BS EN 50083-8:2013

BSI Standards Publication

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

Part 8: Electromagnetic compatibility for networks

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National foreword

This British Standard is the UK implementation of EN 50083-8:2013. It supersedes BS EN 50083-8:2002+A11:2008 which is withdrawn.

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

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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EUROPEAN STANDARD

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English version

Cable networks for television signals, sound signals and interactive services - Part 8: Electromagnetic compatibility for networks

Réseaux de distribution par câbles pour signaux de télévision, signaux de radiodiffusion sonore et services interactifs - Partie 8: Compatibilité électromagnétique des réseaux

Kabelnetze für Fernsehsignale, Tonsignale und interaktive Dienste - Teil 8: Elektromagnetische Verträglichkeit von Kabelnetzen

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre 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 CEN-CENELEC Management Centre 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

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Foreword

This document (EN 50083-8:2013) has been prepared by CLC/TC 209 "Cable networks for television signals, sound signals and interactive services".

The following dates are fixed:

• latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2014-11-08
• latest date by which the national standards conflicting with this document have to be withdrawn	(dow)	2016-11-08

This document supersedes EN 50083-8:2002 + A11:2008.

EN 50083-8:2013 includes the following significant technical changes with respect to EN 50083-8:2002 and EN 50083-8/A11:2008.

— EN 50083-8 with its methods of measurement and EMC performance requirements is explicitly dedicated to “under operating conditions (in situ)” to ensure the ongoing EMC integrity of cable networks.

— The harmonized standard EN 50529-2 is dedicated for the provision of presumption of conformance to the EMC Directive.

— The first intermediate frequency range (1st IF range) for satellite signal transmission was extended to cover now frequencies from 950 MHz up to 3 500 MHz.

— The method of measurement and the requirements for in-band immunity were extended taking into account the new EMC environment due to the allocation of broadband wireless services in the frequency band 790 MHz to 862 MHz. As a consequence, the limits of in-band immunity were specified for analogue and additionally for digital signals in this frequency range.

— The substitution method of measurement (power method) was deleted.

— EMC measurements below 30 MHz were deleted

— New Annex D “Measurement in other distances than the standard distance of 3 m”

— New Annex E “GPS based leakage detection system for cable networks”

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

1 Scope

1.1 General

Standards of the EN 50083 and EN 60728 series deal with cable networks including equipment and associated methods of measurement for headend reception, processing and distribution of television and sound signals and for processing, interfacing and transmitting all kinds of data signals for interactive services using all applicable transmission media. These signals are typically transmitted in networks by frequency-multiplexing techniques.

This includes for instance

- regional and local broadband cable networks,
- extended satellite and terrestrial television distribution systems,
- individual satellite and terrestrial television receiving systems,

and all kinds of equipment, systems and installations used in such cable networks, distribution and receiving systems.

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 of the customer premises equipment.

The standardization work will consider coexistence with users of the RF spectrum in wired and wireless transmission systems.

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.

1.2 Specific scope of EN 50083-8

This European Standard applies to the radiation characteristics and immunity to electromagnetic disturbance of cable networks for television signals, sound signals and interactive services and covers the frequency range 0,15 MHz to 3,5 GHz. It should be noted that measurements below 30 MHz are not generally considered useful in the context of cable networks and are difficult to perform in practice.

Application of the harmonized standard EN 50529-2 provides presumption of conformance to the EMC Directive. Therefore, to fulfil the requirements of EN 50529-2, it is necessary to use cable network equipment that satisfies the requirements of EN 50083-2 regarding limits of radiation and of immunity to external fields.

This European Standard specifies methods of measurement and EMC performance requirements under operating conditions (in situ) to ensure the ongoing EMC integrity of cable networks.

Cable networks beyond the system outlets (e.g. the receiver lead, in simplest terms) which begin at the system outlet and end at the input to the subscriber's terminal equipment are not covered by the standard EN 50083-8. Requirements for the electromagnetic compatibility of receiver leads are laid down in EN 60966-2-4, EN 60966-2-5 and EN 60966-2-6.

Cable networks and a wide range of radio services have to coexist. These include for example the emergency services, safety of life, broadcasting, aeronautical, radio navigation services and also land mobile, amateur and cellular radio services. Frequency ranges of typical safety of life services are listed in Annex B. Additional protection for certain services may be required by national regulations.

2 Normative references

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

EN 50083 (all parts), *Cable networks for television signals, sound signals and interactive services*

EN 50083-2, *Cable networks for television signals, sound signals and interactive services – Part 2: Electromagnetic compatibility for equipment*

EN 50117 (all parts), *Coaxial cables*

EN 50529-2, *EMC Network Standard – Part 2: Wire-line telecommunications networks using coaxial cables*

EN 55016-1-1, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus (CISPR 16-1-1)*

EN 55016-1-4, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-4: Radio disturbance and immunity measuring apparatus – Antennas and test sites for radiated disturbance measurements (CISPR 16-1-4)*

EN 60728 (all parts), *Cable networks for television signals, sound signals and interactive services (IEC 60728, all parts)*

EN 60728-1, *Cable networks for television signals, sound signals and interactive services – Part 1: System performance of forward paths (IEC 60728-1)*

IEC 60050-161, *International Electrotechnical Vocabulary – Chapter 161: Electromagnetic compatibility*

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-161 and the following apply.

NOTE The most important definitions of IEC 60050-161 are repeated hereafter with the IEV-numbering given in brackets. In addition, some more specific definitions, used in this European Standard, are listed.

3.1.1
building penetration loss
ability of buildings, in which networks for distribution of television and sound are located, to attenuate the influence of electromagnetic fields from outside the buildings or to suppress the radiation of electromagnetic fields from inside the buildings

3.1.2
carrier-to-interference ratio
minimum level difference measured at the output of an active equipment or at any other interface within the network between the wanted signal and

- intermodulation products of the wanted signal and/or unwanted signals generated due to non-linearities,
- harmonics generated by an unwanted signal,
- unwanted signals that have penetrated into the operating frequency range,
- unwanted signals that have been converted to the frequency range to be protected (operating frequency range)

3.1.3
degradation (of performance)
undesired departure in the operational performance of any device, equipment or system from its intended performance

Note 1 to entry: The term "degradation" can apply to temporary or permanent failure.

[SOURCE: IEV 161-01-19]

3.1.4
disturbance level
level of an electromagnetic disturbance at a given location, which results from all contributing (interference) sources

3.1.5
electromagnetic disturbance
any electromagnetic phenomenon which may degrade the performance of a device, equipment or system, or adversely affect living or inert matter

Note 1 to entry: An electromagnetic disturbance may be an electromagnetic noise, an unwanted signal or a change in the propagation medium itself.

[SOURCE: IEV 161-01-05]

3.1.6
electromagnetic interference
EMI
degradation of the performance of an equipment, transmission channel or system caused by an electromagnetic disturbance

Note 1 to entry: In French, the terms "perturbation électromagnétique" and "brouillage électromagnétique" designate respectively the cause and the effect, and should not be used indiscriminately.

Note 2 to entry: In English, the terms "electromagnetic disturbance" and "electromagnetic interference" designate respectively the cause and the effect, but they are often used indiscriminately.

[SOURCE: IEV 161-01-06]

3.1.7
(electromagnetic) radiation
1. phenomenon by which energy in the form of electromagnetic waves emanates from a source into space

2. energy transferred through space in the form of electromagnetic waves

Note 1 to entry: By extension, the term "electromagnetic radiation" sometimes also covers induction phenomena.

[SOURCE: IEV 161-01-10]

3.1.8
external immunity
ability of a device, equipment or network to perform without degradation in the presence of electromagnetic disturbances entering other than via its normal input terminals or antenna

[SOURCE: IEV 161-03-07]

3.1.9
headend
equipment that is connected between receiving antennas or other signal sources and the remainder of the cable network, to process the signals to be distributed

Note 1 to entry: The headend can, for example, comprise antenna amplifiers, frequency converters, combiners, separators and generators.

3.1.10
ignition noise
unwanted emission of electromagnetic energy, predominantly impulsive in content, arising from the ignition system within a vehicle or device

3.1.11
immunity (to a disturbance)
ability of a device, equipment or system to perform without degradation in the presence of an electromagnetic disturbance

[SOURCE: IEV 161-01-20]

3.1.12
internal immunity
ability of a device, equipment or system to perform without degradation in the presence of electromagnetic disturbances appearing at its normal input terminals or antennas

[SOURCE: IEV 161-03-06]

3.1.13
operating frequency range
passband for the wanted signals for which the equipment has been designed

3.1.14
receiver lead
lead that connects the system outlet to the subscriber's equipment

3.1.15
screening effectiveness
ability of an equipment or system to attenuate the influence of electromagnetic fields from outside the equipment or system or to suppress the radiation of electromagnetic fields from inside the equipment or system

3.1.16
spur network
cable network normally laid out inside buildings to which splitters, subscriber's taps or looped system outlets are connected

3.1.17
subscriber's feeder
feeder connecting a subscriber's tap to a system outlet or, where the latter is not used, directly to the subscriber's equipment

Note 1 to entry: A subscriber's feeder can include filters and balun transformer.

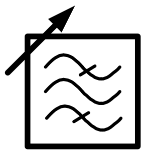
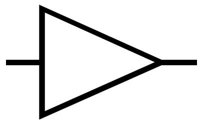
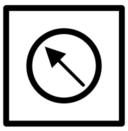
3.1.18
system outlet
device for interconnecting a subscriber's feeder and a receiver lead

3.1.19
well-screened test set-up
test set-up whose radiation level, when terminated with a matched load, is at least 20 dB below the expected radiation level of the equipment under test, the test set-up and the equipment being supplied with the same input signal level

3.2 Symbols

For the purposes of this document, the following graphical symbols apply.

NOTE These graphical symbols are used in the figures of this European Standard. These symbols are either listed in IEC 60617 or based on symbols defined in IEC 60617.

Graphical symbol	Reference number and title	Graphical symbol	Reference number and title
	IEC 60617 (S01249) + IEC 60617 (S00081) Tuneable bandpass filter		IEC 60617 (S01239) Pre-amplifier
	Level meter		

3.3 Abbreviations

For the purposes of this document, the following abbreviations apply.

AM Amplitude Modulation

DSC Distress, Safety and Calling

DVB Digital Video Broadcasting

EMC Electromagnetic Compatibility

EMI Electromagnetic Interference

EPIRB Emergency Position Indicating Radiobeacons

FM Frequency Modulation

GPS Global Positioning System

HFC Hybrid Fibre Coax

IEV International Electrotechnical Vocabulary

ILS Instrument Landing System

LAS	Leakage Analysis Software
MIL	Military (use)
NAV	(Aeronautical) Navigation (Radio)
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
SAT-IF	Satellite Intermediate Frequency
TV	Television
VOR	VHF Omnidirectional Range
VSB	Vestigial Side Band

NOTE Only the abbreviations used in the English version of this part of EN 50083 are mentioned in this subclause. The German and the French versions of this part can use other abbreviations. Refer to 3.3 of each language versions for details.

4 Methods of measurement

4.1 Basic principles

These methods of measurement describe the procedures for the testing of cable networks. The purpose of the measurements is to determine:

- the level of radiation generated by cable networks and
- the immunity of cable networks to external field strengths (e.g. those radiated by other radiocommunication services and RF applications).

The measurements cover the essential parameters and environmental conditions in order to assess cases of electromagnetic incompatibility between cable networks and other electrical or electronic equipment, networks, installations or other cabled networks with respect to the intended operation of such cable networks.

During the test the cable network shall operate within its normal operating conditions e.g. with regard to the signal level and signal quality at the system outlets.

NOTE Methods of measurement for radiated digitally modulated signals are under consideration. For digital egress measurements, where the level of emission is such that the signal is indeterminate from the general and other background noise, an analogue substitution method is employed, by using an analogue video carrier where possible.

4.2 Radiation from cable networks

4.2.1 General

The methods described hereafter are applicable to the measurement of radiation from cable networks (combination of cables and equipment). The termination point of the cable network to be measured is the system outlet.

When testing cable networks the terminal equipment may initially be connected. Testing of the cable networks against the relevant limits requires the terminal equipment to be disconnected. Where limits are exceeded, individual sections of the network (e.g. headend, satellite receiving outdoor unit, cable network, distribution installation) may be tested in succession to determine which section of the network does not operate within the limits.

The number of test frequencies shall be selected to give a realistic representation of the radiation pattern throughout the operating frequency range and to enable the maximum level of radiation to be recorded and the results interpreted accurately.

The field strength measurement procedure is used in order to achieve results which are sufficiently accurate and do not require excessive technical effort.

The maximum permitted radiation level is given in Table 1.

4.2.2 Field strength method

4.2.2.1 Used antenna

The field strength method uses a suitable electromagnetic field antenna in the frequency range 30 MHz to 3,5 GHz which is conventionally calibrated in terms of "equivalent electric component" of the electromagnetic field.

4.2.2.2 Equipment required to measure the electric field in the frequency range 30 MHz to 3,5 GHz

For the measurement of the radiation from a network, a calibrated measurement system comprising a radio disturbance measuring receiver with broadband dipole, or a log-periodic antenna with tripod to measure the electric field component, as specified in EN 55016-1-1 and EN 55016-1-4, are required.

NOTE Measuring results, received by the use of the described calibrated measuring system do not need a further correction due to near field condition while measuring.

This European Standard defines radiation levels in terms of field strength at 3 m distance from a radiating object. The standard distance is 3 m outside a building. In special cases (e.g. block of flats) one can choose a different measurement distance taken into account Formula (D.1).

In the frequency range 30 MHz to 3,5 GHz a measurement bandwidth of 120 kHz and the quasi-peak detector shall be selected. In the frequency range 1 000 MHz to 3 000 MHz a measurement bandwidth of 1 MHz and the peak detector shall be selected. The measurement bandwidths and the relevant detector types are defined in EN 55016-1-1.

4.2.2.3 Measuring procedure to measure the electric field in the frequency range 30 MHz to 3,5 GHz

It will be necessary to ensure that the cable network is operating with its normal signal levels.

To reduce the measurement time, the frequency range is normally scanned using the peak detector. The maximum disturbance field strength values identified should then be re-measured using the quasi-peak detector.

In the case of a broadband dipole, the measurement distance d is equal to the distance between the BALUN and the telecommunications network and in the case of a log-periodic antenna equal to the distance between the telecommunications network and the reference point of the antenna.

At the specified measuring point, the direction, height and polarisation (horizontal and vertical) of the measuring antenna shall be varied in order to measure the maximum disturbance field strength.

NOTE 1 The actual variation of antenna parameters, particularly the antenna height, depends on the frequency to be measured. Where the size of the calibrated measuring antenna is not practical, the use of a calibrated loop antenna is useful.

The measurement result is to be observed for up to approximately 15 s. The relevant result is the maximum sustained value. Individual peaks are to be ignored.

If the measurement system used delivers only measurement results as RF-voltage levels, than the disturbance field strength level is determined by converting the RF-voltage level using Formula (1):

$$E_{dist} = u_l + a_c + k_a \quad (1)$$

where

E_{dist} is the calculated disturbance field strength level in dB(μV/m);

u_l is the measured voltage level in dB(μV) at the antenna input of the measuring receiver (50 Ω);

a_c is the attenuation of the measuring cable in dB;

k_a is the antenna factor due to the specification of the manufacturer or the calibration of the measuring antenna in dB.

NOTE 2 Independent of the actual measurement distance used in any case for the calculation of the disturbance field strength level the antenna factor (free space, due to the specification of the manufacturer or the calibrations) will be taken into account.

4.2.3 Subcarrier measurement procedure

4.2.3.1 General

The analogue subcarrier procedure is used, when a direct measurement of radiation through broadband digital signals is not possible (e.g. when searching leaks or determination of summation of radiated field strength). This is due to a sensitivity decrease at the measurement receiver input resulting from a decrease in the signal-to-noise ratio in case of broadband disturbers. The necessary increase of the measuring dynamics can be achieved by narrow-band subcarriers.

4.2.3.2 Emission level and adjustments

For the evaluation of radiated disturbances of broadband digital signals using the subcarrier method first, the respective power levels shall be determined. First, the level of the wanted broadband digital signal at the feeding point for the subcarrier shall be established using the appropriate bandwidth (see Table 1). It is recommended to use the appropriate detector for each relevant frequency range (i.e. quasi-peak detector below 1 GHz, peak detector above 1 GHz).

Subsequently, it is to be examined whether a subcarrier is already present or other narrow-band reference signals can be used as subcarriers. Otherwise, an unmodulated sinusoid subcarrier, if possible fed into the gap between the digital signals, is used. This subcarrier is applied so that the level of this signal, measured with a measuring bandwidth of 200 Hz, corresponds to the measured value of the digital signal measured before.

NOTE If necessary, the subcarrier can be fed with an increased level compared to the wanted level of the digital signal. It is important to appropriately take the system restrictions into account. With the following determination of the disturbance field strength of the subcarrier, the received measured value is to be corrected accordingly.

In any case, the application of subcarriers should be co-ordinated with the respective local network operator.

4.2.3.3 Determination of disturbing field strength

When the levels of subcarriers and broadband digital signals were adjusted according to 4.2.3.2, the results of the subcarrier measurements at the relevant measuring points provide the dominant electrical field strength either directly or indirectly as conducted voltage at the antenna input of the measurement receiver.

If the subcarrier is fed into the relevant cable network with a higher level compared to the digital wanted signal this level difference shall be subtracted from the received measured values accordingly. The result gives the disturbance field strength levels at the measuring point, together with the wanted signal transmission. The general approach to determine the field strengths as described in 4.2.2.1 and 4.2.2.3 remains untouched and is applied accordingly.

4.2.4 GPS based leakage detection system

To get a first and quick survey upon possible leakages of cable networks, GPS based leakage detection systems could be used. There are systems from different vendors available which all work in a similar manner. Annex E gives a short introduction to the principle function of such detection systems.

4.3 Immunity of cable networks

4.3.1 General

The carrier-to-interference ratio caused by an external field at any system outlet shall be measured by means of a suitable measuring receiver or spectrum analyser. The results shall meet the limits given in 5.3.

4.3.2 Measurement procedure for interference caused by high-power local outdoor transmitter

In the case of disturbance, the carrier-to-interference ratio shall be measured at the outlets subject to disturbance.

At first, the wanted signal level in the disturbed channel shall be measured. After that, the cable network shall be disconnected from the interchange point or the antennas as well as at the system outlet. The open interfaces shall be terminated with 75 Ω terminating loads.

The disturbance level of the ingress unwanted signal is then measured by means of a measuring receiver in the peak mode, taking into account the bandwidth of the wanted signal. Care shall be taken to ensure that the measuring receiver is well-matched to the network under test and that the relevant return loss is taken into consideration.

The difference between the wanted signal level and the level of the interfering unwanted signal level shall meet the RF carrier-to-interference ratio specified in Table 4.

If the carrier-to-interference ratio is equal to or greater than the nominal value, the network meets the requirements. If the carrier-to-interference ratio is less than the required ratio, further studies are necessary. All distribution installations beyond the system outlet (receiver leads, receiver, other subscriber's installations) shall be disconnected from the network under test for the purposes of these studies. In the majority of cases disturbance is caused by these items. The measurement of the disturbance level shall be repeated. After the measurement, the normal operating condition of the network shall subsequently be restored.

If all these provisions do not lead to a better carrier-to-interference ratio, it shall be assumed that the interfering signals intrude into the cable network. Then the interfering field strength outside the building shall be measured in the vicinity of the assumed point of penetration. The maximum field strength shall be determined by changing the site of the antenna. The field strength limit at which the carrier-to-interference ratios according to Table 4 shall be met is indicated in Table 3.

If the interfering field strength is equal to or lower than this value, the network does not meet the requirements.

If the measured interfering field strength exceeds this value then this problem should be referred to the national regulatory authorities.

5 Performance requirements

5.1 General conditions

The relevant conditions in the sense of good engineering practice applicable to cable networks to meet the values specified in 5.2 and 5.3 are as follows:

- professional planning;
- compliance with the requirements of the EN 50083 series, EN 60728 series and EN 50117 series;
- use of suitable equipment, components (plugs, connectors etc.) and coaxial cables fulfilling these standards or use of such equipment which can be deemed suitable on the basis of the details of the technical data sheets;
- correct installation of all parts of network equipment including the provision of appropriate connections between cables, plugs and equipment. Therefore, only suitable connections for plugs and clamps shall be used. The installation instructions of the manufacturer of the equipment and components shall be considered.

Furthermore, to allow presumption of conformance to the EMC Directive, wire-line telecommunications networks using coaxial cables shall comply with the requirements of EN 50529-2. Therefore, to fulfil these requirements, cable network equipment shall comply with the requirements of EN 50083-2 regarding limits of radiation and of immunity to external fields.

5.2 Radiation from cable networks and other sources

5.2.1 General

Cable networks are operated in a general EMC environment that may be influenced by a large number of equipment and systems the EMC behaviour of which is described in different harmonized product standards (e.g. EN 55013, EN 55022, …). Therefore, it might be difficult or even impossible to distinguish between the different sources of disturbances.

The maximum permitted radiation levels, given in Table 1, shall apply according to the method of measurement specified in 4.2. In addition, National regulations for the protection of specific services may apply and replace values in Table 1 and Table 2. Reference is made to Annex A.

5.2.2 Measurement of the total radiation

For the measurement of the radiation (caused by a cable network and/or all other possible disturbance sources) the total radiation level is measured with a receiver having a quasi-peak detector respectively a peak detector and measuring bandwidths as stated in Table 1 (according to EN 55016-1-1 and EN 55016-1-4).

Table 1 – Limits of total radiation

Frequency range MHz	Field strength limits at 3 m distance dB(µV/m)	Measuring bandwidth kHz	Measuring detector
30 to 1 000 [a]	40	120	Quasi-peak
950 [b] to 2 500	50	1 000	Peak
2 500 to 3 500	64	1 000	Peak

[a] Applicable for cable networks with an upper frequency limit of up to 1 000 MHz

[b] Applicable for cable networks with a lower frequency limit of 950 MHz (SAT-IF distribution network)

5.2.3 Measurement of narrowband radiation

If during the measurement of the total radiation according to 5.2.2 a significant contribution of single carrier disturbance is observed, the measurements shall be repeated and the radiation limits according to Table 2 shall apply.

Table 2 – Narrowband radiation limits

Frequency range MHz	Field strength limits at 3 m distance dB(µV/m)	Measuring bandwidth kHz	Measuring detector
30 to 1 000 [a]	27	120	Quasi-peak
950 [b] to 2 500	50	1 000	Peak
2 500 to 3 500	64	1 000	Peak

[a] Applicable for cable networks with an upper frequency limit of 1 000 MHz

[b] Applicable for cable networks with a lower frequency limit of 950 MHz (SAT-IF distribution network)

For single carrier measurements, also other receivers can be used.

To determine the radiation disturbance power of a cable network apply the following calculation using Formula (2).

$$p_U = u_S - a_S - a_c - c_r + G_D + 4\text{ dB} \qquad (2)$$

where

p_U is the calculated radiated disturbance power level in dB(pW);

u_S is the voltage level at the signal generator output in dB(µV) at 50 Ω;

a_S is the attenuation of the attenuator at the antenna feed point in dB;

a_c is the attenuation of the connector cable between the signal generator and the substitution antenna in dB;

c_r is the conversion factor for converting the power level at the feed point of a tuned half-wave dipole (the substitution antenna) to the power corresponding to the RMS radiated disturbance power:

$$c_r = 10 \log Z_{Fp} \text{ dB}(\Omega) \tag{3}$$

the conversion factor for a feed point impedance of Z_{Fp} = 50 Ω is c_r = 17 dB; the losses of the balun are regarded as negligible;

G_D gain of the substitution antenna relative to a half-wave dipole;

4 dB correction factor accounting for the reflection from the wall in front of which the measurement is made.

5.3 Immunity of cable networks

Table 3 details the maximum expected field strength levels immediately outside the building. These levels should be used to determine a defined RF carrier-to-interference ratio (performance criterion as specified in Table 4) to be obtained in the wanted channel at any point in the cable network. Immunity requirements for equipment are specified in EN 50083-2. These requirements however cannot be directly applied to cable networks consisting of several connected equipment and components.

Table 3 – Maximum expected field strength

Frequency range MHz	**Field strength** dB(µV/m)
0,15 to 1 000 [a]	106
790 to 862	120 [c]
950 [b] to 3 500	106

[a] Applicable for cable networks with an upper frequency limit of up to 1 000 MHz

[b] Applicable for cable networks with a lower frequency limit of 950 MHz (SAT-IF distribution network)

[c] In cases where digitally modulated wanted signals are applied

NOTE The interdependence between the maximum allowable field strength and the minimum carrier-to-interference ratio according to EN 60728-1 is given in the informative Annex C.

The performance criteria for the cable networks refer to AM-VSB-TV or QAM-DVB signals in the frequency range 30 MHz to 1 000 MHz and to FM-TV signals in the frequency range 950 MHz to 3 500 MHz.

Where other signals (e.g. digitally modulated signals) are distributed, the lower permissible carrier-to-interference ratios of these signals shall lead to a higher immunity of the cable network.

The method of measurement shall be chosen as specified in 4.3.2.

Table 4 – Required carrier-to-interference ratio

Frequency range MHz			**Carrier-to-interference ratio** dB
5	to	30	currently undefined
30	to	1 000 [a]	≥ 57 (AM) ≥ 35 (64/256 QAM)
950 [b]	to	3 500	≥ 33 (FM) ≥ 13 (QPSK)

[a] Applicable for cable networks with an upper frequency limit of 1 000 MHz

[b] Applicable for cable networks with a lower frequency limit of 950 MHz (SAT-IF distribution network)

Annex A
(informative)

A-deviations

A-deviation: National deviation due to regulations, the alteration of which is for the time being outside the competence of the CENELEC national member.

This European Standard does not fall under any directive of the EU.

In the relevant CENELEC countries these A-deviations are valid instead of the provisions of the European Standard until they have been removed.

A.1 United Kingdom

A.1.1 Regulation

The methods of measurement for radiation from networks as described in Clause 4 of this European Standard as well as the performance requirements according to Clause 5 of this European Standard are replaced by the following regulation:

MPT 1510: Radiation Limits and Measurement Standard; Electromagnetic radiation from cabled distribution systems operating in the frequency range 30 – 1000 MHz; May 1984 (Revised 1989 + 1997 + 1999)

A.1.2 Principle

The method describes the measurement of radiation from complete systems at the distribution frequencies in use and at other relevant frequencies as covered in A.1.4.

A.1.3 Equipment

A.1.3.1 A field strength measuring set complying with BS 727 (1983) [1] and with frequency and sensitivity ranges appropriate to the system under examination.

A.1.3.2 Calibrated dipole antennas covering the frequency range 30 MHz to 1 000 MHz, suitable for connection to the field strength measuring set.

A.1.3.3 A four meter non-metallic mast with accessories suitable for mounting and orienting dipole antennas in the horizontal and vertical planes.

A.1.3.4 A low noise broadband preamplifier with a minimum of 20 dB gain.

A.1.3.5 A tuneable bandpass filter to prevent local off-air signals overloading the preamplifier.

NOTE The test equipment and interconnections used shall be well matched and correctly terminated.

A.1.4 Measurement frequencies

Measurement shall be at the highest and lowest vision carrier frequency used in each band (but see the note below) and a selection of intervening frequencies chosen to give a realistic representation of the radiation level over the operating frequency range.

Measurements should also be made at frequencies where harmonically related products of the signal frequencies, or of frequency converters, may be expected to lie. Particular attention should be given to those harmonically related products that fall in prohibited bands.

NOTE Except when this frequency occurs in an off-air channel, in which case the next higher or lower vision carrier frequency should be used.

A.1.5 Procedure

A.1.5.1 Ensure that the cabled system is operating with normal signal levels at the subscriber's outlets. If the stream is interactive, typical levels of reverse path (upstream) signalling should be maintained during the tests.

A.1.5.2 With the equipment connected as shown in Figure A.1 carry out a mobile survey of the cabled system at the frequencies given in A.1.4 using vertical and horizontal polarisation of the monitoring antenna.

NOTE 1 A check shall first be made to ensure that signals other than those being monitored do not materially affect the measurements.

NOTE 2 For horizontal polarisation, the dipole should have its elements in line with the direction of travel.

A.1.5.3 Identify those locations within the cabled system area where the radiation appears excessive, and the frequency at which this occurs.

A.1.5.4 Determine the median value of the cabled system radiation at these locations using the following procedure.

A.1.5.5 Tune the bandpass filter to the frequency to be monitored.

A.1.5.6 Adjust the length of the dipole to $\lambda/2$ at the frequency to be monitored.

A.1.5.7 Rotate the dipole to achieve vertical polarisation.

A.1.5.8 Position the mast such that the centre of the dipole is 4 m above ground level and a minimum of 10 m from the system.

A.1.5.9 Record the field strength reading (allowing for any correction factors provided by the antenna and instrument manufacturers). The measurements shall be taken at 21 random sample points over a total measurement distance of 30λ m and at a minimum distance of 10 m from the system.

NOTE 3 For vision carriers the field strength shall be expressed in terms of the RMS value at the peak of the modulation envelope.

A.1.5.10 Repeat the procedure from A.1.5.7 after adjusting the antenna for horizontal polarisation with its elements in line with the chosen sampling route.

A.1.6 Expression of results

Determine the median (50 percentile) value of the field strength at each location for vertical and horizontal polarisation of the monitoring antenna at the test frequency, taking into account the preamplifier gain, cable and filter losses.

NOTE The median value of the field strength is obtained by arranging the 21 samples in order of increasing magnitude. The eleventh sample value is then the median field strength.

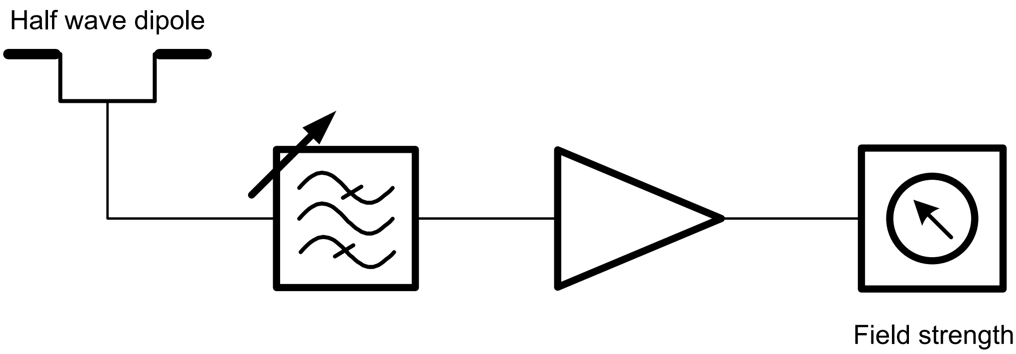


Figure A.1 – Arrangement of test equipment for the measurement of radiation from complete systems

A.1.7 Permitted limits

The median value determined for vertical and horizontal polarisation at each location shall not exceed the maximum field strengths given in Table A.1 for measurements at 10 m distance from the system or the proportionally reduced value, in accordance with the values given in Table A.2, for distances greater than 10 m.

A.1.8 Interpretation

In cases of doubt about the interpretation of this European Standard or the method of carrying out the measurements, the decision of the Radiocommunications Agency [1)] shall be final.

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Radiocommunications Agency
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189 Marsh Wall
London E14 9SX
Telephone: 020 7211 0335

Table A.1 – Radiation from complete systems: maximum permitted field strengths

Frequency range MHz	Maximum permitted interfering field strength at 10 m distance from the system dB(μV/m)
30 - 41	+26 [a]
41 - 50	+6
50 - 54	–8
54 - 68	+6
68 - 74,8	+6
74,8 - 75,2	Use prohibited [b]
75,2 - 108	+5 [a, c]
108 - 117,975	Use prohibited [b]
117,975 - 121,3	+29
121,3 - 121,7	Use prohibited [b]
121,7 - 136	+29
136 - 144	+6 [a]
144 - 146	–18
146 - 156,6	+6 [a]
156,6 - 157	Use prohibited [b]
157 - 225	+5
225 - 235	+21
235 - 242,8	+11
242,8 - 243,2	Use prohibited [b]
243,2 - 328,6	+11
328,6 - 335,4	Use prohibited [b]
335,4 - 400	+11
400 - 405,85	+21
405,85 - 406,25	Use prohibited [b]
406,25 - 425	+32 [a]
425 - 432	+12
432 - 440	–15
440 - 470	+12
470 - 854	+13 [a, c]
854 - 1 000	+18

[a] Where systems operate close to radio astronomy and space service stations, tighter radiation limits may be necessary in one or more of the frequency ranges 37,75 MHz - 38,25 MHz; 80,5 MHz - 82,5 MHz; 136 MHz - 144 MHz; 150,05 MHz - 153 MHz; 406,25 MHz - 410 MHz and 608 MHz - 614 MHz to protect such services.

[b] The use of vision, sound, pilot and narrow band data carriers and colour sub-carriers in this frequency range is prohibited. The radiated levels of any sidebands or any intermodulation products or spurious frequencies on the system falling within this frequency range shall not exceed - 21 dB(μV/m) at a distance of 10 m from the system. However, broadband digitally modulated signals with a noise-like characteristic are permitted provided that the radiated levels do not exceed - 59,0 dB(μV/m/√(Hz)) at a distance of 10 m from the system. This is equivalent to

- 10 dB(μV/m) in 8 MHz bandwidth,
- - 19 dB(μV/m) in 9 kHz bandwidth,
- - 23 dB(μV/m) in 4 kHz bandwidth.

[c] This limit will apply where distribution in a cabled system is on the same, or overlapping, frequencies as used for off-air television and FM radio reception in the area and at frequencies used by video cassette recorders. In cases where distribution in a cabled system is not on the same, or overlapping, frequencies as used for off-air reception, consideration may be given to a relaxation of this limit.

Table A.2 – Distance correction factor

Distance m	Reduction factor dB
15	3,5
20	6,0
25	8,0
30	9,5
NOTE Intermediate values of reduction factor should be obtained by interpolation.	

A.1.9 Bibliography of A.1

[1] BS 727 1983 *Specification for radio interference measuring apparatus*

A.2 United Kingdom

A.2.1 Regulation

The methods of measurement for radiation from networks as described in Clause 4 of this European Standard as well as the performance requirements according to Clause 5 of this European Standard are replaced by the following regulation:

MPT 1520: Radiation Limits and Measurement Standard; Electromagnetic radiation from cabled distribution systems operating in the frequency range 300 kHz – 30 MHz; July 1984 (Revised 1989 + 1997 + 1998)

A.2.2 Principle

The method describes the measurement of electromagnetic radiation from complete systems at the distribution frequencies in use and at other relevant frequencies as covered in A.2.4.

A.2.3 Equipment

A.2.3.1 A field strength measuring set complying with BS 727 (1983) [1] and with frequency and sensitivity ranges appropriate to the system under examination.

A.2.3.2 A calibrated loop antenna covering the frequency range 300 kHz to 30 MHz, with sensitivity such that when connected to the receiver the system is capable of measuring field strengths down to 0 dB(μV/m).

A.2.3.3 A tripod or other suitable means of mounting the loop antenna at a height of between 1,5 m and 2 m above ground level in the vertical plane, with a facility for orientating the loop in the horizontal plane.

NOTE The test equipment and interconnections used shall be well matched and correctly terminated.

A.2.4 Measurement frequencies

Measurements shall be taken at the highest and lowest significant carrier frequencies in use and at a selection of intervening frequencies chosen to give a realistic representation of the radiation level over the frequency range 300 kHz to 30 MHz (but see the Note below). Measurements shall also be taken at frequencies where harmonically related products of the signal frequencies, or of frequency converters, may be expected to lie. Particular attention should be given to those harmonically related products that fall in prohibited bands.

NOTE Except when this frequency occurs in an off-air channel, in which case the next higher or lower carrier frequency should be used.

A.2.5 Procedure

A.2.5.1 Ensure that the cabled system is operating with normal signal levels at the subscriber's outlets. If the system is interactive, typical levels of reverse path (upstream) signalling should be maintained during the tests.

A.2.5.2 Using the calibrated loop antenna and measuring receiver carry out a mobile survey of the cabled system at the frequencies indicated in A.2.4. The loop antenna should be mounted vertically and orientated for maximum signal pick up as indicated on the field strength-measuring receiver.

NOTE 1 A check shall first be made to ensure that signals other than those being measured do not materially affect the results.

A.2.5.3 Identify those locations within the cabled system area where the radiation appears excessive, and the frequency at which this occurs.

A.2.5.4 Determine the electromagnetic field strength level of the radiation emanating from the cabled system at these locations using the following procedure.

A.2.5.5 Mount the loop antenna vertically on a tripod or other supporting structure with the base of the antenna at a height of between 1,5 m and 2 m above ground level, at a minimum distance of 10 m from the system.

A.2.5.6 Rotate the loop antenna in the horizontal plane for maximum signal pick up as indicated on the field strength-measuring receiver.

A.2.5.7 Record the field strength reading (allowing for any correction factors provided by the antenna and instrument manufacturers). Take two further field strength measurements at approximately one metre either side of the first at the same distance from the source.

A.2.5.8 If the last two results do not differ from the first by more than 1,0 dB, then record the first reading as the radiated field at that location.

A.2.5.9 If the field strengths measured deviate by more than 1,0 dB, then record a median field strength value derived from the three measurements.

NOTE 2 The field strength should be expressed in dB(μV/m).

NOTE 3 For vision carriers the field strength shall be expressed in terms of the RMS value at the peak of the modulation envelope.

A.2.6 Permitted limits

The field strength value obtained at each location shall not exceed the maximum field strengths given in Table A.3 for measurements at 10 m distance from the system or the proportionally reduced value, in accordance with the values given in Table A.4, for distances greater than 10 m.

A.2.7 Interpretation

In cases of doubt regarding the interpretation of this European Standard or the method of carrying out the measurements, the decision of the Radiocommunications Agency [2)] shall be final.

Table A.3 – Radiation from complete systems: maximum permitted field strengths

Frequency range kHz	**Maximum permitted interfering field strength at 10 m distance from the system** dB(μV/m)
300 - 499	26
499 - 505	Use prohibited
505 - 2173,5	20
2173,5 - 2190,5	Use prohibited
2190,5 -30 000	20

Table A.4 – Distance correction factor

Distance m	**Reduction factor** dB				
	300 kHz- 1,6 MHz	1,6 MHz- 2 MHz	2 MHz- 3,3 MHz	3,3 MHz- 5 MHz	5 MHz- 30 MHz
15	7,0	7,0	7,0	7,0	3,5
20	12,0	12,0	12,0	9,5	6,0
25	16,0	16,0	14,0	11,5	8,0
30	19,0	17,5	15,5	13,0	9,5
NOTE Intermediate values of reduction factor should be obtained by interpolation.					

A.2.8 Bibliography of A.2

[1] BS 727 1983 *Specification for radio interference measuring apparatus*

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A.3 Finland

A.3.1 In Finland, based on Radio Act and Telecommunications Market Act the Telecommunications Administration Centre can restrict or prohibit the use of certain channels in cable networks for the reason that radiation from the network causes excessive interference to co-frequency radiocommunications, even if the network fulfils the radiation limits as stated in this European Standard.

A.3.2 In Finland, based on Telecommunications Market Act the Telecommunications Administration Centre can restrict or prohibit the use of certain channels in cable networks for the reason that the signal quality in the network will be degraded because of interference caused by leakage to the network of co-frequency radiocommunication signals.

A.3.3 Bibliography of A-deviation A.3

— Radio Act (517/88) section 12.

— Telecommunications Market Act (396/97) sections 37 and 38.

A.4 Germany

A.4.1 In Germany, according to Article 6(3) of the Act on Electromagnetic Compatibility of Equipment of 26 February 2008 the Federal Government is allowed to take special measures to protect radio receiving and transmitting stations operated in defined frequency ranges for safety purposes and public telecommunications networks from the effects of electromagnetic emissions. According to this Article 6(3) suitable and necessary measures have be taken in "Order on the protection of public telecommunications networks and radio receiving and transmitting stations operated in defined frequency ranges for safety purposes (Sicherheitsfunk-Schutzverordnung – SchuTSEV) of 13 May 2009" to protect safety-related radio receiving and transmitting stations operating in defined frequency ranges from electromagnetic emissions, including precautionary measures.

A.4.2 The Order sets out requirements to be met by line-bound telecommunications equipment and networks in defined frequency ranges (Table A.5 and Table A.6).

Table A.5 – Protection of particular frequency ranges according to § 3 of the Order

Frequency range [MHz]	Application to be protected
2,850 - 3,155	Aeronautical communications
3,400 - 3,500	Aeronautical communications
3,800 - 3,950	Aeronautical communications
4,650 - 4,850	Aeronautical communications
5,450 - 5,730	Aeronautical communications
6,525 - 6,765	Aeronautical communications
8,815 - 9,040	Aeronautical communications
10,005 - 10,100	Aeronautical communications
11,175 - 11,400	Aeronautical communications
13,200 - 13,360	Aeronautical communications
15,010 - 15,100	Aeronautical communications
17,900 - 18,030	Aeronautical communications
21,924 - 22,000	Aeronautical communications

23,200	-	23,350	Aeronautical communications
30,350	-	30,750	MIL
34,350	-	35,810	Authorities and organizations with security tasks
38,450	-	39,850	Authorities and organizations with security tasks
43,300	-	45,250	MIL
46,000	-	47,000	MIL
74,205	-	77,485	Authorities and organizations with security tasks, Aeronautical navigation
84,005	-	87,265	Authorities and organizations with security tasks
108,000	-	137,000	Aeronautical communications, Aeronautical navigation
138,000	-	144,000	Aeronautical communications
165,200	-	165,700	Authorities and organizations with security tasks
167,550	-	169,390	Authorities and organizations with security tasks
169,800	-	170,300	Authorities and organizations with security tasks
172,150	-	173,990	Authorities and organizations with security tasks
240,250	-	270,25	Aeronautical communications
275,250	-	285,25	Aeronautical communications
290,250	-	301,25	Aeronautical communications
306,250	-	318,25	Aeronautical communications
328,250	-	345,25	Aeronautical navigation, Aeronautical communications
355,250	-	399,90	Authorities and organizations with security tasks, Aeronautical communications
443,59375	-	444,96875	Authorities and organizations with security tasks
448,59375	-	449,96875	Authorities and organizations with security tasks

Table A.6 – Field strength limit values at 3 m distance from line-bound telecommunications facilities and networks

Frequency				Field strength limit values (Peak) at 3 m distance dB(µV/m)	Measurement bandwidth
1.	9	to	150 kHz	40 - 20 x $\log_{10}$ (f/MHz)	200 Hz
2.	> 150	to	1 000 kHz	40 - 20 x $\log_{10}$ (f/MHz)	9 kHz
3.	> 1	to	30 MHz	40 - 8,8 x $\log_{10}$ (f/MHz)	9 kHz
4.	> 30	to	108 MHz	27 [a]	120 kHz
5.	> 108	to	144 MHz	18 [b] (27) [a]	120 kHz
6	> 144	to	230 MHz	27 [a]	120 kHz
7.	> 230	to	400 MHz	18 [b] (27) [a]	120 kHz
8.	> 400	to	1 000 MHz	27 [a]	120 kHz
9.	> 1	to	3 GHz	40 [c]	1 MHz

[a] The limit corresponds to an equivalent radiation power of 20 dB (pW).

[b] The limit of 18 dB (µV/m) is valid for all broadband digital line-bound broadcast signals. For all other signals the limit value is 27 dB (µV/m).

[c] This limit corresponds to an equivalent radiation power of 33 dB (pW).

A.4.3 Bibliography of A.4

Order on the protection of public telecommunications networks and radio receiving and transmitting stations operated in defined frequency ranges for safety purposes (Sicherheitsfunk-Schutzverordnung - SchuTSEV) of 9 May 2009 with respect to German Act on Electromagnetic Compatibility of Equipment, Article 6(3).

Annex B
(informative)

Frequency ranges of typical safety of life services

Table B.1 – Frequency ranges of typical safety of life services

Frequency range MHz	**Service**
74,800 to 75,200	Aeronautical radionavigation; ILS marker beacons
108,000 to 117,975	VOR and ILS localiser Aeronautical radionavigation;
121,450 to 121,550	Emergency Position Indicating Radiobeacons (EPIRBs)
156,525	DSC distress, safety, and calling
156,7625 to 156,8375	International marine distress, safety, and calling
242,950 to 243,050	EPIRBs
406,000 to 406,100	EPIRBs

In some areas, additional protection is also required for radio astronomy bands and other radio services.

Annex C
(informative)

Interdependence between the maximum allowable field strength and the minimum signal level at system outlet

For the purposes of this document, immunity of the cable network is expressed as a minimum carrier-to-interference ratio that is expected to be achieved for a specified wanted signal in the presence of an external (unwanted) field strength. Both parameters are interrelated and can be derived from each other if it is assumed that the cable network acts as a λ/2 dipole. In the worst case, the following parameters apply:

— minimum signal level of the wanted signal at the system outlet of the cable network as specified in EN 60728-1;

— minimum carrier-to-interference ratio for the wanted signal as specified in EN 60728-1;

— screening effectiveness of the used equipment as specified in EN 50083-2;

— coupling factor which represents the transformation of the external electromagnetic field into a disturbing signal. It varies with frequency over a wide range and is calculated as

$$A_f = -20 \cdot \lg\left[\frac{300/f}{2\pi}\right] \quad \text{with} \quad f \text{ in MHz} \qquad \text{(C.1)}$$

NOTE When measured in arbitrary points in the cable network, signal level and carrier-to-interference ratio can deviate from the above-mentioned parameters.

By taking into account normatively defined (a) or physically determined (b) parameters, a formula can be formed:

Minimum signal level at system outlet (a)	[dB(μV)]
Minus carrier-to-interference ratio (a)	[dB]
Plus screening effectiveness (a)	[dB]
Plus coupling factor at relevant frequency (b)	[dB(1/m)]
Results in maximum external field strength	[dB(μV/m)]

Depending on the actual situation of the network under test, additional parameters may be relevant:

— Tolerance margin
An adjustment of the minimum signal level to account for systematic uncertainties in the system design.

— Allowance for combination of equipment
An adjustment in the resulting allowable field strength to account for deviating characteristics of cable networks consisting of several equipment and components compared to the requirements for equipment as specified in EN 50083-2.

— Building penetration loss
Depending on the reference point where the external field strength is going to be measured and the location where the interference is entering the cable network, the building penetration loss may need to be accounted for by introducing an additional attenuation for the external field strength.

For illustration, an example calculation takes into account a cable network inside a building using analogue signals at a frequency of 166 MHz. The equipment complies with Class A and the field strength is going to be measured outside the building:

Minimum signal level (EN 60728-1)	60 dB(µV)
Minus tolerance margin	1 dB
Minus carrier-to-interference ratio (EN 60728-1)	57 dB
Plus screening effectiveness (EN 50083-2)	85 dB
Plus coupling factor at relevant frequency	11 dB(1/m)
Plus building penetration loss	8 dB
Maximum external field strength	106 dB(µV/m)

In another example calculation, a cable network inside a building uses digital signals at a frequency of 850 MHz. The equipment complies with Class A according to EN 50083-2 and the field strength is going to be measured inside the building:

Minimum signal level (EN 60728-1)	54 dB(µV)
Minus tolerance margin	2 dB
Minus carrier-to-interference ratio (EN 60728-1)	32 dB
Plus screening effectiveness (EN 50083-2)	75 dB
Plus coupling factor at relevant frequency	25 dB(1/m)
Plus building penetration loss	0 dB
Maximum external field strength	120 dB(µV/m)

Annex D
(informative)

Measurements in other distances than the standard distance of 3 m

D.1 Measurement at a reduced distance below 3 m

If the measurement distance is below 3 m, the distance to the telecommunication networks is determined by the geometrical extension of the loop antenna.

If the relevant limits call for a standard measurement distance of 3 m but this is not achievable, for example due to space limitations within buildings, a reduced measurement distance may be used. However, a minimum distance of 1 m has to be chosen. In this case, the measurement result is adjusted using the scaling factor in Formula (D.1).

$$E_{\text{dist}} = E_{\text{meas}} + 20\log\frac{d_{\text{meas}}}{d_{\text{Stand}}} \qquad \text{(D.1)}$$

where

E_{meas} is the measurement result in dB(µV/m);

E_{dist} is the corrected measurement result in dB(µV/m);

d_{meas} is the measurement distance in metres;

d_{Stand} is the standard distance (3 m).

D.2 Measurement at measurement distances above 3 m

If, owing to the local conditions, a measurement distance of more than 3 m must be used, then two measuring points are to be determined on an axis that is rectangular to the direction of the telecommunications cables to be measured. As a guide, the distance between the two measuring points should be as large as possible. The level is to be measured as described in 4.2. Decisive are the local conditions and the measurability of the disturbance field strength.

The measurement results in dB(µV/m) are to be plotted in a diagram over the logarithm of the distance. The straight line interconnecting the measurement results represents the decrease in the field strength in the direction measured. If the decrease in the field strength cannot be determined, additional measuring points shall be chosen. The field strength level at the standard measurement distance is to be read from the diagram using the interconnecting line.

Annex E
(informative)

GPS based leakage detection system for cable networks

E.1 General

GPS based leakage detection systems consist of the main functions described hereafter.

E.2 Automated data collection by driving through the HFC network

Surveying large areas of an HFC system can be done efficiently by monitoring the system with a vehicle-mounted leakage receiver and a roof-mounted antenna. This will quickly isolate the area from which the leak is radiating and will give the operator an indication of signal strength. While driving, the system automatically monitors the leakages and records the data with time and date stamp and the leak's GPS location.

E.3 Tagging of the signal

To be certain to associate the leak with the observed network, a tagged signal is fed into it. A tagged signal is a special low-frequency signal (about 20 Hz) modulated onto a carrier. This signal has no effect on the channel's video, but causes a distinctive response in specialised leakage detectors. These leakage detectors only respond if a tagged signal is detected, making them more immune to false triggering.

E.4 Post processing the collected data and visualisation of leakages

The collected date is processed by the Leakage Analysis Software, (LAS) which is installed on a server at the home base. As result, the LAS will show the location of the leakages on a map with the field strength in dBμV/m calculated 3 m from the source.

E.5 On site location of the leak

Once the position of the leak is determined, it is necessary to pinpoint the location on site using a hand-held leakage detector. Finding the source of a leak can usually be done with the monopolar antenna, affixed to the leakage detector. If the location of the leak cannot be determined by simply "walking it down," the operator may use a dipole antenna to triangulate the source.

Usually the LAS has also a workflow management system, where the finished case can be removed from the work orders.

Bibliography

EN 55013, *Sound and television broadcast receivers and associated equipment – Radio disturbance characteristics – Limits and methods of measurement (CISPR 13)*

EN 55022, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement (CISPR 22)*

EN 60966-2-4, *Radio frequency and coaxial cable assemblies – Part 2-4: Detail specification for cable assemblies for radio and TV receivers – Frequency range 0 MHz to 3 000 MHz, IEC 61169-2 connectors (IEC 60966-2-4)*

EN 60966-2-5, *Radio frequency and coaxial cable assemblies – Part 2-5: Detail specification for cable assemblies for radio and TV receivers – Frequency range 0 MHz to 1 000 MHz, IEC 61169-2 connectors (IEC 60966-2-5)*

EN 60966-2-6, *Radio frequency and coaxial cable assemblies – Part 2-6: Detail specification for cable assemblies for radio and TV receivers – Frequency range 0 MHz to 3 000 MHz, IEC 61169-24 connectors (IEC 60966-2-6)*

EN 61169-2, *Radio-frequency connectors – Part 2: Sectional specification – Radio frequency coaxial connectors of type 9,52 (IEC 61169-2)*

EN 61169-24, *Radio-frequency connectors – Part 24: Sectional specification – Radio frequency coaxial connectors with screw coupling, typically for use in 75 ohm cable networks (type F) (IEC 61169-24)*

IEC 60617 (all parts), *Graphical symbols for diagrams*

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