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ETSI Standard

Electromagnetic compatibility and Radio spectrum Matters (ERM); Active antennas used for broadcast TV and sound reception from 47 MHz to 860 MHz

Reference

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ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
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Contents

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Foreword

This ETSI Standard (ES) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM), and is now submitted for the ETSI standards Membership Approval Procedure.

Introduction

The present document is an ETSI standard for amplifiers and preamplifiers used for broadcast TV and sound reception from 47 MHz to 862 MHz.

The TR 101 837 [2] v1.1.1 demonstrate the need to review limits in EN 55020 and to modify some parameters in EN 50083-2 [1].

The purpose of the present document is to specify technical parameters for the amplifier limiting the interfering effects caused by unwanted signals on the amplified terrestrial broadcasting signals.

1 Scope

The present document covers active antennas used for broadcast TV and sound reception from 47 MHz to 860 MHz.

In many cases TV and sound broadcast receivers are fed from wide band RF active antennas which often have a broad band response covering the 20 to 1 000 MHz range with gains in excess of 20 dB. This frequency range encompasses many other radio communication services, such as GSM phones, short-range devices, Citizen Band radio, emergency services, etc. When one or more of these transmitters is in the proximity of such an amplifier the transmission can cause severe interference to the TV and sound broadcast reception.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

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

[1] EN 50083-2 (2001): "Cable networks for television signals, sound signals and interactive services Part 2: Electromagnetic compatibility for equipment".

[2] ETSI TR 101 837 (2000): "ElectroMagnetic Compatibility and Radio Spectrum Matters (ERM); Study on 27 MHz CB radio compatibility with analogue television broadcast receiver installations".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

active antenna: indoor or outdoor antenna with integrated amplifier used to amplify a TV or sound broadcast electromagnetic field intended to one TV or sound receiver for domestic use

UHF (Ultra High Frequency): 300 MHz to 3 000 MHz nominal frequency band

NOTE: In the present document UHF is referred to only in the TV broadcast band (B IV and BV).

VHF(Very High Frequency): 30 MHz to 300 MHz nominal frequency band

NOTE: In the present document VHF is referred to only in the TV and radio broadcast bands, BI, BII and BIII.

3.2 Symbols

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

NF Noise Figure
F noise Factor

3.3 Abbreviations

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

AC	Alternating Current
CW	Carrier Wave
DC	Direct Current
IMD	InterModulation Distortion
RF	Radio Frequency
SWR	Standing Wave Ratio
UHF	Ultra High Frequency
VHF	Very High Frequency
VSWR	Voltage Standing Wave Ratio
Winc	Incident Power
Wref	Reference Power

4 General conditions of measurement

This clause gives the general operational conditions. The product-specific operating conditions will be derived from the product description and documentation and stated in the test report.

The tests described shall be performed with the Active Antenna Under Test (AAUT) powered up, (i.e. connected to an appropriate power supply), and operate as intended for normal operation.

4.1 Arrangements for test signals applied to the active antenna input

Test signal sources shall be connected to the active antenna input terminals (first leave the dipole, wire etc.) in such a way that the impedance should be adapted.

The levels of the test signals shall be expressed in terms of the emf at the terminals to be connected to the antenna input.

The nominal frequency of the amplifier is the lower and upper frequency channel defined by the manufacturer.

The loses for matching shall be recorded in the test report.

4.1.1 Equipment configuration

Power and signal distribution, grounding, interconnecting cabling and physical placement of equipment of a test system shall simulate the typical application and usage in so far as is practicable, and shall be in accordance with the relevant product specifications.

Only configurations within the range of setting likely to occur in normal use need be considered.

The configuration selected shall be fully detailed and documented in the test report, together with the justification for selecting that particular configuration.

4.1.2 Test conditions

The equipment shall be tested under normal test conditions according to the relevant product and basic standards or to the information accompanying the equipment, which shall be within the manufacturers declared range of humidity, temperature and supply voltage. The test conditions shall be recorded in the test report.

The test configuration and mode of operation shall be representative of the intended use and shall be recorded in the test report.

All impedances should be adapted.

4.1.2.1 Normal test conditions

4.1.2.1.1 Normal temperature and humidity

The normal temperature and humidity conditions for tests shall be a combination of temperature and humidity within the following ranges:

- temperature: +15°C to +35°C;
- relative humidity: 20 % to 75 %.

4.1.2.1.2 Extreme temperatures

For tests at extreme temperatures, measurements shall be made at a lower temperature of -10°C and an upper temperature of +55°C.

For some countries in the north of Europe, all the equipment that will be installed in these locations that are not temperature controlled shall meet the requirements within the temperature range -40ºC to +55ºC. If the equipment is installed in locations that are temperature controlled it shall meet the requirements within the temperature range -10ºC to +55ºC.

5 General assessment

The manufacturer shall at the time of submission of the equipment for test, supply the following information to be recorded in the test report:

- the intended functions of the equipment which shall be in accordance with the documentation accompanying the equipment;
- the ancillary equipment (power supply for example) to be supplied with the equipment for testing (where applicable);
- an exhaustive list of ports, classified as either power or signal. Power ports shall further be classified as AC or DC power;
- the operating frequency ranges over which the equipment is intended to operate (band I, II, III, IV, V);
- the environment(s) in which the equipment is intended to be used.

6 Technical characteristics

6.1 Gain

6.1.1 Definition

Ratio of output current, voltage or power to input current, voltage or power respectively. This ratio is expressed in dB.

6.1.2 Method of measurement

The gain is measured by applying a test signal at an appropriate power level given by the manufacturer at the input port of the Active Antenna Under Test (AAUT) and measuring the power delivered at the output port. The gain shall be measured in the middle and at the extremes of the nominal band of the amplifier, as declared by the manufacturer.

If the gain can be modified, the test shall be carried out at the maximum gain of the amplifier.

The gain in dB is calculated by taking 10 times the logarithm of the ratio of the output to the input power. All the impedances should be adapted.

$$dB = 10 \times \log \frac{output\ \ power}{input\ \ power}$$

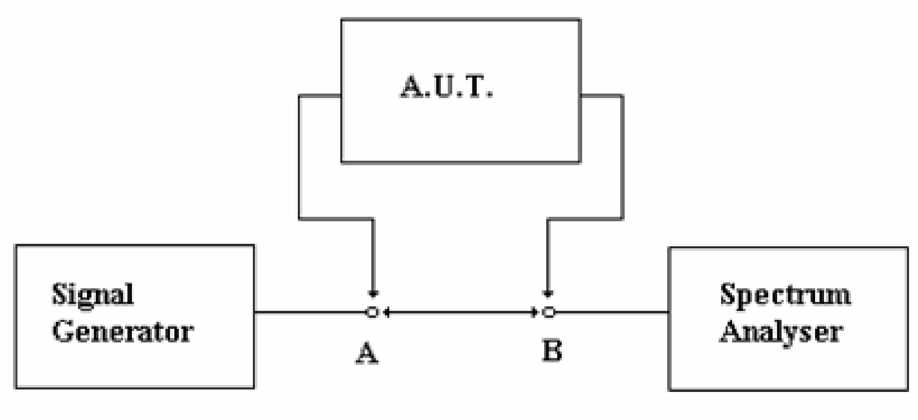


Figure 1: Measurement arrangement

6.1.3 Limits

The gain shall not be more than 20 dB.

The maximal output level should be inferior to 80 dBµV.

6.2 Noise figure

6.2.1 Definition

This is the contribution by the active device itself to thermal noise at its output. The noise figure is usually expressed in decibels (dB) and is with respect to thermal noise power of the system impedance, at a standard noise temperature (usually 20ºC , 293 K) over the bandwidth of interest.

The noise factor is determined by the measuring ratio, of the thermal noise power at the output, to that at the input:

$$F = \frac{C1/N1}{C2/N2}$$

Where C1 = power of input signal;

C2 = power of output signal;

N1 = power of noise at input (thermal noise);

N2 = power of noise at output.

To simplify, the noise factor is the ratio between the power of noise at the output of the active device and the power of noise at the same point if the device was ideal

F = N2 tested / N2 ideal

The noise figure is the noise factor converted to decibel notation:

$$NF = 10 \log F\ (dB)$$

6.2.2 Method of measurement

Usually, the noise figure is measured with a calibrated noise generator, operating in the frequency band used, it can also be done with an automatic noise factor reader instrument, and the use an additional noise generator.

The following describes the method of measurement called "two times the power" using a calibrated noise generator.

Measurement set-up:

- a noise generator (source of supplementary noise) covering the range of used frequencies, calibrated in dB or in KTo;
- a 3 dB attenuator;
- a selective voltmeter.

The AAUT. is connected according figure 2. The cable connection between the noise generator and the AAUT. should be as short as possible. Also the impedances of all the equipment should be adapted.

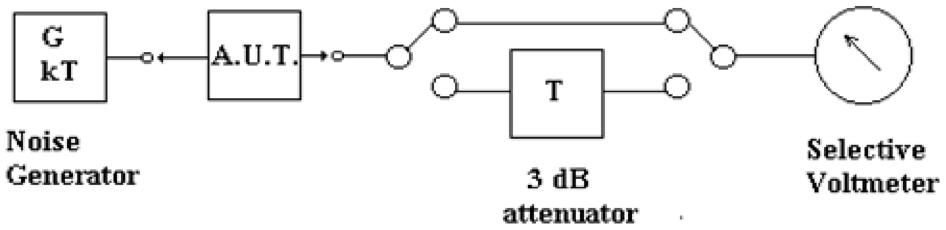


Figure 2: Measurement arrangement

Measurement procedure:

1) Set the voltmeter to the reference level for the range of frequencies used , without the 3dB attenuator and with the noise generator turned off. The bandwidth of voltmeter will be adjusted to obtain a stable reading.
2) Insert the 3 dB attenuator and increase the output of noise generator to obtain the same reading as initially obtained on the selective voltmeter.
3) Record the value of noise factor on the noise generator.

Repeat the steps 1) to 3) for different frequencies in the nominal band. The least favourable reading shall be noted.

6.2.3 Limits

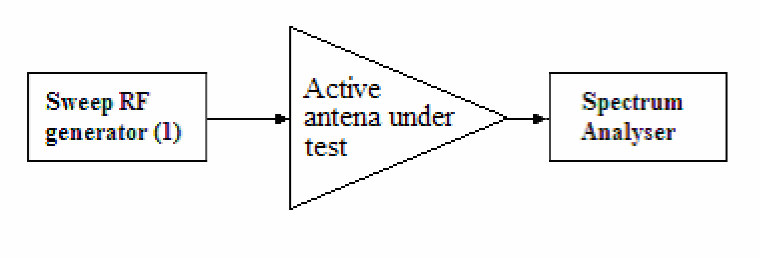
No limits apply, the noise figure shall be specified by the manufacturer.

6.3 Amplitude-frequency response

6.3.1 Definition

The usual peak or peak-to-peak value of a ripple component. In the present document the ripple amplitude is used to determine the variation of the amplitude response in a specified band.

6.3.2 Method of measurement



NOTE: The swept frequency range of the RF generator shall be greater than the nominal band of the active antenna as declared by the manufacturer.

Figure 3: Measurement arrangement

The active antenna has to be fed by the power supply sold by the manufacturer. If this is not possible, an equivalent one shall be provided.

A single CW non-modulated RF signal is applied to the input of the active antenna via a matching network. The RF generator output level shall be adjusted to produce the maximum output level of the active antenna, as declared by the manufacturer (see clause 6.4).

The amplitude frequency response is measured directly by using a spectrum analyser within the nominal band.

The measurements shall be made under normal and extreme test conditions.

6.3.3 Limits

Within an 8 MHz TV channel bandwidth, the ripple shall be less than ±2 dB.

6.4 Intermodulation

6.4.1 Definition

Intermodulation distortion is a non-linear distortion characterized by the appearance of frequencies corresponding to the sum and difference frequencies of the fundamentals and harmonics that are transmitted through the device.

The Intermodulation distortion is the ratio, in dB, taken at the output of the device, of the power of the largest Intermodulation component to the fundamental frequency.

NOTE: Harmonic components themselves are not usually considered to characterize Intermodulation distortion. When the harmonics are included as part of the distortion, a statement to that effect should be made.

6.4.2 Method of measurement

Various methods to measure amplifier intermodulation performance exist.

The two-tone method is detailed in the present document as it has been used successfully for many years, and has the advantage of simplicity.

Two equal amplitude, sinusoidal, non-harmonically related tones 1 MHz frequency separated shall be injected by means of a combiner to the AAUT. input.

The 3^{rd} and 5^{th} order products are measured, with a spectrum analyser.

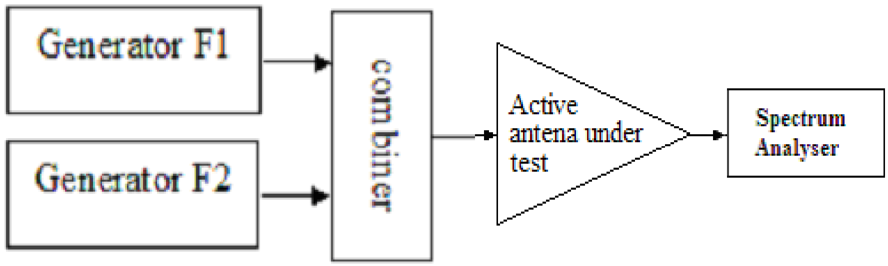
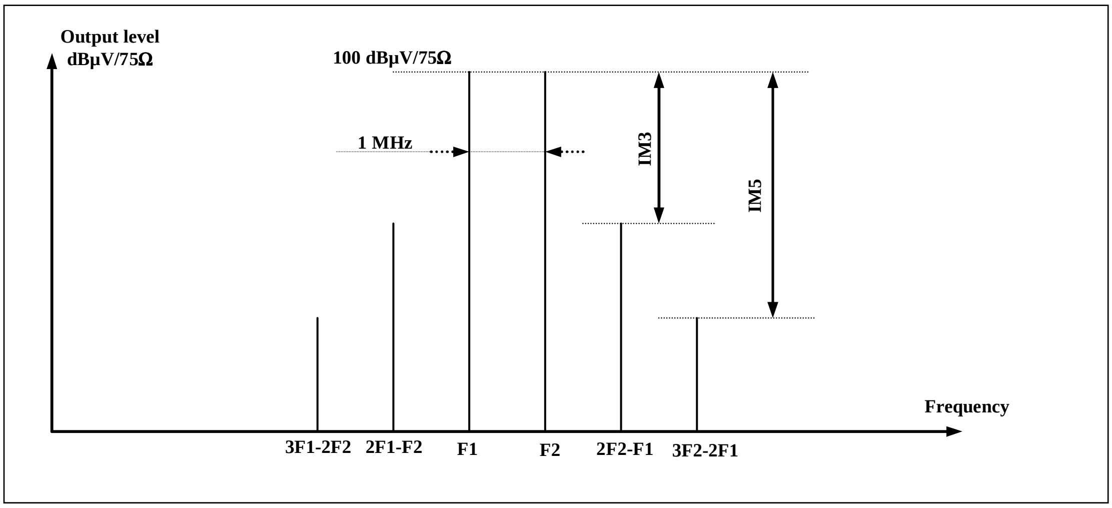


Figure 4: Measurement arrangement



Theoretical IMD illustration

Residual intermodulation distortion caused by the measurement equipment shall be minimized. Without some form of isolation, the two sources can intermodulate with each other, either by the non-linear characteristics of the source output circuitry or by leakage into the phase lock circuits. The residual intermodulation distortion shall be greater than -70 dBc.

The test shall be carried out near the low, mid and high end of the nominal frequency band as declared by the manufacturer and at minimum and maximum gain

The maximum output level referred to in the following limit shall be as declared by the manufacturer.

6.4.3 Limits

The limits of the intermodulation distortion at the maximum output level, as declared by the manufacturer, shall be:

- 54 dBc for the IM3 and IM5;
- the maximum output level shall be less than 80 dBµV;
- the given limits combined with good engineering practice, ensure that analogue or digital terrestrial TV and sound signals are transmitted without noticeable degradation;
- when several carriers are fed to the input of the active antenna, the maximum output level per carrier shall be decreased by 20log10 (number of carriers).

6.5 Return loss

6.5.1 Definition

Parameter describing the attenuation of a guided transmitted signal returned to a source by a device or medium resulting from reflections of the signal generated by the source.

The return loss is a measure of mismatch between two impedances, being equal to the number of decibels that corresponds to the scalar value of the reciprocal of the reflection coefficient, and hence being expressed by the formula:

$$20\log\left|\frac{Z1+Z2}{Z1-Z2}\right| = \text{dB}$$

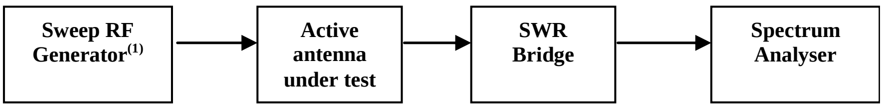
Where Z1 and Z2 are the two impedances.

Considering that the output of active antenna is fitted to transmissions lines, the output impedance of the active antenna, shall be adapted to prevent any reflection.

6.5.2 Method of measurement

To determinate the VSWR value, a network analyser and a SWR bride can be used.

The general test method is show in figure 5:



NOTE: The sweep frequency range of the RF generator shall be greater than the frequency bandwidth of the active antenna as declared by the manufacturer.

Figure 5: Measurement arrangement

The return loss is determined by the following expression :

$$L_{ret}\,(\text{dB}) = -10\log\left|\frac{W_{ref}}{W_{inc}}\right|$$

Wref: reflected power

Winc: incident power

6.5.3 Limits

The value of return losses at output shall be equal to or greater than 6 dB at output ports of the device, within the nominal bandwidth of active antenna.

6.6 Internal immunity

6.6.1 Definition

Internal immunity is defined in clause 4.3 of EN 50083-2 [1].

6.6.2 Method of measurement

The internal immunity test shall be applied using the EN 50083-2 [1] standard method.

6.6.3 Limits

The limits in EN 50083-2 shall be applied, with exception of those for Band I and Band IV/V (see figures 6 and 7).

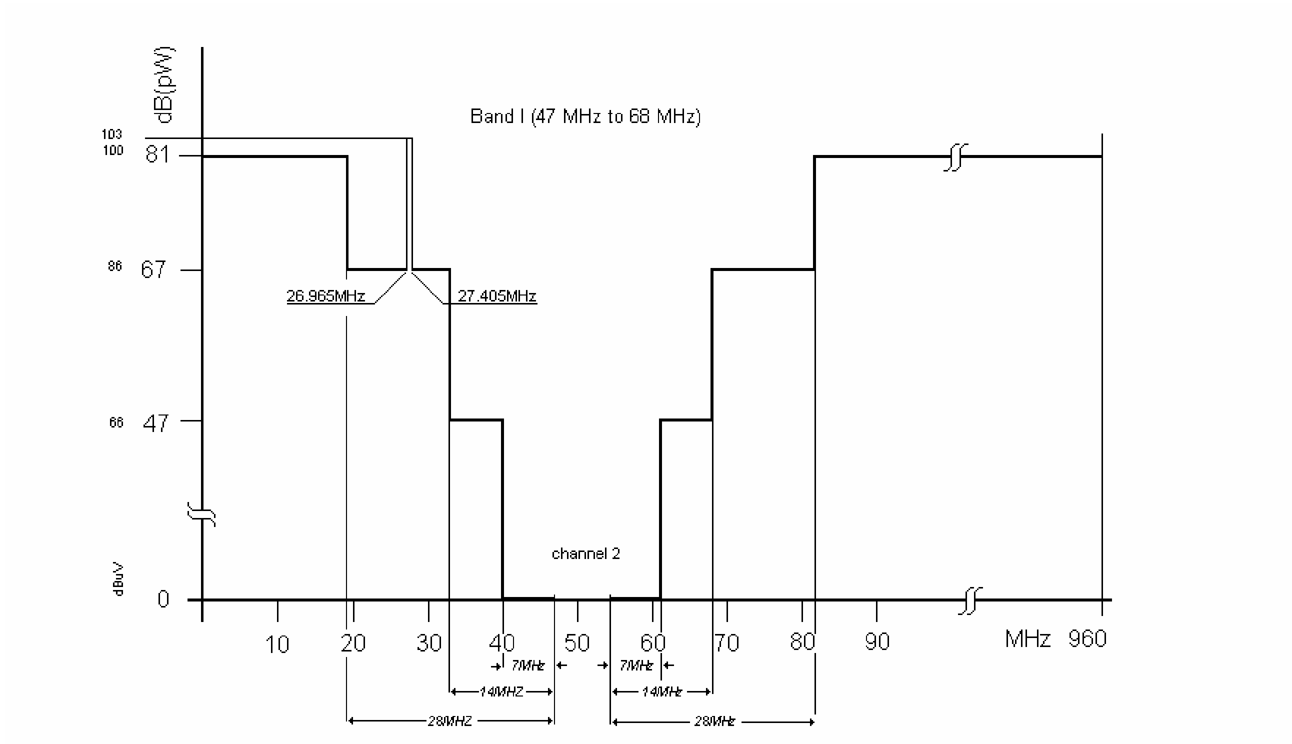


Figure 6

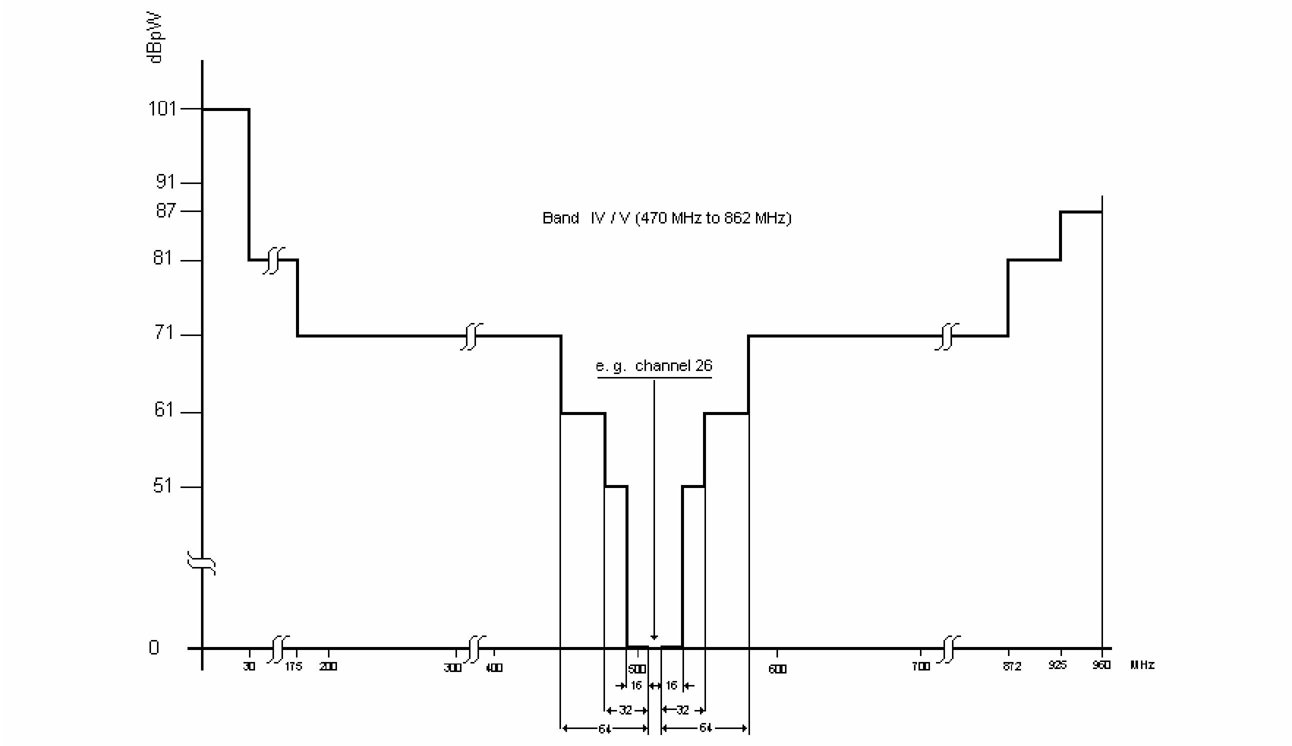


Figure 7

Annex A (informative): Bibliography

EN 60721 (series): "Classification of environmental conditions".

ETSI EN 300 019 (series): "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment".

IEC Publication No. 721 (series): "Classification of environmental conditions".

ETSI EN 300 019: "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment".

EN 55020: "Electromagnetic immunity of broadcast receivers and associated equipment".

History

Document history			
V1.1.1	November 2004	Membership Approval Procedure	MV 20050107: 2004-11-07 to 2005-01-07