

INTERNATIONAL STANDARD

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**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 – IEC 62007-1:2015**
**Partie 1: Modèle de spécification relatif aux valeurs et caractéristiques
essentiels** IEC 62007-1:2015





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

**Dispositifs optoélectroniques à semi-conducteurs pour application dans les
systèmes à fibres optiques – IEC 62007-1:2015**
**Partie 1: Modèle de spécification relatif aux valeurs et caractéristiques
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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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This consolidated version of the official IEC Standard and its amendment has been prepared for user convenience.

IEC 62007-1 edition 3.1 contains the third edition (2015-03) [documents 86C/1256/CDV and 86C/1283/RVC] and its amendment 1 (2022-09) [documents 86C/1785/CDV and 86C/1811/RVC].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.

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 third edition constitutes a technical revision.

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

- 1) The definitions of some symbols and terms are revised in order to harmonize them with those in other SC 86C documents.
- 2) A clause on APD-TIA has been added.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

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

The committee has decided that the contents of the base publication and its amendment will remain unchanged until the stability date indicated on the IEC web site under webstore.iec.ch in the data related to the specific publication. At this date, the publication will be

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- amended.

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SEMICONDUCTOR OPTOELECTRONIC DEVICES FOR FIBRE OPTIC SYSTEM APPLICATIONS –

Part 1: Specification template for essential ratings and characteristics

1 Scope

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.

This part of IEC 62007 provides a frame for the preparation of detail specifications for the essential ratings and characteristics.

In using this part of IEC 62007, detail specification writers add but do not delete specification parameters and/or groups of specification parameters for particular applications.

2 Normative references

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 60825 (all parts), *Safety of laser products*

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

IEC 60747-5-4, *Semiconductor devices – Part 5-4: Optoelectronic devices – Semiconductor lasers*

IEC 60747-5-6, *Semiconductor devices – Part 5-6: Optoelectronic devices – Light emitting diodes*

IEC 60747-5-7, *Semiconductor devices – Part 5-7: Optoelectronic devices – Photodiodes and phototransistors*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions concerning physical concepts, types of devices, general terms, and ratings and characteristics given in ~~IEC 60747-5-1~~ IEC 60747-5-4, IEC 60747-5-6 and IEC 60747-5-7 and the following apply.

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

[SOURCE: IEC 60050-731-06-29, modified — The note has been deleted.]

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 1 to entry: This note applies to the French language only.

[SOURCE: IEC 60050-731-06-30, modified — The note has been deleted.]

3.1.3*RIN***relative intensity noise**

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 1 to entry: *RIN* is usually expressed in dB/Hz.

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

Note 2 to entry: This note applies to the French language only.

3.1.4 $\Delta\lambda_c$ **spectral shift**

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 1 to entry: The specific reference temperature is typically 25 °C.

3.1.5 s_{11} **input reflection coefficient**

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

3.1.6 E_{tr} **tracking error**

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

Note 1 to entry: The specific reference temperature is typically 25 °C.

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

Note 3 to entry: The tracking error is usually expressed as a percentage of the radiant power at the reference case temperature.

3.1.7

R_D

R

diode responsivity

responsivity

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

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

Note 2 to entry: Photodiode means a complete device such as:

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

3.1.8

F_e

excess noise factor

noise resulting from the spatial and timing fluctuations of the avalanche carrier multiplication, 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 1 to entry: 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.

3.1.9

P_o

overload

maximum received power of a photodiode for obtaining a given bit error rate

3.2 Abbreviations

APD	avalanche photodiode
BH	buried heterostructure
CMOS	complementary metal-oxide semiconductor
CW	continuous wave
FWHM	full width at half maximum
HBT	heterojunction bipolar transistor
LD	laser diode
LED	light emitting diode
MQW	multi-quantum well
RIN	relative intensity noise
TEC	thermo-electric cooler
TIA	transimpedance amplifier

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 a fibre 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

See Table 1.

Table 1 – Limiting values for LEDs

Characteristics	Symbol	Requirements ^a		Unit
		Min.	Max.	
Storage temperature	T_{stg}	x	x	°C
Temperature: either ambient temperature or case temperature	T_{amb} T_{case}	x x	x x	°C °C
Soldering temperature at maximum soldering time and minimum distance to case specified	T_{sld}		x	°C
Reverse voltage	V_R		x	V
Continuous forward current Derating curve or derating factor	I_F		x	mA
Repetitive peak forward current at specified pulse conditions (where appropriate) Derating curve or derating factor (where appropriate)	I_{FRM}		x	mA
Power dissipation Derating curve or derating factor (where appropriate)	P_{tot}		x	W
For case-rated devices: Virtual junction temperature (where appropriate)	T_{vj}		x	°C
For devices with pigtail: Bend radius of pigtail (at specified distance from the case)	r	x		mm(cm)
Shock			x	m/s ² , s
Vibration			x	m/s ² , Hz
Tensile force on devices with pigtail: Untight structure: – Tensile force on fibre along its axis – Tensile force on cladding along its axis Tight structure: – Tensile force on pigtail along its axis	F F F		x x x	N N N

^a x represents the value to be specified.

4.5 Electrical and optical characteristics

See Table 2.

Table 2 – Electrical and optical characteristics for LEDs

Characteristics	Conditions at T_{amb} or $T_{case} = 25\text{ °C}$ unless otherwise stated	Symbol	Requirements ^b		Unit
			Min.	Max.	
Forward voltage	I_F or Φ_e specified	V_F		x	V
Reverse current	V_R specified	I_R		x	mA
Differential resistance	I_F or Φ_e specified	r_d		x	Ω
Total capacitance	V_R, f specified	C_{tot}		x	μF
Noise parameter either relative intensity noise ^a or carrier-to-noise ratio ^a	I_F or $\Phi_e, f_o, \Delta f_N$ specified I_F or $\Phi_e, f_c, \Delta f_N, f_m, m$ specified	RIN C/N		x	dB/Hz dB
Output parameter either radiant output power or forward current	I_F specified (d.c. or pulse, or both) Φ_e specified	Φ_e I_F	x x^a	x^a x	mW mA
For devices without pigtail: Half-intensity angle ^a	I_F or Φ_e , angle ϕ specified	$\theta_{1/2}$		x	°
For devices without pigtail: Misalignment angle ^a	I_F or Φ_e , angle ϕ specified	$\Delta\theta$		x	°
Spectral radiation bandwidth	I_F or Φ_e specified	$\Delta\lambda$		x	nm
Bandwidth either switching times: – rise time – fall time – delay times ^a – peak emission wavelengths or cut-off frequency	d.c. current input pulse current pulse width and duty cycle specified I_F or Φ_e specified	t_r t_f $t_{d(on)},$ $t_{d(off)}$ f_c		x x x x	s s s s nm Hz
^a Where appropriate.					
^b x represents the value to be specified.					

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.