



SLOVENSKI STANDARD
oSIST prEN IEC 60728-114:2023
01-maj-2023

Optični prenosni sistemi s tehnologijo RFoG (TA5)

Optical transmission systems using RFoG technology (TA5)

iTeh STANDARD PREVIEW
(standards.iteh.ai)

Ta slovenski standard je istoveten z: prEN IEC 60728-114:2023

<https://standards.iteh.ai/catalog/standards/sist/04a2227e-163f-4732-8ce4-c6bea4d250e0/osist-pr-en-iec-60728-114-2023>

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33.180.20	Povezovalne naprave za optična vlakna	Fibre optic interconnecting devices

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IEC TA 5 : CABLE NETWORKS FOR TELEVISION SIGNALS, SOUND SIGNALS AND INTERACTIVE SERVICES

SECRETARIAT:

Japan

SECRETARY:

Mr Hiroo Tamura

OF INTEREST TO THE FOLLOWING COMMITTEES:

PROPOSED HORIZONTAL STANDARD:

Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.

FUNCTIONS CONCERNED:

 EMC ENVIRONMENT QUALITY ASSURANCE SAFETY SUBMITTED FOR CENELEC PARALLEL VOTING NOT SUBMITTED FOR CENELEC PARALLEL VOTING**Attention IEC-CENELEC parallel voting**

The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting.

The CENELEC members are invited to vote through the CENELEC online voting system.

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of

- any relevant patent rights of which they are aware and to provide supporting documentation,
- any relevant "in some countries" clauses to be included should this proposal proceed. Recipients are reminded that the enquiry stage is the final stage for submitting "in some countries" clauses. See AC/22/2007.

TITLE:

Optical transmission systems using RFoG technology (TA5)

PROPOSED STABILITY DATE: 2027

NOTE FROM TC/SC OFFICERS:

This project was approved to proceed to the CDV stage at the TA5 meeting that was held on November 18.

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2

CONTENTS

3

4	CONTENTS	2
5	FOREWORD	5
6	INTRODUCTION	7
7	1 Scope	8
8	2 Normative references	8
9	3 Terms, definitions, symbols and abbreviations	10
10	3.1 Terms and definitions	10
11	3.2 Symbols	15
12	3.3 Abbreviations	15
13	4 System reference model	16
14	5 RFoG ONU reference architecture	17
15	6 Method of measurements	19
16	6.1 Optical power	19
17	6.2 Centroidal wavelength and spectral width under modulation	19
18	6.3 Optical wavelength	19
19	6.4 Linewidth and chirping of transmitters with single mode lasers	19
20	6.5 Optical modulation index	19
21	6.6 Reference output level of an optical receiver	19
22	6.7 Noise parameters of optical transmitters and optical receivers	20
23	6.8 Relative intensity noise (RIN), optical modulation index and equivalent	
24	input noise current (EINC)	20
25	6.9 Signal level and signal-to-noise ratio	20
26	6.10 Noise power ratio (NPR)	20
27	6.11 Signal-to-noise ratio defined by optical signal	20
28	6.12 Signal-to-crosstalk ratio (SCR)	20
29	7 System performance requirements	21
30	7.1 Digital data system	21
31	7.1.1 ODN	21
32	7.1.2 Performance allocation	21
33	7.2 Forward path and return path frequency split	22
34	8 RFoG equipment specifications	22
35	8.1 General specifications	22
36	8.1.1 Safety	22
37	8.1.2 Electromagnetic compatibility (EMC)	22
38	8.1.3 Environmental conditions	23
39	8.1.4 Marking	23
40	8.2 R-ONU	23
41	8.2.1 Indicators	23
42	8.2.2 R-ONU optical isolation specifications	24
43	8.2.3 R-ONU's optional pass through filter	24
44	8.2.4 R-ONU forward path receiver specifications	25
45	8.2.5 Return path performance of R-ONU	27
46	8.3 Headend specifications	31

47	8.3.1	Headend forward path specifications	31
48	8.3.2	Headend return path specifications	31
49	Annex A (informative)	Implementation notes	33
50	Annex B (informative)	System loss specification	35
51	B.1	General.....	35
52	B.2	Forward path considerations	35
53	B.3	Return path considerations	36
54	Annex C (informative)	Optical beat interference	39
55	C.1	General.....	39
56	C.2	Operating conditions of ODN	39
57	C.3	Operating conditions of optical receiver at the headend system	39
58	C.4	Operating conditions of CMTS	40
59	C.5	Environmental conditions	40
60	C.6	Relation between optical transmission loss and OMI.....	40
61	C.7	Design margin of ODN	41
62	C.8	Example of system design	42
63	C.9	Method of measurement of OBI.....	43
64	C.9.1	Purpose	43
65	C.9.2	Measurement setup	43
66	C.9.3	Example of measurement conditions.....	43
67	C.9.4	Procedure.....	44
68	C.9.5	Presentation of results.....	44
69	C.10	Method of measurement of OBI (measurement with CW signals)	44
70	C.10.1	Purpose.....	44
71	C.10.2	Measurement setup	44
72	C.10.3	Procedure.....	45
73	Annex D (informative)	Outdoor housings for R-ONU protection	46
74	Annex E (informative)	Effect of off-state optical power on SNR ratio of transmission	
75	signal		47
76	Bibliography.....		49
77			
78	Figure 1 – Optical system reference model for RFOG		17
79	Figure 2 – Principle schematics of R-ONU		18
80	Figure 3 – Measurement of optical wavelength using WDM coupler		19
81	Figure 4 – Optional xPON pass through filter block diagram		24
82	Figure 5 – R-ONU turn-on and turn-off diagram		31
83	Figure A.1 – Placement of attenuators when system loss is too low		34
84	Figure B.1 – Performance allocation of the return path transmission system		36
85	Figure B.2 – Section SNR specification for SDU and MDU in-house cabling.....		38
86	Figure C.1 – Optical transmission loss and OMI.....		41
87	Figure C.2 – ODN design margin		41
88	Figure C.3 – Setup used for the measurement of OBI		43
89	Figure C.4 – Setup used for the measurement of OBI (CW method).....		45
90			
91	Table 1 – ODN specifications.....		21

92	Table 2 – RF frequencies ^a	22
93	Table 3 – R-ONU Optical Isolation	24
94	Table 4 – R-ONU's optional xPON pass through filter	25
95	Table 5 – Classification of R-ONU optical receivers	25
96	Table 6 – Data publication requirements for R-ONU optical receivers	26
97	Table 7 – Recommendations for R-ONU optical receivers	26
98	Table 8 – Performance requirements for R-ONU optical receivers.....	27
99	Table 9 – Classes of optical return path transmitters.....	27
100	Table 10 – Data publication requirements for optical return path transmitters	27
101	Table 11 – Performance requirements for optical parameters and interfaces.....	28
102	Table 12 – Electrical properties requirements for R-ONU optical return path	
103	transmitters.....	28
104	Table 13 – R-ONU turn-on and turn-off specifications	29
105	Table 14 – Data publication requirements for return path optical receivers.....	32
106	Table 15 – Performance requirements for optical return path receivers	32
107	Table C.1 – Operating conditions related to ODN parameters	39
108	Table C.2 – Operating conditions related to ODN parameters	40
109	Table C.3 – Environmental conditions for system evaluation	40
110	Table C.4 – Factors affecting the transmission loss of ODN	42
111	Table C.5 – System design example 1	42
112	Table C.6 – System design example 2	42
113	Table C.7 – Example of list of measurement conditions	43
114	Table C.8 – Presentation of OBI measurement results	44
115		
116		
117		

118 INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

124

Part 114: Optical transmission systems using RFoG technology

125

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FOREWORD

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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.

161

The text of this International Standard is based on the following documents:

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

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

164

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

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This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available

167 at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are
168 described in greater detail at www.iec.ch/standardsdev/publications.

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

171 This standard follows closely (where applicable) the ANSI/SCTE 174 2018 standard “Radio
172 Frequency over Glass / Fiber-to-the-Home (RFoG) Specification / Extension”. In agreement with
173 SCTE¹ major parts of ANSI/SCTE 174:2018 have been copied into this standard.

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

- 177 • reconfirmed,
- 178 • withdrawn,
- 179 • replaced by a revised edition, or
- 180 • amended.

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¹ SCTE = Society of Cable Telecommunications Engineers

182

INTRODUCTION

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

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

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

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

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

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

201 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 gives a design guideline of housings for R-ONU protection
Annex E contains information on the effect of off-state optical power on SNR of transmission signal

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

Part 114: Optical transmission systems using RFoG technology

210 **1 Scope**

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

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

223 **2 Normative references**

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

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

229 IEC 60068-2-1:2007, *Environmental testing – Part 2-1: Tests – Test A: Cold*

230 IEC 60068-2-2:2007, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

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

232 IEC 60068-2-14:2009, *Environmental testing – Part 2-14: Tests – Test N: Change of*
233 *temperature*

234 IEC 60068-2-27:2008, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

235 IEC 60068-2-30:2005, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic*
236 *(12 h + 12 h cycle)*

237 IEC 60068-2-31:2008, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling*
238 *shocks, primarily for equipment-type specimens*

239 IEC 60068-2-40:1976, *Environmental testing – Part 2-40: Tests – Test Z/AM: Combined*
240 *cold/low air pressure tests*

- 241 IEC 60529: Consolidated version from 2013, *Degrees of protection provided by enclosures (IP*
242 *Code)*
- 243 IEC 60728-2:2018, *Cable networks for television signals, sound signals and interactive services*
244 *– Part 2: Electromagnetic compatibility of equipment*
- 245 IEC 60728-3:2018, *Cable networks for television signals, sound signals and interactive services*
246 *– Part 3: Active wideband equipment for cable networks*
- 247 IEC 60728-6:2011, *Cable networks for television signals, sound signals and interactive services*
248 *– Part 6: Optical equipment*
- 249 IEC 60728-10:2014, *Cable networks for television signals, sound signals and interactive*
250 *services – Part 10: System performance of return path*
- 251 IEC 60728-11:2016, *Cable networks for television signals, sound signals and interactive*
252 *services – Part 11: Safety*
- 253 IEC 60728-13:2010, *Cable networks for television signals, sound signals and interactive*
254 *services – Part 13: Optical systems for broadcast signal transmissions*
- 255 IEC 60728-13-1:2017, *Cable networks for television signals, sound signals and interactive*
256 *services – Part 13-1: Bandwidth expansion for broadcast signal over FTTH system*
- 257 IEC 60728-106.202x, *Cable networks for television signals, sound signals and interactive*
258 *services – Part 106: Optical equipment for systems loaded with digital channels only*
- 259 IEC 60793-2-50:2018, *Optical fibres – Part 2-50: Product specifications – Sectional*
260 *specification for class B single-mode fibres* <https://standards.iteh.ai/catalog/standards/sist/04a2227e-163f-4732-8ce4->
- 261 IEC 60794-3-11:2010, *Optical fibre cables – Part 3-11: Outdoor cables – Product specification*
262 *for duct, directly buried, and lashed aerial single-mode optical fibre telecommunication cables*
- 263 IEC 60825-1:2014, *Safety of laser products – Part 1: Equipment classification and requirements*
- 264 IEC 61169-2:2007, *Radio-frequency connectors – Part 2: Sectional specification – Radio*
265 *frequency coaxial connectors type 9,52*
- 266 IEC 61169-24:2019, *Radio-frequency connectors – Part 24: Sectional specification – Radio-*
267 *frequency coaxial connectors with screw coupling, typically for use in 75 Ω cable networks (type*
268 *F)*
- 269 IEC 61280-1-1:2013, *Fibre optic communication subsystem basic test procedures – Part 1-1:*
270 *Test procedures for general communication subsystems – Transmitter output optical power*
271 *measurement for single-mode optical fibre cable*
- 272 IEC 61280-1-3:2010, *Fibre optic communication subsystem test procedures – Part 1-3: General*
273 *communication subsystems – Central wavelength and spectral width measurement*
- 274 IEC 61754-4:2013, *Fibre optic interconnecting devices and passive components – Fibre optic*
275 *connector interfaces – Part 4: Type SC connector family*
- 276 IEC TR 61931:1998, *Fibre optic – Terminology*

277 ISO/IEC/IEEE Standard 8802-3:2021, *Standard for Ethernet*

278 **3 Terms, definitions, symbols and abbreviations**

279 **3.1 Terms and definitions**

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

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

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

285

286 **3.1.1**

287 **equivalent input noise current density**

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

291 Note 1 to entry: It can be calculated from the RF signal-to-noise ratio (see IEC 60728-106) of a device or system.

292 **3.1.2**

293 **flatness**

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

296 **3.1.3**

297 **headend system**

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

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

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

304 **3.1.4**

305 **local broadband cable network**

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

308 **3.1.5**

309 **WDM device**

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

313 **3.1.6**

314 **noise power ratio**

315 **NPR**

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

318 **3.1.7**
 319 **off-state optical power**
 320 residual optical output power emitted from the fibre of the R-ONU when the laser is switched to
 321 off-state

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

325 **3.1.8**
 326 **optical amplifier**
 327 **OA**
 328 optical waveguide device containing a suitably pumped, active medium which is able to amplify
 329 an optical signal

330 [SOURCE: IEC TR 61931:1998, 2.7.75]

331 **3.1.9**
 332 **optical distribution network**
 333 **ODN**
 334 passive optical network (PON) mainly consisting of optical fibres and splitters

335 **3.1.10**
 336 **optical receiver**
 337 **Rx**
 338 receive fibre optic terminal device accepting at its input port a modulated optical carrier, and
 339 providing at its output port the corresponding demodulated electrical signal (with the associated
 340 clock, if digital)

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

343 **3.1.11**
 344 **optical modulation index**
 345 optical modulation index m is defined as

$$m = \frac{\phi_h - \phi_l}{\phi_h + \phi_l} \quad (1)$$

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

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

351 [SOURCE: IEC 60728-6:2011, 3.1.10, modified – repetition of "optical modulation" has been deleted.]

352 **3.1.12**
 353 **optical return loss**
 354 **return loss**
 355 **ORL**
 356 ratio of the total reflected power to the incident power from an optical fibre, optical device, or
 357 optical system, and defined as:

$$-10 \lg \frac{P_r}{P_i} \quad (2)$$

where

P_r is the reflected power;

P_i is the incident power

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

360 [SOURCE: IEC TR 61931:1998, 2.6.49]

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

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

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

366 3.1.13

367 optical transmitter

368 Tx

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

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

373 3.1.14

374 radio frequency over glass oSIST prEN IEC 60728-114:2023

375 RFoG

376 transmission technology on optical networks where information is transmitted in both, forward
377 and return path directions, using RF subcarrier multiplexing technology, and where the return
378 path transmission uses additionally time division multiple access technique imposed by the
379 transmission of the return path signals using a TDMA (e.g. TDMA mode of DOCSIS) protocol

380 3.1.15

381 reference output level of an optical receiver

382 offset x by which the electrical output level of an optical receiver can be calculated from the
383 optical input level at a modulation index of $m = 0,05$ using the following equation:

$$U = 2 P_{\text{opt,RX}} + x \text{ dB}(\mu\text{V}) \quad (3)$$

384 where

385 U is the electrical output level in dB(μV)

386 $P_{\text{opt,RX}}$ is the optical input level in dB(mW)

387 x is the reference output level in dB(μV)

388 3.1.16

389 responsivity

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

391 Note 1 to entry: The responsivity is expressed in ampere per watt (A/W) or volts per watt (V/W) of incident radiant
392 power.

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

394 [SOURCE: IEC 60050-731:1991, 731-06-36, modified – "given wavelength" has been added and Note 1 has been
395 clarified.]

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

397 [SOURCE: IEC TR 61931:1998, 2.7.56]

398 **3.1.17**

399 **relative intensity noise**

400 **RIN**

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

403 Note 1 to entry: The RIN is usually expressed in $\text{dB}(\text{Hz}^{-1})$ resulting in negative values.

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

406 [SOURCE: IEC 60728-106.202x, 4.15]

407 **3.1.18**

408 **RFoG optical network unit**

409 **R-ONU**

410 fibre optic terminal comprising an optical receiver for reception of analogue signals and an
411 optical transmitter for the transmission of analogue signals originating from the customer side
412 of the optical network and a coaxial interface for the transmission of analogue signals to the
413 customer network and reception of analogue signals from the customer network generally
414 consisting of digital data using a TDMA (e.g. TDMA mode of DOCSIS) protocol

415 **3.1.19**

416 **signal-to-crosstalk ratio**

417 **SCR**

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

420 Note 1 to entry: SCR is defined by the following equation:

$$R_{\text{SC}} = D - U_{\text{OS}} \quad (4)$$

421

422 where

423 D is the nominal level of the desired signal in $\text{dB}(\mu\text{V})$ at RF output port of optical receiver;

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

426 Note 2 to entry: SCR is expressed in dB.

427 **3.1.20**

428 **signal-to-noise ratio**

429 **SNR**

430 level difference of desired signal level and noise level

431 Note 1 to entry: SNR is defined for both, analogue and digital modulated signals in IEC 60728-13.

432 [SOURCE: IEC 60728-13:2010, 3.1.19]