, whereas the orthogonal polarization can be used by near-by adjacent satellites. Then polarization alignment is required to minimize adjacent satellite interference. If both polarizations are used by the satellite network that the antenna receives, then polarization alignment is a network internal issue.

Specification 1:

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

Specification 2:

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

Verification:

~~The~~Specification 1 shall be verified by inspection. For specification 2 the test method specified in clause 6.5.5 in ETSI ETS 300 457 [1] shall apply.

4.3.6 Image frequency rejection

Purpose:

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

Specification:

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

Verification:

The test method specified in clause 6.1.8 ~~in~~ of ETSI ETS 300 457 [1] shall apply.

NOTE 1: If the LNB is integrated with a feed horn, then the input signal may be injected by a feed horn adapter. The LNB manufacturer should supply the feed horn adaptor and characterization frequency and gain data. The data supplied should be used to correct the measurements taken.

NOTE 2: If signal injection through free space radiation in an anechoic chamber achieves higher accuracy of measurement results, this method may be used.

4.3.7 Receiver blocking

Purpose:

To prevent high power signals outside the receive frequency band from blocking the reception of signals inside the receive frequency band.

Specification:

Receiver blocking is characterized here through gain compression for a signal inside the receive frequency band that is caused by another signal outside the receive frequency band at high power. The level of the other signal is compared to the level of a signal inside the receive frequency band that would cause the same gain compression.

Receiver blocking rejection at a particular frequency is defined as the level of a second signal at this frequency that causes a certain gain compression to a first signal inside the receive frequency band, minus the level of a second signal at a frequency inside the receive frequency band that causes the same gain compression.

The first signal shall be at the centre frequency of the receive frequency band and have a level in the operational range. The second signal shall cause a gain compression for the first signal of 1 dB. Then the rejection shall comply with table 1.

Table 1: Receiver blocking rejection

Frequency	Minimum rejection
below 9 GHz	20 dB
9 GHz to 10 GHz	10 dB
14 GHz to 16 GHz	10 dB
Above 16 GHz	20 dB

Verification:

The test method specified in clause 6.2 shall apply.

5 Testing for compliance with technical requirements

5.1 Environmental conditions for testing

Tests defined in the present document shall be carried out at representative points within the boundary limits of the ~~declared~~ operational environmental profile defined by its intended use.

Where technical performance varies subject to environmental conditions, tests shall be carried out under a sufficient variety of environmental conditions (within the boundary limits of the ~~declared~~ operational environmental profile defined by its intended use) to give confidence of compliance for the affected technical requirements.

5.2 Interpretation of the measurement results

The interpretation of the results recorded in a test report for the measurements described in the present document shall be as follows:

- the measured value related to the corresponding limit will be used to decide whether an equipment meets the requirements of the present document;
- the value of the measurement uncertainty for the measurement of each parameter shall be included in the test report.

6 Test methods

6.1 Pointing accuracy capability

- a) A rotary table that allows rotating the EUT and reading ~~precisely~~ the applied rotation angle shall be used.
- b) The EUT shall be mounted on the rotary table so that the rotation axis and the aperture plane are parallel.
- c) The antenna shall be pointed towards a satellite in the same way as a user will do it.
- d) The pointing shall be improved by rotating the rotary table. The absolute of the rotation angle applied shall be noted down.
- e) Mounting, pointing and improving shall be performed as above, but with an axis perpendicular to the previous one.
- f) The greater of the two noted down angles is the pointing accuracy capability.

6.2 Receiver blocking

- a) The output signals of two signal generators shall be combined with equal weight. The combined signal shall be coupled to the LNB input ~~in a reasonable and appropriate way~~.
- b) A spectrum analyser shall be connected to the LNB output in a way that allows to supply the LNB with power.
- c) f_c is the center frequency of the receive frequency band.
- d) The first signal generator frequency shall be set to f_c .
- e) The first signal generator level shall be set to a level in the centre of the LNB operational input level range.
- f) The spectrum analyser shall be set for measuring the level of the converted first signal at the LNB output.
- g) The second signal generator frequency shall be set to $f_c - 20$ MHz.
- h) The second signal generator level shall be adjusted so that the measured level of the converted first signal is 1 dB less than in absence of the second signal.
- ~~h) a) The second signal generator level shall be adjusted so that the measured level is 1 dB less than in absence of the second signal.~~
- i) The second signal generator level shall be noted down as reference level.
- j) The second signal generator frequency shall be set to the frequency of interest where blocking rejection shall be determined.
- k) The second signal generator level shall be adjusted so that the measured level is 1 dB less than in absence of the second signal.

- k) ~~The second signal generator level shall be adjusted so that the measured level is 1 dB less than in absence of the second signal.~~
- l) ~~The rejection at the this frequency of interest (see step j)) is equal to the second signal generator level determined in step k) minus the reference level determined in step i).~~
- m) Steps j) to l) shall be repeated for frequencies in the ranges of table 1.

NOTE 1: The worst case rejection in a particular frequency range can be determined after step i) by sweeping the second signal generator frequency over the frequency range and observe the gain compression, then perform steps j) to l) with the frequency where gain compression is highest.

NOTE 2: If the LNB is integrated with a feed horn, then the coupling in step a) may be done by a feed horn adaptor. The LNB manufacturer should supply the feed horn adaptor and characterization frequency and gain data. The data supplied should be used to correct the measurements taken.

NOTE 3: Figure 1 illustrates the test set-up.

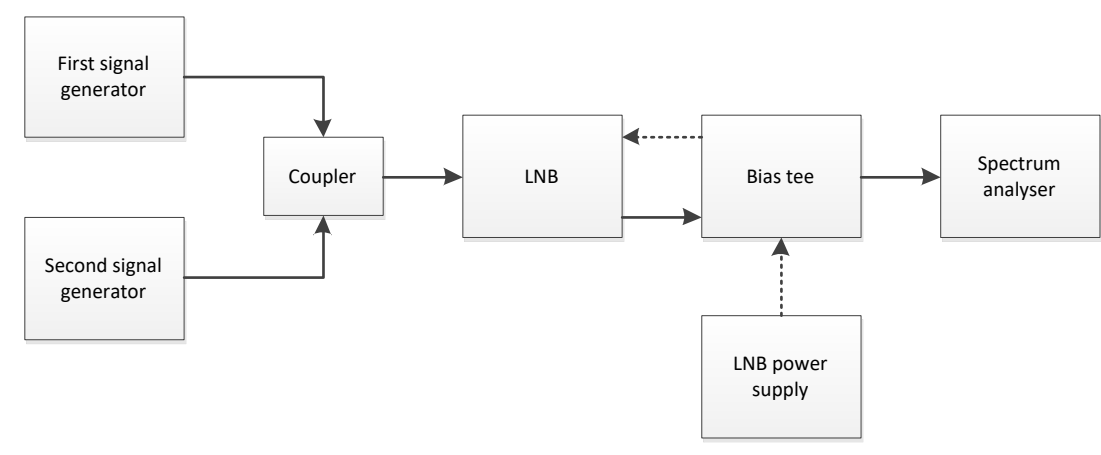


Figure 1: Test set-up for receiver blocking

6.3 LNBF cross-polar discrimination

6.3.1 Linear polarization

In case the LNBF is intended for receiving linear polarization, the following procedure applies.

- a) The following test equipment shall be used:
- 1) A signal generator that covers the LNBF input frequency range.
 - 2) A feed horn adaptor, which enables to bypass the feed horn and couple signals of horizontal and vertical polarization into the waveguide of the LNBF input.
 - 3) A DC injector (also called bias tee) that passes the LNBF output frequency range.
 - 4) A power supply unit that provides LNBF power supply and control signals for setting frequency band and polarization.
 - 5) A spectrum analyser that covers the output frequency range of the LNBF.
- b) Mount the feed horn adaptor to the LNBF.
- c) Connect the DC port of the DC injector to the power supply unit.
- d) Connect the spectrum analyser to the RF port of the DC injector.
- e) Set the signal generator level to the centre of the LNBF input level range.

f) For each output port of the LNBF:

1) Connect the *DC+RF* port of the DC injector to the output port of the LNBF.

2) For each receive frequency band of the LNBF:

i) Set the LNBF by control signals to the receive frequency band.

ii) Set the signal generator frequency set to the center frequency of the receive frequency band.

iii) Set the spectrum analyser for measuring the level of the converted signal at the LNBF output port.

iv) Set the LNBF by control signals to horizontal polarization.

v) Connect the signal generator to the *horizontal* port of the feed horn adapter.

vi) Align the polarization planes of feed horn adapter and LNBF as follows. Maximize the level measured by the spectrum analyser by rotating the feed horn adapter around the axis of the feed horn. Attach the feed horn adapter to the LNBF.

vii) Note down the level measured by the spectrum analyser.

viii) Connect the signal generator to the *vertical* port of the feed horn adapter.

ix) Note down the level measured by the spectrum analyser.

x) Set the LNBF by control signals to vertical polarization.

xi) Note down the level measured by the spectrum analyser.

xii) Connect the signal generator to the *horizontal* port of the feed horn adapter.

xiii) Note down the level measured by the spectrum analyser.

xiv) Horizontal cross-polar discrimination is equal to the level measured in step vii) minus the level measured in step ix.

xv) Vertical cross-polar discrimination is equal to the level measured in step xi) minus the level measured in step xiii).

g) If horizontal and vertical cross-polar discrimination in all receive frequency bands and on all LNBF output ports complies with the requirement, then the LNBF has passed the test.

NOTE: Figure 2 illustrates the test set-up.

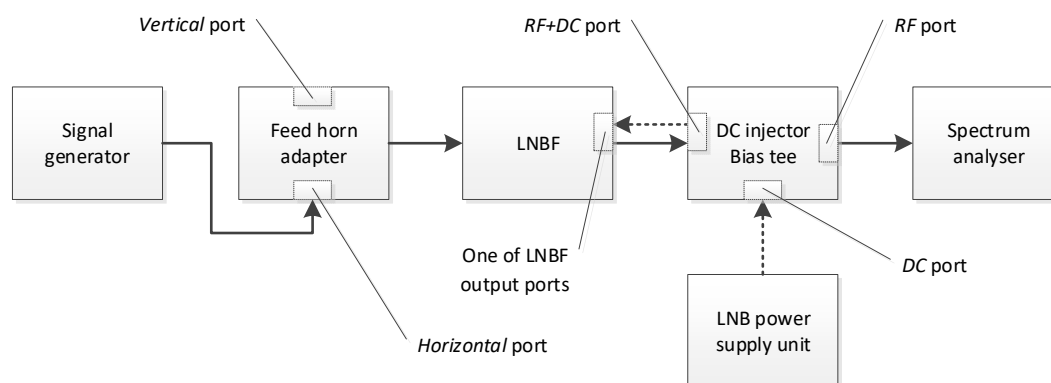


Figure 2: Test set-up for LNBF cross-polar discrimination

6.3.2 Circular polarization

In case the LNBF is intended for receiving circular polarization, the procedure for linear polarization in clause 6.3.1 with the following changes applies.

- Skip step vi).
- Replace "horizontal" by "left hand circular".
- Replace "vertical" by "right hand circular".

6.4 Linear polarization plane alignment error

- a) A rotary table that allows rotating the EUT and reading the applied rotation angle shall be used.
- b) The EUT shall be mounted on the rotary table so that the rotation axis is identical to the antenna axis of radiation.
- c) The EUT shall be switched to receive *horizontal* polarization.
- d) The antenna shall be pointed towards a satellite in the same way as a person will do it for installation.
- e) The polarization plane shall be aligned in the same way as a person will do it for installation.
- f) The polarization plane alignment shall be improved by rotating the rotary table. The absolute of the rotation angle applied shall be noted down.
- g) The EUT shall be switched to receive *vertical* polarization.
- h) The polarization plane alignment shall be improved by rotating the rotary table. The absolute of the rotation angle applied shall be noted down.
- i) The greater of the two noted down angles is the linear polarization plane alignment error.

Annex A (normative/informative): Relationship between the present document and the essential requirements of Directive 2014/53/EU

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.1] to provide one voluntary means of conforming to the essential requirements of Directive 2014/53/EU on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC [i.1].

Once the present document is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of the present document given in table A.1 confers, within the limits of the scope of the present document, a presumption of conformity with the corresponding essential requirements of that Directive; and associated EFTA regulations.

**Table A.1: Relationship between the present document and
the essential requirements of Directive 2014/53/EU**

Harmonised Standard ETSI-EN 303 372-1					
The following requirements are relevant to the presumption of conformity under the article 3.2 of Directive 2014/53/EU [i.1]					
Requirement				Requirement Conditionality	
No	Description	Essential requirements of Directive	Reference- Clause No(s) of the present document	U/C	Condition
1	Radiation from the ODU Unwanted radiation including Local Oscillator (LO) leakage radiated from the antenna	3.2	4.3.1	U	
2	Antenna gain pattern	3.2	4.3.2	U	
3	Pointing accuracy capability	3.2	4.3.3	U	
4	Antenna pointing and efficiency stability under severe environmental conditions	3.2	4.3.4	U	
5	Linear polarization plane alignment capability	3.2	4.3.5	U	
6	Image frequency rejection	3.2	4.3.6	U	
7	Receiver blocking	3.2	4.3.7	U	
8	Radiation from the LNBF Unwanted radiation including Local Oscillator (LO) leakage radiated from the antenna	3.2	C.3.3.1	C	Device under test is a replacement LNBF for unspecified ODU model
9	Cross-polar discrimination	3.2	C.3.3.2	C	Device under test is a replacement LNBF for unspecified ODU model
10	Image frequency rejection	3.2	C.3.3.3	C	Device under test is a replacement LNBF for unspecified ODU model
11	Clamp diameter	3.2	C.3.3.4	C	Device under test is a replacement LNBF for unspecified ODU model
12	Location of phase center	3.2	C.3.3.5	C	Device under test is a replacement LNBF for unspecified ODU model

Harmonised Standard ETSI_EN 303 372-1					
The following requirements are relevant to the presumption of conformity under the article 3.2 of Directive 2014/53/EU [i.1]					
Requirement				Requirement Conditionality	
No	Description	<u>Essential requirements of Directive</u>	<u>Reference- Clause No(s) of the present document</u>	U/C	Condition
13	Taper	<u>3.2</u>	C.3.3.6	C	Device under test is a replacement LNBF for unspecified ODU model
14	Receiver blocking	<u>3.2</u>	C.3.3.7	C	Device under test is a replacement LNBF for unspecified ODU model

Key to columns:**Requirement:**

No A unique identifier for one row of the table which may be used to identify a requirement.

Description A textual reference to the requirement.

Essential requirements of Directive

_____ Identification of article(s) defining the requirement in the Directive.

Clause-Number(s) of the present document

_____ Identification of clause(s) defining the requirement in the present document unless another document is referenced explicitly.

Requirement Conditionality:

U/C Indicates whether the requirement shall be unconditionally applicable (U) or is conditional upon the manufacturer's claimed functionality of the equipment (C).

Condition Explains the conditions when the requirement shall or shall not be applicable for a requirement which is classified "conditional".

Presumption of conformity stays valid only as long as a reference to the present document is maintained in the list published in the Official Journal of the European Union. Users of the present document should consult frequently the latest list published in the Official Journal of the European Union.

Other Union legislation may be applicable to the product(s) falling within the scope of the present document.

Annex B (informative): Interface between ODU and IDU

The different parts of the present multi-part deliverable concern ODUs and IDUs. The present annex gives an overview of standards for the interface between ODU and IDU. The annex is informative, since the interface has no significant impact on efficient use of spectrum.

~~CENELEC~~ EN 61319-1 [i.7] defines the IDU ODU interface that is widely used in Europe. It comprises the IF signal from ODU to IDU and the control signals from IDU to ODU.

~~CENELEC~~ EN 61319-1-/A11 [i.12i.10] is an extension that defines control signals with more capabilities. It is based on a previously proprietary system.

An ODU allows connecting a certain number of IDUs each with a separate IFL cable. A large number of IDUs can be connected by means of multiswitches. The control signals between IDU and multiswitch are the same as used between IDU and ODU.

~~CENELEC~~ EN 50607 [i.8] defines the system known as SatCR, which allows connecting IDUs to an ODU through a single coaxial cable and splitters without the need for a multiswitch. The ODU contains frequency converters for single channels that put on a certain frequency the channel that a particular IDU requests.

~~CENELEC~~ EN 50585 [i.5] defines the system known as Sat>IP, which allows viewing satellite broadcast on tablets, smartphones and other Internet protocol enabled devices. A server demodulates and forwards via video over internet protocol the channels that a particular device requests.

Annex C (normative): Generic LNBF specification

C.1 Introduction

The most popular kind of ODU antenna is a parabolic reflector antenna with offset feed. In that case the feed horn is often integrated with the LNB into one unit called ~~low noise block~~ Low Noise Block converter with ~~feed~~ Feed (LNBF). The combination of reflector and LNBF determines the antenna gain pattern.

LNBFs are on the market as replacement part for existing ODUs. Replacing the LNBF provides additional functionality, for example more outputs or further frequency bands. If replacement LNBFs are foreseen for particular reflector models, then the vendor can take care that the feed horn fits with the reflector. However, LNBFs that are not specific for a reflector model are on the market as well. In that case a specification of the feed characteristics is required in order to allow fit of replacement LNBFs with reflectors that are foreseen for replacement LNBFs. Specifically, the characteristics are illumination taper and the location of the phase centre. Besides the feed characteristics, also characteristics of unwanted emissions and mounting means need to be specified for the replacement LNBF.

The present annex specifies replacement LNBFs in order to enable the market of replacement LNBFs. In the past, no such specification existed, which means that non-fit is possible. Combinations of reflectors and replacement LNBFs may not be conform with regard to the Radio Equipment Directive- [1.1]. In order to maintain the market of replacement LNBFs, a generic LNBF specification is given in the present annex.

C.2 Scope

The present annex applies to LNBFs that are a replacement part for ODUs of unspecified model.

LNBFs that are a replacement part for specific ODU models are out of scope.

C.3 Technical requirements specifications

C.3.1 Environmental profile

Clause 4.1 shall apply.

C.3.2 Equipment capabilities

Clause 4.2 shall apply with regard to the following characteristics:

- Receive frequency band
- Polarization states
- Local oscillator frequency

C.3.3 Conformance requirements

C.3.3.1 Radiation from the LNBF

Specification 1: Unwanted radiation including Local Oscillator (LO) leakage radiated from the LNBF antenna

The power of the unwanted radiation, including the LO frequency as well as its second harmonic, measured at the transition between wave guide and feed (including the polarizer, ortho mode transducer, band-pass filter, RF waveguides), shall not exceed the following limits:

- -60 dBm in a 120 kHz bandwidth at the fundamental frequency of the LO;
- -50 dBm in a 120 kHz bandwidth at the second harmonic of the LO;
- -60 dBm in any other 120 kHz bandwidth.

This ~~specification~~ requirement applies to the frequency range from 2,5 GHz to 25 GHz.

NOTE 1: The transition between waveguide and feed can be accessed by means of a waveguide adapter. This adapter fits into the waveguide and bypasses the feed.

NOTE 2: These limits are derived from those in ETSI ETS 300 784 [i.2]. Here the transition between waveguide and feed is used instead of the antenna flange, because an antenna flange may not be present.

Verification:

The test method specified in clause 6.2 ~~in~~ of ETSI ETS 300 457 [1] shall apply.

NOTE 3: Version 1.1.1 of the present document [i.11] contained a requirement "Specification 2: Radiation from the LNBF

". The LNBF shall be compliant with the requirement in clause 4.3.1. The waveguide or feed shall be terminated during requirement has been deleted because this kind of requirement is in the measurementscope of harmonised standards covering essential requirements on electromagnetic compatibility.

C.3.3.2 Cross-polar discrimination

The cross-polar discrimination of the LNBF including the effect of cross-talk between frequency converted signals shall be ~~less~~ greater or equal 20 dB.

The test method specified in clause 6.3 shall apply.

C.3.3.3 Image frequency rejection

The LNBF shall be compliant with the requirement in clause 4.3.6.

C.3.3.4 Clamp diameter

The LNBF shall be designed for being mounted in a clamp with nominal diameter 23 mm or 40 mm.

C.3.3.5 Location of phase centre

The LNBF shall carry a mark on the cylindrical feed section that supports mounting with the feed phase centre located in the reflector focus. The phase centre is located in 25 mm distance from the mark towards the reflector.

NOTE 1: The end of the cylindrical feed section, where the feed starts, can be used as mark.

NOTE 2: ODU manufacturers can use the mark for describing how to mount correctly a replacement LNBF. The manufacturer gives in mounting instructions the distance between the mark and the surface of the feed clamp that faces the reflector. (This distance is equal to the distance between focal point and feed clamp surface minus 25 mm.)

C.3.3.6 Taper

The feed shall ~~illuminate~~ be designed for illuminating the reflector with anominal taper of 10 dB at an angle (single sided) of ~~45,238~~°.

NOTE: ~~45,2 1:38°~~ corresponds to $\frac{F}{D} = 0,6$ an offset reflector antenna with focal length 36 cm, reflector width 60 cm and clearance 5 cm.

NOTE 2: The actual taper is typically in the range 8 to 18 dB and increasing with frequency.

C.3.3.7 Receiver blocking

The LNBF shall be compliant with the requirement in clause 4.3.7. Rejection shall be determined by signal levels at the LNB input.

NOTE: The LNB input can be accessed by means of a waveguide adapter. This adapter fits into the waveguide and bypasses the feed.

Annex D (~~informative~~normative): Applicability in conjunction with ~~ETSI EN 50585:2014~~

~~ETSI EN 50585:2014~~ [i.5] defines the SAT>IP communication protocol. It enables a SAT>IP server to forward satellite delivered signals to SAT>IP clients over IP networks. The typical use case would be the transport of television programs that were received from the satellite by the SAT>IP server to the SAT>IP client via the IP network. SAT>IP specifies a control protocol as well as the media transport.

A SAT>IP server may be integrated with the LNB or LNBF of the ODU into a "SAT>IP LNB". This means that part of the IDU functionality is integrated with the ODU. As defined in clause 1, the present document applies only to the conventional ODU functionality of amplifying the receive signal at low noise, converting it to a lower frequency band and making it available for the IDU functionality.

Some SAT>IP LNB models provide conventional LNB outputs in addition to the network interface, which enable the use with conventional IDUs. In that case all requirements of the present document ~~can~~shall be tested by means of a conventional output.

If a SAT>IP LNB does not provide a conventional LNB output, then a modified version that provides such an output is required.

Annex E (informative): Applicability of parameters given in ETSI EG 203 336

ETSI EG 203 336 [i.4] gives guidance on the selection of technical parameters for the production of Harmonised Standards covering articles 3.1(b) and 3.2 of the Radio Equipment Directive [i.1]. Clause 5.3 of ETSI EG 203 336 [i.4] gives receiver parameters under article 3.2 that should be contained in a Harmonised Standard.

Table E.1 explains how these parameters are considered in the present document.

Table E.1: Parameters given in ETSI EG 203 336 [i.4]

ETSI EG 203 336 [i.4]		Present document		Explanation
Clause	Parameter	Clause	Parameter	
5.3.2	Receiver sensitivity	-	-	This parameter is not applicable, because it is a network specific design choice.
5.3.3	Receiver co-channel rejection	4.3.2	Antenna gain pattern	Co-channel signals on other orbital positions are rejected by low antenna off-axis gain.
5.3.4.2.1	Single signal selectivity – receiver Receiver Selectivity - Receiver adjacent signal channel selectivity	-	-	This parameter is not applicable, because the ODU does not select a single signal. Requirements are contained in IDU parts of the present multi-part deliverable.
5.3.4.2.2 4	Receiver spurious response rejection	4.3.6	Image frequency rejection	Other spurious frequencies are not relevant because of the large difference between radio frequency and intermediate frequency.
5.3.4.3.1	Receiver blocking	4.3.7	Receiver blocking	
5.3.4.3.2 5	Receiver radio-frequency intermodulation	-	-	This parameter is not applicable, because it is a network specific requirement.
5.3.4.3.3	Receiver multiple signal selectivity – receiver adjacent signal selectivity	-	-	This parameter is not applicable, because the ODU does not select a single signal. Requirements are contained in IDU parts of the present multi-part deliverable.
5.3.4.4.1	Receiver dynamic range	-	-	This parameter is not applicable to the ODU. Requirements are contained in IDU parts of the present multi-part deliverable.
5.3.4.4.2 2	Reciprocal mixing	-	-	The effect is negligible, because noise sidebands of the local oscillator have a negligible power spectral density outside the signal bandwidth.
5.3.4.4.3 3	Desensitization	-	-	This parameter is not applicable, because receiver sensitivity is not applicable.
5.3.5	Receiver unwanted emissions in the spurious domain	4.3.1	Radiation from the ODU Unwanted radiation including Local Oscillator (LO) leakage radiated from the antenna	

Annex F (informative): Other ODU features and performance characteristics

The present document contains requirements on equipment characteristics that are relevant regarding harmful interference. Further characteristics of ODU equipment are relevant regarding the intended use. Network operators or satellite operators typically specify features and minimum performance requirements that enable satisfactory use in particular networks. Characteristics of this kind are listed in the following for information:

- Items of equipment capabilities in clause 4.2
- Items of conformance requirements in clause 4.3
- Number of outputs
- Phase noise of LNB
- Conversion gain of LNB
- G/T (includes LNB noise and received noise)
- Gain ripple
- Noise figure of LNB
- 1 dB compression point of LNB (output level)
- 3rd order intermodulation intercept point of LNB (output level)
- Output impedance
- Output return loss
- LNB supply voltage including control signals
- Current consumption
- Output gain difference between outputs

Annex G (normative): Partial testing of new LNBF models

G.1 Introduction

The most popular kind of ODU antenna is a parabolic reflector antenna with offset feed. In that case the feed horn is often integrated with the LNB into one unit called Low Noise Block converter with Feed (LNBF). The remaining parts of an ODU, including reflector, pole mount and feed boom, are often called dish. The combination of reflector and LNBF determines the antenna gain pattern. Therefore, LNBF models and dish models shall be combined and used together only if foreseen by the manufacturer.

A manufacturer may develop a new LNBF model based on an existing model with the feed and mounting means unchanged. This new LNBF model combined with a particular dish model will have the same antenna characteristics as the combination of existing LNBF model and that dish model. If the combination of existing LNBF model and dish is compliant with conformance requirements, then the combination of new LNBF model and dish will be compliant with the requirements that concern the antenna characteristics. It is not necessary to test against these requirements.

G.2 Scope

The present annex applies to LNBFs that have the same feed and mounting means as an existing LNBF model and that are foreseen for combination with an existing dish model.

G.3 Excluded conformance requirements

The combination of LNBF and dish shall be tested according to clause 4 with the following conformance requirements excluded:

- 4.3.2 Antenna gain pattern
- 4.3.3 Pointing accuracy capability
- 4.3.4 Antenna pointing and efficiency stability under severe environmental conditions
- 4.3.5 Linear polarization plane alignment capability

Annex H (informative): Change history

<u>Version</u>	<u>Information about changes</u>
<u>1.1.1</u>	<u>First publication of the standard</u>
<u>1.2.1</u>	<u>Correction of editorial errors, more detailed test procedures, provisions for special purpose outdoor equipment</u>

History

Document history		
V1.1.0	January 2016	EN Approval Procedure AP 20160413: 2016-01-14 to 2016-04-13
V1.1.1	June 2016	Vote V 20160821: 2016-06-22 to 2016-08-22
V1.1.1	August 2016	Publication
<u>V1.2.0</u>	<u>March 2021</u>	<u>EN Approval Procedure AP 20210620: 2021-03-22 to 2021-06-21</u>
<u>V1.2.1</u>	<u>June 2021</u>	<u>Publication</u>