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Third edition
2001-11

Cabled distribution systems for television and sound signals –

Part 1: Methods of measurement and system performance



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Cabled distribution systems for television and sound signals –

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International Electrotechnical Commission
Telefax: +41 22 919 0300

3, rue de Varembé Geneva, Switzerland
e-mail: inmail@iec.ch IEC web site <http://www.iec.ch>



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International Electrotechnical Commission
Международная Электротехническая Комиссия

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**CABLED DISTRIBUTION SYSTEMS
FOR TELEVISION AND SOUND SIGNALS –****Part 1: Methods of measurement and system performance**

FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 60728-1 has been prepared by TA 5: Cable networks for television signals, sound signals and interactive services, of IEC technical committee 100: Audio, video and multimedia systems and equipment

This third edition cancels and replaces the second edition published in 1986, its amendment 1 (1992) and amendment 2 (1995) of which it constitutes a technical revision.

The text of this standard is based on

FDIS	Report on voting
100/404/FDIS	100/436/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

Annexes A, B, C, D, E, F, G, H and I form an integral part of this standard.

The committee has decided that the contents of this publication will remain unchanged until 2005. At this date, the publication will be

- reconfirmed;
- withdrawn;

- replaced by a revised edition, or
- amended.

The following differences exist in some countries:

– 5.2.1: Replace by the following “Minimum and maximum carrier levels” regulation (France):

AM-VSB television:	
between 47 MHz and 68 MHz:	57,5 dB(μV) _{min} 74,0 dB(μV) _{max}
between 118,75 MHz and 862 MHz:	57,0 dB(μV) _{min} 74,0 dB(μV) _{max}
FM sound mono or stereo:	50 dB(μV) _{min} 66 dB(μV) _{max}

Replace by/add the following “Minimum and maximum carrier levels” regulation (Japan):

AM-VSB television	60 dB(μV) _{min} 85 dB(μV) _{max}
FM sound mono or stereo	50 dB(μV) _{min} 75 dB(μV) _{max}
FM NTSC television	57 dB(μV) _{min}
FM HDTV (1 035 MHz~1 335 MHz)	57 dB(μV) _{min}
AM HDTV	65 dB(μV) _{min} 85 dB(μV) _{max}
64QAM digital TV	53 dB(μV) _{min} 85 dB(μV) _{max}
Upper CH adjacent to AM-VSB television	53 dB(μV) _{min} 81 dB(μV) _{max}
Lower CH adjacent to AM-VSB television	53 dB(μV) _{min} 79 dB(μV) _{max}

Replace by/add the following “Minimum and maximum carrier levels” regulation (Netherlands):

FM sound mono:	80 dB(μV) _{max}
DSR:	39 dB(μV) _{max}

(measured in accordance with CISPR 16-1 (quasi peak measurement within 120 kHz bandwidth))

Replace by the following “Minimum and maximum carrier levels” regulation (Norway):

AM-VSB television:	60,0 dB(μV) _{min} 84,0 dB(μV) _{max}
FM sound mono or stereo:	52 dB(μV) _{min} 80,0 dB(μV) _{max}

– 5.2.2: Replace by/add the following “Carrier level differences” regulation (France):

TV channels in AM-VSB:	≤12 dB	Between 47 MHz and 862 MHz
TV channels in FM:	≤12 dB	Between 950 MHz and 2 050 MHz
	≤4 dB	Between adjacent channels spaced less than 40 MHz

– 5.2.2: Replace by/add the following “Carrier level differences” regulation (Japan):

AM-VSB television	Not more than 10 dB (not more than 3 dB between adjacent CH)
Sound carrier to vision carrier	–3 to –14 dB (–9 dB to –14 dB between adjacent CH)
FM	Not more than 10 dB
FM carrier to AM-VSB	Not more than –10 dB
FM NTSC	Not more than 6 dB
FM HDTV	Not more than 6 dB
AM HDTV	Not more than 3 dB between adjacent CH
64 QAM carrier to AM-VSB	
Upper CH adjacent to AM-VSB	–4 dB to –18 dB
Lower CH adjacent to AM-VSB	–6 dB to –20 dB

Replace by/add the following “Carrier level differences” regulation (Norway):

AM-VSB television:	
≤2 dB	within a TV channel
≤6 dB	within band I, II, III
≤10 dB	within band IV
≤12 dB	within band V

– 5.3.1: Replace by/add the following “Isolation between two subscribers” regulation (France):

TV/TV: ≥30 dB	Between 10 MHz and 2 050 MHz
TV/FM sound: ≥50 dB	Between the TV outlet of any subscriber and the FM sound outlet of an other subscriber

Replace by /add the following “Isolation between two subscribers” regulation (Japan):

TV/TV (mutual isolation of a subscriber tap)	Not less than 25 dB
TV/FM (in case of FM filter use)	Not less than 35 dB

Replace by/add the following “Isolation between two subscribers” regulation (Norway):

TV/TV	≥36 dB	Between 47 MHz – 470 MHz
	≥30 dB	Between 470 MHz – 790 MHz
FM sound/TV	≥46 dB	

- 5.4.1: Replace by/add the following “Amplitude response” regulation (France):

For an RF outlet and SECAM channels:	
$\leq \pm 1,2$ dB	Between 0 and 4 MHz
$\leq \pm 2$ dB	For the 4,8 MHz burst

- 5.4.1: Replace by/add the following “Amplitude response” regulation (Japan):

For an RF outlet and NTSC channels (–0,5 MHz~4 MHz)	–3 dB to +4 dB
64QAM digital channels (bandwidth 5,274 MHz)	± 3 dB

- 5.4.2: Add the group delay response curve valid for PAL with FM-FM sound (figure 39) (Netherlands).

- 5.5: Replace by/add the following “Frequency stability” regulation (France):

NOTE The stability values, given hereinafter, are referenced to the specified value of the carrier.

AM-VSB-TV and L-SECAM channels:	± 50 kHz
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NOTE Regulation makes provision for precision offset tuning between adjacent channels.

FM-TV:	± 3 MHz	for satellite originated channels
	± 175 kHz	for locally modulated channels

- Replace by/add the following “Frequency stability” regulation (Japan):

AM-VSB television	± 20 kHz
Between vision carrier and sound carrier	± 2 kHz
FM	± 20 kHz
64QAM digital (DVB-C)	± 20 kHz
QPSK digital (DVB-S)	u.c.
OFDM (Japan)	u.c.

- 5.6: Replace by/add the following “Random noise” regulation (France):

AM-VSB-TV:	C/N $\geq 45,5$ dB	in a 5 MHz bandwidth (measured according to 4.5 of IEC 60728-1)
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- Replace by/add the following “Random noise” regulation (Japan):

AM-VSB television (bandwidth 4 MHz)	C/N: not less than 38 dB
FM (bandwidth 200 kHz)	C/N: not less than 28 dB
FM-NTSC (bandwidth 27MHz)	C/N: not less than 15 dB
FM-HDTV (bandwidth 27MHz)	C/N: not less than 16 dB
AM-HDTV (bandwidth 4 MHz equivalent)	C/N: not less than 41 dB
64QAM digital (bandwidth 5,274 MHz)	C/N: not less than 31 dB

- Replace by the following “Random noise” regulation (Norway):

AM-VSB-TV:	C/N ≥ 43 dB
FM sound mono and stereo:	C/N ≥ 45 dB

– 5.7.1: Replace by the following “Single frequency interference” regulation (France):

Single frequency interference for AM-VSB-TV-channels according to the templates given in figure 40.

Replace by/add the following “Single frequency interference” regulation (Japan):

VSB-AM NTSC	Not less than 50 dB (figure 41)
VSB-AM HDTV	Not more than –60 dB (figure 42)
64 QAM digital	Not more than –30 dB (figure 43)

– 5.7.1: Replace by/add the following “Single frequency interference” regulation (Netherlands):

AM-VSB-PAL-signals: C/I ≥ 60 dB	(measured in a bandwidth of 300 kHz)
For signals outside used TV channels: C/I ≥ 40 dB	

Replace by the following “Single frequency interference” regulation (Norway):

AM-VSB-channels:	C/I ≥ 60 dB
------------------	-------------

– 5.7.2: Replace by/add the following “Single channel intermodulation” regulation (Japan):

FM-NTSC	Not more than –36 dB
FM HDTV	Not more than –36 dB

– 5.7.3: Replace by the following “Multiple frequency intermodulation interference” regulation (France):

Third order: weighted summation of the clusters of composite triple beats, with the frequency channel allocation anticipated for the cable system:

$$\frac{C}{CTB} \geq 52 \text{ dB}$$

Otherwise, with the test carriers listed in table 15 (30 carriers):

$$\frac{C}{CTB} \geq 52 \text{ dB} + 20 \lg n/30$$

(n is the number of anticipated channels)

Second order: no specification

– 5.7.4: Replace by/add the following “Cross modulation” regulation (Japan):

Cross modulation ($20 \lg \{(a-b)/a\}$)	Not more than –40 dB
---	----------------------

- 5.8.1 Replace by the following “Differential gain and phase” regulation (France):

PAL or SECAM:	Differential gain $\leq 15\%$
	Differential phase $\leq 10^\circ$

- 5.8.2: Replace the requirements for “Echoes in television channels, PAL-SECAM standards” by the “Requirement for echo loss in relation to the time delay of the reflected signal for AM-PAL-TV and FM-radio” (figure 44) (Netherlands).

- 5.8.2 Replace by/add the following “Echoes” regulation (Japan):

VSB-AM NTSC	(figure 45)
FM NTSC	(figure 46)
FM HDTV	(figure 47)
VSB-AM HDTV	(figure 48)
64 QAM Digital	(figure 49)

- 5.9: Replace the requirement for “Hum modulation” by ≥ 52 dB (Norway).

- 5.9: Replace by /add the following “Hum modulation” regulation (Japan):

AM-VSB $(20 \lg\{(a-b)/a\})$	Not more than -50 dB (50 Hz) Not more than -40 dB (60 Hz)
AM-HDTV $(20 \lg\{(a-b)/a\})$	Not more than -50 dB (50 Hz) Not more than -40 dB (60 Hz)

- 5.10.1: Add the requirement for “Decoding margin” being “The decoding margin must be 40 %, when the margin is minimum 70 % at the receiving antenna” (Denmark).

- 5.11.1.5: Replace by/add the following “Phase noise” regulation (Japan):

64 QAM digital (DVB-C)	u.c.
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- 5.12.1: Add the requirement for “Amplitude response within the entire FM-band” being ≤ 6 dB (Norway).

- 5.12.3: Add the requirement for “Adjacent channel spacing” by ≥ 400 kHz (Netherlands).

Add the requirement for “Adjacent channel spacing” by ≥ 500 kHz (Norway).

- 5.12.4: Replace the requirement for “AM hum modulation on FM sound carriers” by 52 dB (Norway).

INTRODUCTION

The reception of television signals inside a building requires an outdoor antenna and a distribution network to convey the signal to the TV receivers.

The installation of an outdoor antenna for each TV receiver must be avoided for several obvious technical, economical and practical reasons.

In apartment blocks, the installation of a master antenna television system for terrestrial (MATV) and/or satellite (SMATV) reception as shown in figure 1 is usual.

When signals to be conveyed to the TV receivers are picked-up far away due to geographical reasons and the number of users (subscribers) is very high, the installation of a cabled distribution system using coaxial cables and/or fibre optic cables is used as indicated in figure 2.

A system model of a cabled distribution system is shown in figure 3, where the main parts of the systems are indicated, as defined in clause 3.

Withdrawn

CABLED DISTRIBUTION SYSTEMS FOR TELEVISION AND SOUND SIGNALS –

Part 1: Methods of measurement and system performance

1 Scope

This part of IEC 60728 is applicable to any cabled distribution system (including individual receiving systems) having a coaxial cable output and primarily intended for television and sound signals operating between about 30 MHz and 2 150 MHz.

This standard specifies the basic methods of measurement of the operational characteristics of cabled distribution systems having coaxial cable outputs in order to assess the performance of these systems and their performance limits.

All requirements refer to the performance limits which are obtained between the input(s) to the headend or headends and any system outlet when terminated in a resistance equal to the nominal load impedance of the system, unless otherwise specified. Where system outlets are not used, the above applies at the subscriber's end of the subscriber's feeder.

NOTE 1 Basic methods of measurement are described in this standard. However, any equivalent method that ensures at least the same accuracy may be used.

NOTE 2 If the system operator wishes to subdivide the system into a number of parts, the accumulation of degradations should not exceed the figures given below.

NOTE 3 An extension of the frequency range to that from 5 MHz to 3 000 MHz will be considered for future work.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60728. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 60728 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60050-713, *International Electrotechnical Vocabulary – Part 713: Radiocommunications: transmitters, receivers, networks and operation*

IEC 60728-3, *Cabled distribution systems for television and sound signals – Part 3: Active coaxial wideband distribution equipment*

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

ITU-T Recommendation J.63, *Insertion of test signals in the field-blanking interval of monochrome and colour television signals*

ITU-R Recommendation BT.470-6, *Conventional television systems*

ITU-R Recommendation BT.500-10, *Methodology for the subjective assessment of the quality of television pictures*

EN 300421, *Digital Video Broadcasting (DVB); DVB framing structure, channel coding and modulation for 11/12 GHz satellite services*

EN 300429, *Digital Video Broadcasting (DVB); DVB framing structure, channel coding and modulation for cable systems*

EN 300468, *Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB systems*

EN 300473, *Digital Video Broadcasting (DVB); DVB Satellite Master Antenna Television (SMATV) distribution systems*

EN 300744, *Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for digital terrestrial television*

ETR 211, *Digital Video Broadcasting (DVB); DVB guidelines on implementation and usage of Service Information (SI)*

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

For the purpose of this part of IEC 60728, the following terms and definitions apply.

3.1.1

headend

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

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

3.1.2

local headend

a headend which is directly connected to the system trunk feeders or to a short haul trunk feeder replacement link

3.1.3

hub headend

a headend used to feed the entire operating network in the service area

3.1.4

remote headend

a headend from which signals are delivered to a local headend via a long-distance terrestrial link

3.1.5

distribution point

a point where signals are taken from the trunk feeder to energize branch and/or spur feeders

NOTE In some cases, a distribution point may be directly connected to the headend.

3.1.6

feeder

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

3.1.7

supertrunk feeder

a feeder which connects only between headends or between a headend and the first distribution point

3.1.8

trunk feeder

a feeder used for the transmission of signals between a headend and a distribution point or between distribution points

3.1.9

branch feeder

a feeder used for connecting a distribution point to spur feeders

3.1.10

spur feeder

a feeder to which splitters, subscriber taps, or looped system outlets are connected

3.1.11

subscriber feeder

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

NOTE A subscriber feeder may include filters and balun transformers.

3.1.12

antenna amplifier

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

3.1.13

trunk amplifier

an amplifier to compensate for the attenuation in a trunk feeder

3.1.14

bridger amplifier

a) an amplifier for connection in a trunk feeder to energize a distribution point

b) an amplifier for connection in a branch feeder, to energize one or more branch or spur feeders

3.1.15

trunk-bridger amplifier

an amplifier to compensate for the attenuation in a trunk feeder and also to energize a distribution point

3.1.16**distribution amplifier**

an amplifier designed to feed one or more branch or spur feeders

NOTE This is a general term embracing branch amplifier and spur amplifier.

3.1.17**branch amplifier**

an amplifier to compensate for the attenuation in a branch feeder

3.1.18**spur amplifier (line extender)**

an amplifier to compensate for the attenuation in a spur feeder

3.1.19**automatic level controlled amplifier**

an amplifier which includes means to control automatically the level of the signal(s) at its output.

NOTE This may be achieved by controlling the variation of gain or slope or both, by means of:

- one or more pilot carriers;
- a temperature sensing device;
- remote control.

3.1.20**frequency converter**

a device for changing the carrier frequency of one or more signals

3.1.21**combiner**

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

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

3.1.22**separator**

a device in which the signal energy, covering a frequency band, at one input port is divided between two or more output ports each of which covers a part of that frequency band

NOTE 1 For example, a diplexer is a two-output separator.

NOTE 2 Some forms of this device may be used in the reverse direction for combining.

3.1.23**splitter (spur unit)**

a device in which the signal power at the (input) port is divided equally or unequally between two or more (output) ports

NOTE Some forms of this device may be used in the reverse direction for combining signal energy.

3.1.24**directional coupler**

a splitter in which the attenuation between any two output ports exceeds the sum of the attenuations between the input port and each of those output ports

3.1.25**equalizer**

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

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

3.1.26

subscriber tap

a device for connecting a subscriber feeder to a spur feeder

3.1.27

system outlet

a device for interconnecting a subscriber feeder and a receiver lead

3.1.28

looped system outlet

a device through which the spur feeder passes and to which is connected a receiver lead, without the use of a subscriber feeder

3.1.29

receiver lead

a lead which connects the system outlet to the subscriber's equipment

NOTE A receiver lead may include filters and balun transformers in addition to the cable.

3.1.30

signal adaptor

a device which modifies the input signal to achieve conformity with the appropriate ITU system, without changing the baseband characteristics, for use in a cabled distribution system which distributes television signals not conforming to any ITU system (only in respect of RF structure)

3.1.31

decibel ratio

ten times the logarithm to the base 10 of the ratio of two quantities of power P_1 and P_2 i.e.

$$10 \lg \frac{P_1}{P_2} \text{ (dB)}$$

NOTE May also be expressed in terms of voltages

$$20 \lg \frac{V_1}{V_2} \text{ (dB)}$$

3.1.32

standard reference power P_0

in cabled systems, the standard reference power P_0 is 1/75 pW

NOTE This is the power dissipated in a 75 Ω resistor with a voltage drop of 1 μV_{RMS} across it.

3.1.33

level

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

$$10 \lg \frac{P_1}{P_0} \text{ (dB)}$$

the decibel ratio of any voltage V_1 to the standard reference voltage V_0 , i.e.

$$20 \lg \frac{V_1}{V_0} \text{ (dB)}$$

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.

3.1.34

attenuation

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

3.1.35**gain**

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

3.1.36**automatic gain control (AGC)**

the automatic control of a device to maintain constant the level of the signal at its output, using that signal as the control stimulus

3.1.37**frequency amplitude response**

the gain or loss of an equipment or system plotted against frequency

3.1.38**slope**

the difference in gain or attenuation at two specified frequencies between any two points in a system

3.1.39**signal tilt**

the difference in level deliberately established between specified signals at any point in a system. If groups of signals are established at differing levels, this is referred to as block tilt

3.1.40**crossview**

the effect on a wanted television signal of the undesired transfer of one or more television signal(s) from other circuit(s)

3.1.41**crossmodulation**

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

3.1.42**intermodulation**

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

3.1.43**carrier to intermodulation ratio**

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

3.1.44**carrier to noise ratio**

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

3.1.45**mutual isolation**

the attenuation between two specified system outlets at any frequency within the range of the system under investigation. It is always specified, for any particular installation, as the minimum value obtained within specified frequency limits

3.1.46

echo rating E

The result of a system test with a $2T$ sine-squared pulse (as determined in ITU-T Recommendation J.61 and ITU-T Recommendation J.63) using the boundary line on a specified graticule (e.g. figure 25) within which all parts of the received pulse fall

NOTE The object of the graticule design is to ensure that the subjective effect of an echo of rating E % is the same as that of a single echo, with displacement greater than $12T$, of $(E/2)$ % relative to the peak amplitude of the test pulse.

3.1.47

frequency designations

the frequency designations and abbreviations of IEC 60050-713 is to be used in relation to cabled systems (e.g. a VHF system includes frequencies between 30 MHz and 300 MHz)

3.1.48

well-matched

the matching condition when the return loss of the equipment complies with the requirements of table 1 of IEC 600728-3

3.1.49

definitions for digital radio

under consideration

3.1.50

definitions for return paths

under consideration

3.1.51

definitions for satellite broadcasting outdoor unit

part of the TVRO installed in a position within line of sight to the satellite(s) to be received

It normally comprises two main parts:

a) the antenna sub-system which converts the incident radiation field into a guided wave. The antenna sub-system consists of:

- the main reflector, the secondary reflectors (if any) and the radiator;
- the feed network, which may include optional polarizing devices, to receive orthogonal linear polarizations, in a simultaneous or exclusive way.

Instead of reflector(s) / feed network sub-system, other types of antennas may be used, for example flat array antennas;

b) the LNB(s), which may include an optional filter, is a device with very low internal noise that amplifies the received signals in the radio frequency (RF) band and converts them to intermediate frequencies, (often called the 1st IF), for transmission to one or more indoor units where tuning, demodulation and decoding of the received signals are performed.

3.1.52

definitions for scrambled signals

under consideration

3.1.53

definitions for teletext

under consideration

3.1.54

MPEG-2

refers to the ISO/IEC 13818 series. System coding is defined in part 1. Video coding is defined in part 2. Audio coding is defined in part 3

3.1.55 multiplex

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

3.1.56 service information (SI)

digital data describing the delivery system, content and scheduling/timing of broadcast data streams, etc. It includes MPEG-2 program specific information (PSI) together with independently defined extensions

3.1.57 transport stream (TS)

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

3.1.58

E_b/N_0

ratio between the energy of the bit (E_b) and the noise density power (N_0)

3.2 Symbols

Symbols	Terms	Symbols	Terms
	Attenuator		Variable attenuator
	Sine-wave generator		Low-pass filter
	Band-pass filter		Variable band-pass filter
	Amplifier		RF amplifier
	Oscilloscope		Mixer
	Modulator		Demodulator
	RF-choke		Resistor
	Detector		Directional coupler

3.3 Abbreviations

AC	alternating current
AFC	automatic frequency control
AGC	automatic gain control
AI	amplitude imbalance
ALC	automatic level control
AM	amplitude modulation
ASCII	American standard code for information interchange
ATM	asynchronous transfer mode
AWGN	additive white Gaussian noise
BAT	bouquet association table
BEP	bit error probability
BER	bit error rate
BPSK	binary phase shift keying
bslbf	bit string, left bit first
BW	bandwidth
C/N	carrier to noise ratio (ratio of RF or IF power to noise power)
CA	conditional access
CATV	community antenna television
CENELEC	Comité Européen de Normalisation Electrotechnique
COFDM	coded orthogonal frequency division multiplex
CPE	common phase error
CRC	cyclic redundancy check
CS	carrier suppression
CSO	composite second order beat
CTB	composite triple beat
CW	continuous wave
D/A	digital-to-analogue converter
DAB	digital audio broadcasting
DC	direct current
DFT	discrete Fourier transform
DSR	digital satellite radio
DVB	digital video broadcasting
DVB-C	digital video broadcasting baseline system for digital cable television (EN 300429)
DVB-CS	digital video broadcasting baseline system for SMATV distribution systems (EN 300473)
DVB-MC	digital video broadcasting baseline system for multi-point video distribution systems below 10 GHz (EN 300749)
DVB-MS	digital video broadcasting baseline system for multi-point video distribution systems at 10 GHz and above (EN 300748)

DVB-S	digital video broadcasting baseline system for digital satellite television (EN 300421)
DVB-T	digital video broadcasting baseline system for digital terrestrial television (EN 300744)
EB	error block
EIT	event information table
EMM	entitlement management message
EN	European norm
ENB	equivalent noise bandwidth
END	equivalent noise degradation
ES	errored second
ETR	ETSI technical report
ETS	European telecommunication standard
FDM	frequency division multiplex
FEC	forward error correction
FFT	fast Fourier transform
FIFO	first-in, first-out shift register
FM	frequency modulation
HDTV	high definition television
HEX	hexadecimal notation
HP	high priority bit stream
ICI	inter-carrier interference
IF	intermediate frequency
IFFT	inverse fast Fourier transform
ITS	insertion test signal
ITU	International Telecommunication Union
LDTV	limited definition television
LO	local oscillator
LP	low priority bit stream
LSB	least significant bit
MATV	master antenna television
MMDS	microwave multipoint distribution systems
MPEG	moving picture experts group
MSB	most significant bit
MUX	multiplex
MVDS	microwave video distribution systems
NICAM	near-instantaneously companded audio multiplex
NTSC	national television system committee
OCT	octal notation
OFDM	orthogonal frequency division multiplex
PAL	phase alternation line

PCR	program clock reference
PID	packet identifier
PRBS	pseudo-random binary sequence
PSK	phase shift keying
QAM	quadrature amplitude modulation
QEF	quasi error free
QPSK	quaternary phase shift keying
RF	radio frequency
RMS	root mean square
RS	Reed-Solomon
RSBW	resolution bandwidth
SDTV	standard definition television
SECAM	séquentiel couleur à mémoire
SFN	single frequency network
SMATV	satellite master antenna television
TC8PSK	trellis coded 8 phase shift keying
TPS	transmission parameter signaling
TV	television
TVRO	television receive only
UHF	ultra-high frequency
uimsbf	unsigned integer, most significant bit first
UTC	universal time co-ordinated
VHF	very high frequency
VSF	vestigial side band

WINDOWN

4 Methods of measurement

General

The methods of measurement listed below are applicable to analogue and/or digitally modulated signals as indicated in table 1.

Table 1 – Application of the methods of measurement

Methods of measurement Subclause reference	Modulation of carriers											
	Analogue					Digital						
	Television				Radio FM TV sound carrier	Television				Radio		
	Vision carrier AM-VSB			Vision and sound carriers		Vision and sound DVB			Sound			
	NTSC	PAL	SECAM			FM	FM/AM	PSK	QAM			OFDM
4.1 Mutual isolation between system outlets	x	x	x	x	x	x	x	x	x	x	x	
4.2 Amplitude response within a channel	x	x	x	x	x	x	x	x	x	x	x	
4.3 Chrominance-luminance gain and delay inequalities		x	x									
4.4 Non-linear distortion	x	x	x	x	x							
4.5 Carrier to noise ratio	x	x	x	x	x							
4.6 Echoes	x	x	x									
4.7 AM-VSB television, FM radio and FM television signal level	x	x	x	x	x							
4.8 Data echo rating and data delay inequality	x	x	x									
4.9 Interference in FM sound radio channels					x							
4.10 Methods of measurement for digitally modulated signals						x	x	x				
4.10.3 Signal level						x	x	x		x		
4.10.4 S/N						x	x	x		x		
4.10.5 BER						x	x	x		x		
4.10.6 BER versus E_b/N_o						x	x	x		x		
4.10.7 Noise margin						x	x	x		x		
4.10.8 MER						x	x					
4.10.9 Phase jitter						x	x					
4.10.10 Phase noise of an RF carrier						x	x	x		x		

4.1 Mutual isolation between system outlets

4.1.1 Introduction

Although the method described applies also to the far ends of subscribers' feeders when no system outlets are used, isolation will usually be measured between:

- a) system outlets connected to adjacent subscribers' taps;
- b) system outlets connected to the same multiple subscribers' tap;
- c) adjacent looped system outlets.

4.1.2 Equipment required

The test set-up shall be well-matched.

NOTE 1 "Wideband" is understood to mean of sufficient bandwidth to cover the full frequency range of the system under investigation.

NOTE 2 Some sweep frequency generators may include a terminating wideband detector.

- a) A sweep frequency generator, with frequency range or ranges to suit the system to be examined, equipped with a frequency marking system.
- b) A terminating wideband detector.
- c) A variable attenuator, adjustable in steps of not more than 1 dB up to a value greater than the maximum mutual isolation to be measured.
- d) A wideband amplifier with sufficient gain to raise the signal level at the system outlet to a level suitable to drive the detector.
- e) An oscilloscope or other display unit suitable for operation with the sweep frequency generator.
- f) A suitable coaxial cable of sufficient length to reach from one system outlet to an adjacent one in the cabled distribution system.

4.1.3 Connection of the equipment

The equipment shall be connected as in figure 4.

4.1.4 Measurement procedure

- a) With the equipment connected as shown in figure 4a, set the variable attenuator to a value just greater than the maximum value of mutual isolation expected to be measured. Note this value a_1 .
- b) Adjust the output level of the sweep generator to give a level at the input to the amplifier approximately equal to that available at a system outlet.
- c) Adjust the oscilloscope and amplifier gain controls to produce a display and note the amplitude of the display over the frequency range under inspection.
- d) Remove from the section under test, the signals normally distributed on the system whilst maintaining the correct terminating conditions. Connect the equipment as shown in figure 4b. Note that the output from the sweep generator is connected to the "local" system outlet and the long cable (according to 4.1.2 f)) is used to connect to the "remote" outlet.
- e) Reduce the attenuator setting until the peak of the display just reaches the same amplitude as that noted in item c) of this subclause for the frequency at which the peak occurs.
- f) Note the new value of the attenuator a_2 .
- g) Mutual isolation is given by $a_1 - a_2$.
- h) If the system outlets are of dual socket design, for example, TV – radio, the mutual isolation should also be measured at the appropriate frequencies between one socket, for

example TV, of the "local" system outlet and the alternate socket, for example, radio, of the "remote" system outlet and vice versa. In these cases, it will be necessary also to measure mutual isolation with the unused sockets in both terminated and open-circuit conditions. The conditions of measurement should be stated when tabulating results. When unused sockets are terminated, the terminating resistance shall be 75 Ω .

- i) Where the measurements are made in a number of discrete frequency bands, the lowest result obtained shall be taken as the mutual isolation between the two system outlets under investigation.

4.1.5 Presentation of the results

The results shall be presented in a table listing the values obtained for each couple of measured system outlets.

4.2 Amplitude response within a channel

4.2.1 Introduction

The method described is applicable to the measurement of the amplitude response of cabled distribution systems over the frequency range of an individual channel between two specified points within the system.

However, where input signals to the system are received at, or are reduced to, baseband, and modulated onto the system carrier frequencies, the response of any demodulator and modulator shall not be included. If it is required to include the characteristics of these items, a separate assessment shall be made using test techniques applicable to such equipment.

Where the system contains frequency changing equipment between the antenna input and the system outlet at which the tests are to be made, the calibration of the equipment (as detailed in 4.2.4 a) to 4.2.4 g)) shall be carried out at the output frequencies, having first checked that the output of the sweep frequency generator is also flat over the input channel.

4.2.2 Equipment required

The test set-up shall be well-matched.

- a) A sweep frequency generator.
- b) A terminating RF detector.
- c) Two variable attenuators.
- d) An amplifier.
- e) A dual-trace oscilloscope.
- f) A high output (at least 300 mV_{RMS} terminated) signal generator of known frequency calibration over the frequency range of the channel to be tested.
- g) A balanced mixer.
- h) A low-pass filter with cut-off at approximately 200 kHz for television channels or approximately 10 kHz for FM sound radio.
- i) A directional coupler suitable for use in the frequency range of the channel to be tested.
- j) A termination to match the output of the filter specified in item h) of this subclause.

4.2.3 Connection of the equipment

The equipment shall be connected as in figure 5a. If the tests are to be carried out in the presence of other signals on the system, a filter may be necessary at the input of the amplifier to prevent distortion of the display. This filter shall have a flat response and shall match the system correctly over the channel to be tested. It shall have sufficient attenuation at the frequencies of the other signals to reduce them to about 20 dB below the level of the swept test signal.

4.2.4 Measurement procedure

- a) With the equipment connected as shown in figure 5a, adjust the output frequencies of the sweep generator to cover the channel to be tested and set the variable attenuator A1, so that the level of the signal at its output is that which will be required when connected to the system input.
- b) Set the variable attenuator A2, so that the level of the signal at the input to the amplifier is about 3 dB to 4 dB below that expected at the system outlet at which the test will be made.
- c) Adjust the oscilloscope controls to obtain a satisfactory display on the Y1 channel, which shall be DC coupled, locking the timebase to the leading edge of the display.

NOTE It may be necessary to operate the oscilloscope at a repetition rate equal to half that of the sweep generator and examine the "second" displayed response.

- d) Adjust the frequency of the signal generator to that of the lower limit of the channel under investigation and arrange the level of this signal and the gain and shift controls of the Y2 channel of the oscilloscope to produce a satisfactory "marker".
- e) Move the "marker" to the upper frequency limit of the channel and carefully note the amplitude of the display between the two marks (see "reference" in figure 6) and the level of the display during the blanking period.
- f) Adjust the attenuator A₂ to values 3 dB either side of that set as specified in item b) of this subclause and check that the shape of the reference curve does not alter materially.
- g) Connect the equipment to the cabled distribution system as shown in figure 5b removing the normal signal input to the channel under test, but retaining any pilot signals which may be necessary to maintain correct operation of the system.

NOTE Signal-operated AGC systems may not function correctly on swept input signals and may have to be rendered inoperative and manual gain control used during these tests.

- h) Adjust the attenuator A₂ to produce the same general amplitude of display as obtained in item c) of this subclause, using the "reference" curve and carefully aligning the blanking level with that obtained in item e) of this subclause.
- i) Mark the frequency limits of the channel as described in item d) and item e) of this subclause.
- j) Using the attenuator A₂, set up the display so that within the frequency limits marked in item i) of this subclause:

- 1) the curve crosses the "reference" at the vision carrier frequency, interpolating if necessary; note the value a_0 , with correction for interpolation;
- 2) the "peak" of the response touches the "reference", interpolating if necessary; note the value a_1 , with correction for interpolation.

The "trough" of the response touches the "reference", interpolating if necessary.

Note the value a_2 , with correction for interpolation.

- k) The variation of amplitude/frequency response within the channel is given by $(a_1 - a_0)$ and $(a_2 - a_0)$.

4.2.5 Presentation of the results

The results are presented in a table or by a curve showing the amplitude response within the measured channel.

4.3 Chrominance-luminance gain and delay inequalities

NOTE This is relevant only for PAL and SECAM standards.

4.3.1 Introduction

The methods described are applicable to the measurement of chrominance/luminance gain and delay inequalities for complete systems and constituent items of equipment. The test

signals employed are in both cases those recommended in ITU-T Recommendation J.61, and are shown in figure 7 and figure 8.

It is intended that these measurements are carried out with test signals inserted at the system headend. They may be either of the full frame type or, where convenient, may be inserted in the field blanking periods. The use of inserted test signals available on the broadcast television channel is not generally recommended as these are subject to variations beyond the control of the user. However, where such signals, of known stability and of adequate quality, are available, they may be used to carry out these measurements.

4.3.2 Equipment required

The test set-up shall be well-matched.

- a) An oscilloscope which will not contribute significant distortion to the signal displayed.
- b) A modulator (unless transmitted test signals in the field blanking interval are to be used) having the following characteristics:
 - 1) radio-frequency characteristics (excluding sound) corresponding to ITU-R Recommendation BT.470, and appropriate to the television transmission system used;
 - 2) video signal input requirement of 1 V peak-to-peak composite;
 - 3) a modulated output signal of a convenient amplitude.
- c) A synchronous demodulator having characteristics appropriate to the television transmission system used.
- d) Two attenuators variable in steps of not more than 1 dB.
- e) A test signal generator (unless transmitted test signals are used) providing signals having characteristics appropriate to the television transmission system under consideration, as specified in ITU-T Recommendation J.61, and containing composite pulse and bar signal elements B2 and F.

NOTE 1 Most commercially available test signal generators will provide this signal as part of a composite test line.

NOTE 2 For measurement on system I, a composite pulse of half-amplitude duration = 1 μ s would be an acceptable alternative to that shown as element F.

- f) A test set capable of providing calibrated variable delay and attenuation in either the chrominance or luminance areas of the video spectrum.

4.3.3 Connection of the equipment

The equipment shall be connected as in figure 9.

4.3.4 Measurement procedure

- a) With point A directly connected to point B (see figure 9), adjust attenuator A_1 for an output level sufficient to drive the system to be tested and attenuator A_2 to obtain the correct input level to the demodulator.
- b) Adjust the oscilloscope Y gain, Y shift and time base to obtain a suitable display of the composite pulse.

For convenience, the oscilloscope may be triggered so that the top of the bar is superimposed over the pulse, as in figure 7.

Ensure that the distortion of the test signal due to the control loop (test equipment) is small compared with the limit specified for the system or equipment to be tested.

- c) Connect the system or equipment to be tested between points A and B.

Adjust the attenuator A_2 to return the input level to the demodulator to that given in item a) of this subclause.

- d) Using the oscilloscope controls, obtain a display as in item b) of this subclause.

- e) With the controls on the test set, null the delay inequality so that the bottom edge of the pulse is symmetrical about the vertical centre line of the pulse (see figures 10b and 11b).
- f) Using the calibrated attenuator on the test set, null the gain inequality so that the peak-to-peak amplitude of the chrominance signal equals that of the luminance bar.
- g) If necessary, repeat the procedure of 4.3.4 e) and 4.3.4 f).
- h) Read the gain and delay inequalities from the calibrated test set.

NOTE 1 If the measurement is made in the presence of echoes generated by discontinuities in the system under test, the result obtained will be subject to an error of magnitude not exceeding that of the echo.

NOTE 2 It is possible, without the use of the test set, to estimate the delay or gain inequality by direct observation of the pulse against a calibrated graticule, and use of a suitable nomograph. The nomograph employed is that applicable to the half-amplitude duration of the particular composite pulse employed for the test. However, where non-linear distortion is present, particularly quadrature distortion in the demodulator, the results will be substantially in error.

4.3.5 Presentation of the results

The results are presented in a table showing the measured value of the chrominance-luminance gain and delay inequalities related to the measured channel.

4.4 Non-linear distortion

General

See IEC 60728-3. The methods described there are applicable to PAL and SECAM systems.

4.4.1 Intermodulation

See IEC 60728-3.

4.4.2 Composite beat

General

The method of measurement of composite beat using AM television signals is applicable to the measurement of the ratio of the carrier-to-composite beat at a specified point in a cabled distribution system. The method can also be used to determine the composite beat intermodulation performance of individual items of equipment. This measurement is made using the existing channels in the system with their normal modulation.

4.4.2.1 Introduction

When the input signals are at regularly spaced intervals (as is common in most frequency allocations for TV channels), the various distortion products tend to cluster in groups, close to the vision carriers and at other regular positions within the TV channels. The number of different products in each cluster increases rapidly with the number of channels. They combine in different ways, depending on the degree of coherence between the generating signals, and the relative phases of the different distortion products.

The method described in this subclause measures the non-linear distortion of a device or system by the composite effect of all the beats clustered close to the vision carrier or at other positions within a TV channel. During the measurement, that channel has to be turned off. The composite beat measured is that generated by all carriers except that or those of the measured channel.

NOTE On systems carrying more than 10 channels, removal of the wanted channel does not significantly affect the result.

If the major contribution to the composite beat is due to distortion products of a particular order, the composite beat will follow the standard level variation for that order. If the

composite beat, as measured, does not follow a standard level variation, it shall have significant contributions from distortion products of different orders.

The method is used to support a specification of the following general format:

"The composite beat ratio for (list of carriers) in channel (A) at (B) dB(μ V) is (C)dB".

(A) designates the channel in which the test is made. If omitted, the specification is understood to be a minimum specification for measurements at all the channels specified by the list of carriers.

(B) is the reference level at which all carriers are set during the measurement, unless otherwise specified. If all carriers are not at the same level, the specification should clearly indicate the level of each carrier relative to the reference level, which is that of the highest carrier level.

(C) is the composite beat ratio, usually given as a minimum specification.

The list of carriers will usually be specified as a list of standard channel designations, signifying test signals at the frequencies of the corresponding vision carriers.

The ratio of carrier-to-composite beat may not vary with output signal level in the way expected for distortion of a given order, and it may therefore be necessary to repeat the tests at levels higher and lower than those initially used. Repeat the tests at levels 2 dB higher and lower. It is recommended that these repeat tests are done on the channel which produced the lowest beat ratio during the test.

4.4.2.2 Equipment required

- a) A spectrum analyzer with 30 kHz IF bandwidth and 10 Hz video bandwidth capability.

NOTE When using a spectrum analyzer with minimum video filtering capabilities greater than 10 Hz, the composite third-order distortion may be noisy and should be read at the middle of the trace.

- b) A variable 75 Ω attenuator, adjustable in 1 dB steps.

- c) A bandpass filter for each channel to be tested or a tunable bandpass filter. This filter should attenuate the other channels present on the system to be tested sufficiently to ensure that the products generated by non-linearity in the spectrum analyzer itself do not contribute significantly to the composite beat products to be measured. The passband of this filter shall at least be flat within 1 dB over the frequency range of interest.

NOTE If the linearity of the spectrum analyzer is sufficient and known, this filter is not necessary.

4.4.2.3 Connection of the equipment

The equipment is connected as in figure 14.

4.4.2.4 Measurement procedure

- a) Connect point A directly to point B and disconnect the bandpass filter (see figure 14).
b) Adjust the spectrum analyzer as follows:

IF bandwidth:	30 kHz
Video bandwidth:	10 Hz
Scan width:	50 kHz/div.
Vertical scale:	10 dB/div.
Scan-time:	0,2 s/div

- c) Tune the spectrum analyzer to the channel in which the measurement is to be made so as to display the vision carrier in a frequency range of 0,5 MHz towards the sound carrier.
- d) Adjust the sensitivity of the spectrum analyzer together with its internal and external input attenuator in such a way that the response to the vision carrier corresponds to a full scale reference. At the same time the noise level shall be at least 60 dB, and preferably 65 dB, below the reference level.
- e) Insert the bandpass filter (if necessary) corresponding to the channel to be measured and adjust the input attenuator to correct for the attenuation of the filter.
- f) Disconnect the signal feed for the channel to be measured and terminate the input socket with its nominal impedance.
- g) Verify that the intermodulation products generated in the spectrum analyzer over the entire channel are below the reference level by an amount at least 20 dB greater than the required distortion distance. If this is not the case, disconnect the bandpass filter and repeat the steps d) to g) of this procedure with an increased input attenuation of the spectrum analyzer.
- h) Note the setting of the sensitivity control or the reference level control.
- i) Reconnect the signal feed for the channel and repeat steps c) to h) of this procedure for all channels.
- j) Connect the system to be tested between points A and B.
- k) Adjust the centre frequency of the spectrum analyzer as in step c) and insert the appropriate band-pass filter, if necessary.
- l) Adjust the input attenuator (internal and/or external) to return the response of the spectrum analyzer to the vision carrier to full scale with the appropriate setting of its sensitivity control (see step h)).

NOTE The external attenuator should be set to a minimum of 10 dB if the filter is in use, otherwise the system under test will see a serious mismatch.

- m) Disconnect the signal feed for the channel to be measured and terminate the input socket with its nominal impedance.
- n) Note the frequencies at which intermodulation products occur and the level of these products compared with the reference level in the frequency range displayed by the spectrum analyzer.
- o) Reconnect the signal feed for the channel, adjust the analyzer tuning so as to display the next 0,5 MHz range.
- p) Repeat steps k) to o) until the entire channel has been examined.
- q) If the composite beats are clustered about the vision carrier, then the signal/composite beat ratio is read directly off the screen of the spectrum analyzer. In cases where there are several clusters, then the ratio is calculated and the subjective effect will be obtained by using the following formula which assumes power addition of the beats:

$$\text{Signal / composite beat} = -10 \lg \sum_{j=1}^M 10^{-(L_j + K_j)/10}$$

where

M is the number of different frequencies at which intermodulation products clusters occur;

L_j corresponds to the ratio, expressed in decibels, of the reference level, at the relevant frequency, to that of the intermodulation product;

K_j is the weighting factor expressed in decibels at the relevant frequency as obtained from figures 12, 13, 15 and 16.

NOTE A cluster is a group of beats (intermodulation products) falling around a carrier or inside a TV channel.

- r) Repeat the steps k) to p) of this procedure for every channel used in this test.

- s) The signal/composite beat ratio for the system under test is taken to be the lowest obtained in step r).

4.4.2.5 Presentation of the results

The results are presented in a table showing the measured values of composite beats (CTB/CSO) for each relevant TV channel.

4.4.3 Composite crossmodulation

Under consideration.

4.4.4 Hum modulation of carriers

4.4.4.1 Introduction

This is a method of measurement of the amplitude modulation (AM), at supply frequencies and harmonics thereof, of the signals on cabled distribution systems primarily intended for television and sound.

A simplified procedure for use where lower sensitivity will suffice is outlined in 4.4.4.6. For relatively high levels of hum modulation, the two methods will yield the same result. Both of the above methods use a DC reference.

An alternative method using an AC reference is described in 4.4.4.7 to 4.4.4.9.

NOTE These methods, are not suited to the measurement of "hum" modulation resulting from the use of switched-mode power supplies, due to the insertion of the 1 kHz low-pass filter. It may be possible to obtain such a measurement without the filter in the circuit, but the results may be inaccurate due to the presence of wide-band noise. A revised method of measurement is currently under consideration.

4.4.4.2 Definition

The signal / hum ratio measured by this method is defined as:

$$\text{signal/hum} = 20 \lg \frac{\text{reference modulation}}{\text{peak-to-peak "hum" modulation}} \text{ dB}$$

When the reference modulation is a vision signal, its amplitude is that of the peak-to-peak composite signal. For an AM sound signal, the reference modulation depth is taken to be 40 % (see figure 17).

4.4.4.3 Equipment required for DC method

The test set-up shall be well-matched.

NOTE 1 The items a), b), c) and e) of this subclause, if applicable, should preferably be powered from batteries (see also 4.4.4.4 b)).

NOTE 2 In item b) of this subclause "negligible" means small compared with the level of hum modulation expected to be measured.

- A CW signal generator with output frequency range and output level to suit the system to be tested (see note 1).
- A tuned signal amplifier to raise, with negligible distortion, the level of the test signal at the point of measurement to about 2 V_{RMS} (see notes 1 and 2).
- An oscilloscope: dual channel, DC coupled, with differential facility, capable of measurement of a signal of 1 mV peak-to-peak (see note 1).
- A terminating RF detector of impedance equal to the Z₀ of the system under test.
- A low-pass filter with 1 kHz cut-off; impedances to suit the detector output.

- f) Two attenuators, variable in steps of 1 dB.
- g) A calibrated potential divider (as shown in figure 19).
- h) A stable variable DC source (as shown in figure 20).

4.4.4.4 Connection of the equipment

- a) If battery-powered equipment is available, this shall be connected as in figure 18.
- b) If mains-powered equipment is to be used, point A should be linked to point B and a check carried out in accordance with 4.4.4.5 a) and 4.4.4.5 c) to 4.4.4.5 f), to ascertain that the level of hum modulation within the test equipment is such that it may be neglected. It shall be small compared with the maximum allowed by the relevant system performance requirement. If this check is satisfactory, the system to be tested may be connected as shown in figure 18.

4.4.4.5 Measurement procedure

- a) Set the signal generator frequency to that of the vision carrier (or sound carrier) of the channel to be tested.
- b) Adjust attenuator A_1 to provide the correct level of CW signal at the input to the system. This level is equal to the RMS value of the relevant television signal during its modulation peaks, or the unmodulated carrier level for sound.
- c) Adjust attenuator A_2 to give a signal of about $2 V_{RMS}$ across the RF termination of the detector.
- d) With the switch of the potential divider set to "a", adjust the oscilloscope controls and the DC offset voltage to the Y_2 input to obtain a display of the demodulated hum signal. Note the peak-to-peak amplitude of the display.
- e) Move the potential divider switch to "b" or "c", depending upon the amplitude of the displayed hum, and keeping all other settings adjusted as described in step d) of this subclause, note the change in DC level of the display. This change is equivalent to an amplitude reduction of 0,07 % for position "b", and of 0,3% for position "c".
- f) Interpolate the result obtained in step d) of this subclause, in relation to the change observed in step e) of this subclause, as a percentage of peak-to-peak (see figure 21).
- g) Calculate the signal/hum ratio (in dB) as follows:

$$\text{signal/hum} = 20 \lg \left(\frac{100}{\% \text{ peak-to-peak hum}} \right) - R \quad (\text{dB})$$

where R is appropriate to the system, as given in table 2.

4.4.4.6 Simplified procedure

- a) Where suitable equipment is available and the levels of hum modulation to be measured are relatively high (signal/hum $\gg$ 34 dB to 40 dB), a simplified procedure may be adopted.
- b) This entails the use of a tuned demodulator, for example, a signal level meter (having a DC coupled video output) and the measurement, with a suitable oscilloscope, of the DC and AC components of the hum modulated test carrier. Battery operation of the test equipment is again advisable and a low-pass filter (similar to that described in 4.4.4.3 e)) will also be required.
- c) The calculation of signal/hum ratio (in dB) is then as follows:

$$\text{signal/hum} = 20 \lg \left(\frac{\text{measured DC voltage}}{\text{measured peak-to-peak AC voltage}} \right) - R \quad (\text{dB})$$