



SLOVENSKI STANDARD
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**Kabelska omrežja za televizijske in zvokovne signale ter interaktivne storitv - 113.
del: Optični sistemi za razpršeno oddajanje signalov z obremenitvami izključno
digitaliziranih kanalov**

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

Kabelnetze für Fernsehsignale, Tonsignale und interaktive Dienste - Teil 113: Optische
Systeme zur Rundfunksignalübertragung bei Vollbelegung mit digitalen Kanälen

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 radiodiffusion soumis à une charge de porteuses exclusivement numériques

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TITLE:

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

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

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

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FOREWORD

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302 International Standard IEC 60728-113 has been prepared by technical area 5: Cable networks
303 for television signals, sound signals and interactive services, of IEC technical committee 100:
304 Audio, video and multimedia systems and equipment.

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

FDIS	Report on voting
100/3xxx/FDIS	100/3xxx/RVD

306

307 Full information on the voting for its approval can be found in the report on voting indicated in
308 the above table.

309 The language used for the development of this of this International Standard is English.

310 This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in
311 accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available
312 at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are
313 described in greater detail at www.iec.ch/standardsdev/publications.

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

316 The committee has decided that the contents of this document will remain unchanged until the
317 stability date indicated on the IEC website under webstore.iec.ch in the data related to the
318 specific document. At this date, the document will be

- 319 • econfirmed,
- 320 • withdrawn,
- 321 • replaced by a revised edition, or
- 322 • amended.

323

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326

INTRODUCTION

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

332 This includes, for instance:

- 333 • regional and local broadband cable networks,
 - 334 • extended satellite and terrestrial television distribution systems,
 - 335 • individual satellite and terrestrial television receiving systems,
- 336 and all kinds of equipment, systems and installations used in such cable networks, distribution
337 and receiving systems.

338 The extent of this standardization work ranges from antennas and/or special interfaces to
339 headends, or other interface points on the network up to any terminal interface of the equipment
340 on the customer's premises.

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

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

346

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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 to about 3 300 MHz.

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 performance of the optical portion of the system defined in 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 (OFCSs)*

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

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

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

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

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

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

403 **3 Terms, definitions, graphical symbols and abbreviated terms**

404 **3.1 Terms and definitions**

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

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

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

410 **3.1.1**

411 **BER**

412 **bit error ratio**

413 ratio between erroneous bits and the total number of transmitted bits

414 [SOURCE: IEC 60728-1:2014, 3.1.60]

415 **3.1.2**

416 **central wavelength**

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

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

421 **3.1.3**

422 **D/U ratio**

423 single or multiple frequency interference ratio of desired signal level to undesired signal level

424 Note 1 to entry: The ratio of desired signal level, $D(\text{dB}(\mu\text{V}))$, to undesired signal level, $U(\text{dB}(\mu\text{V}))$ is given by

$$425 \quad D/U \text{ (dB)} = D - U$$

426 Note 2 to entry: The desired and the undesired signals can also be expressed both in dB(mW).

427 Note 3 to entry: The D/U ratio is generally used for multiple frequency interference as CSO and CTB, for single
428 frequency interference as SCR.

429 Note 4 to entry: Note the similarity of the definition to the definition of SINR.

430 **3.1.4**

431 **MER**

432 **modulation error ratio**

433 sum of the sequence of the squares of the magnitudes of the ideal symbol vectors divided by
434 the sum of the squares of magnitudes of the symbol error vectors of a sequence of symbols,
435 the result being expressed as a power ratio in dB

436 [SOURCE: IEC 60728-1:2014, 3.1.61]

437 **3.1.4**438 **OFDM signal**439 **orthogonal frequency division multiplexing**

440 multiplexing scheme used for the transportation of terrestrial digital broadcasting SDTV and
441 HDTV signals based on the idea of frequency-division multiplexing

442 Note 1 to entry: OFDM is based on the idea of frequency-division multiplexing, where each frequency channel is
443 modulated with a simpler modulation, and the frequencies and modulation of FDM are arranged to be orthogonal with
444 each other, which almost eliminates the interference between channels.

445 **3.1.5**446 **optical amplifier**

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

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

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

452 **3.1.6**453 **optical modulation index**

454 optical modulation index of k -th RF signal, m_k is defined as

455

$$456 \quad m_k = \frac{\phi_h - \phi}{\phi_h + \phi}$$

457 where

458 ϕ_h is the highest instantaneous optical power of the intensity modulated optical signal;

459 ϕ is the lowest instantaneous optical power of the intensity modulated optical signal;

460

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

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

466 **3.1.7**467 **optical receiver**

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

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

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

474 **3.1.8**475 **optical transmitter**

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

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

480 Note 2 to entry: This piece of equipment amplifies frequency multiplexed electrical signals and converts these
481 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
482 1 625 nm range).

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