



BSI Standards Publication

# Cable networks for television signals, sound signals and interactive services

Part 3: Active wideband equipment for cable networks

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### National foreword

This British Standard is the UK implementation of EN 60728-3:2011. It is identical to IEC 60728-3:2010. It supersedes BS EN 60728-3:2006 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee EPL/100, Audio, video and multimedia systems and equipment, to Subcommittee EPL/100/4, Cable distribution equipment and systems.

A list of organizations represented on this committee can be obtained on request to its secretary.

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February 2011

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Supersedes EN 60728-3:2006

English version

## **Cable networks for television signals, sound signals and interactive services -**

### **Part 3: Active wideband equipment for cable networks (IEC 60728-3:2010)**

Réseaux de distribution par câbles pour  
signaux de télévision, signaux de  
radiodiffusion sonore et services  
interactifs -  
Partie 3: Matériel actif à large bande pour  
réseaux de distribution par câbles  
(CEI 60728-3:2010)

Kabelnetze für Fernsehsignale,  
Tonsignale und interaktive Dienste -  
Teil 3: Aktive Breitbandgeräte für koaxiale  
Kabelnetze  
(IEC 60728-3:2010)

This European Standard was approved by CENELEC on 2011-01-13. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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# CENELEC

European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

**Management Centre: Avenue Marnix 17, B - 1000 Brussels**

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## Foreword

The text of document 100/1746/FDIS, future edition 4 of IEC 60728-3, prepared by Technical Area 5, Cable networks for television signals, sound signals and interactive services, of IEC TC 100, Audio, video and multimedia systems and equipment, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60728-3 on 2011-01-13.

This European Standard supersedes EN 60728-3:2006.

EN 60728-3:2011 includes the following significant technical changes with respect to EN 60728-3:2006:

- extension of upper frequency range limit for cable network equipment from 862 MHz to 1 000 MHz;
- method of measurement and requirements for immunity to surge voltages;
- extension of scope to equipment using symmetrical ports;
- additional normative references;
- additional terms and definitions and abbreviations.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

The following dates were fixed:

- latest date by which the EN has to be implemented  
at national level by publication of an identical  
national standard or by endorsement (dop) 2011-10-13
- latest date by which the national standards conflicting  
with the EN have to be withdrawn (dow) 2014-01-13

Annex ZA has been added by CENELEC.

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## Endorsement notice

The text of the International Standard IEC 60728-3:2010 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

|                  |                                                    |
|------------------|----------------------------------------------------|
| IEC 60728-6:2003 | NOTE Harmonized as EN 60728-6:2003 (not modified). |
| IEC 60728-10     | NOTE Harmonized as EN 60728-10.                    |
| IEC 61169-2      | NOTE Harmonized as EN 61169-2.                     |
| IEC 61169-24     | NOTE Harmonized as EN 61169-24.                    |

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## Annex ZA (normative)

### Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

| <u>Publication</u> | <u>Year</u> | <u>Title</u>                                                                                                                                 | <u>EN/HD</u>  | <u>Year</u> |
|--------------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------|
| IEC 60065          | -           | Audio, video and similar electronic apparatus -<br>Safety requirements                                                                       | EN 60065      | -           |
| IEC 60068-1        | 1988        | Environmental testing -<br>Part 1: General and guidance                                                                                      | EN 60068-1    | 1994        |
| IEC 60068-2-1      | -           | Environmental testing -<br>Part 2-1: Tests - Test A: Cold                                                                                    | EN 60068-2-1  | -           |
| IEC 60068-2-2      | -           | Environmental testing -<br>Part 2-2: Tests - Test B: Dry heat                                                                                | EN 60068-2-2  | -           |
| IEC 60068-2-6      | -           | Environmental testing -<br>Part 2-6: Tests - Test Fc: Vibration<br>(sinusoidal)                                                              | EN 60068-2-6  | -           |
| IEC 60068-2-14     | -           | Environmental testing -<br>Part 2-14: Tests - Test N: Change of<br>temperature                                                               | EN 60068-2-14 | -           |
| IEC 60068-2-27     | -           | Environmental testing -<br>Part 2-27: Tests - Test Ea and guidance:<br>Shock                                                                 | EN 60068-2-27 | -           |
| IEC 60068-2-29     | -           | Environmental testing -<br>Part 2: Tests - Test Eb and guidance: Bump                                                                        | EN 60068-2-29 | -           |
| IEC 60068-2-30     | -           | Environmental testing -<br>Part 2-30: Tests - Test Db: Damp heat, cyclic<br>(12 h + 12 h cycle)                                              | EN 60068-2-30 | -           |
| IEC 60068-2-31     | -           | Environmental testing -<br>Part 2-31: Tests - Test Ec: Rough handling<br>shocks, primarily for equipment-type<br>specimens                   | EN 60068-2-31 | -           |
| IEC 60068-2-32     | -           | Environmental testing.<br>Part 2-32: Tests. Test Ed: Free fall                                                                               | EN 60068-2-32 | -           |
| IEC 60068-2-40     | -           | Basic environmental testing procedures -<br>Part 2-40: Tests - Test Z/AM: Combined<br>cold/low air pressure tests                            | EN 60068-2-40 | -           |
| IEC 60068-2-48     | -           | Environmental testing -<br>Part 2-48: Tests - Guidance on the application<br>of the tests of IEC 60068 to simulate the<br>effects of storage | EN 60068-2-48 | -           |
| IEC 60529          | -           | Degrees of protection provided by enclosures -<br>(IP Code)                                                                                  |               | -           |

| <u>Publication</u>         | <u>Year</u> | <u>Title</u>                                                                                                                                  | <u>EN/HD</u> | <u>Year</u> |
|----------------------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|
| IEC 60728-1                | -           | Cable networks for television signals, sound signals and interactive services - Part 1: System performance of forward paths                   | EN 60728-1   | -           |
| IEC 60728-2                | -           | Cabled distribution systems for television and sound signals - Part 2: Electromagnetic compatibility for equipment                            | EN 50083-2   | -           |
| IEC 60728-4                | -           | Cable networks for television signals, sound signals and interactive services - Part 4: Passive wideband equipment for coaxial cable networks | EN 60728-4   | -           |
| IEC 60728-5                | -           | Cable networks for television signals, sound signals and interactive services - Part 5: Headend equipment                                     | EN 60728-5   | -           |
| IEC 60728-11               | -           | Cable networks for television signals, sound signals and interactive services - Part 11: Safety                                               | EN 60728-11  | -           |
| IEC 60950-1                | -           | Information technology equipment - Safety - Part 1: General requirements                                                                      | EN 60950-1   | -           |
| IEC 61000-4-5              | -           | Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test                                      | EN 61000-4-5 | -           |
| IEC 61319-1                | -           | Interconnections of satellite receiving equipment - Part 1: Europe                                                                            | EN 61319-1   | -           |
| IEC 61319-2                | -           | Interconnections of satellite receiving equipment - Part 2: Japan                                                                             | -            | -           |
| ITU-T Recommendation G.117 | -           | Transmission aspects of unbalance about earth                                                                                                 | -            | -           |
| ITU-T Recommendation O.9   | -           | Measuring arrangements to assess the degree of unbalance about earth                                                                          | -            | -           |

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## INTRODUCTION

Standards of the IEC 60728 series deal with cable networks including equipment and associated methods of measurement for headend reception, processing and distribution of television signals, sound signals and their associated data signals and for processing, interfacing and transmitting all kinds of signals for interactive services using all applicable transmission media.

This includes

- CATV<sup>1</sup>-networks;
- MATV-networks and SMATV-networks;
- individual receiving networks;

and all kinds of equipment, systems and installations installed in such networks.

For active equipment with balanced RF signal ports this standard applies to those ports which carry RF broadband signals for services as described in the scope of this standard.

The extent of this standardization work is from the antennas and/or special signal source inputs to the headend or other interface points to the network up to the terminal input.

The standardization of any user terminals (i.e., tuners, receivers, decoders, multimedia terminals, etc.) as well as of any coaxial, balanced and optical cables and accessories thereof is excluded.

---

<sup>1</sup> This word encompasses the HFC (Hybrid Fibre Cable) networks used nowadays to provide telecommunications services, voice, data, audio and video both broadcast and narrowcast.

## CABLE NETWORKS FOR TELEVISION SIGNALS, SOUND SIGNALS AND INTERACTIVE SERVICES –

### Part 3: Active wideband equipment for cable networks

#### 1 Scope

This part of IEC 60728 lays down the measuring methods, performance requirements and data publication requirements for active wideband equipment of cable networks for television signals, sound signals and interactive services.

This standard

- applies to all broadband amplifiers used in cable networks;
- covers the frequency range 5 MHz to 3 000 MHz;

NOTE The upper limit of 3 000 MHz is an example, but not a strict value. The frequency range, or ranges, over which the equipment is specified, should be published.

- applies to one-way and two-way equipment;
- lays down the basic methods of measurement of the operational characteristics of the active equipment in order to assess the performance of this equipment;
- identifies the performance specifications to be published by the manufacturers;
- states the minimum performance requirements of certain parameters.

Amplifiers are divided into the following two quality levels:

Grade 1: amplifiers typically intended to be cascaded;

Grade 2: amplifiers for use typically within an apartment block, or within a single residence, to feed a few outlets.

Practical experience has shown that these types meet most of the technical requirements necessary for supplying a minimum signal quality to the subscribers. This classification is not a requirement but is provided to users and manufacturers for information about minimum quality criteria of the material required to install networks of different sizes. The system operator has to select appropriate material to meet the minimum signal quality at the subscriber's outlet, and to optimise cost/performance, taking into account the size of the network and local circumstances.

All requirements and published data are understood as guaranteed values within the specified frequency range and in well-matched conditions.

#### 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60065, *Audio, video and similar electronic apparatus – Safety requirements*

IEC 60068-1:1998, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Tests A: Cold*

- IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Tests B: Dry heat*
- IEC 60068-2-6, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*
- IEC 60068-2-14, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*
- IEC 60068-2-27, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*
- IEC 60068-2-29, *Basic environmental testing procedures – Part 2-29: Tests – Test Eb and guidance: Bump*
- IEC 60068-2-30, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*
- IEC 60068-2-31, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment-type specimens*
- IEC 60068-2-32, *Basic environmental testing procedures – Part 2-32: Tests – Test Ed: Free fall*
- IEC 60068-2-40, *Basic environmental testing procedures – Part 2-40: Tests – Test Z/AM: Combined cold/low air pressure tests*
- IEC 60068-2-48, *Basic environmental testing procedures – Part 2-48: Tests – Guidance on the application of the tests of IEC publication 60068 to simulate the effects of storage*
- IEC 60529, *Degrees of protection provided by enclosures (IP Code)*
- IEC 60728-1, *Cable networks for television signals, sound signals and interactive services – Part 1: System performance of forward paths*
- IEC 60728-2, *Cable networks for television signals, sound signals and interactive services – Part 2: Electromagnetic compatibility for equipment*
- IEC 60728-4, *Cable networks for television signals, sound signals and interactive services – Part 4: Passive wideband equipment for coaxial cable networks*
- IEC 60728-5, *Cable networks for television signals, sound signals and interactive services – Part 5: Headend equipment*
- IEC 60728-11, *Cable networks for television signals, sound signals and interactive services – Part 11: Safety*
- IEC 60950-1, *Information technology equipment – Safety – Part 1: General requirements*
- IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*
- IEC 61319-1, *Interconnections of satellite receiving equipment – Part 1: Europe*
- IEC 61319-2, *Interconnections of satellite receiving equipment – Part 2: Japan*
- ITU-T Recommendation G.117, *Transmission systems and media – Digital systems and networks – International telephone connections and circuits – General recommendations on the transmission quality for an entire international telephone connection – Transmission aspects of unbalance about earth*
- ITU-T Recommendation O.9, *Specifications of measuring equipment – General – Measuring arrangements to assess the degree of unbalance about earth*

### 3 Terms, definitions, symbols and abbreviations

For the purposes of this document, the following terms, definitions, symbols and abbreviations apply.

#### 3.1 Terms and definitions

##### 3.1.1

**amplitude frequency response**

gain or loss of an equipment or system plotted against frequency

##### 3.1.2

**attenuation**

ratio of the input power to the output power of an equipment or system, usually expressed in decibels

##### 3.1.3

**balun**

device to match symmetrical impedance  $100\ \Omega$  (balanced) to un-symmetrical impedance  $75\ \Omega$  (unbalanced) and vice-versa

##### 3.1.4

**carrier-to-noise ratio**

difference in decibels between the vision or sound carrier level at a given point in an equipment or system and the noise level at that point (measured within a bandwidth appropriate to the television or radio system in use)

##### 3.1.5

**chrominance-luminance delay inequality**

difference in transmission delay of chrominance and luminance signals, which results in the spilling of colour to left or right of the area of corresponding luminance

[IEC 60050-723:1997, 723-06-61]

##### 3.1.6

**composite intermodulation noise****CIN**

sum of noise and intermodulation products from digital modulated signals

##### 3.1.7

**composite intermodulation noise ratio****CINR**

ratio of the signal level and the CIN level

##### 3.1.8

**crossmodulation**

undesired modulation of the carrier of a desired signal by the modulation of another signal as a result of equipment or system non-linearities

##### 3.1.9

**crosstalk attenuation**

unwanted signals beside the wanted signal on a lead caused by electromagnetic coupling between leads; ratio of the wanted signal power to the unwanted signal power, while equal signal powers are applied to the leads

NOTE Crosstalk attenuation is usually expressed in decibels.

**3.1.10****decibel ratio**

ten times the logarithm of the ratio of two quantities of power  $P_1$  and  $P_2$ , i.e.

$$10 \lg \frac{P_1}{P_2} \quad \text{in dB}$$

**3.1.11****equaliser**

device designed to compensate over a certain frequency range for the amplitude/frequency distortion or phase/frequency distortion introduced by feeders or equipment

NOTE This device is for the compensation of linear distortions only.

**3.1.12****feeder**

transmission path forming part of a cable network

NOTE Such a path may consist of a metallic cable, optical fibre, waveguide or any combination of them. By extension, the term is also applied to paths containing one or more radio links.

**3.1.13****gain**

ratio of the output power to the input power, usually expressed in decibels

**3.1.14****ideal thermal noise**

noise generated in a resistive component due to the thermal agitation of electrons

NOTE The thermal power generated is given by

$$P = 4 \cdot B \cdot k \cdot T$$

where

$P$  is the noise power in watts;

$B$  is the bandwidth in hertz;

$k$  is the Boltzmann's constant =  $1,38 \cdot 10^{-23}$  J/K;

$T$  is the absolute temperature in kelvins.

It follows that

$$\frac{U^2}{R} = 4 \cdot B \cdot k \cdot T$$

and

$$U = \sqrt{4 \cdot R \cdot B \cdot k \cdot T}$$

where

$U$  is the noise voltage (e.m.f.);

$R$  is the resistance in ohms.

In practice, it is normal for the source to be terminated with a load equal to the internal resistance value, the noise voltage at the input is then  $U/2$ .

**3.1.15****level**

decibel ratio of any power  $P_1$  to the standard reference power  $P_0$ , i.e.

$$10 \lg \frac{P_1}{P_0}$$

decibel ratio of any voltage  $U_1$  to the standard reference voltage  $U_0$ , i.e.

$$20 \lg \frac{U_1}{U_0}$$

NOTE The power level may be expressed in decibels relative to  $P_0 = (U_0^2/R) = (1/75) \text{ pW}$ , i.e. in  $\text{dB}(P_0)$ , taking into account that the level of  $P_0$  corresponds to 0  $\text{dB}(P_0)$  or, as more usually, in  $\text{dB}(\text{pW})$ , taking into account that the level of  $P_0$  corresponds to  $-18,75 \text{ dB}(\text{pW})$ . The voltage level is expressed in decibels relative to 1  $\mu\text{V}$  (across 75  $\Omega$ ), i.e. in  $\text{dB}(\mu\text{V})$ .

### 3.1.16

#### modulation error ratio

##### MER

sum of the squares of the magnitudes of the ideal symbol vectors is divided by the sum of the squares of the magnitudes of the symbol error vectors of a sequence of symbols, the result being expressed as a power ratio in dB

$$MER = 10 \lg \left\{ \frac{\sum_{j=1}^N (I_j^2 + Q_j^2)}{\sum_{j=1}^N (\delta I_j^2 + \delta Q_j^2)} \right\} \text{ in dB}$$

### 3.1.17

#### multi-switch

equipment used in distribution systems for signals that are received from satellites and converted to a suitable IF

NOTE The IF signals that are received from different polarisations, frequency bands and orbital positions are input signals to the multi-switch. Subscriber feeders are connected to the multi-switch output ports. Each output port is switched to one of the input ports, depending on control signals that are transmitted from the subscriber equipment to the multi-switch. Besides a splitter for each input port and a switch for each output port, a multi-switch can contain amplifiers to compensate for distribution or cable losses.

### 3.1.18

#### multi-switch loop through port

one or more ports to loop through the input signals through a multi-switch

NOTE This enables larger networks with multiple multi-switches, each one installed close to a group of subscribers. The multi-switches are connected in a loop through manner. The IF signals that are received by an outdoor unit from different polarisations, frequency bands and orbital positions are input signals to a first multi-switch. Cables connect the loop through ports of this multi-switch to the input ports of a second multi-switch and so on.

### 3.1.19

#### multi-switch port for terrestrial signals

port in a multi-switch used to distribute terrestrial signals in addition to the signals received from satellites

### 3.1.20

#### noise factor/noise figure

used as figures of merit describing the internally generated noise of an active device

NOTE The noise factor,  $F$ , is the ratio of the carrier-to-noise ratio at the input, to the carrier-to-noise ratio at the output of an active device.

$$F = \frac{C_1/N_1}{C_2/N_2}$$

where

- $C_1$  is the signal power at the input;
- $C_2$  is the signal power at the output;
- $N_1$  is the noise power at the input (ideal thermal noise);
- $N_2$  is the noise power at the output.

In other words, the noise factor is the ratio of noise power at the output of an active device to the noise power at the same point if the device had been ideal and added no noise.

$$F = \frac{N_{2\text{actual}}}{N_{2\text{ideal}}}$$

The noise factor is dimensionless and is often expressed as noise figure,  $NF$ , in dB

$$NF = 10 \lg F \quad \text{in dB}$$

### 3.1.21

#### slope

difference in gain or attenuation at two specified frequencies between any two points in an equipment or system

NOTE The slope sign is considered

- a) negative when the attenuation increases with frequency (cables) or the gain (amplifiers) decreases with frequency,
- b) positive when the gain (amplifiers) increases with frequency (compensating slope).

### 3.1.22

#### standard reference power and voltage

in cable networks, the standard reference power,  $P_0$ , is (1/75) pW

NOTE 1 This is the power dissipated in a 75  $\Omega$  resistor with an RMS voltage drop of 1  $\mu\text{V}$  across it.

NOTE 2 The standard reference voltage,  $U_0$ , is 1  $\mu\text{V}$ .

### 3.1.23

#### surge voltage

produced by a direct or indirect lightning stroke

### 3.1.24

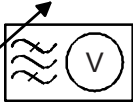
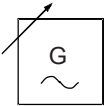
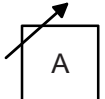
#### well-matched

matching condition when the return loss of the equipment complies with the requirements of Table 3

NOTE Through mismatching of measurement instruments and the measurement object, measurement errors are possible. Comments to the estimation of such errors are given in Annex E.

### 3.2 Symbols

The following graphical symbols are used in the figures of this standard. These symbols are either listed in IEC 60617 or based on symbols defined in IEC 60617.

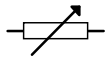
| Symbols                                                                             | Terms                                                                                | Symbols                                                                              | Terms                                                                                                                   |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
|    | Amperemeter<br>based on<br>[IEC 60617-S00910<br>(2001-07)]                           |     | Voltmeter<br>based on<br>[IEC 60617-S00910<br>(2001-07)]                                                                |
|    | Selective voltmeter                                                                  |     | Power meter<br>based on<br>[IEC 60617-S00910<br>(2001-07)]                                                              |
|    | Equipment Under Test<br>based on<br>[IEC 60617-S00059<br>(2001-07)]                  |    | Signal generator<br>based on<br>[IEC 60617-S00899,<br>IEC 60617-S01403<br>(2001-07)]                                    |
|   | Noise generator<br>[IEC 60617-S01230<br>(2001-07)]                                   |   | Variable signal genera-<br>tor<br>based on<br>[IEC 60617-S00081,<br>IEC 60617-S00899,<br>IEC 60617-S01403<br>(2001-09)] |
|  | Surge generator<br>[IEC 60617-S01228<br>(2001-07)]                                   |  | VSWR-bridge                                                                                                             |
|  | High-pass filter<br>[IEC 60617-S01247<br>(2001-07)]                                  |  | Low-pass filter<br>[IEC 60617-S01248<br>(2001-07)]                                                                      |
|  | Band-stop filter<br>[IEC 60617-S01250<br>(2001-07)]                                  |  | Band-pass filter<br>[IEC 60617-S01249<br>(2001-07)]                                                                     |
|  | Oscilloscope<br>based on<br>[IEC 60617-S00059, and<br>IEC 60617-S00922<br>(2001-07)] |  | Spectrum analyzer<br>(electrical)<br>based on<br>[IEC 60617-S00910<br>(2001-07)]                                        |
|  | Attenuator<br>based on<br>[IEC 60617-S01244<br>(2001-07)]                            |  | Variable attenuator<br>[IEC 60617-S01245<br>(2001-07)]                                                                  |
|  | Combiner<br>based on<br>[IEC 60617-S00059<br>(2001-07)]                              |  | Tap-off-box                                                                                                             |
|  | Double tap-off-box                                                                   |  | Optical receiver<br>[IEC 60617-S00213<br>(2001-07)]                                                                     |

**Symbols****Terms**

Amplifier with return path  
amplifier  
[IEC 60617-S00433  
(2001-07)]



Functional equipotential  
bonding  
[IEC 60617-S01410  
(2001-11)]



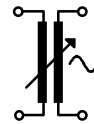
Variable resistor  
[IEC 60617-S00557  
(2001-07)]



RF choke  
[IEC 60617-S00583  
(2001-07)]

**Symbols****Terms**

Detector with LF-  
amplifier



Adjustable AC voltage  
source



Capacitor  
[IEC 60617-S00567  
(2001-07)]

**3.3 Abbreviations**

|      |                                       |
|------|---------------------------------------|
| AC   | alternating current                   |
| AF   | audio frequency                       |
| AGC  | automatic gain control                |
| AM   | amplitude modulation                  |
| BER  | bit error ratio                       |
| CATV | community antenna television (system) |
| CIN  | composite intermodulation noise       |
| CINR | composite intermodulation noise ratio |
| CSO  | composite second order                |
| CTB  | composite triple beat                 |
| CW   | continuous wave                       |
| CXM  | composite crossmodulation             |
| DC   | direct current                        |
| EMC  | electromagnetic compatibility         |
| EUT  | equipment under test                  |
| HP   | high pass                             |
| IF   | intermediate frequency                |
| IP   | international protection              |
| LF   | low frequency                         |
| LP   | low pass                              |
| MATV | master antenna television (system)    |
| MER  | modulation error ratio                |
| MTBF | meantime between failure              |
| OMI  | optimum modulation index              |
| PAL  | phase alternating line                |
| PID  | packet identifier                     |
| PRBS | pseudo-random bit sequence            |

|       |                                                              |
|-------|--------------------------------------------------------------|
| QAM   | quadrature amplitude modulation                              |
| QPSK  | quadrature phase shift keying                                |
| RF    | radio frequency                                              |
| RMS   | root mean square                                             |
| RS    | rotary switch                                                |
| SECAM | sequential colour with memory (séquentiel couleur à mémoire) |
| SG    | signal generator                                             |
| SMATV | satellite master antenna television (system)                 |
| TV    | television                                                   |
| UHF   | ultra-high frequency                                         |
| VHF   | very-high frequency                                          |
| VSWR  | voltage standing wave ratio                                  |
| XM    | crossmodulation                                              |

## 4 Methods of measurement

### 4.1 General

This clause defines basic methods of measurement. Any equivalent method that ensures the same accuracy may be used for assessing performance.

Unless stated otherwise, all measurements shall be carried out with 0 dB plug-in attenuators and equalisers. The position of variable controls used during the measurements shall be published.

The test set-up shall be well-matched over the specified frequency band.

A network can be used to distribute terrestrial signals in addition to the signals received from satellites. The terrestrial antennas are connected to an optional terrestrial input port of a multi-switch. On each output port the terrestrial signals are available in addition to the satellite IF signals. Since the usual frequency ranges for terrestrial signals and satellite IF signals do not overlap, both can be carried on the same cable.

For large networks with loop through connected multi-switches, two possibilities exist to carry the terrestrial signals from one multi-switch to another multi-switch:

- to use a specialised cable for the terrestrial signal, in addition with the cables used for the satellite IF signals and then, on each output port the terrestrial signal is combined with the selected satellite IF signal;
- to combine the terrestrial signal with each satellite IF signal before the first multi-switch in order to minimise the number of cables between multi-switches.

**NOTE** The signal coming from an outdoor unit for satellite reception may contain unwanted signal-components with frequencies below the foreseen satellite IF frequency range. These signal-components overlap with the frequency range of terrestrial signals. For example, an outdoor unit that converts the frequency band 11,7 GHz to 12,75 GHz to the satellite IF frequency range may convert signals in the 10,7 GHz to 11,7 GHz band to frequencies below the satellite IF frequency range. These frequencies have to be filtered out sufficiently to avoid interference with terrestrial signals on the same cable.

For measurements on multi-switches, it is necessary that control signals be fed to the output ports that are involved in the measurement. Therefore, a bias-tee has to be connected between the multi-switch output port and the measurement set. The DC port of the bias-tee is connected to a standard receiver that generates the required control signals. Care has to be taken that the influence of the bias-tee on the measurement result is insignificant. This can be

achieved by including it into the calibration or using a network analyzer with a built in bias-tee.

Measurements on active equipment with symmetrical ports shall be performed using a measurement balun. The symmetry (common mode suppression) of the output signal of such a measurement balun shall be >30 dB for 100 MHz to 1 000 MHz and >50 dB for 30 MHz to 100 MHz. The common mode suppression shall be measured according to ITU-T Rec. G.117 and ITU-T Rec. O.9. The return loss of the measurement balun shall be 10 dB higher than the return loss of the EUT to which the coaxial measurement equipment is connected via the measurement balun.

## 4.2 Linear distortion

### 4.2.1 Return loss

#### 4.2.1.1 General

The method described is applicable to the measurement of the return loss of equipment operating in the frequency range 5 MHz to 3 000 MHz.

All input and output ports of the unit shall meet the specification under all conditions of automatic and manual gain controls and with any combination of plug-in equalisers and attenuators fitted.

#### 4.2.1.2 Equipment required

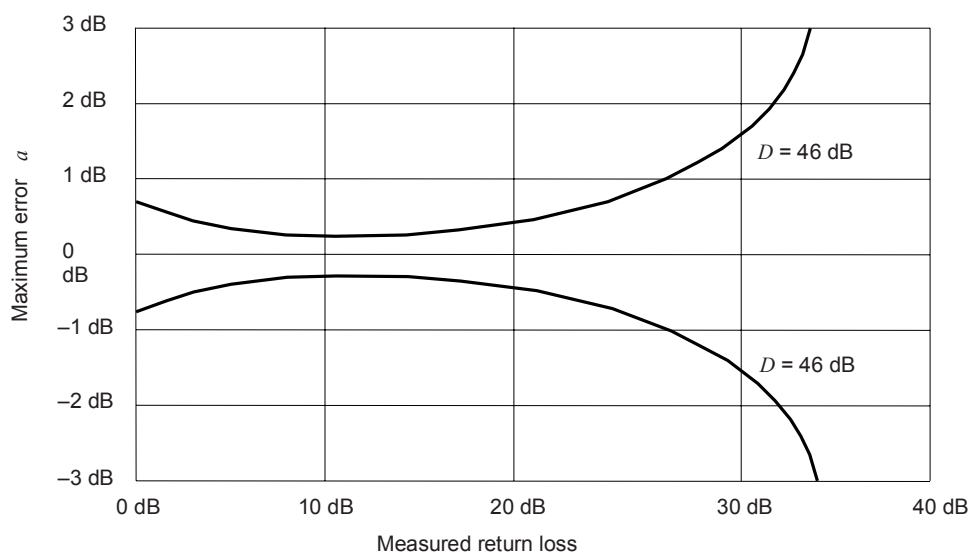
The following equipment is required.

- a) A signal generator or sweep generator, adjustable over the frequency range of the equipment to be tested.

Care shall be taken to ensure that the signal generator or sweep generator output does not have a high harmonic content as this can cause serious inaccuracy.

- b) A voltage standing wave ratio bridge with built-in or separate RF detector.

The accuracy of measurement is dependent on the quality of the bridge. In particular on the directivity and on the return loss of the test port of the bridge. For example Figure 1 shows the maximum accuracy achieved by a bridge with 46 dB directivity and 26 dB return loss.



IEC 2501/10

Figure 1 – Maximum error  $\alpha$  for measurement of return loss using VSWR-bridge with directivity  $D = 46$  dB and 26 dB test port return loss