

STN	Káblové siete pre televízne signály, rozhlasové signály a interaktívne služby Časť 101: Vlastnosti systému vzostupných trás pri zaťažení digitálnych kanálov	STN EN 60728-101 36 7211
------------	---	--

Cable networks for television signals, sound signals and interactive services - Part 101: System performance of forward paths loaded with digital channels only

Táto norma obsahuje anglickú verziu európskej normy.
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 09/17

Obsahuje: EN 60728-101:2017, IEC 60728-101:2016

125495

Úrad pre normalizáciu, metrológiu a skúšobníctvo Slovenskej republiky, 2017
Podľa zákona č. 264/1999 Z. z. o technických požiadavkách na výrobky a o posudzovaní zhody a o zmene a doplnení niektorých zákonov v znení neskorších predpisov sa slovenská technická norma a časti slovenskej technickej normy môžu rozmnožovať alebo rozširovať len so súhlasom slovenského národného normalizačného orgánu.

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 60728-101

May 2017

ICS 33.040.20; 33.160.01

English Version

**Cable networks for television signals, sound signals and
interactive services - Part 101: System performance of forward
paths loaded with digital channels only
(IEC 60728-101:2016)**

Réseaux de distribution par câbles pour signaux de
télévision, signaux de radiodiffusion sonore et services
interactifs - Partie 101: Performances des systèmes de voie
directe soumis à une charge de porteuses exclusivement
numériques
(IEC 60728-101:2016)

Kabelnetze für Fernsehsignale, Tonsignale und interaktive
Dienste - Teil 101: Systemanforderungen in Verteilrichtung
bei kompletter digitaler Kanallast
(IEC 60728-101:2016)

This European Standard was approved by CENELEC on 2016-06-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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

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

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

European foreword

The text of document 100/2641/FDIS, future edition 1 of IEC 60728-101, 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 approved by CENELEC as EN 60728-101:2017.

The following dates are fixed:

- latest date by which the document has to be (dop) 2017-11-19
implemented at national level by
publication of an identical national
standard or by endorsement
- latest date by which the national (dow) 2020-05-19
standards conflicting with the
document have to be withdrawn

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

Endorsement notice

The text of the International Standard IEC 60728-101:2016 was approved by CENELEC as a European Standard without any modification.

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

ISO/IEC 13818 (series)

NOTE Harmonized as EN ISO/IEC 13818 (series).

Annex ZA

(normative)

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

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

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60050-705	-	International Electrotechnical Vocabulary (IEV) -- Chapter 705: Radio wave propagation	-	-
IEC 60050-712	-	International Electrotechnical Vocabulary (IEV) -- Chapter 712: Antennas	-	-
IEC 60050-725	-	International Electrotechnical Vocabulary (IEV) -- Chapter 725: Space radiocommunications	-	-
IEC 60728-1	-	Cable networks for television signals, sound signals and interactive services -- Part 1: System performance of forward paths	EN 60728-1	-
IEC 60728-1-1	-	Cable networks for television signals sound signals and interactive services -- Part 1-1: RF cabling for two way home networks	EN 60728-1-1	-
IEC 60728-1-2	-	Cable networks for television signals, sound signals and interactive services -- Part 1-2: Performance requirements or signals delivered at the system outlet in operation	EN 60728-1-2	-
IEC 60728-2	-	Cable networks for television signals, sound signals and interactive services - 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 cable networks	EN 60728-3	-
IEC 60728-3-1	-	Cable networks for television signals, sound signals and interactive services -- Part 3-1: Methods of measurement of non-linearity for full digital channel load with DVB-C signals	EN 60728-3-1	-
IEC 60728-5	-	Cable networks for television signals, sound signals and interactive services - Part 5: Headend equipment	EN 60728-5	-
IEC 60728-10	-	Cable networks for television signals, sound signals and interactive services -- Part 10: System performance of return paths	EN 60728-10	-
IEC 60728-11	-	Cable networks for television signals, sound signals and interactive services -- Part 11: Safety	EN 60728-11	-
IEC 60728-12	-	Cabled distribution systems for television and sound signals -- Part 12: Electromagnetic compatibility of systems	-	-

EN 60728-101:2017

IEC 60966-2-4	-	CABLE ASSEMBLIES - Part 2-4: Detail specification for cable assemblies for radio and TV receivers - Frequency range 0 MHz to 3 000 MHz, IEC 61169-2 connectors	-
IEC 60966-2-5	-	Radio frequency and coaxial cable assemblies -- Part 2-5: Detail specification for cable assemblies for radio and TV receivers - Frequency range 0 MHz to 1 000 MHz, IEC 61169-2 connectors	EN 60966-2-5 -
IEC 60966-2-6	-	Radio frequency and coaxial cable assemblies -- Part 2-6: Detail specification for cable assemblies for radio and TV receivers - Frequency range 0 MHz to 3 000 MHz, IEC 61169-24 connectors	EN 60966-2-6 -
ISO/IEC 13818-1	-	Information technology - Generic coding of moving pictures and associated audio information - Part 1: Systems	-
ISO/IEC 13818-2	-	Information technology - Generic coding of moving pictures and associated audio information - Part 2: 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	-
ISO/IEC 14496-1	-	Information technology -- Coding of audio-visual objects -- Part 1: Systems	-
ISO/IEC 14496-2	-	Information technology - Coding of audio-visual objects - Part 2: Visual	-
ISO/IEC 14496-3	-	Information technology - Coding of audio-visual objects - Part 3: Audio	-
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 300 748	-	Digital Video Broadcasting (DVB): Multipoint Video Distribution Systems (MVDS) at 10 GHz and above	-
ETSI EN 300 749	-	Digital Video Broadcasting (DVB): Microwave Multipoint Distribution Systems (MMDS) below 10 GHz	-
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 (DVB-S2)	-

ETSI EN 302 755	-	Digital Video Broadcasting (DVB); Frame structure channel coding and modulation for a second generation digital terrestrial television broadcasting system (DVB-T2)	-	-
ETSI EN 302 769	-	Digital Video Broadcasting (DVB) - Frame structure channel coding and modulation for a second generation digital transmission system for cable systems (DVB-C2)	-	-
ETSI ETS 300 784	-	Satellite Earth Stations and Systems (SES);Television Receive-Only (TVRO) satellite earth stations operating in the 11/12 GHz frequency bands	-	-
ETSI TR 101 211	-	Digital Video Broadcasting (DVB); Guidelines on implementation and usage of Service Information (SI)	-	-
ETSI TR 101 290	-	Digital Video Broadcasting (DVB);Measurement guidelines for DVB systems	-	-
ETSI TS 102 831 V1.2.1	-	Digital Video Broadcasting (DVB); Implementation guidelines for a second generation digital terrestrial television broadcasting system (DVB-T2)	-	-
ETSI TS 102 991 V1.2.1	-	Digital Video Broadcasting (DVB) - Implementation Guidelines for a second generation digital cable transmission system (DVB-C2)	-	-



INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Cable networks for television signals, sound signals and interactive services –
Part 101: System performance of forward paths loaded with digital channels only**

**Réseaux de distribution par câbles pour signaux de télévision, signaux de
radiodiffusion sonore et services interactifs –
Partie 101: Performances des systèmes de voie directe soumis à une charge de
porteuses exclusivement numériques**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2016 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 15 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

65 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Catalogue IEC - webstore.iec.ch/catalogue

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - www.iec.ch/searchpub

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 15 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

65 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.



INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Cable networks for television signals, sound signals and interactive services –
Part 101: System performance of forward paths loaded with digital channels only**

**Réseaux de distribution par câbles pour signaux de télévision, signaux de
radiodiffusion sonore et services interactifs –
Partie 101: Performances des systèmes de voie directe soumis à une charge de
porteuses exclusivement numériques**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 33.040.20; 33.160.01

ISBN 978-2-8322-3288-0

Warning! Make sure that you obtained this publication from an authorized distributor. Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.
--

CONTENTS

FOREWORD.....	8
INTRODUCTION.....	10
1 Scope.....	15
2 Normative references	15
3 Terms, definitions, symbols and abbreviations.....	17
3.1 Terms and definitions	17
3.2 Symbols.....	29
3.3 Abbreviations	31
4 Methods of measurement at system outlet.....	33
4.1 General.....	33
4.2 Basic assumptions and measurement interfaces	34
4.3 Signal level	37
4.3.1 General	37
4.3.2 Equipment required.....	38
4.3.3 Connection of the equipment.....	38
4.3.4 Measurement procedure.....	38
4.3.5 Presentation of the results.....	39
4.4 RF signal-to-intermodulation and noise ratio S/IN	39
4.4.1 General	39
4.4.2 Equipment required.....	39
4.4.3 Connection of the equipment.....	40
4.4.4 Measurement procedure.....	40
4.4.5 Presentation of the results.....	40
4.5 Bit error ratio (BER)	40
4.5.1 General	40
4.5.2 Equipment required.....	41
4.5.3 Connection of the equipment.....	41
4.5.4 Measurement procedure.....	41
4.5.5 Presentation of the results.....	42
4.6 BER versus S/N	42
4.6.1 General	42
4.6.2 Equipment required.....	42
4.6.3 Connection of the equipment.....	43
4.6.4 Measurement procedure.....	43
4.6.5 Presentation of the results.....	44
4.7 System operating levels and margins.....	45
4.7.1 General	45
4.7.2 White noise signal margin (SM_{WN})	47
4.7.3 Intermodulation noise signal margin (SM_{IN})	48
4.8 Modulation error ratio (MER).....	50
4.8.1 General	50
4.8.2 Equipment required.....	50
4.8.3 Connection of the equipment.....	50
4.8.4 Measurement procedure.....	51
4.8.5 Presentation of the results.....	52
4.9 Phase jitter	52

4.9.1	General	52
4.9.2	Equipment required	52
4.9.3	Connection of the equipment	53
4.9.4	Measurement procedures	53
4.9.5	Presentation of the results	55
4.10	Phase noise of an RF carrier	55
4.10.1	General	55
4.10.2	Equipment required	55
4.10.3	Connection of the equipment	56
4.10.4	Measurement procedure	56
4.10.5	Presentation of the results	57
4.11	Mutual isolation between system outlets	58
4.11.1	General	58
4.11.2	Equipment required	58
4.11.3	Connection of the equipment	58
4.11.4	Measurement procedure	58
4.11.5	Presentation of the results	59
4.12	Amplitude response within a channel	59
4.12.1	General	59
4.12.2	Equipment required	59
4.12.3	Connection of the equipment	60
4.12.4	Measurement procedure	60
4.12.5	Presentation of the results	62
4.13	Non-linear distortion	62
4.13.1	General	62
4.13.2	Intermodulation	62
4.13.3	Composite crossmodulation	62
5	Performance requirements at system outlet	62
5.1	General requirements	62
5.2	Overview	62
5.3	Impedance	62
5.4	Requirements at the terminal input	63
5.4.1	General	63
5.4.2	Signal level	63
5.4.3	Other parameters	63
5.5	RF signal levels at system outlets	63
5.5.1	Minimum and maximum RF signal levels	63
5.5.2	RF signal level differences	65
5.6	Mutual isolation between system outlets	66
5.6.1	Isolation between two subscribers	66
5.6.2	Isolation between individual outlets in one household	66
5.6.3	Isolation between forward and return paths	66
5.7	Frequency response within a television channel at any system outlet	67
5.7.1	Amplitude response	67
5.7.2	Group delay	67
5.8	Long-term frequency stability of distributed signals at any system outlet	68
5.9	Random noise	69
5.10	Interference to television channels	71
5.10.1	Single-frequency interference	71

5.10.2	Intermodulation noise.....	71
5.11	DVB (PSK, QAM, OFDM) additional performance requirements.....	71
5.11.1	<i>BER</i>	71
5.11.2	<i>PER</i>	71
5.11.3	White noise signal margin (SM_{WN})	71
5.11.4	Intermodulation noise signal margin (SM_{IN})	72
5.11.5	<i>MER</i>	72
5.11.6	Phase noise of a DVB signal	72
5.12	DAB performance.....	73
6	Performance requirements at receiving antennas	74
6.1	General.....	74
6.2	Method of measurement of field strength	74
6.2.1	General	74
6.2.2	Equipment required.....	74
6.2.3	Connection of the equipment.....	74
6.2.4	Measurement procedure.....	75
6.2.5	Presentation of the results.....	75
6.3	Requirements.....	75
6.3.1	General	75
6.3.2	Field strength requirements.....	76
6.3.3	Quality of received signals	77
6.3.4	Safety.....	80
6.3.5	Electromagnetic compatibility (EMC)	80
6.4	Interference reduction	80
6.4.1	General	80
6.4.2	Active antennas	80
7	Performance requirements at home network interfaces of cable networks	80
7.1	General.....	80
7.2	Requirements at HNI1 for passive coaxial home networks.....	81
7.2.1	General	81
7.2.2	Signal levels at the HNI1	82
7.2.3	Mutual isolation between two HNI1	84
7.2.4	Frequency response within any television channel at the HNI1.....	84
7.2.5	Long-term frequency stability of distributed RF signals at HNI1	85
7.2.6	Random noise at the HNI1	85
7.2.7	Interference to television channels at the HNI1	85
7.2.8	Return path requirements at the HNI1.....	86
7.3	Requirements at HNI2 for active coaxial home networks	86
7.3.1	General	86
7.3.2	RF signal levels at the HNI2	86
7.3.3	Mutual isolation between two HNI2	89
7.3.4	Frequency response within any television channel at the HNI2.....	89
7.3.5	Long-term frequency stability of distributed RF signals at HNI2	90
7.3.6	Random noise at HNI2	90
7.3.7	Interference to television channels at the HNI2	92
7.3.8	Return path requirements at the HNI2.....	93
7.4	Requirements at HNI3 and at system outlet or terminal input when the home network is mainly of balanced type	93

7.4.1	General	93
7.4.2	Requirements at HNI3	93
7.4.3	Requirements at system output	93
7.4.4	Additional requirements at HNI3 for upstream transmission	94
7.5	Requirements at HNI3 (case C)	94
7.6	Requirements at HNI3 (case D)	94
Annex A	(normative) Correction factors for noise	96
A.1	Signal level measurement	96
A.2	Noise level measurement	96
Annex B	(normative) Null packet and PRBS definitions	98
B.1	Null packet definition	98
B.2	PRBS definition	99
Annex C	(normative) Digital signal level and bandwidth	100
C.1	RF/IF power ("carrier")	100
C.2	Bandwidth of a digital signal	100
C.2.1	Occupied bandwidth	100
C.2.2	Noise bandwidth	101
C.2.3	Equivalent signal bandwidth	101
C.3	Examples	102
Annex D	(normative) Correction factor for a spectrum analyser	103
Annex E	(informative) Differences in some countries	104
E.1	Subclause 3.1.48, Norway	104
E.2	Subclause 5.5.1, Japan	104
E.3	Subclause 5.5.2, Japan	104
E.4	Subclause 5.6.1, Japan	105
E.5	Subclause 5.7.1, Japan	105
E.6	Subclause 5.7.2 Japan	105
E.7	Subclause 5.8, Japan	105
E.8	Subclause 5.9, Japan	105
E.9	Subclause 5.10.1, Japan	105
E.10	Subclause 5.11.6, Japan	106
E.11	Subclause 6.3.3, Japan	107
E.12	Clause 7, Japan	107
Bibliography		108
Figure 1	– Example of a master antenna television system (MATV) for terrestrial reception	11
Figure 2	– Example of the headend of a master antenna television system for satellite (SMATV) reception	12
Figure 3	– Example of a master antenna television system for terrestrial and satellite (SMATV) reception	12
Figure 4	– Example of a cabled distribution system for television and sound signals	13
Figure 5	– System model for downstream direction of a cable network for television and sound signals (CATV)	14
Figure 6	– PSK modulation (QPSK, BPSK or TC8PSK)	34
Figure 7	– DVB-S2 modulation (QPSK, 8PSK, 16APSK, 32APSK)	34
Figure 8	– DVB-C QAM modulation	34
Figure 9	– DVB-C2 QAM modulation	35

Figure 10 – DVB-T OFDM modulation	35
Figure 11 – DVB-T2 OFDM modulation.....	35
Figure 12 – Reference receiver for PSK demodulation (QPSK, BPSK or TC8PSK)	36
Figure 13 – Reference receiver for DVB-S2 demodulation (QPSK, 8PSK, 16APSK, 32APSK)	36
Figure 14 – Reference receiver for DVB-C QAM demodulation.....	36
Figure 15 – Reference receiver for DVB-C2 demodulation	36
Figure 16 – Reference receiver for DVB-T OFDM demodulation.....	37
Figure 17 – Reference receiver (buffer model) for DVB-T2 OFDM demodulation.....	37
Figure 18 – Test set-up for <i>BER</i> measurement.....	41
Figure 19 – Test set-up for BER measurement versus <i>S/N</i>	43
Figure 20 – Example of <i>BER</i> measurement versus <i>S/N</i>	45
Figure 21 – Example of <i>S/N</i> and <i>BER</i> versus signal level <i>S</i> for a cable network without optical link	46
Figure 22 – Optical and coaxial subsystems of an HFC network.....	46
Figure 23 – Test set-up for SM_{WN} and SM_{IN} measurement.....	48
Figure 24 – Test set-up for modulation error ratio (<i>MER</i>) measurement and phase jitter measurement.....	51
Figure 25 – Example of constellation diagram for a 64 QAM modulation format	52
Figure 26 – Example of constellation diagram for a 64 QAM modulation format with arcs due to phase jitter	54
Figure 27 – Test set-up for phase noise measurement.....	56
Figure 28 – Example of mask for phase noise measurements: PSK, APSK and QAM formats.....	57
Figure 29 – Example of mask for phase noise measurements: OFDM format.....	57
Figure 30 – Arrangement of test equipment for measurement of mutual isolation between system outlets.....	58
Figure 31 – Arrangement of test equipment for measurement of frequency response within a channel.....	60
Figure 32 – Interpretation of displays for measurement of frequency response within a channel	61
Figure 33 – Home network types used to define the requirements at several HNI types (coaxial)	81
Figure A.1 – Noise correction factor <i>CF</i> versus measured level difference <i>D</i>	97
Figure E.1 – Single-frequency interference (64 QAM digital) (Japan).....	106
Figure E.2 – Single-frequency interference (256 QAM digital) (Japan).....	106
Table 1 – Application of the methods of measurement	33
Table 2 – Frequency distance f_m	57
Table 3 – Digital signal levels at any system outlet	64
Table 4 – Maximum level differences at any system outlet between distributed television channels	66
Table 5 – Residual carrier level at television or FM radio output within the same outlet or between two different outlets	67
Table 6 – Amplitude response variation.....	67
Table 7 – Group delay variation	68

Table 8 – Maximum deviation of conversion frequency for digitally modulated DVB signals.....	68
Table 9 – RF signal-to noise ratio at system outlet.....	69
Table 10 – Modulation error ratio <i>MER</i> of DVB signals	72
Table 11 – Phase noise of a DVB signal (PSK, APSK and QAM).....	73
Table 12 – Phase noise of a DVB-T or DVB-C2 signal (COFDM).....	73
Table 13 – Minimum field strength levels recommended by CEPT [3]	76
Table 14 – Minimum signal level at the headend input for the reception of DAB signals	77
Table 15 – Minimum signal level and RF signal-to-noise ratio at the headend input for stationary reception of DVB-T signals.....	77
Table 16 – Minimum signal-to-noise ratio <i>S/N</i> at the headend input for DVB-T2 signals.....	78
Table 17 – Minimum RF signal-to-noise ratio at the headend input for the reception of DVB-S or DVB-S2 satellite signals	79
Table 18 – Signal level at HNI1	82
Table 19 – Maximum level differences at HNI1	84
Table 20 – Amplitude response variation at HNI1	85
Table 21 – Group delay variation at HNI1	85
Table 22 – Signal level at HNI2	87
Table 23 – Maximum level differences at HNI2	89
Table 24 – Amplitude response variation at HNI2	90
Table 25 – Group delay variation at HNI2	90
Table 26 – Minimum RF signal-to-noise ratios at HNI2.....	91
Table 27 – Minimum signal level at coaxial terminal input (case A) or at coaxial system outlet (case B)	94
Table A.1 – Noise correction factor	96
Table B.1 – Null transport stream packet definition	98
Table C.1 – Examples of bandwidths for digital modulation techniques	102

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**CABLE NETWORKS FOR TELEVISION SIGNALS,
SOUND SIGNALS AND INTERACTIVE SERVICES –****Part 101: System performance of forward paths
loaded with digital channels only**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of 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, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). 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. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60728-101 has been prepared by technical area 5: Cable networks for television signals, sound signals and interactive services, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

The text of this standard is based on the following documents:

FDIS	Report on voting
100/2641/FDIS	100/2668/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 2.

The list of all the parts of the IEC 60728 series, under the general title *Cable networks for television signals, sound signals and interactive services*, can be found on the IEC website.

For the differences in some countries, see Annex E.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

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

This includes for instance

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

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

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

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

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

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 should be avoided for technical, economical and practical reasons.

In a building divided into apartment blocks, the installation of a master antenna television system for terrestrial (MATV) and/or satellite (SMATV) reception, as shown in Figure 1, Figure 2, Figure 3, Figure 4 and Figure 5, describing as an example the various parts of the system is usual. Most of the terms used in the IEC 60728 series can be referred to these figures.

When signals to be conveyed to the TV receivers are picked up far away, for geographical reasons, and the number of users (subscribers) is very high, the installation of a cable network using coaxial cables and/or fibre optic cables is used, as indicated in Figure 4, describing as an example the various parts of the system.

A system model of a cable network is shown in Figure 5, where the main parts of the systems are indicated, as defined in Clause 3.

This standard deals with digital signals only.

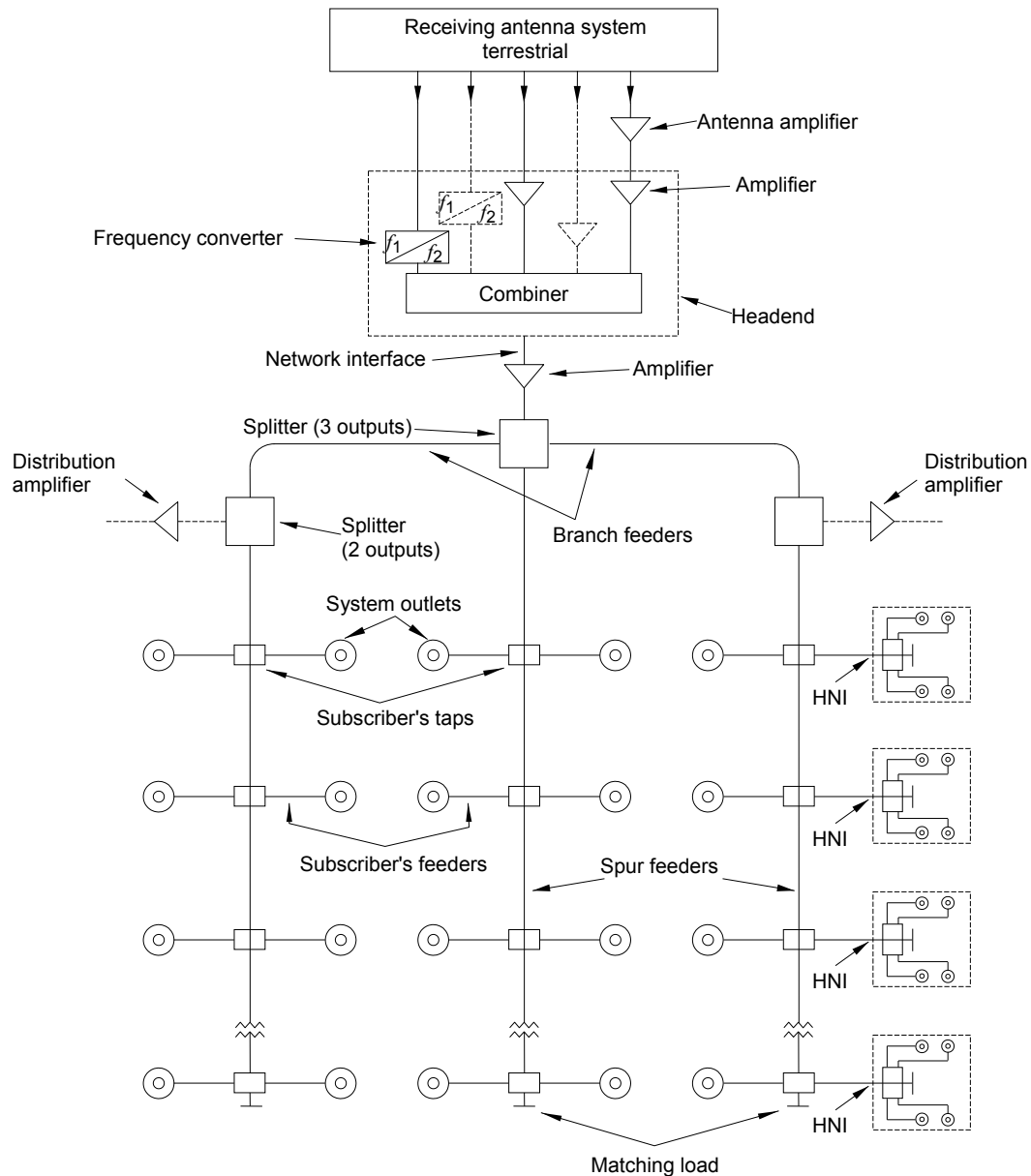
For forward path analogue signals refer to IEC 60728-1. For return paths signals (analogue and digital) refer to IEC 60728-10.

Clause 4 defines the methods of measurement of the system performance parameters at the system outlet.

Clause 5 defines the system performance limits which will, with an unimpaired input, (headend input signal), produce picture and sound signals (at system outlets) where the quality requirement is a quasi-error-free (QEF) reception.

Appropriate performance requirements for the signals at the receiving antennas site are given in Clause 6 in order to provide, at the input of the headend of the cable network, for digital television signals with suitable quality.

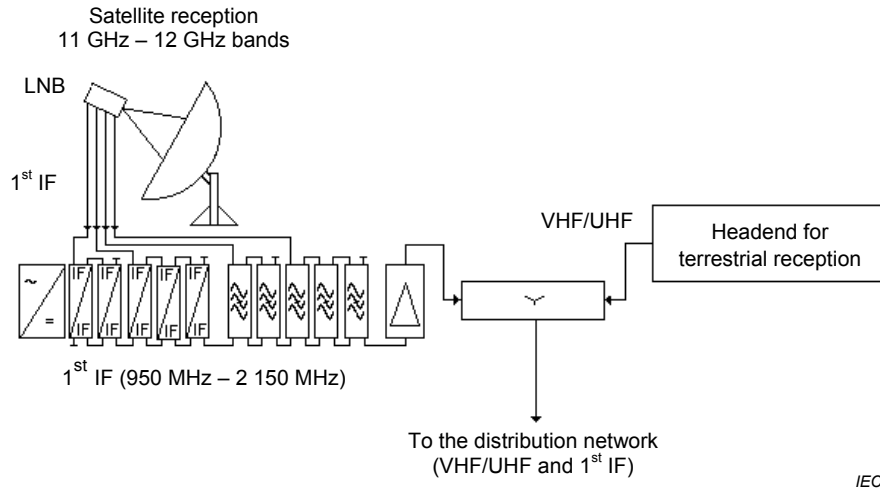
Clause 7 is applicable to home networks (including those of individual receiving systems) using coaxial cables, balanced cables or optical cables and is primarily intended for television signals, sound signals and interactive services, operating between about 30 MHz and 3 000 MHz. Clause 7 also considers basic operational characteristics of a home network, specifies the requirements with respect to the home network interface (HNI) taking into account the performance requirements given at the system outlet or at the terminal input.



IEC

Some apartments (dwelling units) are served with a home network (HN), interfaced to the MATV system by the home network interface (HNI).

Figure 1 – Example of a master antenna television system (MATV) for terrestrial reception



NOTE Distribution at the 1st IF on the same cable as terrestrial VHF/UHF channels.

Figure 2 – Example of the headend of a master antenna television system for satellite (SMATV) reception

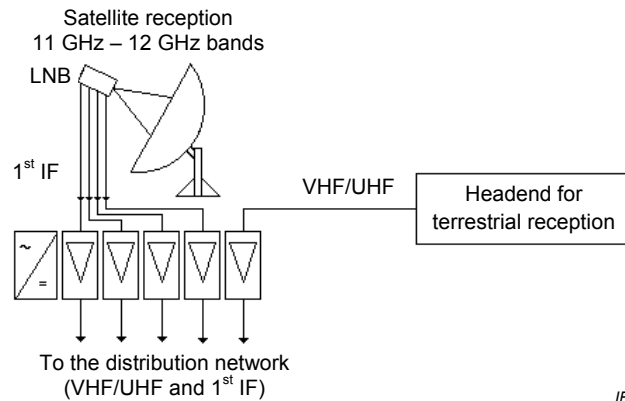


Figure 3a – Headend for terrestrial and satellite reception using multicable distribution

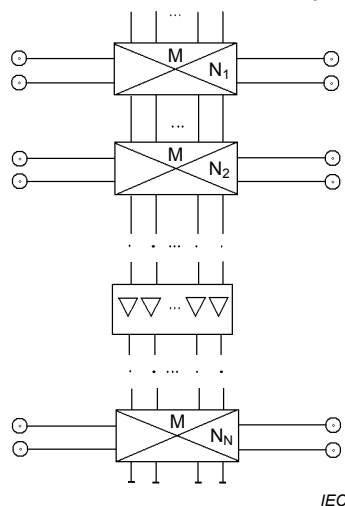


Figure 3b – Distribution with switching matrix at each flat

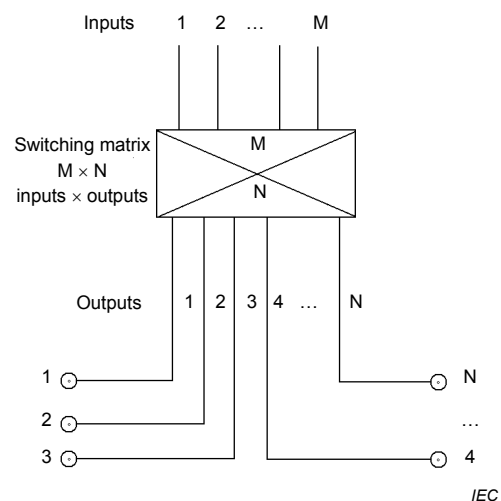


Figure 3c – Distribution with switching matrix: star configuration

NOTE Distribution at the 1st IF using multicable and multi-switch technique.

Figure 3 – Example of a master antenna television system for terrestrial and satellite (SMATV) reception

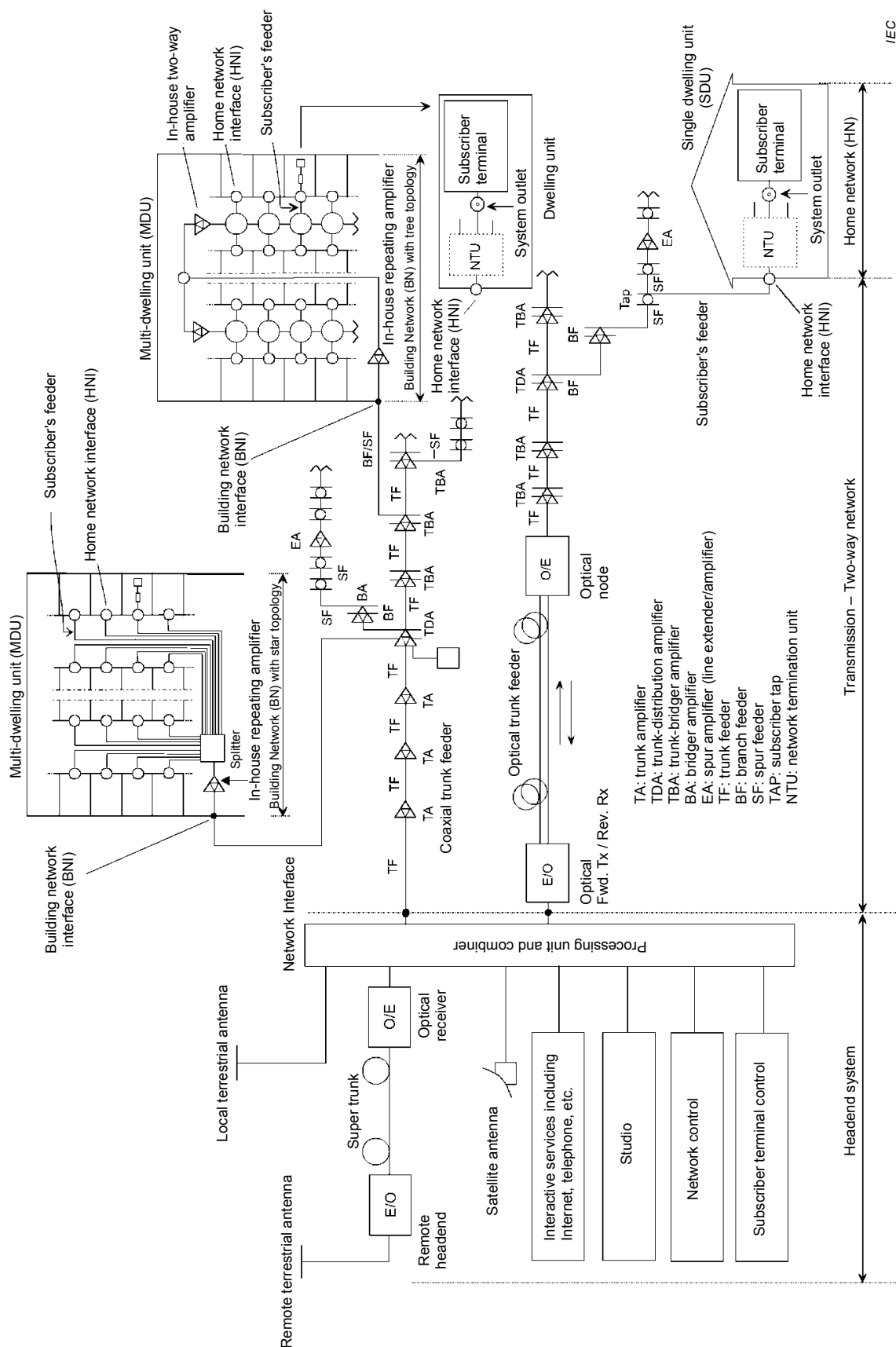


Figure 4 – Example of a cabled distribution system for television and sound signals

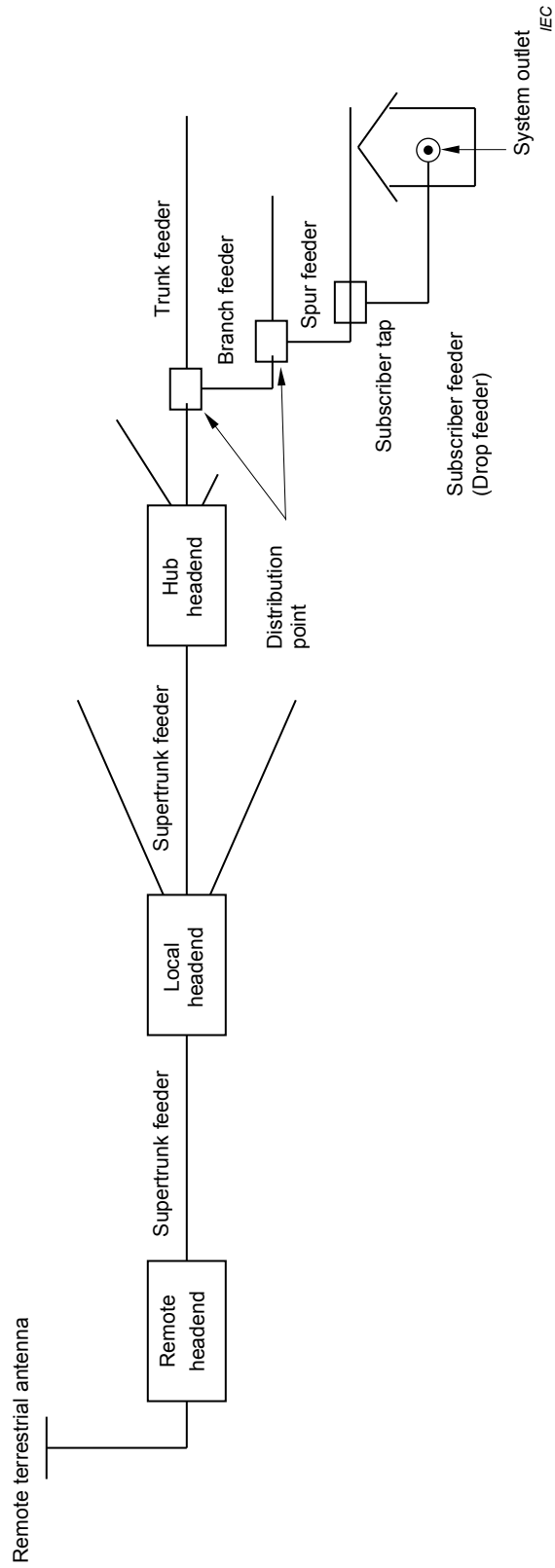


Figure 5 – System model for downstream direction of a cable network for television and sound signals (CATV)

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

Part 101: System performance of forward paths loaded with digital channels only

1 Scope

This part of IEC 60728 is applicable to any cable network (including individual receiving systems) distributing only digital channels having in the forward path a coaxial cable output and primarily intended for television and sound signals operating between about 30 MHz and 3 000 MHz.

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

2 Normative references

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

IEC 60050-705, *International Electrotechnical Vocabulary – Chapter 705: Radio wave propagation*

IEC 60050-712, *International Electrotechnical Vocabulary – Chapter 712: Antennas*

IEC 60050-725, *International Electrotechnical Vocabulary – Chapter 725: Space radiocommunications*

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

IEC 60728-1-1, *Cable networks for television signals, sound signals and interactive services – Part 1-1: RF cabling for two way home networks*

IEC 60728-1-2, *Cable networks for television signals sound signals and interactive services – Part 1-2: Performance requirements for signals delivered at the system outlet in operation*

IEC 60728-2, *Cable networks for television signals, sound signals and interactive services – 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 cable networks*

IEC 60728-3-1, *Cable networks for television signals, sound signals and interactive services – Part 3-1: Active wideband equipment for cable networks – Methods of measurement of non-linearity for full digital channel load with DVB-C signals*

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

IEC 60728-10, *Cable networks for television signals, sound signals and interactive services – Part 10: System performance of return paths*

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

IEC 60728-12, *Cabled distribution systems for television and sound signals – Part 12: Electromagnetic compatibility of systems*

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

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

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

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

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

ISO/IEC 14496-1, *Information technology – Coding of audio-visual objects – Part 1: Systems*

ISO/IEC 14496-2, *Information technology – Coding of audio-visual objects – Part 2: Visual*

ISO/IEC 14496-3, *Information technology – Coding of audio-visual objects – Part 3: Audio*

EN 50248, *Characteristics of DAB receivers*

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 300 748, *Digital Video Broadcasting (DVB) – Multipoint Video Distribution Systems (MVDS) at 10 GHz and above*

ETSI EN 300 749, *Digital Video Broadcasting (DVB) – Microwave Multipoint Distribution Systems (MMDS) below 10 GHz*

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 EN 302 755, *Digital Video Broadcasting (DVB) – Frame structure, channel coding and modulation for a second generation digital terrestrial television broadcasting system (DVB-T2)*

ETSI EN 302 769, *Digital Video Broadcasting (DVB) – Frame structure channel coding and modulation for a second generation digital transmission system for cable systems (DVB-C2)*

ETSI ETS 300 784, *Satellite Earth Stations and Systems (SES) – TeleVision Receive-Only (TVRO) satellite earth stations operating in the 11/12 GHz frequency bands*

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

ETSI TR 101 290, *Digital Video Broadcasting (DVB) – Measurement guidelines for DVB systems*

ETSI TS 102 831, V1.1.1 (2010-10), *Digital Video Broadcasting (DVB) – Implementation guidelines for a second generation digital terrestrial television broadcasting system (DVB-T2)*

ETSI TS 102 991, V1.2.1 (2011-06), *Digital Video Broadcasting (DVB) – Implementation guidelines for a second generation digital cable transmission system (DVB-C2)*

koniec náhľadu – text ďalej pokračuje v platenej verzii STN