

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Semiconductor optoelectronic devices for fibre optic system applications –
Part 1: Specification template for essential ratings and characteristics**

**Dispositifs optoélectroniques à semiconducteurs pour application dans les
systèmes à fibres optiques –
Partie 1: Modèle de spécification relatif aux valeurs et caractéristiques
essentielles**



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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX

W

ICS 33.180.01; 31.260; 31.080.01

ISBN 978-2-88910-605-9

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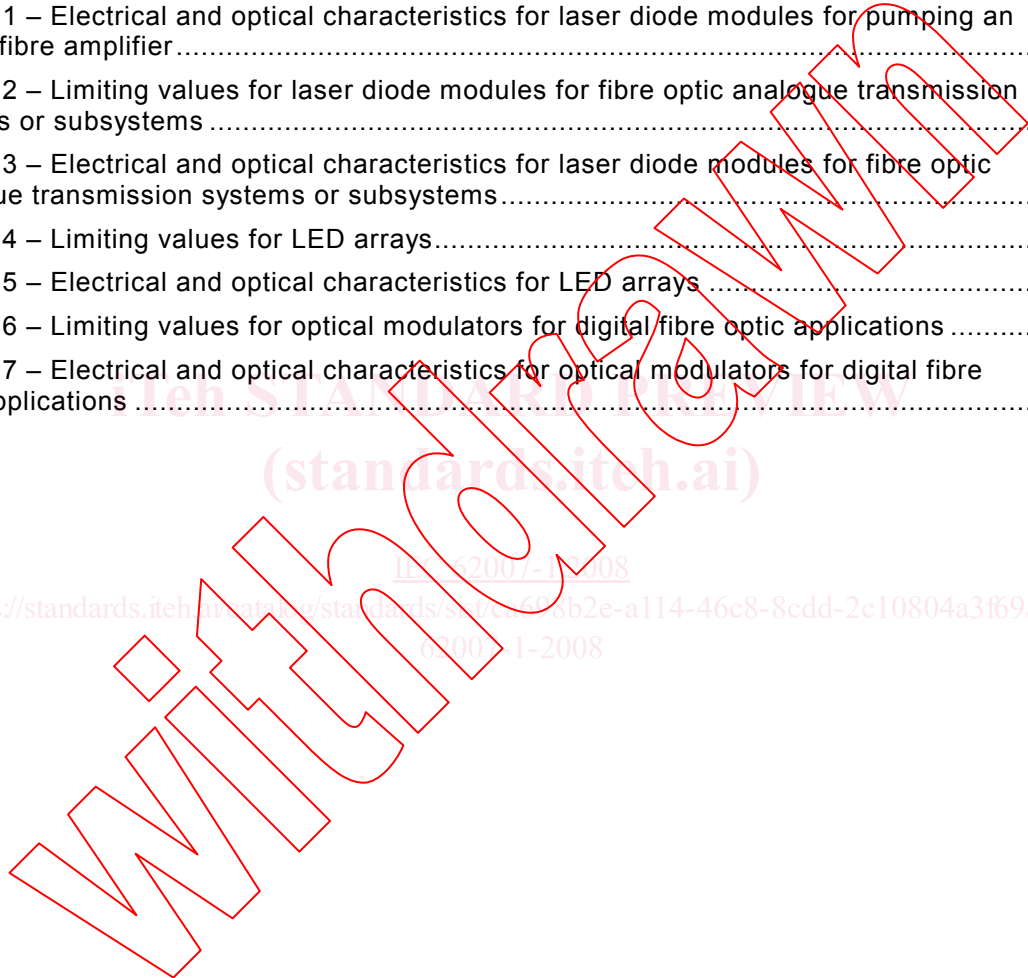
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**SEMICONDUCTOR OPTOELECTRONIC DEVICES
FOR FIBRE OPTIC SYSTEM APPLICATIONS –****Part 1: Specification template for essential ratings and characteristics**

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International Standard IEC 62007-1 has been prepared by subcommittee 86C: Fibre optic systems and active devices, of IEC technical committee 86: Fibre optics.

This second edition cancels and replaces the first edition published in 1997, and its Amendment 1 (1998). It is a technical revision.

This edition includes the following significant technical changes with respect to the previous edition.

- 1) The title has been changed to indicate that this is a template.
- 2) The definitions of some symbols and terms in IEC 62007-1 Ed.1 are revised in order to harmonize them with those in other SC 86C documents. A dated part in IEC 62007-1 ed.1 is removed and the other dated parts are updated.

NOTE The field of this standard will henceforth be placed under the responsibility of IEC technical committee 86: Fibre optics.

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

FDIS	Report on voting
86C/849/FDIS	86C/866/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.

A list of all parts of the IEC 62007 series can be found, under the general title *Semiconductor optoelectronic devices for fibre optic system applications*, on the IEC website.

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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SEMICONDUCTOR OPTOELECTRONIC DEVICES FOR FIBRE OPTIC SYSTEM APPLICATIONS –

Part 1: Specification template for essential ratings and characteristics

1 Scope and object

This part of IEC 62007 is a specification template for essential ratings and characteristics of the following categories of semiconductor optoelectronic devices to be used in the field of fibre optic systems and subsystems:

- semiconductor photoemitters;
- semiconductor photoelectric detectors;
- monolithic or hybrid integrated optoelectronic devices and their modules.

The object of this performance specification template is to provide a frame for the preparation of detail specifications for the essential ratings and characteristics.

Detail specification writers may add specification parameters and/or groups of specification parameters for particular applications. However, detail specification writers may not remove specification parameters specified in this standard.

2 Normative references

The following referenced documents are indispensable for the application 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 60825 (all parts), *Safety of laser products*

IEC 60747-5-1, *Discrete semiconductor devices and integrated circuits – Part 5-1: Optoelectronic devices – General*

3 Terms, definitions and abbreviations

For the purposes of this document, the following terms, definitions and abbreviations apply, as well as terms and definitions concerning *physical concepts, types of devices, general terms, and ratings and characteristics* given in IEC 60747-5-1.

3.1 Terms and definitions

3.1.1

PIN photodiode

photodiode with a large intrinsic region sandwiched between p- and n-doped semiconducting regions used for the detection of optical radiation

NOTE Adapted from IEC 731-06-29, specialized

**3.1.2
avalanche photodiode**

APD

photodiode operating with a bias voltage such that the primary photocurrent undergoes amplification by cumulative multiplication of charge carriers.

NOTE Adapted from IEV 731-06-30, specialized.

**3.1.3
relative intensity noise**

RIN

quotient of the radiant power mean square fluctuations $\langle \Delta\Phi_e^2 \rangle$ to the mean square radiant power $\langle \Phi_e \rangle^2$, normalized to a frequency band of unit width

NOTE *RIN* is usually expressed in dB/Hz.

$$RIN = 10 \log_{10} \left\{ \frac{\langle \Delta\Phi_e^2 \rangle}{\langle \Phi_e \rangle^2 \times \Delta f} \right\}$$

**3.1.4
spectral shift**

$\Delta\lambda_c$

deviation of the peak-emission wavelength at a particular case temperature or a particular forward current from its value at a specified reference case temperature or a specified reference forward current, respectively

NOTE The specific reference temperature is usually 25 °C.

**3.1.5
input reflection coefficient**

s_{11}

quotient of the high frequency reflected voltage to the high frequency incident voltage

**3.1.6
tracking error**

E_{tr}

deviation of the radiant power at a particular case temperature from its value at a specified reference case temperature

NOTE 1 The specific reference temperature is usually 25 °C.

NOTE 2 Specifications usually refer to the maximum deviation (absolute value) in two specified temperature ranges below and above the specified reference case temperature.

NOTE 3 The tracking error is usually expressed as a percentage of the radiant power at the reference case temperature.

**3.1.7
(diode) responsivity R_D , R (of a photodiode)**

quotient of the photocurrent I_p by the radiant power Φ_e at the optical port of the photodiode

NOTE 1 If no ambiguity is likely to occur, the shorter term and letter symbol may be used.

NOTE 2 "Photodiode" means a complete device such as:

- chip itself;
- packaged component with window or pigtail.

3.1.8

excess noise factor

 F_e

noise resulting from the spatial and timing fluctuations of the avalanche carrier multiplication: it is defined as the ratio of the noise power at a specified reverse bias to the amplified shot noise of the photocurrent at a reference reverse bias

NOTE The reference reverse voltage should be sufficiently low that no carrier multiplication takes place but sufficiently large that the device is fully depleted and has achieved its rated speed and responsivity.

3.2 Abbreviations

3.2.1

TEC

thermo-electric cooler

3.2.2

TIA

transimpedance amplifier

3.2.3

LED

light emitting diode

3.2.4

LD

laser diode

3.2.5

APD

avalanche photodiode

4 LEDs for fibre optic systems or subsystems

4.1 Type

Ambient-rated or case-rated LED with or without optical fibre pigtail for fibre optic systems or subsystems.

4.2 Semiconductor materials

GaAs, GaAlAs, InGaAs, InP, etc.

4.3 Details of outline and encapsulation

4.3.1 IEC and/or national reference number of outline drawing.

4.3.2 Method of encapsulation: glass/metal/plastic/other.

4.3.3 Terminal identification and indication of any electrical connection between a terminal and the case.

4.3.4 Characteristics of the optical port: relative orientation to mechanical axis, relative position to mechanical axis, area, numerical aperture.

4.3.5 For devices with pigtail: information on the pigtail fibre, kind of protection, connector, length.

4.3.6 Information on the heat sink of the package.

4.4 Limiting values (absolute maximum ratings) over the operating temperature range, unless otherwise stated

Table 1 – Limiting values for LEDs

Subclauses	Characteristics	Symbols	Requirements	
			Min.	Max.
4.4.1	Storage temperature	T_{stg}	x	x
4.4.2	Temperature			
either 4.4.2.1	Ambient temperature	T_{amb}	x	x
or 4.4.2.2	Case temperature	T_{case}	x	x
4.4.3	Soldering temperature at maximum soldering time and minimum distance to case specified	T_{sld}		x
4.4.4	Reverse voltage	V_R		x
4.4.5	Continuous forward current Derating curve or derating factor	I_F		x
4.4.6	Repetitive peak forward current at specified pulse conditions (where appropriate) Derating curve or derating factor (where appropriate)	I_{FRM}		x
4.4.7	Power dissipation Derating curve or derating factor (where appropriate)	P_{tot}		x
4.4.8	For case-rated devices: Virtual junction temperature (where appropriate)	T_{vj}		x
4.4.9	For devices with pigtail: Bend radius of pigtail (at specified distance from the case)	r	x	
4.4.10	Shock			x
4.4.11	Vibration			x
4.4.12	Tensile force on devices with pigtail:			
4.4.12.1	Untight structure: – Tensile force on fibre along its axis – Tensile force on cladding along its axis	F F		x x
4.4.12.2	Tight structure: – Tensile force on pigtail along its axis	F		x

4.5 Electrical and optical characteristics

Table 2 – Electrical and optical characteristics for LEDs

Subclauses	Characteristics	Conditions at T_{amb} or $T_{case} = 25\text{ °C}$ unless otherwise stated	Symbols	Requirements	
				Min.	Max.
4.5.1	Forward voltage	I_F or Φ_e specified	V_F		x
4.5.2	Reverse current	V_R specified	I_R		x
4.5.3	Differential resistance	I_F or Φ_e specified	r_d		x
4.5.4	Total capacitance	V_R, f specified	C_{tot}		x
4.5.5	Noise parameter				
either 4.5.5.1	Relative intensity noise (where appropriate)	I_F or $\Phi_e, f_o, \Delta f_N$ specified	RIN		x
or 4.5.5.2	Carrier-to-noise ratio (where appropriate)	I_F or $\Phi_e, f_c, \Delta f_N, f_m, m$ specified	C/N		x
4.5.6	Output parameter				
either 4.5.6.1	Radiant output power	I_F specified (d.c. or pulse, or both)	Φ_e	x	x^a
or 4.5.6.2	Forward current	Φ_e specified	I_F	x^a	x
4.5.7	For devices without pigtail: Half-intensity angle (where appropriate)	I_F or Φ_e , angle ϕ specified	$\theta_{1/2}$		x
4.5.8	For devices without pigtail: Misalignment angle (where appropriate)	I_F or Φ_e , angle ϕ specified	$\Delta\theta$		x
4.5.9	Spectral radiation bandwidth	I_F or Φ_e specified	$\Delta\lambda$		x
4.5.10	Bandwidth				
either 4.5.10.1	Switching times: – rise time – fall time – delay times (where appropriate) – peak emission wavelengths	DC current, input pulse current pulse width and duty cycle specified	t_r t_f $t_{d(on)}$ / $t_{d(off)}$		x x x x
or 4.5.10.2	Cut-off frequency	I_F or Φ_e specified	f_c	x	

^a Where appropriate.

4.6 Supplementary information

4.6.1 Typical curve or coefficient

Provide the curve or coefficient in 4.6.1.1 or 4.6.1.2.

4.6.1.1 Typical curve or coefficient of radiant power versus temperature and typical curve of radiant output power versus forward current (d.c. or pulse, as specified).

4.6.1.2 Typical curve or coefficient of radiant intensity versus temperature and typical curve of radiant intensity versus forward current (d.c. or pulse, as specified).

4.6.2 Typical curve or coefficient of change in peak emission wavelength versus temperature.

4.6.3 Typical radiation diagram.

4.6.4 Thermal resistance, ambient-rated or case-rated.

5 Laser module with pigtails

5.1 Type

The laser module consists of the following basic parts:

- laser diode
 - pigtail
 - photodiodes
 - thermal sensor
 - TEC element
- } where appropriate

5.2 Semiconductor

5.2.1 Materials

The laser module consists of the following materials:

- laser diode
 - photodiode
 - thermal sensor
 - TEC element
- e.g. GaAs, GaAlAs, InGaAsP, InP
e.g. Ge, Si, GaInAs
where appropriate

5.2.2 Structure

Laser diode, e.g.: gain guided, index guided, distributed feedback, etc.

5.3 Details of outline and encapsulation

5.3.1 IEC and/or national reference number of the outline drawing.

5.3.2 Method of encapsulation: glass/metal/plastic/other.

5.3.3 Terminal identification and indication of any electrical connection between a terminal and the case.

5.3.4 Information on the pigtail fibre, e.g.: type of fibre, kind of protection, connector, length.

5.3.5 Information on the heatsinking of the package.

5.4 Limiting values (absolute maximum ratings) over the operating temperature range, unless otherwise stated

General conditions

5.4.1 Minimum and maximum storage temperatures (T_{stg}).

5.4.2 Minimum and maximum operating case temperatures (T_{case}).

5.4.3 Minimum and maximum operating submount temperature (T_{sub}).

5.4.4 Maximum soldering temperature (soldering time and minimum distance to case) (T_{sld}).

5.4.5 Minimum bend radius of pigtail (at specified distance from the case) (r).

5.4.6 Shock (maximum acceleration and pulse duration).

5.4.7 Vibration (maximum acceleration and frequency range).

5.4.8 Tensile force along cable axis.

5.4.8.1 Untight structure:

- Maximum tensile force on fibre (F).
- Maximum tensile force on cable (F).

5.4.8.2 Tight structure:

- Maximum tensile force on cable (F).

Laser diode

For laser module without TEC, derating curve or derating factor must be given for one of following parameters, 5.4.10 to 5.4.13. For laser module with TEC, T_{sub} equals to 25 °C.

5.4.9 Maximum reverse voltage (V_R).

5.4.10 Maximum continuous forward current (I_F).

5.4.11 Maximum continuous radiant power (ϕ_e).

5.4.12 Maximum pulsed forward current at stated frequency and pulse duration (I_{FP}).

5.4.13 Maximum pulsed radiant power at stated frequency and pulse duration (ϕ_{ep}).

Photodiode

5.4.14 Maximum reverse voltage (V_R).

5.4.15 Maximum forward current (I_F).

Thermal sensor (where appropriate)

5.4.16 Maximum ratings

5.4.16.1 Maximum power dissipation (P).

or

5.4.16.2 Maximum voltage supply (V).

Thermoelectric cooler (where appropriate)

5.4.17 Maximum cooler current under cooling and heating (I_{PE}).