

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE

**Discrete semiconductor devices and integrated circuits –  
Part 5-2: Optoelectronic devices – Essential ratings and characteristics**

**Dispositifs discrets à semiconducteurs et circuits intégrés –  
Partie 5-2: Dispositifs optoélectroniques – Valeurs limites et caractéristiques  
essentielles**

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**DISCRETE SEMICONDUCTOR DEVICES  
AND INTEGRATED CIRCUITS –****Part 5-2: Optoelectronic devices –  
Essential ratings and characteristics**

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This consolidated version of IEC 60747-5-2 consists of the first edition (1997) [documents 47C/173/FDIS and 47C/186/RVD] and its amendment 1 (2002) [documents 47E/209/FDIS and 47E/214/RVD].

The technical content is therefore identical to the base edition and its amendment and has been prepared for user convenience.

It bears the edition number 1.1.

A vertical line in the margin shows where the base publication has been modified by amendment 1.

It should be read jointly with IEC 60747-1, IEC 62007-1 and IEC 62007-2.

Annex A is for information only.

Annex B forms an integral part of this standard.

The committee has decided that the contents of the base publication and its amendments 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

This part of IEC 60747 provides basic information on semiconductors:

- terminology,
- letter symbols,
- essential ratings and characteristics,
- measuring methods,
- acceptance and reliability.

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## DISCRETE SEMICONDUCTOR DEVICES AND INTEGRATED CIRCUITS –

### Part 5-2: Optoelectronic devices – Essential ratings and characteristics

#### 1 Scope

This part of IEC 60747 gives the essential ratings and characteristics of the following categories or subcategories of optoelectronic devices which are not intended to be used in the field of fibre optic systems or subsystems:

- Semiconductor photoemitters, including:
  - . light-emitting diodes (LEDs);
  - . infrared-emitting diodes (IREDs);
  - . laser diodes.
- Semiconductor photoelectric detectors, including:
  - . photodiodes;
  - . phototransistors.
- Semiconductor photosensitive devices.
- Semiconductor devices utilizing the optical radiation for internal operation, including:
  - . photocouplers, optocouplers.

#### 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 60065:1985, *Safety requirements for mains operated electronic and related apparatus for household and similar general use*

IEC 60068-2-1:1990, *Environmental testing – Part 2: Tests – Tests A: Cold*

IEC 60068-2-2:1974, *Environmental testing – Part 2: Tests – Tests B: Dry heat*

IEC 60068-2-3:1969, *Environmental testing – Part 2: Tests – Test Ca: Damp heat, steady state*

IEC 60068-2-6:1995, *Environmental testing – Part 2: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-14:1984, *Environmental testing – Part 2: Tests – Test N: Change of temperature*

IEC 60068-2-17: 1994, *Environmental testing – Part 2: Tests – Test Q: Sealing*

IEC 60068-2-27:1987, *Environmental testing – Part 2: Tests – Test Ea and guidance: Shock*

IEC 60068-2-30:1980, *Environmental testing – Part 2: Tests – Test Db and guidance: Damp heat, cyclic (12 + 12-hour cycle)*

IEC 60112:1979, *Method for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions*

IEC 60216-1:1990, *Guide for the determination of thermal endurance properties of electrical insulating materials – Part 1: General guidelines for ageing procedures and evaluation of test results*

IEC 60216-2:1990, *Guide for the determination of thermal endurance properties of electrical insulating materials – Part 2: Choice of test criteria*

IEC 60306-1:1969, *Measurement of photosensitive devices – Part 1: Basic recommendations*

IEC 60664-1:1992, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60672-2:1980, *Specification for ceramic and glass insulating materials – Part 2: Methods of test*

IEC 60695-2-2:1991, *Fire hazard testing – Part 2: Test methods – Section 2: Needle-flame test*

IEC 60747-5-1:1997, *Discrete semiconductor devices and integrated circuits – Part 5-1: Optoelectronic devices – General*

IEC 60747-5-3:1997, *Discrete semiconductor devices and integrated circuits – Part 5-3: Optoelectronic devices – Measuring methods*

### 3 Light-emitting diodes

(excluding devices for fibre optic systems or subsystems)

#### 3.1 Type

Ambient-rated or case-rated light-emitting diode.

#### 3.2 Semiconductor material

Gallium arsenide-phosphide, etc.

#### 3.3 Colour

#### 3.4 Details of outline and encapsulation

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

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

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

#### 3.5 Limiting values (absolute maximum system) over the operating temperature range, unless otherwise stated

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

3.5.2 Minimum and maximum operating ambient or case temperature ( $T_{amb}$  or  $T_{case}$ ).

3.5.3 Maximum reverse voltage ( $V_R$ ).

NOTE Not applicable to dual-diode devices connected anode-to-cathode and cathode-to-anode.

3.5.4 Maximum continuous forward current ( $I_F$ ) at an ambient or case temperature of 25 °C and derating curve or derating factor.

**3.5.5** Where appropriate, maximum peak forward current ( $I_{FM}$ ) at an ambient or case temperature of 25 °C, under specified pulse conditions.

### 3.6 Electrical characteristics

For multiple diodes, the characteristics should be given for each diode. For special applications, additional characteristics may be required.

Ref.	Characteristics	Conditions at $T_{amb}$ or $T_{case} = 25\text{ °C}$ , unless otherwise stated	Notes	Symbols	Requirements	
					Min.	Max.
3.6.1	Forward voltage	$I_F$ specified (d.c. or pulse)		$V_F$		Max.
3.6.2	Reverse current	$V_R$ specified	1	$I_R$		Max.
3.6.3	Luminous intensity along the defined mechanical axis	$I_F$ specified (d.c. or pulse)	2, 3	$I_v$	Min.	
3.6.4	Peak emission wavelength	$I_F$ specified (d.c. or pulse)		$\lambda_p$	Min.	Max.
3.6.5	Spectral radiation bandwidth (where appropriate)	Half value of peak emission, with $I_F$ as specified in 3.6.4		$\Delta\lambda$		Max.
3.6.6	Switching times (where appropriate)					Max.
3.6.7	Half-intensity angle (where appropriate)					Max.

NOTE 1 Not applicable to dual-diode devices connected anode-to-cathode and cathode-to-anode.

NOTE 2 If the included solid angle over which the intensity is measured is not negligible, it should be specified.

NOTE 3 For diodes intended for use in multi-diode arrays, maximum luminous intensity is also required.

### 3.7 Supplementary information

#### 3.7.1 Radiation diagram

A diagram graphically expressing typical luminous intensity versus viewing angle, and using either polar or rectangular co-ordinates.

#### 3.7.2 Spectral diagram (where appropriate)

A diagram graphically expressing typical luminous intensity versus wavelength.

#### 3.7.3 Mechanical information

Mounting and soldering conditions, where appropriate.

## 4 Infrared-emitting diodes

(excluding devices for fibre optic systems or subsystems)

### 4.1 Type

Ambient-rated or case-rated infrared-emitting diode.

### 4.2 Semiconductor material

Gallium arsenide, etc.

**4.3 Details of outline and encapsulation**

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

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

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

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

**4.4.1** Minimum and maximum storage temperature ( $T_{stg}$ ).

**4.4.2** Minimum and maximum operating ambient or case temperature ( $T_{amb}$  or  $T_{case}$ ).

**4.4.3** Maximum reverse voltage ( $V_R$ ).

**4.4.4** Maximum continuous forward current ( $I_F$ ) at an ambient or case temperature of 25 °C and derating curve or derating factor.

**4.4.5** Where appropriate, maximum peak forward current ( $I_{PM}$ ) at an ambient or case temperature of 25 °C, under specified pulse conditions.

**4.5 Electrical characteristics**

For special applications, additional characteristics may be required.

Ref.	Characteristics	Conditions at $T_{amb}$ or $T_{case} = 25\text{ °C}$ , unless otherwise stated	Notes	Symbols	Requirements	
4.5.1	Forward voltage	$I_F$ specified (d.c. or pulse)		$V_F$		Max.
4.5.2	Reverse current	$V_R$ specified		$I_R$		Max.
4.5.3	Radiant power output or radiant intensity along the defined mechanical axis	$I_F$ specified (d.c. or pulse)	1	$\phi_e$ $I_e$	Min. Min.	
4.5.4	Peak emission wavelength	$I_F$ specified (d.c. or pulse)		$\lambda_p$	Min.	Max.
4.5.5	Spectral radiation bandwidth (where appropriate)	Half-value of peak emission, with $I_F$ as specified in 4.5.4		$\Delta\lambda$		Max.
4.5.6	Switching times (where appropriate)					Max.
4.5.7	Half-intensity angle (where appropriate)					Max.
4.5.8	Capacitance (where appropriate)					Max.

NOTE 1 If the included solid angle over which the intensity is measured is not negligible, it should be specified.

## 4.6 Supplementary information

### 4.6.1 Radiation diagram

A diagram graphically expressing typical radiant power output or radiant intensity versus angle with respect to the defined mechanical axis, and using either polar or rectangular coordinates.

### 4.6.2 Spectral diagram (where appropriate)

A diagram graphically expressing typical radiant power output or radiant intensity versus wavelength.

### 4.6.3 Mechanical information

Mounting and soldering conditions, where appropriate.

## 5 Photodiodes

(excluding devices for fibre optic systems or subsystems)

### 5.1 Type

Ambient-rated or case-rated photodiode intended for small-signal and switching applications.

### 5.2 Semiconductor material

Silicon, 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 connection between a terminal and the case.

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

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

5.4.2 Minimum and maximum operating ambient or case temperature ( $T_{amb}$  or  $T_{case}$ ).

5.4.3 Maximum reverse voltage ( $V_R$ ).

5.4.4 Where appropriate:

- maximum total power dissipation ( $P_{tot}$ ) up to ambient or case temperature of 25 °C, and
- derating factor above 25 °C ( $K_f$ ) or derating curve.

### 5.5 Electrical characteristics

Ref.	Characteristics	Conditions at $T_{amb}$ or $T_{case} = 25\text{ }^{\circ}\text{C}$ , unless otherwise stated	Notes	Symbols	Requirements
5.5.1	Reverse current under irradiation	$V_R$ specified $E_v$ or $E_e$ specified	1	$I_{R(H)}$ or $I_{R(e)}$	Min.
5.5.2	Dark current	$V_R$ specified, $E_e = 0$		$I_R$	Max.
5.5.3	Dark current	$V_R$ specified, $E_e = 0$ at a specified high temperature of $T_{amb}$ or $T_{case}$ specified		$I_R$	Max.
5.5.4	Where appropriate, spectral sensitivity	$V_R$ specified, $E_e$ specified, at a short wavelength $\lambda_1$ specified and at a longer wavelength $\lambda_2$ specified		$S$ $S$	Min. Min.
5.5.5	Switching times (where appropriate): rise time and fall time or: turn-on time and turn-off time	Specified circuit specified value of $V_R$ , $E_v$ or $E_e$ specified  Specified circuit specified value of $V_R$ , $E_v$ or $E_e$ specified		$t_r$ $t_f$  $t_{on}$ $t_{off}$	Max. Max.  Max. Max.

NOTE 1 Illumination by standard illuminant A (according to IEC 60306-1) emitted from a filament tungsten lamp with a colour temperature  $T = 2\ 855,6\ \text{K}$  or with radiation from a defined monochromatic source.

### 5.6 Supplementary information

#### 5.6.1 Diagram of typical sensitivity

#### 5.6.2 Typical spectral diagram

A diagram graphically expressing relative spectral sensitivity versus wavelength.

## 6 Phototransistors

(excluding devices for fibre optic systems or subsystems)

### 6.1 Type

Ambient-rated or case-rated phototransistor intended for small-signal and switching applications.

### 6.2 Semiconductor material

Silicon, etc.

### 6.3 Polarity

NPN/PNP.

### 6.4 Details of outline and encapsulation

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

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