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TECHNICAL SPECIFICATION

Categorization of optical devices

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IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
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Email: inmail@iec.ch
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CATEGORIZATION OF OPTICAL DEVICES

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IEC/TS 62538, which is a technical specification, has been prepared by IEC technical committee 86: Fibre optics.

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The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
86/282/DTS	86/308/RVC

Full information on the voting for the approval of this technical specification 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 committee has decided that the contents of this publication will remain unchanged until the maintenance result 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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INTRODUCTION

IEC/TS 62538, which is a technical specification, is based on the conclusions of the coordinating group on categorization, approved by TC86 in 2005 and 2006, with the aim to allocate the various optical devices among the appropriate working groups. It contains fundamental definitions of broad validity and the procedure to categorize any optical devices.

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CATEGORIZATION OF OPTICAL DEVICES

1 Scope

IEC/TS 62438, which is a technical specification, applies to optical devices (i.e. elements, components, assemblies, sub-assemblies or modules) of interest to TC86 and its subcommittee. It provides the definitions of the three main categories of optical devices (i.e. dynamic, active and passive) together with other related definitions. It also gives a general procedure to identify the category of any optical devices.

2 Terms and definitions

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

NOTE 1 The definitions given in 2.1 are determined for the three main categories of optical devices: “optical dynamic devices,” “optical active devices” and “optical passive devices.” Other supporting definitions are given in 2.2 and concern the term “optical device” and the related terms “optical element,” “optical component,” “optical assembly,” “optical sub-assembly” and “optical module.” The categorization criteria leading to the definitions of 2.1 are reported in Annex A.

NOTE 2 Some definitions reported in IEC 61931, analogous to those given in this clause, are superseded by the present technical specification.

NOTE 3 The terms optical (or fibre optic) “system” and “subsystem” as defined in IEC 61281-1 do not describe an optical device (according to the definitions given in this clause) and are outside the scope of this technical specification. The use of these two terms to indicate optical assemblies, sub-assemblies or modules is deprecated.

2.1 Categorization of main definitions

2.1.1
optical dynamic device
optical device designed to monitor and control dynamically some characteristics of one or more optical signals, by means of suitable electronic controls, in order to improve or to maintain definite performances of the system in which it is intended to be inserted

NOTE 1 Said characteristics may include optical paths, optical intensities, spectrum characteristics, polarization states, dispersion, etc.

NOTE 2 Optical dynamic devices may comprise optical active and optical passive elements or components.

NOTE 3 The control/response time of optical dynamic devices is much larger than the signal time characteristics and typically may range from a few microseconds to tens of seconds.

2.1.2
optical active device
optical device, other than an optical dynamic device, exhibiting one or more of the following functions:

- generation or detection of optical power;
- conversion of an electronic signal to a corresponding optical one or vice versa;
- optical amplification or optical regeneration (2R or 3R) of an optical signal;
- direct conversion of the optical frequency of an optical signal.

NOTE Optical active devices may comprise optical passive elements.

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2.1.3
optical passive device
optical device, other than an optical dynamic device or an optical active device, which does not require external power for its operation, unless to control the stability of its own characteristics

NOTE Optical passive devices may comprise optical detectors for monitoring purposes only.

2.2 Other related definitions

2.2.1
optical element
unpackaged or partially packaged optical basic unit, typically non repairable and non re-workable (at least by users)

NOTE Examples of optical elements include laser chips or laser diodes, photodiodes, lenses, prisms, optical collimators, grating chips and filter chips.

2.2.2
optical component
packaged unit comprising at least one optical element, typically non repairable and non re-workable (at least by users), suitably pigtailed or connectorized

NOTE Examples of optical components include packaged lasers, photodiodes, optical splitters, couplers, attenuators, isolators, MEMS's and modulators.

2.2.3
optical assembly
unpackaged integration of optical components and/or elements, accomplishing defined functionality, typically settable, repairable, re-workable and re-arrangeable (possibly also with addition of other components) by the user

NOTE 1 An optical assembly may comprise electronic components.

NOTE 2 An optical assembly may usually appear as a printed wiring board with optical components/elements.

2.2.4
optical sub-assembly
part of an optical assembly, incomplete to fully accomplish the target functionality of the assembly

2.2.5
optical module
packaged integration of optical components and/or elements, accomplishing defined functionality, typically repairable and re-workable

NOTE 1 An optical module may comprise electronic components.

NOTE 2 An optical module is to be used as it is; users are not normally enabled to re-arrange inner components or add other components inside.

2.2.6
optical device
generic optical unit, either an optical element, an optical component, an optical assembly, an optical sub-assembly or an optical module.

NOTE This term may have more specific meanings in different contexts.

3 Categorization procedure of optical devices

The categorization definitions given in 2.1 allow the following 3-step procedure to be pursued in order to identify the category of any optical device:

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1) if the optical device to be categorized mainly exhibits dynamic functionality (as described in 2.1.1), it shall be regarded as an optical dynamic device;

2) otherwise, if it mainly exhibits an active functionality (as described in 2.1.2, with the exception in the note to 2.1.3), it shall be regarded as an optical active device;

3) otherwise, it shall be regarded as an optical passive device.

NOTE Allocation of optical devices in the three categories and in the various working groups of TC86 and its subcommittees is considered in Annex B.

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Annex A
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Categorization criteria

The following guidance criteria were established for the definitions of optical dynamic, active and passive devices:

a) Three groups of devices only, namely dynamic, active and passive, are to be identified.

b) These three groups should be ranked in the following order: 1. Dynamic, 2. Active, 3. Passive (that is, all devices exhibiting dynamic characteristics are dynamic; among the other ones, all those exhibiting active characteristics are active; the remaining ones are passive).

c) As an exception to the previous criterion, passive devices may contain photodiodes (which per se are active) for monitoring purposes, continuing to be regarded as passive.

d) Dynamic devices shall be mainly characterized by the possibility to change some of their characteristics with time, finalized to keep or improve defined performances of the system in which they are intended to be inserted.

e) Active devices shall be mainly characterized by either

   i) optical generation or detection,

   ii) signal e/o or o/e conversion,

   iii) optical amplification or regeneration,

   iv) wavelength conversion.

f) passive devices shall be mainly characterized by their not needing external power, except to stabilize their own characteristics.

NOTE 1 Criterion a) is according to a requirement from TC 86.

NOTE 2 Criterion b) introduces the concept of ranking among the different categories. This concept greatly helps to categorize those devices simultaneously exhibiting more than one single characteristic (the most critical case), indicating which characteristic should prevail for categorization purposes.

NOTE 3 Criterion c), an exception to criterion b), is needed for those passive devices that include photodiodes (which are active) merely for monitoring purposes, necessary to stabilize their characteristics.

NOTE 4 Criteria d) to f) indicate the characterizing aspects of each category.

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Annex B
(informative)

Allocation of optical devices by categories and working groups

Representative (but not exhaustive) lists of optical devices standardized or under study by the working groups of TC86 subcommittees mainly involved in the categorization effort, namely 86B-WG7, 86C-WG3, 86C-WG4 and SC86C-WG5, are reported in Table 1. They are allotted in the table both by working groups and device categories (as defined in Clause 1).

NOTE The allocation of devices among the working groups reflects the situation at the time of publication of this technical specification. Successive changes might be possible in principle.

Table A.1 – Allocation of optical devices by categories and working groups

	Dynamic	Active	Passive
86B – WG7			**Optical passive devices:** Wavelength selective branching devices, Fixed optical attenuators, Variable optical attenuators, Optical isolators, Optical switches and blockers, WDM devices, Optical circulators, Optical filters, Tunable optical filters, Optical branching devices, Chromatic dispersion compensators, Polarization controllers
86C – WG3		**Optical amplifiers:** Rare-earth doped-fibre amplifier, Semiconductor optical amplifiers, Fibre Raman amplifiers, Optical waveguide amplifiers, Optical amplifiers for digital applications, Optical amplifiers for multichannel applications	
86C – WG4		**Optical sources and detectors**: Semiconductor Lasers, VCSELs, LEDs, Tunable laser diodes, Mode-lock and external cavity laser diodes, Fibre lasers; APD, PIN and PIN-FET photodetectors, MSM photodetectors **E/O and O/E signal converters:** optical transmitters, receivers and transceivers, Modulator integrated transmitters; Single fibre bi-directional module, Optical Triplexers, Transmitter and receiver optical sub-assemblies; Electro-absorption, lithium niobate and semiconductor Mach-Zehnder modulators; EO switches **Wavelength converters:** Transponders, Semiconductor and lithium niobate nonlinear effect-based converters	
86C – WG5	**Dynamic devices:** Dynamic channel equalizers, Dynamic chromatic dispersion compensators, Dynamic tilt equalizers, Polarization mode dispersion compensators, Dynamically variable optical attenuators; Dynamical optical switches		

With the one exception of OPTICAL AMPLIFIERS/SC86C-WG3 (however easily identifiable), Table 1 shows a unique two-way correspondence between categories and working groups. This indicates the following allocation of optical devices versus working groups:

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- optical dynamic devices: SC86C-WG5 ;
- optical active devices (except optical amplifiers): SC86C-WG4;
- optical amplifiers: SC86C-WG3;
- optical passive devices: SC86B-WG7.

For the sake of completeness, other passive devices studied by different working groups of TC86 and its subcommittees and not listed in Table 1 are worth mentioning, namely:

- optical fibres (including active fibres): SC86A-WG1;
- optical cables: SC86A-WG3;
- optical interconnecting devices: SC86B-WG6;
- optical devices characterized by implementation on circuit boards: TC86-TC91/JWG9.

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IEC 61281-1, *Fibre optic communication subsystems – Part 1: Generic specification*

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

3, rue de Varembé
PO Box 131
CH-1211 Geneva 20
Switzerland

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

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