

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

Part 5: Headend equipment

ICS 33.060.40

National foreword

This British Standard is the UK implementation of EN 60728-5:2008. It is identical to IEC 60728-5:2007. It supersedes BS EN 50083-5:2002 which is withdrawn.

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

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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**Cable networks for television signals,
sound signals and interactive services -
Part 5: Headend equipment
(IEC 60728-5:2007)**

Réseaux de distribution par câbles
pour signaux de télévision,
signaux de radiodiffusion sonore
et services interactifs -
Partie 5: Equipements de tête de réseau
(CEI 60728-5:2007)

Kabelnetze für Fernsehsignale,
Tonsignale und interaktive Dienste -
Teil 5: Geräte für Kopfstellen
(IEC 60728-5:2007)

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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.

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CENELEC

European Committee for Electrotechnical Standardization
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Foreword

The text of document 100/1244/FDIS, future edition 2 of IEC 60728-5, 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 60728-5 on 2008-04-01.

This European Standard supersedes EN 50083-5:2001.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
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- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2011-04-01

For this European Standard the informative Annex D of IEC 60728-5:2007 shall be disregarded and has been replaced by the normative Annex ZB, *Special national conditions*.

Annexes ZA and ZB have been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60728-5:2007 was approved by CENELEC as a European Standard without any modification.

CONTENTS

INTRODUCTION.....	9
1 Scope.....	10
2 Normative references	12
3 Terms, definitions, symbols and abbreviations.....	13
3.1 Terms and definitions	13
3.2 Symbols	18
3.3 Abbreviations	18
4 Methods of measurement	20
4.1 Methods of measurement for digitally modulated signals	20
4.1.1 Introduction	20
4.1.2 Basic assumptions and measurement interfaces.....	20
4.1.3 Signal level for digitally modulated signals.....	20
4.2 Single-channel intermodulation specification for channel amplifier and frequency converter.....	22
4.3 Three-carrier intermodulation measurement	23
4.4 Two carrier intermodulation measurements for second- and third-order products	24
4.4.1 Introduction	24
4.4.2 Intermodulation products with test signals at frequencies f_a and f_b	25
4.4.3 Signal levels	25
4.5 Carrier-to-spurious signal ratio at the output.....	25
4.5.1 Carrier-to-spurious signal ratio at the output of equipment for AM-TV systems.....	25
4.5.2 Carrier-to-spurious signal ratio at the output of equipment for FM-TV systems.....	26
4.5.3 Shoulder attenuation	27
4.6 Signal-to-noise measurement.....	28
4.6.1 Television carrier-to-noise ratio (analogue modulated signals).....	28
4.6.2 RF signal-to-noise ratio ($S_{D,RF}/N$) for digitally modulated signals	31
4.7 Differential gain and phase for PAL/SECAM signals	33
4.7.1 Introduction	33
4.7.2 Differential gain (for PAL/SECAM only).....	33
4.7.3 Differential phase	34
4.8 Group delay measurements.....	37
4.8.1 Group delay variation of analogue TV signals	37
4.8.2 Procedure for the measurement of group delay variation on DVB channel converters	38
4.9 Phase noise of an RF carrier	41
4.9.1 Introduction	41
4.9.2 Equipment required	41
4.9.3 Connection of the equipment	41
4.9.4 Measurement procedure	42
4.9.5 Presentation of the results.....	42
4.10 Hum modulation of carrier	43
4.10.1 Definition	43

4.10.2	Description of the method of measurement	44
4.10.3	Measuring Procedure	45
4.10.4	Calculating the hum modulation ratio	46
4.11	2T-pulse response, <i>K</i> -factor	47
4.12	Chrominance-luminance delay inequalities (20T-pulse method).....	48
4.13	Luminance non-linearity	49
4.14	Intermodulation distortion (FM stereo radio)	50
4.14.1	Introduction	50
4.14.2	Equipment required	51
4.14.3	Connection of equipment.....	51
4.14.4	Measurement.....	51
4.15	Decoding margin (Teletext)	52
4.15.1	Definition	52
4.15.2	Method of measurement and measuring set-up (Figure 29)	52
4.15.3	Applicability of measuring set-up	52
5	Performance requirements and recommendations	53
5.1	Safety	53
5.2	Electromagnetic compatibility	53
5.3	Environmental	53
5.4	Marking	54
5.4.1	Marking of equipment	54
5.4.2	Marking of ports	54
6	Equipment characteristics required to be met	54
6.1	General	54
6.2	Power supply voltage	55
6.3	RF signal requirements	55
6.3.1	Impedance (input).....	55
6.3.2	Impedance (output)	55
6.3.3	Return loss (input, output) of equipment	55
6.3.4	Return loss (output) of headend	55
6.3.5	Typical back off for digital against analogue signals	56
6.3.6	Immunity against other signals in the FM radio and TV range	56
6.3.7	Carrier-to-spurious-signals ratio at output in the frequency range of 40 MHz to 862 MHz	56
6.3.8	Image rejection for AM TV and FM radio.....	56
6.3.9	Carrier to local oscillator signal ratio at the output for AM TV and FM radio	57
6.3.10	Frequency stability	57
6.3.11	Phase noise of digital modulated signals at the output of the headend	58
6.3.12	In-channel group delay variation for digital modulated signals	59
6.3.13	In-channel peak-to-peak amplitude response variation for digitally modulated signals.....	59
6.3.14	Stability of sound intercarrier	59
6.3.15	Stability of residual carrier amplitude	60
6.3.16	Frequency stability – SAT IF/IF converter	60
6.3.17	Typical modulation error ratio (MER) for a QAM signal	60
6.3.18	Minimum <i>C/N</i> values at the output of the headend	60
6.4	Composite video signal requirements	61
6.4.1	Impedance.....	61

6.4.2	Return loss	61
6.4.3	Signal voltage	61
6.4.4	Polarity	61
6.4.5	Offset voltage	61
6.5	Audio signal requirements	61
6.5.1	Input impedance	61
6.5.2	Output impedance	61
6.5.3	Signal level	62
6.6	Requirements for decoding margin (teletext)	62
6.7	IF signal requirements (AM-TV)	62
6.7.1	Impedance	62
6.7.2	Return loss	62
6.8	Antennas for terrestrial reception	62
6.8.1	Impedance	62
6.8.2	Return loss	62
6.9	Antenna amplifier	62
7	Equipment characteristics required to be published	63
7.1	General	63
7.2	Environmental conditions	63
7.3	Maximum permissible output level	63
7.4	Operating range for output level	64
7.5	TV standard	64
7.6	Clamp	64
7.7	Noise figure	64
7.7.1	Equipment without AGC	64
7.7.2	Equipment with AGC	65
7.8	Data control signals, description of interface	65
7.9	Output level stability for TV modulators, TV converters and pilot generators	65
7.10	Pilot signal	65
7.11	Differential gain and phase	66
7.11.1	Differential gain	66
7.11.2	Differential phase	66
7.12	Group delay variation for analogue TV signals	66
7.13	Luminance non-linearity	67
7.14	2T-pulse	67
7.15	20T-pulse	67
7.16	Hum modulation	67
7.17	Television carrier-to-noise ratio	67
7.18	Audio in TV	67
7.19	Processing units for FM radio	68
7.19.1	Audio input	68
7.19.2	Stereo crosstalk	68
7.19.3	Total harmonic distortion	68
7.19.4	Intermodulation distortion	68
7.19.5	Deviation, pre-emphasis	68
7.20	Antennas for terrestrial reception	68
7.20.1	Antenna gain	68
7.20.2	Sidelobe suppression	68
7.20.3	Return loss of antennas	68
7.21	Control signals for outdoor units	69

Annex A (normative) Definition of the specified test frequency range for return loss and noise figure	70
Annex B (informative) Audio connector for European system	72
Annex C (informative) Selectivity diagram for adjacent channel transmission	73
Annex D (informative) Differences in some countries	78
Annex E (normative) Correction factors for noise	79
Annex F (informative) Digital signal level and bandwidth	81
Annex G (informative) Minimum frequency distance of converted satellite signals in the IF range	84
Annex H (informative) Measurement errors which occur due to mismatched equipment	85
Annex I (normative) Correction factor for spectrum analyser	86
Annex ZA (normative) Normative references to international publications with their corresponding European publications	88
Annex ZB (normative) Special national conditions	90
Bibliography	87
Figure 1 – Example of headend	11
Figure 2 – Frequencies and levels of test carriers	23
Figure 3 – Test carrier and interfering products in the pass band	24
Figure 4 – Example showing products formed when $2 f_a > f_b$	25
Figure 5 – Carrier-to-spurious signal ratio in the output	26
Figure 6 – Carrier-to spurious signal ratio at the output	27
Figure 7 – Shoulder attenuation	27
Figure 8 – Arrangement of test equipment for carrier-to-noise ratio measurement	28
Figure 9 – Arrangement of test equipment for measurement of differential gain and phase	36
Figure 10 – Signal D2 waveform	36
Figure 11 – Example of modified staircase	36
Figure 12 – Measuring set-up for determining the group delay variation	37
Figure 13 – RF signal (time domain) amplitude-modulated with a split-frequency signal	38
Figure 14 – Spectral presentation of the group delay measurement	39
Figure 15 – Description of the measuring set-up	40
Figure 16 – Choices of measuring aperture (value of the split frequency) for various measurement tests	40
Figure 17 – Test set-up for phase noise measurement	42
Figure 18 – Mask for phase noise measurements	43
Figure 19 – Carrier/hum ratio	44
Figure 20 – Test set-up for equipment with built-in power supply	45
Figure 21 – Test set-up for equipment with external power supply	45
Figure 22 – Oscilloscope display	46
Figure 23 – K-factor mask for Quality Grade 2	47
Figure 24 – Generation of 20T-pulse	48
Figure 25 – Example of amplitude and delay error using 20T-pulse	49

Figure 26 – Staircase signal for measurement of luminance non-linearity before and after differentiation.....	50
Figure 27 – Example of a possible frequency combination displayed on a spectrum analyser.....	50
Figure 28 – Arrangement of test equipment for intermodulation distortion	51
Figure 29 – Principal measuring set-up for determination of decoding margin	52
Figure 30 – Example of diagram of NF , C/N or S/N for equipment with AGC	65
Figure A.1 – Test frequency range for TV channel processors	70
Figure A.2 – Test frequency range for sub-band, full-band, multi-band amplifier	70
Figure A.3 – Test frequency range for FM radio channel processor.....	71
Figure B.1 – Mechanical dimensions.....	72
Figure C.1 – Selectivity diagram	73
Figure C.2 – Selectivity diagram	74
Figure C.3 – Selectivity diagram	75
Figure C.4 – Group delay mask.....	75
Figure C.5 – Group delay pre-correction diagram.....	76
Figure C.6 – Selectivity diagram	76
Figure C.7 – Group delay mask.....	77
Figure C.8 – Selectivity diagram	77
Figure E.1 – Noise correction factor CF (dB) versus measured level difference D (dB)	80
Figure G.1 – Frequency tolerance of converted signals in the IF range	84
Figure H.1 – Error concerning return loss measurement	85
Figure H.2 – Maximum ripple	85
Table 1 – Test signal levels in decibels relative to reference level	22
Table 2 – Test signal levels in decibels relative to reference level	23
Table 3 – Test signal levels in decibels relative to reference level	26
Table 4 – Noise bandwidth.....	30
Table 5 – Frequency distances for phase noise measurement	42
Table 6 – Publications for environmental requirements of headend equipment.....	54
Table 7 – Return loss (input, output) of equipment.....	55
Table 8 – Return loss (output) of headend	56
Table 9 – Typical levels of digital signals with respect to analogue signals (back off).....	56
Table 10 – Carrier-to-spurious-signals ratio of digital modulated channel with respect to the peak level of an analogue TV carrier.....	56
Table 11 – Frequency stability for AM TV related to the nominal AM TV frequency	57
Table 12 – Long-term frequency stability for digital modulated signals	57
Table 13 – Shoulder attenuation for digital modulated signals.....	58
Table 14 – Phase noise of a DVB signal (PSK and QAM).....	58
Table 15 – Phase noise of a DVB signal (OFDM).....	58
Table 16 – In-channel group delay variation for digital modulated signals	59
Table 17 – In-channel peak-to-peak amplitude response variation of DVB signals	59
Table 18 – Stability of sound intercarrier.....	59
Table 19 – Stability of residual carrier amplitude.....	60
Table 20 – Frequency stability – SAT IF/IF converter	60

Table 21 – Minimum requirements for MER for different QAM modulation schemes	60
Table 22 – C/N values for converters at the headend output	60
Table 23 – Return loss	61
Table 24 – Signal voltage	61
Table 25 – Signal level	62
Table 26 – Requirements for decoding margin (Teletext)	62
Table 27 – Return loss – IF signal	62
Table 28 – Return loss – Antennas for terrestrial reception	62
Table 29 – Recommended temperature ranges	63
Table 30 – Carrier-to-third-order intermodulation ratio for maximum output level of channel amplifiers/frequency converters	63
Table 31 – Carrier-to-third-order intermodulation ratio for maximum output level of sub-band, full band, multi-band amplifiers and multi-channel frequency converters for AM TV (not for channel amplifier)	63
Table 32 – Carrier-to-second-order intermodulation ratio for maximum output level of sub-band, full band, multi-band amplifiers and frequency converters for AM TV or FM radio (not for channel amplifier)	64
Table 33 – Carrier-to-intermodulation ratio for maximum output level of FM-TV channel amplifiers/frequency converters	64
Table 34 – Carrier-to-third-order intermodulation ratio for maximum output level of FM TV full band, sub-band amplifiers	64
Table 35 – Output level stability for TV modulators and TV converters	65
Table 36 – Recommendation for differential gain	66
Table 37 – Recommendation for differential phase	66
Table 38 – Recommendation for group delay variation	66
Table 39 – Recommendation for luminance non-linearity	67
Table 40 – K-factor masks for 2T-pulse responses	67
Table 41 – Recommendations for sidelobe suppression	68
Table 42 – Recommendation for return loss of antennas	68
Table B.1 – Mechanical dimensions	72
Table B.2 – Pin and signal allocation	72
Table B.3 – Application	72
Table C.1 – Selectivity table	74
Table C.2 – Group delay pre-correction table	76
Table E.1 – Noise correction factor	79
Table F.1 – Examples of bandwidths for digital modulation techniques	83

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

- CATV¹-networks,
- MATV-networks and SMATV-networks,
- individual receiving networks

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

The extent of this standardisation 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 standardisation 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 This word encompasses the HFC networks used nowadays to provide telecommunications services, i.e. data, audio and video both broadcast and narrowcast.

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

Part 5: Headend equipment

1 Scope

This part of IEC 60728 defines the characteristics of equipment used in the headends of terrestrial broadcast and satellite receiving systems (without satellite outdoor units and without those broadband amplifiers in the headend as described in IEC 60728-3). The satellite outdoor units for FSS are described in ETSI ETS 300 158, for BSS in ETSI ETS 300 249. Test methods for both types (FSS and BSS) of satellite outdoor units are laid down in ETSI ETS 300 457.

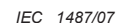
This standard

- covers the frequency range 5 MHz to 3 000 MHz,
- identifies performance requirements for certain parameters,
- lays down data publication requirements for certain parameters,
- stipulates methods of measurements;
- introduces minimum requirements defining quality grades (Q-grades).

This standard defines the overall characteristics for upstream/downstream signals between external sources/sinks (for example, antennas, cable modem termination systems, etc.) and the system interface to the cable network. In the case of modular headend systems, also single equipment as modulators, converters, etc. are described. Cable modem termination systems, encrypters, decrypters, etc. are not described in this standard. If such equipment is used in headends, the relevant parameters for RF, video, audio and data interfaces should be met.

According to the definitions in 3.1, the headends are divided into the following three quality grades:

- Grade 1: central headend;
- Grade 2: hub headend or hubsite;
- Grade 3: MATV headend/individual reception headend.



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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 60068 (all parts), *Environmental testing*

IEC 60130-9, *Connectors for frequencies below 3 MHz – Part 9: Circular connectors for radio and associated sound equipment*

IEC 60244-5, *Methods of measurement for radio transmitters – Part 5: Performance characteristics of television transmitters*

IEC 60417, *Graphical symbols for use on equipment*

NOTE IEC 60417 can be consulted on the IEC website.

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60617, *Graphical symbols for diagrams*

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

IEC 60728-2, *Cabled distribution systems for television and sound signals – Part 2: Electromagnetic compatibility for equipment*

IEC 60728-3, *Cable networks for television signals, sound signals and interactive services – Part 3: Active wideband equipment for coaxial cable networks*

IEC 60728-11, *Cable networks for television signals, sound signals and interactive services – Part 11: Safety*

IEC 61319-1, *Interconnections of satellite receiving equipment – Part 1: Europe*

ISO/IEC 13818-1, *Information technology – Generic coding of moving pictures and associated audio information: Systems*

ISO/IEC 13818-2, *Information technology – Generic coding of moving pictures and associated audio information: Video*

ISO/IEC 13818-3, *Information technology – Generic coding of moving pictures and associated audio information – Part 3: Audio*

ISO/IEC 13818-4, *Information technology – Generic coding of moving pictures and associated audio information – Part 4: Conformance testing*

ITU-R Recommendation BS.468-4, *Measurement of audio-frequency noise voltage level in sound broadcasting*

ITU-R Report BT.624-4, *Characteristics of television systems*

ITU-T Recommendation J.61, *Transmission performance of television circuits designed for use in international connections*

ITU-T Recommendation J.101, *Measurement methods and test procedures for teletext signals*

ETSI EN 300 421, *Digital Video Broadcasting (DVB): Framing structure, channel coding and modulation for 11/12 GHz satellite services*

ETSI EN 300 429, *Digital Video Broadcasting (DVB): Framing structure, channel coding and modulation for cable systems*

ETSI EN 300 468, *Digital Video Broadcasting (DVB): Specification for Service Information (SI) in DVB systems*

ETSI EN 300 473, *Digital Video Broadcasting (DVB): Satellite Master Antenna Television (SMATV) distribution systems*

ETSI EN 300 744, *Digital Video Broadcasting (DVB): Framing structure, channel coding and modulation for digital terrestrial television*

ETSI EN 302 307, *Digital Video Broadcasting (DVB): Second generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications*

ETSI ETS 300 163, *Television systems; NICAM 728: Specification for transmission of two-channel digital sound with terrestrial television systems B, G, H, I and L*

ETSI TR 101 211, *Digital Video Broadcasting (DVB): Guidelines on implementation and usage of Service Information (SI)*

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

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

NOTE Terms and definitions defined in the IEC (IEC 60050-312, IEC 60050-702, IEC 60050-713, IEC 60050-723) are used as far as possible.

3.1.1

amplitude frequency response

gain or losses of an equipment or system plotted against frequency

3.1.2

antenna preamplifier

amplifier (often a low noise type) associated with an antenna

3.1.3

attenuation

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

[IEV 312-06-06, modified]

3.1.4

automatic gain control (AGC)

automatic control of an equipment to maintain the level of the signal at its output constant, using the signal to be controlled as the control stimulus

[IEV 702-09-30, modified]

3.1.5**back-off**

nominal difference of the lower level to a higher reference level

3.1.6**carrier-to-intermodulation ratio (C/I)**

difference in decibels between the carrier level at a specified point in a system or in an equipment and the level of a specified intermodulation product or combination of products

3.1.7**carrier-to-noise ratio (C/N)**

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

[IEV 713-11-21, modified]

3.1.8**combiner**

equipment in which the signals arriving at two or more input ports are fed to a single output port

NOTE Some forms of this equipment may be used in the reverse direction as splitters.

3.1.9**composite intermodulation noise (CIN)**

sum of noise and intermodulation products from digital modulated signals

3.1.10**composite intermodulation noise ratio (CINR)**

ratio of the signal level and the CIN level

3.1.11**decibel ratio**

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

$$10 \lg \frac{P_1}{P_2} \text{ [dB]} \quad (1)$$

3.1.12**frequency converter**

equipment for changing the carrier frequency of one or more signals

3.1.13**gain**

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

[IEV 702-02-11, modified]

3.1.14**grade**

classification of performance for equipment for the use in cable networks. The choice of the appropriate grade is depending on, for example,

- size of network
- structure of network
- lengths of cable between equipment
- kind of services

– kind of signals

NOTE The essential requirement is that the system performance specification is fulfilled by the design of the network and choice of the grade of equipment used.

3.1.15 headend

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

[IEV 723-09-11, modified]

NOTE The headend may, for example, comprise antenna amplifiers, frequency converters, combiners, separators and generators.

3.1.16 headend for individual reception

headend supplying an individual household; this type of installation may include one or more system outlets

3.1.17 hub headend (hubsite)

headend used to feed the entire operating network in the service area (local distribution) via multiple optical or RF trunks; the hubsite has no local signal acquisition

3.1.18 image carrier power

"power", in relation to a vision-modulated carrier, is defined as the power at the peak of the modulation envelope (i.e. the maximum RMS voltage squared, divided by the resistance)

3.1.19 intermodulation

process whereby the non-linearity of equipment in a system produces spurious output signals (called intermodulation products) at frequencies which are linear combinations of those of the input signals

[IEV 702-07-64, modified]

3.1.20 landline link (cable or radio)

point-to-point or point-to-multipoint connection to headends

3.1.21 level

level of any power P_1 is the decibel ratio of that power to the standard reference power P_n , i.e.

$$10 \lg \frac{P_1}{P_0} \quad (2)$$

level of any voltage U_1 is the decibel ratio of that voltage to the standard reference voltage U_0 , i.e.

$$20 \lg \frac{U_1}{U_0} \quad (3)$$

NOTE This may be expressed in decibels (relative to 1 μV in 75 Ω) or more simply in dB(μV) if there is no risk of ambiguity.

3.1.22**local headend**

headend having stand-alone signal acquisition or fed from central headend; distribution to hubsites via optical or RF trunks and possibly some local area distribution

3.1.23**MATV headend**

headend used in blocks of flats and in built-up sites to feed TV channels and FM radio channels into the house network or the spur network

3.1.24**modulation error ratio (MER)**

sum of the squares of the magnitudes of the ideal symbol vectors divided by the sum of the squares of the magnitudes of the symbol error vectors of a sequence of symbols

$$MER = 10 \lg \left\{ \frac{\sum_{j=1}^N (I_j^2 + Q_j^2)}{\sum_{j=1}^N (\delta I_j^2 + \delta Q_j^2)} \right\} \quad [\text{dB}] \quad (4)$$

The result is expressed as a power ratio in dB.

3.1.25**MPEG-2**

refers to the ISO/IEC 13818 series. System coding is defined in ISO/IEC 13818-1, video coding in ISO/IEC 13818-2, audio coding in ISO/IEC 13818-3

3.1.26**multiplex**

stream of all the digital data carrying one or more services within a single physical channel

3.1.27**out-of-band emissions**

emissions on a frequency or on frequencies immediately outside the necessary bandwidth, which results from the modulation process, but excluding spurious emissions

3.1.28**phase noise**

phase instability of random nature; The sources of random sideband noise in an oscillator are thermal noise, flicker noise and shot noise.

NOTE Each time the signal is frequency processed, this signal is degraded by an addition of phase noise due to phase noise of the local oscillator. Frequency converters or modulators generate phase noise.

3.1.29**central headend**

headend from which signals are delivered to a local headends via a long-distance terrestrial link; no local distribution

3.1.30**satellite master antenna television system (SMATV)**

system which is designed to provide sound and television signals to the households of a building or group of buildings. Two system configurations are defined in ETSI EN 300 473 as follows:

- SMATV system A, based on transparent transmodulation of QPSK satellite signals into QAM signals to be distributed to the user;

- SMATV system B, based on direct distribution of QPSK signals to the user, with two options:
 - SMATV-IF distribution in the satellite IF band (above 950 MHz);
 - SMATV-S distribution in the VHF/UHF band, for example in the extended S-band (230 MHz to 470 MHz)

3.1.31

$S_{D,RF}/N$

signal-to-noise ratio for a digitally modulated signal intended in the RF band

3.1.32

service information (SI)

digital data describing the delivery system, content and scheduling/timing of broadcast data streams, etc. including MPEG-2 PSI together with independently defined extensions

3.1.33

shoulder attenuation

ratio between signal and spectrum re-growth outside channel

3.1.34

spurious emissions

emissions on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information, including harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products but excluding out-of-band emissions

3.1.35

standard reference power and voltage

in cable networks, 1/75 pW

NOTE 1 This is the power dissipated in a 75 Ω resistor with an RMS voltage drop of 1 μ V across it.

NOTE 2 The standard reference voltage U_0 is 1 μ V.

3.1.36

subscriber equipment

equipment at the subscriber premises such as receivers, tuners, decoders, video recorders

3.1.37

symbol rate stability

short-term variation of symbol rate due to signal processing; for instance, caused by zero packet stuffing in headend equipment

3.1.38

transport stream (TS)

data structure defined in ISO/IEC 13818-1 which is the basis of the digital video broadcasting (DVB) related standards

3.1.39

unwanted emissions

consisting of spurious and out-of-band emissions

3.1.40

well-matched

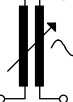
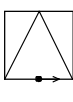
matching condition when the return loss of the equipment complies with the requirements of Table 3 of IEC 60728-3

NOTE Through mismatching of measurement instruments and the measured equipment, measurement errors are possible. Comments on the estimation of such errors are given in Annex H.

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.

NOTE Numbers in brackets ([]) refer to symbols in IEC 60617.

Symbols	Terms	Symbols	Terms
	voltmeter [IEC 60617-S00059(2001:07)] [IEC 60617-S00913(2001:07)]		spectrum analyser [IEC 60617-S00059(2001:07)] [IEC 60617-S00910(2001:07)]
	variable generator [IEC 60617-S00081(2001:07)] [IEC 60617-S01225(2001:07)] [IEC 60617-S01403(2001:09)]		ampere meter [IEC 60617-S00059(2001:07)] [IEC 60617-S00910(2001:07)]
	equipment under test [IEC 60617-S00059(2001:07)]		variable attenuator [IEC 60617-S01245(2001:07)]
	high pass filter [IEC 60617-S01247(2001:07)]		oscilloscope [IEC 60617-S00059(2001:07)], [IEC 60617-S00922(2001:07)]
	band pass filter [IEC 60617-S01249(2001:07)]		low pass filter [IEC 60617-S01248(2001:07)]
	frequency converter [IEC 60617-S00213(2001:07)]		band stop filter [IEC 60617-S01250(2001:07)]
	splitter		amplifier [IEC 60617-S01239(2001:07)]
	tap		pilot generator
	adjustable AC voltage source		modulator [IEC 60617-S01278(2001:07)]
	detector with LF-amplifier [IEC 60617-S00641(2001:07)] [IEC 60617-S01239(2001:07)]		demodulator [IEC 60617-S01278(2001:07)]
	ground [IEC 60617-S00200(2001:07)]		variable resistor [IEC 60617-S00557(2001:07)]

3.3 Abbreviations

AC	alternating current	AF	audio frequency
AFC	automatic frequency control	AGC	automatic gain control
ALC	automatic level control	AM	amplitude modulation
BER	bit error ratio	BSS	broadcast satellite services
BW	bandwidth	C/N	carrier to noise (ratio)
CATV	community antenna television (system)	CH	channel
CIN	composite intermodulation noise	CINR	composite intermodulation noise ratio

CMTS	cable modem termination system	COFDM	coded orthogonal frequency division multiplexing
CPE	common phase error	CW	continuous wave
DVB	digital video broadcasting	DVB-C	Digital video broadcasting, cable
DVB-S	Digital video broadcasting, satellite	EMC	electromagnetic compatibility
EUT	equipment under test	FM	frequency modulation
FSS	fixed satellite services	HEC	headend controller
HP	high pass	ICI	inter-carrier interference
IF	intermediate frequency	INA	interactive network adaptor
IP class	international protection class	ITS	insertion test signal
LF	low frequency	LNC	low noise converter
LP	low pass	LUM NL	luminance non-linearity
MATV	master antenna television (system)	MER	modulation error ratio
MMDS	microwave multichannel distribution systems	MPEG	motion picture experts group
MTBF	meantime between failure	MVDS	multichannel video distribution system
NF	noise figure	NICAM	near-instantaneously companded audio multiplex
OFDM	orthogonal frequency division multiplexing	PAL	phase alternating line
PSK	phase shift keying	Q grade(s)	quality grade(s)
QAM	quadrature amplitude modulation	QPSK	quaternary phase shift keying
RF	radio frequency	RMS	root mean square
RSBW	resolution bandwidth	S/N	signal to noise (ratio)
SAT IF	(1st) satellite intermediate frequency	SECAM	séquentiel couleur à mémoire
SHF	super high frequency	SI	service information
SMATV	satellite master antenna television (system)	TS	transport stream
T-STD	Transport Stream System Target Decoder	TV	television
TVRO	television receive only (system)	VCO	voltage-controlled oscillator
VHF	very high frequency	VSF-IF	vestigial sideband intermediate frequency

4 Methods of measurement

4.1 Methods of measurement for digitally modulated signals

4.1.1 Introduction

The methods of measurement for digitally modulated signals differ from those for analogue modulation for several reasons.

- a) The carrier is not present in the modulated signal and therefore cannot be measured (i.e. DVB systems using PSK or QAM modulation) or there are thousands of carriers (i.e. DVB systems using OFDM modulation).
- b) The modulated signal has a spectrum that is flat in the bandwidth and is similar to noise.
- c) The parameters that affect the quality of the received signal are related to the bit and word errors introduced by the channel (noise, amplitude and phase response inequalities, echoes, etc.) before demodulation and error correction.

4.1.2 Basic assumptions and measurement interfaces

The methods of measurement for digitally modulated signals are based on the assumption that

- a) the MPEG-2 TS is the specified input and output signal for all the baseline systems, i.e. for satellite, cable, SMATV, MMDS/MVDS and terrestrial distribution; as an alternative the MPEG-4 TS can be used as input and output signal for the baseline systems satellite, cable, and SMATV,
- b) the digitally modulated signals received by satellite are modulated in the PSK format, i.e. according to ETSI EN 300 421 and ETSI 302 307 for the QPSK format, or according to ETSI EN 302 307 for the 8PSK and APSK formats, and can be distributed in the same format in cable systems (SMATV systems),
- c) the digitally modulated signals received by satellite are distributed in CATV systems in the QAM format, i.e. according to ETSI EN 300 429,
- d) the digitally modulated signals received from terrestrial broadcasting in the OFDM format are distributed in SMATV/CATV systems in the same OFDM format; sometimes it is more efficient in terms of frequency economy to convert the signal to DVB-C as described in ETSI EN 300 429,
- e) an I/Q baseband signal source for PSK, QAM or OFDM formats is available, as described in IEC 60728-1; appropriate interfaces are accessible and are consistent with the DVB-SI documents (see ETSI TR 101 211 and ETSI EN 300 468),
- f) a reference receiver for PSK, QAM or OFDM formats is available (for details, see IEC 60728-1), where appropriate interfaces are indicated,
- g) the decoder implementation will not affect the consistency of the results. The MPEG-2 T-STD model constraints, as defined in ISO/IEC 13818-1 (MPEG-2 system), shall be satisfied as specified in ISO/IEC 13818-4 (MPEG-2 compliance testing).

4.1.3 Signal level for digitally modulated signals

4.1.3.1 Introduction

This measuring method applies to the measurement of the level of digitally modulated signals using QPSK (ETSI EN 300 421 and ETSI EN 302 307), 8PSK or APSK (ETSI EN 302 307), QAM (ETSI EN 300 429, ETSI EN 300 473), and COFDM (ETSI EN 300 744) formats.

Because the modulated signal is similar in characteristics to white noise, the measurement is based on the use of a suitable spectrum analyser, able to tune the frequency range of the channel and to display the whole bandwidth, to measure spectral power density. The result

may be expressed as dB(mW/Hz). The signal level in dB(mW) or in dB(μV) can be calculated if the bandwidth is known.

The measurement can be performed at the system outlet, at the output of distribution equipment (passive or active), at the output of the headend or at the output of an outdoor unit (SHF receiver) for satellite reception.

4.1.3.2 Equipment required

The equipment required is a spectrum analyser having a known noise bandwidth and a calibrated display of the tuned signal. The calibration accuracy should preferably be within ±0,5 dB and shall be stated with the results.

The equipment shall be able to tune over the nominal frequency range of the system.

4.1.3.3 Connection of the equipment

Connect the measuring equipment to the system outlet or to the point where the measurement shall be performed, using a suitable cable and connectors, taking care to maintain correct impedance matching.

4.1.3.4 Measurement procedure

- a) When signal levels are to be measured where a high ambient field is present, the measuring equipment shall be checked for spurious readings. Connect a shielded termination to its input cable, place both the meter and the lead approximately in their measuring positions and check that there is a negligible reading at the frequency(ies) and on the meter ranges to be used.
- b) Tune the channel that must be measured (selecting the centre frequency of the spectrum analyser) and select the span and level settings to show the whole channel whose bandwidth depends on the type of modulation used (see Annex F);
- c) Set the RSBW of the spectrum analyser to 100 kHz and set the video bandwidth low enough to obtain a smooth display (100 Hz if available).
- d) Measure the level S of the flat top of the displayed signal in dB(μV) or in dB(mW), using the display line cursor if this feature is available.
- e) If the spectrum of the signal does not have a flat top, due to echoes, measure the signal level at the centre frequency of the channel.
- f) Measure on the displayed channel the upper and lower frequencies at the channel edges where the level is 3 dB lower than the maximum level S ; the difference between these two frequencies is assumed to be the equivalent signal bandwidth BW , expressed in Hz.
- g) Calculate the level $S_{D,RF}$ of the signal using the following formula:

$$S_{D,RF} = S + 10 \lg \left[\frac{BW}{RSBW} \right] + K_{sa} \quad (5)$$

where

- $S_{D,RF}$ is the signal level for a digitally modulated signal;
- S is the displayed signal level (flat top);
- BW is the signal bandwidth;
- $RSBW$ is the resolution bandwidth of the spectrum analyser;
- K_{sa} is the correction factor.

The correction factor K_{sa} depends on the measuring equipment used and shall be provided by the manufacturer of the measuring equipment or obtained by calibration. The value of the correction factor for a typical spectrum analyser is about 1,7 dB (see also Annex I).

The correction factor is not necessary if the measuring equipment can be set to display the level in dB(mW/Hz) units. In this case the level $S_{D,RF}$ of the signal can be obtained from the measured maximum level S using the following formula:

$$S_{D,RF} = S + 10 \lg(BW) \quad (6)$$

where

$S_{D,RF}$ is the signal level for a digitally modulated signal;

S is the displayed maximum signal level;

BW is the signal bandwidth (in Hz).

In this formula the bandwidth BW shall be expressed in Hz.

NOTE This measuring method actually measures the $S + N$ level. The contribution of noise is considered negligible if the level of noise displayed outside the channel band is at least 15 dB lower than the maximum level displayed within the channel band. This noise level includes that of the measuring equipment (spectrum analyser) which should be at least 10 dB lower than the noise level displayed outside the channel band in order not to affect the results. Otherwise, the contribution of noise (due to the system or the equipment under test and to the measuring equipment) should be taken into account in the measurement of signal level S (see Annex F).

4.1.3.5 Presentation of the results

The measured level is expressed in dB(μ V) or dB(mW) with reference to the BW and referred to 75 Ω or in dB(mW/Hz). The accuracy of the measuring equipment shall be stated with the results.

4.2 Single-channel intermodulation specification for channel amplifier and frequency converter

Frequencies and levels of test carriers, as shown in Figure 2, simulate a colour television transmission where f_a , f_b and f_c respectively correspond to vision carrier, colour subcarrier and sound carrier. The most significant intermodulation products are:

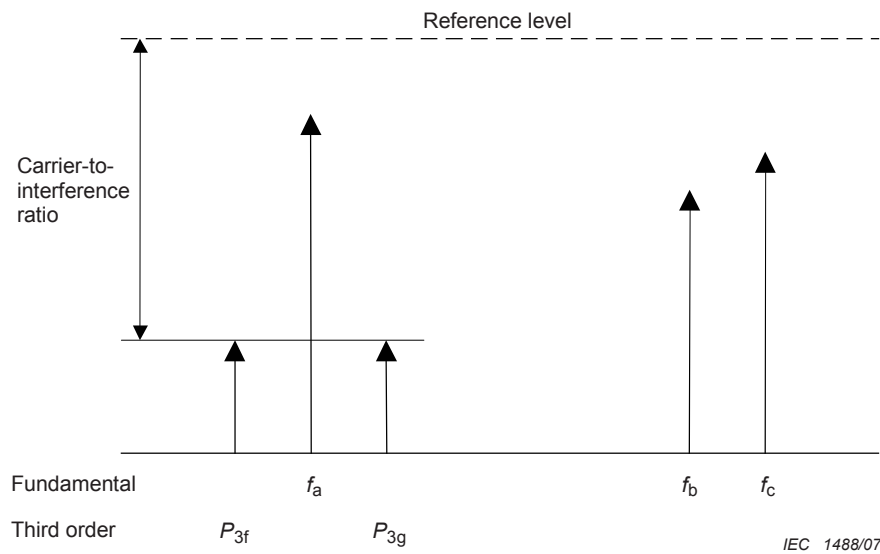
$$P_{3f} = f_a + f_b + f_c \quad (7)$$

$$P_{3g} = f_a + f_c - f_b \quad (8)$$

The carrier levels for different television systems are given in Table 1.

Table 1 – Test signal levels in decibels relative to reference level

Test signal		Relative signal level dB	
		System	
		B, G, H, I, D, D1, K	L
Vision carrier	f_a	–8	0
Colour subcarrier	f_b	–17	0
Sound carrier	f_c	–10	0



NOTE Levels of measuring signals are to be adjusted as in Table 1.

Figure 2 – Frequencies and levels of test carriers

4.3 Three-carrier intermodulation measurement

The specifications for the measurement of three-carrier intermodulation apply to sub-band, full-band and multi-band amplifiers or multi-channel frequency converters.

In television band amplifiers, the simultaneous transmission of multi-channel programming may cause mutual interference between vision carriers through cross-modulation. The carrier-to-cross-modulation distortion ratio is defined as the difference between the level of a given test carrier and the level of the cross modulation products produced by interfering signals and falling near that test carrier.

This method of measurement is used to simulate transfer of modulation between two television signals. The test carrier having the frequency f_a is an unmodulated wanted signal, while the carriers having the frequencies f_b and f_c represent the sidebands of a 100 % AM interfering signal (Table 2 and Figure 3).

Table 2 – Test signal levels in decibels relative to reference level

Test signal		Relative signal level dB
Test frequency	f_a	0
Interfering frequency	f_b	–6
Interfering frequency	f_c	–6

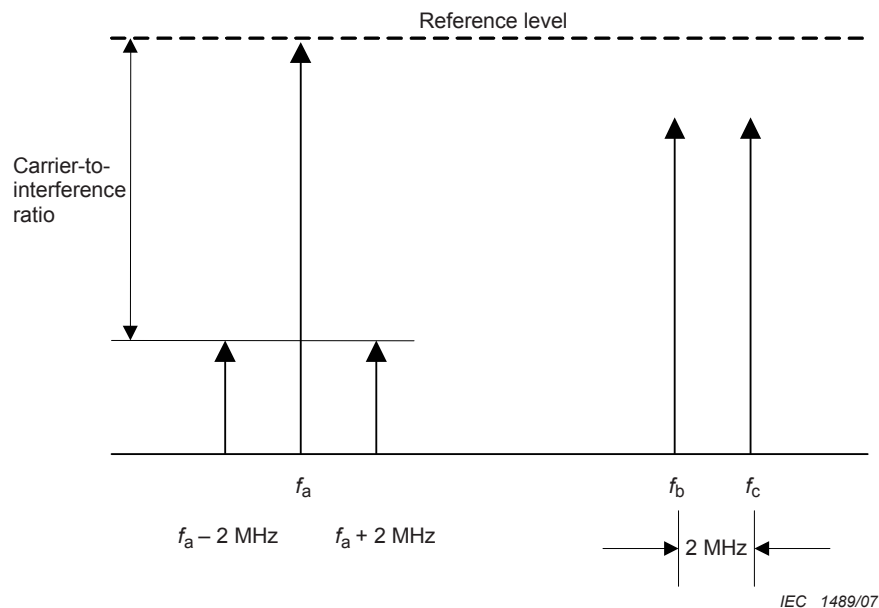


Figure 3 – Test carrier and interfering products in the pass band

The carriers having the frequencies f_a , f_b and f_c shall be varied over the entire frequency range.

NOTE If the equal carrier method of measurement as described in IEC 60728-3 is used, the output level giving the appropriate signal-to-distortion ratio must be increased by 6 dB.

4.4 Two carrier intermodulation measurements for second- and third-order products

4.4.1 Introduction

The two-carrier method is applicable to the measurement of the ratio of the carrier to a single intermodulation product at a specified point within a cable network. The method can also be used to determine the intermodulation performance of individual items of equipment.

Second-order products are encountered only in wideband equipment and systems covering more than one octave and can be measured using two signals.

Third-order products are encountered in both wideband and narrowband equipment and systems and, depending on the type, can also be measured using two signals.

4.4.2 Intermodulation products with test signals at frequencies f_a and f_b

Second-order products:

$$P_{2a} = f_b - f_a$$

$$P_{2b} = f_a + f_b$$

NOTE Not applicable to narrowband equipment unless the frequency range covered by the equipment is such that $2f_{\min} < f_{\max}$.

Third-order products:

$$P_{3a} = 2f_a - f_b \quad \text{where } 2f_a > f_b$$

$$P_{3a} = f_b - 2f_a \quad \text{where } 2f_a < f_b$$

$$P_{3b} = 2f_b - f_a$$

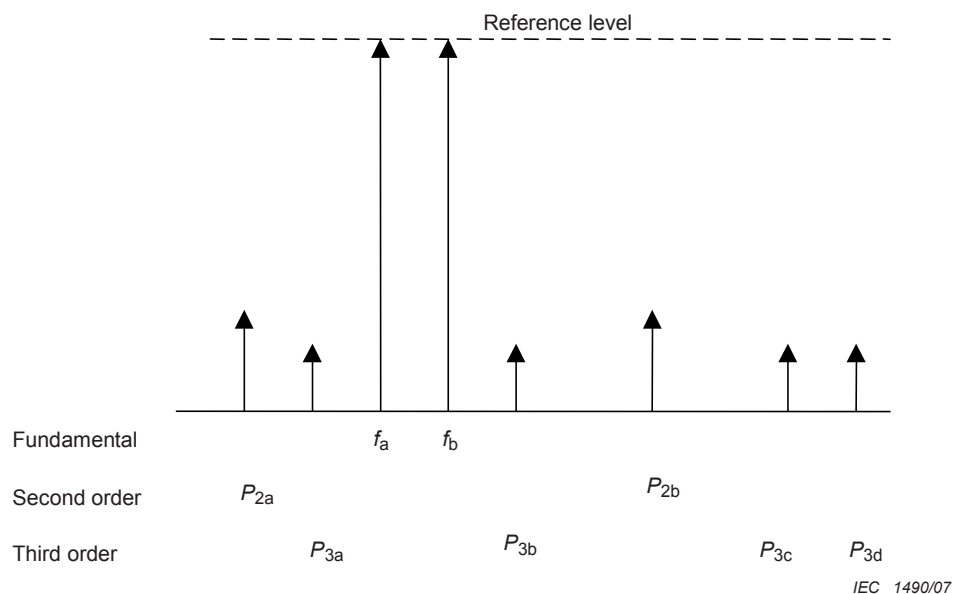
$$P_{3c} = 2f_a + f_b$$

$$P_{3d} = 2f_b + f_a$$

4.4.3 Signal levels

The two test carriers shall be set to the reference level.

An example showing products formed when $2f_a > f_b$ is shown in Figure 4.



NOTE The sequence of the intermodulation products will depend on the fundamental frequency chosen.

Figure 4 – Example showing products formed when $2f_a > f_b$

4.5 Carrier-to-spurious signal ratio at the output

4.5.1 Carrier-to-spurious signal ratio at the output of equipment for AM-TV systems

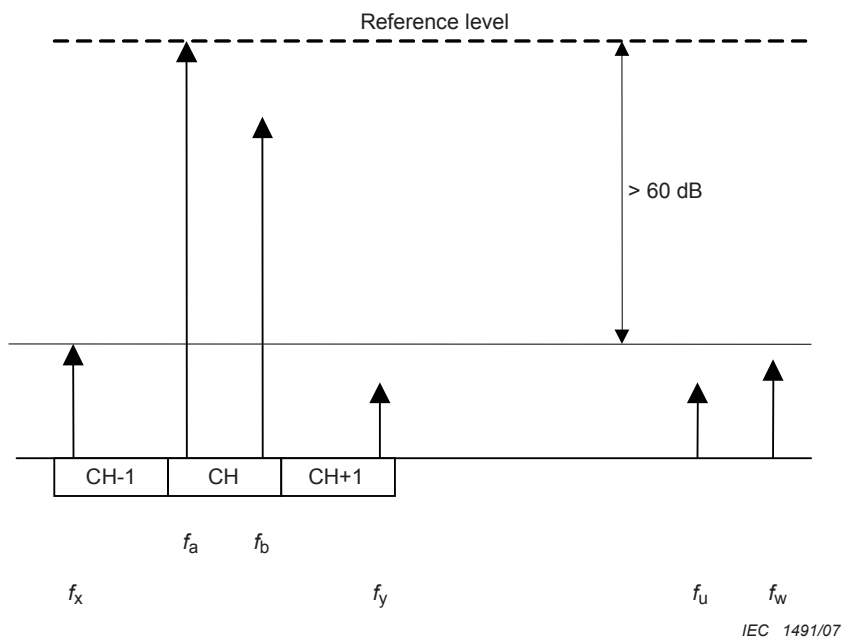
The carrier-to-spurious signal ratio at the output, out of channels, is applied between 40 MHz and 862 MHz.

The carrier levels are given in Table 3.

Table 3 – Test signal levels in decibels relative to reference level

Test signal		Relative signal level	
		dB	
		System	
		B, G, I, D, D1,K	L
Vision carrier	f_a	0	0
Sound carrier	f_b	–10	0

The carrier-to-spurious signal ratio in the output is shown in Figure 5.



$f_x = 2f_a - f_b; \quad f_y = 2f_b - f_a$

f_u, f_w are examples for all other spurious outputs

Figure 5 – Carrier-to-spurious signal ratio in the output

If for channel processing in CH-1 and CH+1 the difference between the intermodulation products f_x and f_y and the reference level is less than 60 dB, the equipment shall be marked with the note: “not suitable for adjacent channel operation”.

4.5.2 Carrier-to-spurious signal ratio at the output of equipment for FM-TV systems

Carrier-to-spurious signal ratio at the output of equipment for FM TV systems, out of channels and in channels between 950 MHz and 3 000 MHz shall be in accordance with Figure 6.

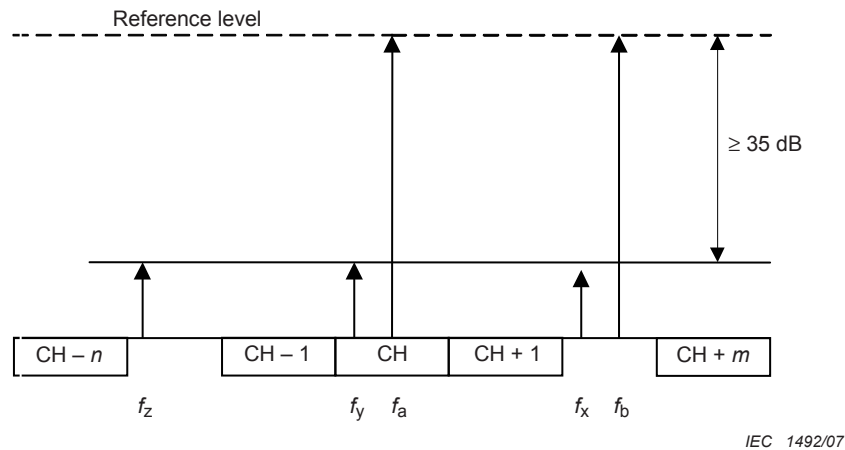


Figure 6 – Carrier-to spurious signal ratio at the output

Values f_x , f_y and f_z are intermodulation products between f_a and f_b or with other signals occurring in the system like oscillator frequency signals; f_b is varied within the whole transmission range assigned to the equipment except for the useful channel regarded.

4.5.3 Shoulder attenuation

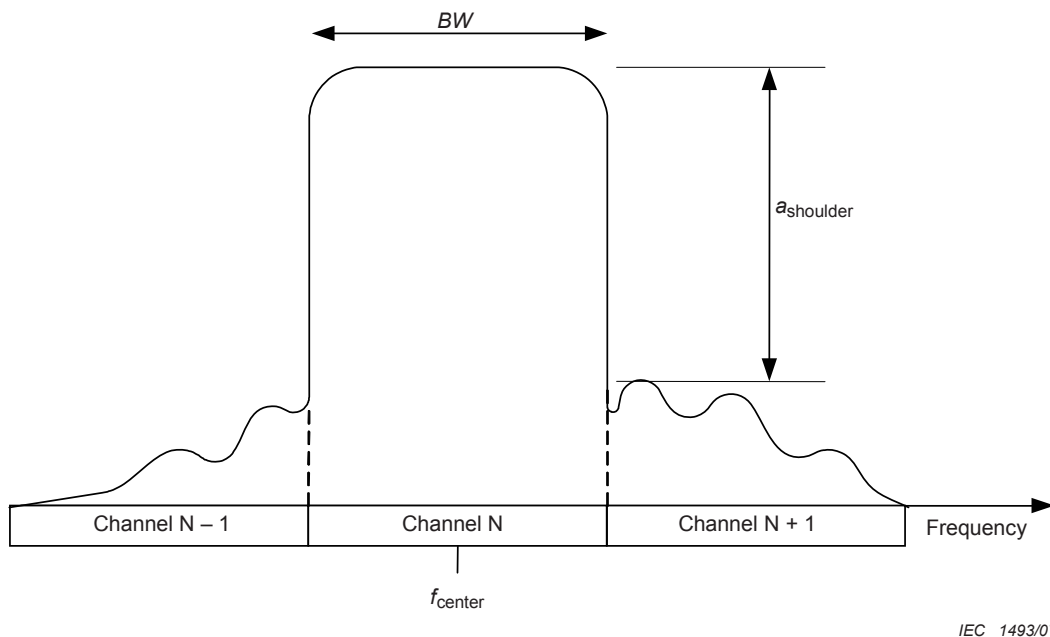


Figure 7 – Shoulder attenuation

The shoulder attenuation is measured as the difference between the top of channel N and maximum noise like spurious of channel N measured in the adjacent channels N + 1 or channel N-1 respectively (see Figure 7).

The resolution bandwidth of the measurement should be 10 kHz.