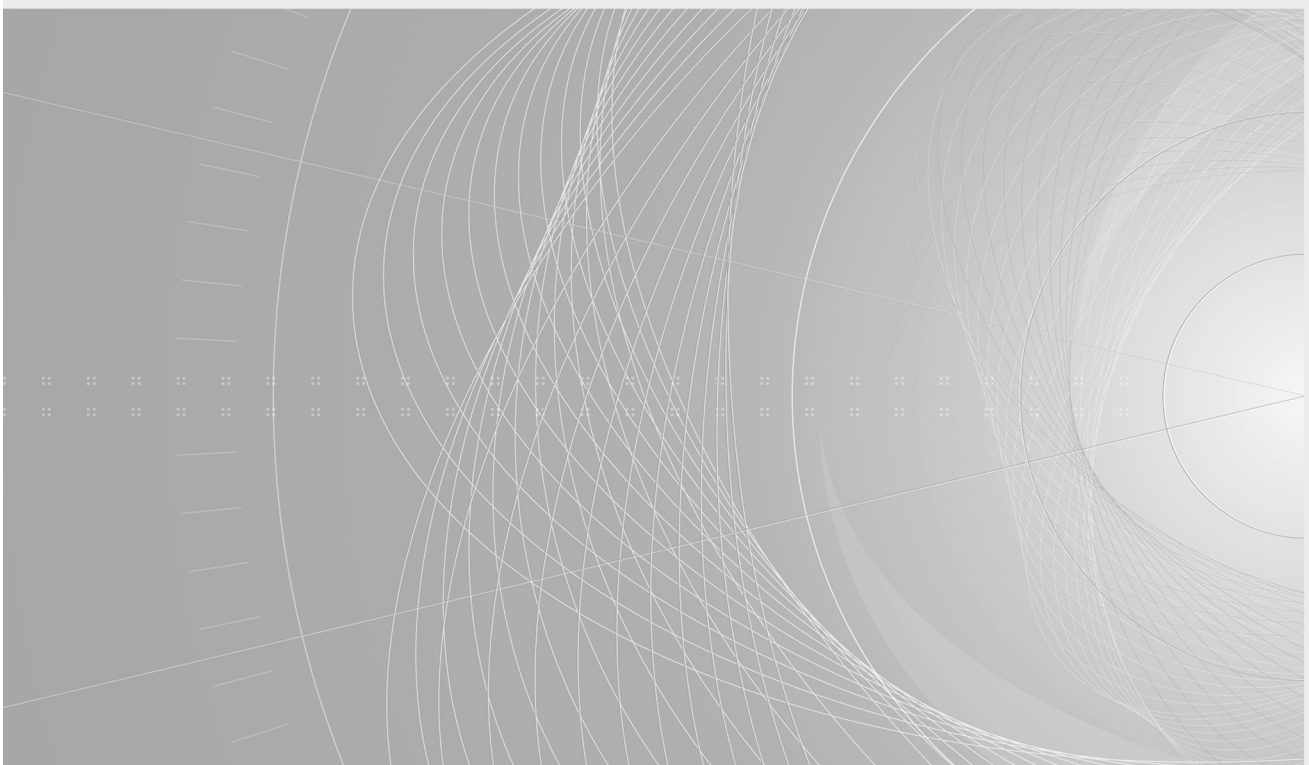


INTERNATIONAL STANDARD

NORME INTERNATIONALE

Cable networks for television signals, sound signals and interactive services –
Part 14: Optical transmission systems using RFoG technology

Réseaux de distribution par câbles pour signaux de télévision, signaux de
radiodiffusion sonore et services interactifs –
Partie 14: Systèmes de transmission optique appliquant la technologie RFoG





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INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Cable networks for television signals, sound signals and interactive services –
Part 14: Optical transmission systems using RFoG technology**

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Partie 14: Systèmes de transmission optique appliquant la technologie RFoG**

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**CABLE NETWORKS FOR TELEVISION SIGNALS,
SOUND SIGNALS AND INTERACTIVE SERVICES –**
Part 14: Optical transmission systems using RFoG technology
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International Standard IEC 60728-14 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
100/2248/FDIS	100/2284/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.

This standard follows closely (where applicable) the ANSI/SCTE 174 2010 standard “Radio Frequency over Glass / Fiber-to-the-Home Specification”. In agreement with SCTE¹ major parts of ANSI/SCTE 174:2010 have been copied into this standard.

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

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¹ SCTE = Society of Cable Telecommunications Engineers

INTRODUCTION

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.

- 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.

(standards.iteh.ai)

The Annexes provide the following information.

Annex A	describes implementation notes with design consideration based on this standard
Annex B	describes the system loss specification
Annex C	describes multiple CMTS operation
Annex D	contains specifications for an optional remote control system
Annex E	gives a design guideline of housings for R-ONU protection
Annex F	contains information on the effect of off-state optical power on C/N ratio of transmission signal

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

Part 14: Optical transmission systems using RFoG technology

1 Scope

This part of IEC 60728 describes the system and equipment specification of FTTH/FTTB (fibre to the home/fibre to the building) networks where information is transmitted in both, forward and return path directions using RF subcarrier multiplexing technology, and where the return path transmission uses additionally time division multiple access technique imposed by the transmission of the return path signals using a TDMA (e.g. TDMA mode of DOCSIS) protocol. Such systems are called RF over Glass (RFoG) and consist of an RFoG optical network unit (R-ONU), an optical distribution network based on xPON structure, and an RFoG optical return path receiver. This standard specifies the basic system parameters and methods of measurement for RFoG systems in order to assess the system performance and its performance limits.

The detailed description of physical layer is out of the scope of this standard and it does not include IP transport technologies.

iTeh STANDARD PREVIEW

2 Normative references (standards.iteh.ai)

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 60068-1:1988, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-6:2007, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-14, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-27, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-30, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-31, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment-type specimens*

IEC 60068-2-40, *Environmental testing – Part 2-40: Tests – Test Z/AM: Combined cold/low air pressure tests*

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

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

IEC 60728-2, *Cable networks for television signals, sound signals and interactive services – Part 2: Electromagnetic compatibility of equipment*

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

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

IEC 60728-10:2014, *Cable networks for television signals, sound signals and interactive services – Part 10: System performance of return path*

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

IEC 60728-13:2010, *Cable networks for television signals, sound signals and interactive services – Part 13: Optical systems for broadcast signal transmissions*

IEC 60728-13-1:2012, *Cable networks for television signals, sound signals and interactive services – Part 13-1: Bandwidth expansion for broadcast signal over FTTH system*

IEC 60793-2-50:2012, *Optical fibres – Part 2-50: Product specifications – Sectional specification for class B single-mode fibres*

IEC 60794-3-11:2010, *Optical fibre cables – Part 3-11: Outdoor cables – Product specification for duct, directly buried, and lashed aerial single-mode optical fibre telecommunication cables*

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

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

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

IEC 61280-1-1, *Fibre optic communication subsystem basic test procedures – Part 1-1: Test procedures for general communication subsystems – Transmitter output optical power measurement for single-mode optical fibre cable*

IEC 61280-1-3, *Fibre optic communication subsystem test procedures – Part 1-3: General communication subsystems – Central wavelength and spectral width measurement*

IEC 61754-4, *Fibre optic interconnecting devices and passive components – Fibre optic connector interfaces – Part 4: Type SC connector family*

IEC/TR 61931:1998, *Fibre optics – Terminology*

IEEE Standard 802.3-2008, *Carrier sense multiple access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications (Includes the EPON standard). See also subsequent corrigenda*

IEEE Standard 802.3av-2009, *IEEE Standard for Information Technology-Part 3: Amendment 1: Physical Layer Specifications and Management Parameters for 10Gb/s Passive Optical Networks*, October 2009

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60728-1 and IEC/TR 61931 as well as the following apply.

3.1.1

carrier-to-crosstalk ratio

CCR

level difference of desired signal carrier level and worst case of other services single frequency crosstalk signal measured at RF output port of optical receiver

Note 1 to entry: *CCR* is defined by the following equation:

$$CCR = D - U_{\text{OtherService}} \quad (1)$$

where

D is the nominal level of the desired signal in dB(μ V) at RF output port of optical receiver;

$U_{\text{OtherService}}$ is the worst case level of another service's single frequency crosstalk in dB(μ V) at RF output port of the optical receiver.

Note 2 to entry: *CCR* is expressed in dB. [IEC 60728-14:2014](https://standards.iteh.ai/catalog/standards/sist/e48ba062-e304-4b39-8c00-9c511fd30f23/iec-60728-14-2014)

3.1.2

equivalent input noise current density

notional input noise current density which, when applied to the input of an ideal noiseless device, produces an output noise current density equal in value to that observed at the output of the actual device under consideration

Note 1 to entry: It can be calculated from the carrier-to-noise ratio *CIN* (see IEC 60728-6) of a device or system using:

$$I_r = \sqrt{\frac{C}{Z 10^{\frac{1}{10} CIN}}} \quad (2)$$

where

C is the power of the carrier at the input of the device or system, in W/Hz;

Z is its input impedance, in Ω .

Note 2 to entry: The equivalent input noise current density is expressed in A/ \sqrt Hz.

3.1.3

extended satellite television distribution network or system

distribution network or system designed to provide sound and television signals received by satellite receiving antenna to households in one or more buildings

Note 1 to entry: This kind of network or system can be combined with terrestrial antennas for the additional reception of TV and/or radio signals via terrestrial networks.

Note 2 to entry: This kind of network or system can also carry control signals for satellite switched systems or other signals for special transmission systems (e.g. MoCA or WiFi) in the return path direction.

3.1.4

extended terrestrial television distribution network or system

distribution network or system designed to provide sound and television signals received by terrestrial receiving antenna to households in one or more buildings

Note 1 to entry: This kind of network or system can be combined with a satellite antenna for the additional reception of TV and/or radio signals via satellite networks.

Note 2 to entry: This kind of network or system can also carry other signals for special transmission systems (e.g. MoCA or WiFi) in the return path direction.

3.1.5

fibre optic branching device

<optical> <fibre> branching device

<optical> splitter

DEPRECATED: <optical> <fibre> coupler

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 may be connected to fibres, sources, detectors, etc.

[SOURCE: IEC/TR 61931:1998, definition 2.6.21]

3.1.6

flatness

difference between the maximum and the minimum RF gain or attenuation not taking into account the slope within the specified modulation frequency range of a device or system

3.1.7

headend system

system comprising modulators, demodulators, CMTS, an optical transmitter with optional optical amplifiers and a WDM for the transmission of analogue video as well as digitally modulated signals located at the central office side of the optical network

Note 1 to entry: The headend system is equipped with an optical return path receiver receiving digitally modulated signals of data in the return path direction to enable e.g. VoIP, VOD and internet services.

Note 2 to entry: V-OLT is a part of the headend system and deals with video transmission in the forward path only.

3.1.8

individual satellite television receiving system

system designed to provide sound and television signals received from satellite(s) to an individual household

Note 1 to entry: This kind of system can also carry control signals for satellite switched systems or other signals for special transmission systems (e.g. MoCA or WiFi) in the return path direction.

3.1.9

individual terrestrial television receiving system

system designed to provide sound and television signals received via terrestrial broadcast networks to an individual household

Note 1 to entry: This kind of system can also carry other signals for special transmission systems (e.g. MoCA or WiFi) in the return path direction.

3.1.10

local broadband cable network

network designed to provide sound and television signals as well as signals for interactive services to a local area (e.g. one town or one village)

3.1.11
multiplexing device
WDM device

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

[SOURCE: IEC/TR 61931:1998, definition 2.6.51]

3.1.12
noise power ratio
NPR

ratio of the signal power density to the power density of the combined noise and intermodulation distortion

3.1.13
off-state optical power

residual optical output power emitted from the fibre of the R-ONU when the laser is switched to off-state

Note 1 to entry: In a typical burst mode transmitter, for fast switching operation, the laser bias may be kept near the threshold bias level to avoid turn-on and turn-off delays. The off-state optical power affects the system performance when a large number of transmitters are connected to the same distribution network.

3.1.14
optical amplifier
OA

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

[IEC 60728-14:2014](#)

[SOURCE: IEC/TR 61931:1998, definition 2.7.75]

3.1.15
optical distribution network
ODN

passive optical network (PON) mainly consisting of optical fibres and splitters

3.1.16
optical receiving unit
optical receiver
Rx

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

[SOURCE: IEC/TR 61931:1998, definition 2.9.7]

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

3.1.17
optical modulation index
index defined as

$$m = \frac{\phi_h - \phi_l}{\phi_h + \phi_l} \quad (3)$$

where ϕ_h is the highest and ϕ_l is the lowest instantaneous optical power of the intensity modulated optical signal

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, definition 3.1.10, modified – repetition of "optical modulation" has been deleted.]

3.1.18 optical return loss return loss ORL

ratio of the total reflected power to the incident power from an optical fibre, optical device, or optical system, and defined as:

$$-10 \lg \frac{P_r}{P_i} \quad (4)$$

where

P_r is the reflected power;

P_i is the incident power

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Note 1 to entry: When referring to a reflected power from an individual component, reflectance is the preferred term.

[SOURCE: IEC/TR 61931:1998, definition 2.6.49]

Note 2 to entry: For the purposes of this standard, the term reflectance is used for optical amplifiers only. The term optical return loss is used for ports of all other types of equipment.

Note 3 to entry: The term return loss is also used for electrical ports. The definition relates to electrical powers in this case.

Note 4 to entry: The ratio is expressed in dB.

3.1.19 optical transmitting unit optical transmitter Tx

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

[SOURCE: IEC/TR 61931:1998, definition 2.9.6]

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