

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



**Cable networks for television signals, sound signals and interactive services –  
Part 113: Optical systems for broadcast signal transmissions loaded with digital  
channels only**

**Réseaux de distribution par câbles pour signaux de télévision, signaux de  
radiodiffusion sonore et services interactifs –  
Partie 113: Systèmes optiques pour la transmission de signaux de diffusion  
soumis à une charge de porteuses exclusivement numériques**



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INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

ICS 33.060.40

ISBN 978-2-8322-6337-2

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## CONTENTS

FOREWORD.....	7
INTRODUCTION.....	9
1 Scope.....	10
2 Normative references .....	10
3 Terms, definitions, graphical symbols and abbreviated terms.....	11
3.1 Terms and definitions .....	11
3.2 Graphical symbols.....	16
3.3 Abbreviated terms .....	17
4 Optical system reference model.....	19
5 Preparation of measurement.....	21
5.1 Environmental conditions .....	21
5.1.1 Standard measurement conditions.....	21
5.1.2 Temperature and humidity.....	21
5.1.3 Setting up the measuring setup and system under test.....	21
5.1.4 AGC/ALC operation.....	21
5.1.5 Impedance matching between pieces of equipment.....	21
5.1.6 Standard operating condition.....	21
5.1.7 Standard signal and measuring equipment.....	22
5.2 Accuracy of measuring equipment.....	22
5.3 Source power.....	22
6 Methods of measurement.....	22
6.1 Measuring points and items.....	22
6.1.1 General.....	22
6.1.2 Measuring points.....	22
6.1.3 Measured parameters .....	22
6.2 Optical power.....	24
6.2.1 Introduction.....	24
6.2.2 Measuring setup .....	24
6.2.3 Measuring method .....	24
6.2.4 Precautions for measurement.....	25
6.2.5 Presentation of the results.....	25
6.3 Signal level and RF signal to intermodulation and noise ratio S/IN.....	25
6.3.1 General .....	25
6.3.2 Measuring setup .....	25
6.3.3 Measuring conditions .....	26
6.3.4 Precautions for measurement.....	26
6.3.5 Presentation of the results.....	27
6.4 Signal-to-noise ratio of optical signals.....	27
6.4.1 General .....	27
6.4.2 Measuring setup .....	27
6.4.3 Measurement conditions .....	28
6.4.4 System RIN measuring method .....	28
6.4.5 S/N calculation based on RIN value.....	29
6.4.6 Component RIN calculation .....	30
6.4.7 Example for calculating signal-to-noise ratio S/N .....	31
6.5 Optical modulation index .....	32

6.6	Signal-to-crosstalk ratio (SCR) .....	32
6.6.1	General .....	32
6.6.2	Equipment required .....	32
6.6.3	General measurement requirements .....	33
6.6.4	Procedure .....	33
6.6.5	Potential sources of error .....	34
6.6.6	Presentation of the results .....	34
6.7	RF signal-to-intermodulation and noise ratio S/IN .....	34
6.7.1	General .....	34
6.7.2	Equipment required .....	34
6.7.3	Connection of the equipment .....	35
6.7.4	Measurement procedure .....	35
6.7.5	Presentation of the results .....	36
6.8	Bit error ratio (BER) .....	36
6.8.1	General .....	36
6.8.2	Connection of the equipment .....	36
6.8.3	Measurement procedure .....	37
6.8.4	Presentation of the results .....	37
6.9	BER versus S/N .....	37
6.9.1	General .....	37
6.9.2	Connection of the equipment .....	37
6.9.3	Measurement procedure .....	38
6.9.4	Presentation of the results .....	38
6.10	System noise margins .....	39
6.10.1	General .....	39
6.10.2	Connection of the equipment .....	39
6.10.3	Measurement procedure .....	40
6.10.4	Presentation of the results .....	40
6.11	Modulation error ratio (MER) .....	41
6.11.1	General .....	41
6.11.2	Connection of the equipment .....	41
6.11.3	Measurement procedure .....	42
6.11.4	Presentation of the results .....	42
7	Specification of the optical system for broadcast signal transmission .....	42
7.1	Digital broadcast system over optical network .....	42
7.2	Relationship between RIN and S/N .....	46
7.3	Optical wavelength .....	48
7.4	Frequency of source signal .....	48
7.5	Level difference between adjacent channels .....	48
7.6	BER at headend input .....	50
7.7	MER .....	50
7.8	S/N specification for in-house and in-building wirings .....	50
7.9	Electrical signal interference .....	51
7.10	Crosstalk due to optical fibre non-linearity .....	55
7.11	Interference due to intermodulation noise caused by fibre non-linearity .....	55
7.12	Environmental conditions .....	56
Annex A (informative)	Actual service systems and design considerations .....	57
A.1	General .....	57
A.2	Multi-channel service system .....	57

A.2.1	General .....	57
A.2.2	Operating conditions .....	58
A.2.3	Operating environment.....	58
A.3	Re-transmission service system .....	59
A.3.1	General .....	59
A.3.2	Operating conditions .....	59
A.3.3	Operating environment.....	60
A.4	S/N ratio calculation of optical network .....	60
A.5	System reference model.....	61
A.6	Hints for actual operation .....	64
A.6.1	Optimum operation.....	64
A.6.2	Key issues to be specified .....	65
Annex B (informative)	BER extrapolation method.....	66
Annex C (informative)	Optical system degradations .....	68
C.1	System degradation factors .....	68
C.2	Non-linear degradation .....	69
C.2.1	Degradation factors.....	69
C.2.2	Stimulated Brillouin scattering (SBS) .....	69
C.2.3	Stimulated Raman scattering (SRS).....	70
C.2.4	Self-phase modulation (SPM) .....	73
C.2.5	Cross-phase modulation (XPM).....	73
Annex D (informative)	Measurement of parameters ( $R$ , $I_{d0}$ , $I_{eq}$ and $G$ ) required for $RIN$ calculation .....	74
D.1	Measurement of the responsivity ( $R$ ).....	74
D.2	Measurement of dark current ( $I_{d0}$ ).....	74
D.3	Measurement of equivalent noise current density ( $I_{eq}$ ).....	74
D.4	Measurement of gain ( $G$ ).....	75
Annex E (informative)	Measurement of peak and average signal levels of digitally modulated signals.....	76
E.1	General.....	76
E.2	Peak and average power measurement using CCDF .....	76
E.3	Measurement method of CCDF .....	78
E.3.1	General .....	78
E.3.2	Measurement procedure.....	78
E.3.3	Estimation of BER from the CCDF measurement result .....	78
E.3.4	Examples of CCDF measurements .....	80
E.4	Performance evaluation of the FTTH system.....	81
E.4.1	General .....	81
E.4.2	Evaluation procedure .....	81
E.5	Potential sources of error .....	82
Annex F (informative)	Clipping noise .....	83
Bibliography	.....	84
Figure 1	– Example of FTTH system for television and sound signal .....	20
Figure 2	– Points of performance specification of the FTTH system.....	21
Figure 3	– Typical optical video distribution system .....	23
Figure 4	– Test set-up for optical power measurement using a wavelength filter .....	24
Figure 5	– Test set-up for optical power measurement using a WDM coupler .....	24

Figure 6 – Test setup for RF signal to intermodulation and noise ratio measurement .....	26
Figure 7 – Measuring points in the optical cable TV network .....	27
Figure 8 – Test setup for RIN measurement .....	28
Figure 9 – Test setup for signal to crosstalk measurement.....	33
Figure 10 – Test setup for BER measurement .....	37
Figure 11 – Test setup for BER versus S/N measurement.....	37
Figure 12 – Extrapolation method of BER measurement .....	38
Figure 13 – Example of BER versus S/N characteristics .....	39
Figure 14 – Test setup for system noise margin measurement.....	40
Figure 15 – Example of system noise margin characteristics.....	41
Figure 16 – Test setup for MER measurement.....	41
Figure 17 – Example of result of MER measurement (64 QAM modulation format).....	42
Figure 18 – Performance specified points .....	43
Figure 19 – Permissible signal level of adjacent channels (in the case of Japan).....	49
Figure 20 – Section S/N for MDU wiring (specified by electrical signal) .....	51
Figure 21 – Section S/N for MDU wiring (specified by optical signal) .....	51
Figure 22 – Signal level difference with 3 <sup>rd</sup> order interference signal (ISDB-T).....	52
Figure 23 – Level difference between signal and reflected (echo) signal (ISDB-T) .....	53
Figure 24 – Signal level difference with 3 <sup>rd</sup> order interference signal (ISDB-C 64 QAM) .....	53
Figure 25 – Signal level difference with 3 <sup>rd</sup> order interference signal (ISDB-C 256 QAM)	54
Figure 26 – Level difference between signal and reflected (echo) signal (ISDB-C 64 QAM, ISDB-C2 256 QAM to 4 096 QAM).....	54
Figure 27 – Level difference between signal and reflected (echo) signal (ISDB-C 256 QAM) .....	55
Figure A.1 – Example of a multi-channel service system of one million terminals.....	57
Figure A.2 – Example of a multi-channel service system of 2 000 terminals.....	58
Figure A.3 – Example of re-transmission service system of 72 terminals .....	59
Figure A.4 – Example of re-transmission service system of 144 terminals .....	59
Figure A.5 – Model 1 system performance calculation.....	63
Figure A.6 – Model 4 system performance calculation.....	64
Figure B.1 – Extrapolation method of BER measurement.....	66
Figure B.2 – BER characteristics for 256 QAM, 1 024 QAM and 4 096 QAM (Extrapolation method).....	67
Figure C.1 – Reflection model .....	68
Figure C.2 – Degradation factors of optical transmission system .....	69
Figure C.3 – SBS generation image .....	69
Figure C.4 – Interference between two wavelengths .....	71
Figure C.5 – Simulation of SRS (OLT transmission power versus D/U).....	71
Figure C.6 – Simulation of SRS (D/U in arbitrary unit versus fibre length).....	72
Figure C.7 – Fibre length of the first peak of SRS D/U versus frequency .....	72
Figure C.8 – GE-PON idle pattern spectrum (ISO/IEC/IEEE 8802-3:2017 1 000 Base-PX) (62,5 MHz = 1 250 Mbps/20 bit).....	73
Figure D.1 – Measurement of gain ( <i>G</i> ).....	75
Figure E.1 – Typical CCDF curves for OFDM and M-QAM signals .....	77

Figure E.2 – CCDF measurement setup .....	78
Figure E.3 – CCDF measurement example .....	79
Figure E.4 – SER vs S/N performance in an AWGN channel .....	80
Figure E.5 – Example of CCDF measurements .....	80
Figure E.6 – Performance evaluation of digital optical signals in the FTTH system .....	81
Figure E.7 – CCDF measurement bandwidth .....	81
Figure F.1 – Clipping effects in laser diode static curve (IL curve).....	83
Figure F.2 – Clipping noise, zero span, sweeping time is 100 $\mu$ s.....	83
Table 1 – Level of RF signals .....	14
Table 2 – Optical wavelength for FTTH system.....	19
Table 3 – Frequency range .....	19
Table 4 – Measuring instruments.....	22
Table 5 – Measuring points and measured parameters .....	23
Table 6 – Parameters used for the calculation of signal-to-noise ratio (S/N) .....	31
Table 7 – RF signal noise bandwidth.....	36
Table 8 – Minimum S/N ratio (SDU case).....	43
Table 9 – Minimum S/N ratio (MDU case).....	44
Table 10 – Minimum RF signal to noise ratio requirements in operation .....	45
Table 11 – Types of broadcast services and relative carrier level .....	47
Table 12 – Type of service and minimum operational RIN values .....	47
Table 13 – Section S/N ratio for in-house/in-building wiring (Japan).....	50
Table 14 – Limits for in-channel electrical signal interference.....	52
Table 15 – Interference level due to fibre non-linearity.....	56
Table 16 – Environmental conditions .....	56
Table A.1 – Operating conditions of a multi-channel service system.....	58
Table A.2 – Operating conditions of re-transmission service system.....	60
Table A.3 – Basic system parameters for multi-channel and re-transmission service systems.....	62
Table C.1 – Disturbance parameter of Raman crosstalk.....	70

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**CABLE NETWORKS FOR TELEVISION SIGNALS,  
SOUND SIGNALS AND INTERACTIVE SERVICES –****Part 113: Optical systems for broadcast signal  
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The text of this standard is based on the following documents:

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100/3103/FDIS	100/3125/RVD

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The French version of this standard has not been voted upon.

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IEC 60728-113:2018

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## INTRODUCTION

International Standards and other 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 ranges from antennas and/or special interfaces to headends, or other interface points on the network up to any terminal interface of the equipment on the customer's premises.

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) as well as of any coaxial, balanced and optical cables and accessories thereof is excluded.

[IEC 60728-113:2018](https://standards.iteh.ai/catalog/standards/sist/769fa043-7dc5-4ff8-bd0a-a26f46132995/iec-60728-113-2018)

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

## Part 113: Optical systems for broadcast signal transmissions loaded with digital channels only

### 1 Scope

This part of IEC 60728 is applicable to optical transmission systems for broadcast signal transmission that consist of headend equipment, optical transmission lines, in-house wirings and system outlets. These systems are primarily intended for television and sound signals using digital transmission technology. This document specifies the basic system parameters and methods of measurement for optical distribution systems between headend equipment and system outlets in order to assess the system performance and its performance limits.

In this document, the upper signal frequency is limited at about 1 000 MHz. For systems requiring more bandwidth, refer to IEC 60728-13-1.

The purpose of this part of IEC 60728 is to describe the system specifications of FTTH (fibre to the home) networks for digitally modulated broadcast signal transmission. This document is also applicable to broadcast signal transmission using a telecommunication network if it satisfies the optical portion of this document. This document describes RF transmission for fully digitalized broadcast and narrowcast (limited area distribution of broadcast) signals over FTTH, and introduces xPON system as a physical layer media. The detailed description of the physical layer is out of the scope of this document. The scope is limited to RF signal transmission over FTTH, thus, it does not include IP transport technologies, such as IP Multicast and associate protocols.

Some interference descriptions between the telecommunication system and the broadcast system are addressed in Clause 7.

### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-1:2013, *Environmental testing – Part 1: General and guidance*

IEC 60728-1:2014, *Cable networks for television signals, sound signals and interactive services – Part 1: System performance of forward paths*

IEC 60728-6:2011, *Cable networks for television signals, sound signals and interactive services – Part 6: Optical equipment*

IEC TR 60728-6-1:2006, *Cable networks for television signals, sound signals and interactive services – Part 6-1: System guidelines for analogue optical transmission systems*

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

IEC 60825-1, *Safety of laser products – Part 1: Equipment classification and requirements*

IEC 60825-2, *Safety of laser products – Part 2: Safety of optical fibre communication systems (OFCS)*

IEC 60825-12, *Safety of laser products – Part 12: Safety of free space optical communication systems used for transmission of information*

IEC 61755-1:2005, *Fibre optic connector optical interfaces – Part 1: Optical interfaces for single mode non-dispersion shifted fibres – General and guidance*

ITU-T Recommendation G.692, *Optical interfaces for multichannel systems with optical amplifiers*

ITU-T Recommendation G.694.2, *Spectral grids for WDM applications: CWDM wavelength grid*

ITU-T Recommendation J.83, *Digital multi-programme systems for television, sound and data services for cable distribution*

ITU-T Recommendation J.382, *Advanced digital downstream transmission systems for television, sound and data services for cable distribution*

### 3 Terms, definitions, graphical symbols and abbreviated terms

#### 3.1 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

##### 3.1.1

###### optical transmitter

transmitting fibre optic terminal device accepting at its input port an electrical signal and providing at its output port an optical signal modulated by that input signal

Note 1 to entry: For the purposes of this document, optical transmitters can have more than one input port accepting electrical RF signals.

Note 2 to entry: This piece of equipment amplifies frequency multiplexed electrical signals and converts these electrical signals into optical signals. The optical wavelength is a 1 500 nm band ( $1\,550 \pm 10$  nm in the 1 530 nm to 1 625 nm range).

[SOURCE: IEC TR 61931:1998, 2.9.6, modified – Notes 1 and 2 have been added]

##### 3.1.2

###### optical receiver

receiving fibre optic terminal device accepting at its input port a modulated optical signal, and providing at its output port the corresponding demodulated electrical signal (with the associated clock, if digital)

Note 1 to entry: For the purposes of this document, optical receivers can have more than one output port providing electrical RF signals.

[SOURCE: IEC TR 61931:1998, 2.9.7, modified – Note 1 has been added]

### 3.1.3

#### **optical amplifier**

optical waveguide device containing a suitably pumped, active medium which is able to amplify an optical signal

Note 1 to entry: There are several methods based on wavelength to be used for amplification. The term "Erbium Doped Fibre Amplifier (EDFA)" is the synonym of optical amplifier in this document.

[SOURCE: IEC TR 61931:1998, 2.7.75, modified – Note 1 has been added.]

### 3.1.4

#### **splitter**

optical fibre device, possessing three or more optical ports, which shares optical power among its ports in a predetermined fashion, at the same wavelength or wavelengths, without wavelength conversion

Note 1 to entry: The ports can be connected to fibres, detectors, etc.

[SOURCE: IEC TR 61931:1998, 2.6.21, modified – The term "splitter" has been added, and "optical fibre branching device" and "optical fibre coupler" have been deleted.]

### 3.1.5

#### **WDM filter**

wavelength selecting device (used in WDM transmission systems) in which optical signals can be transferred between two predetermined ports, depending on the wavelength of the signal

### 3.1.6

#### **WDM coupler**

wavelength coupling device (used in WDM transmission systems) in which optical signals in different wavelengths can be coupled between two predetermined ports

<https://standards.iteh.ai/catalog/standards/sist/769fa043-7dc5-4ff8-bd0a-a26f46132995/iec-60728-113-2018>

### 3.1.7

#### **optical modulation index**

optical modulation index of  $k^{\text{th}}$  RF signal,  $OMI_k$  is defined as

$$OMI_k = \frac{\phi_h - \phi_l}{\phi_h + \phi_l}$$

where

$\phi_h$  is the highest instantaneous optical power of the intensity modulated optical signal;

$\phi_l$  is the lowest instantaneous optical power of the intensity modulated optical signal;

$k$  is the total number of RF signals.

Note 1 to entry: This definition does not apply to systems where the input signals are converted and transported as digital baseband signals. In this case, the terms "modulation depth" or "extinction ratio" defined in 2.6.79 and 2.7.46 of IEC TR 61931:1998 are used. A test procedure for extinction ratio is described in IEC 61280-2-2.

[SOURCE: IEC 60728-6:2011, 3.1.10, modified – The definition has been clarified and Notes 1 and 2 to entry have been replaced by a new Note 1 to entry.]

### 3.1.8

#### **total optical modulation index**

resulting optical modulation index when more than one RF signal is transmitted,  $OMI_{\text{tot}}$ , which is defined as

$$OMI_{\text{tot}} = \sqrt{\sum_{k=1}^K OMI_k^2}$$

where

$OMI_k$  is the optical modulation index of the  $k$ -th RF signal;

$K$  is the total number of RF signals.

### 3.1.9

#### RIN

#### relative intensity noise

ratio of the mean square of the intensity fluctuations in the optical power of a light source to the square of the mean of the optical output power

Note 1 to entry: The RIN is usually expressed in dB(Hz<sup>-1</sup>) resulting in negative values.

Note 2 to entry: The value of RIN can also be calculated from the results of a signal to noise measurement for the system.

[SOURCE: IEC 60728-6:2011, 3.1.12, modified – Note 2 has been added]

### 3.1.10

#### responsivity

ratio of an optical detector's electrical output to its optical input at a given wavelength

Note 1 to entry: The responsivity is generally expressed in ampere per watt or volt per watt of incident radiant power.

Note 2 to entry: Sensitivity is sometimes used as an imprecise synonym for responsivity.

Note 3 to entry: The wavelength interval around the given wavelength can be specified.

[SOURCE: IEC 60728-6:2011, 3.1.15]

### 3.1.11

#### wavelength

distance covered in a period by the wavefront of a harmonic plane wave

Note 1 to entry: The wavelength  $\lambda$  of light in vacuum is given by

$$\lambda = \frac{c}{f}$$

where

$c$  is the speed of light in vacuum ( $c = 2,997\,92 \times 10^8$  m/s);

$f$  is the optical frequency.

Note 2 to entry: Although the wavelength in dielectric material, such as fibres, is shorter than in vacuum, only the wavelength of light in vacuum is used.

[SOURCE: IEC TR 61931:1998, 2.2.9, modified – Notes 1 and 2 to entry have been added.]

### 3.1.12

#### central wavelength

average of those wavelengths at which the amplitude of a light source reaches or last falls to half of the maximum amplitude

[SOURCE: IEC 60728-6:2011, 3.1.26, modified – The term "centre wavelength" has been replaced by "central wavelength".]