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British Standard

Semiconductor devices: discrete devices and integrated circuits

Part 1. Discrete devices

Section 1.5 Recommendations for optoelectronic devices

Dispositifs à semiconducteurs: dispositifs discrets et circuits intégrés
Partie 1. Dispositifs discrets
Section 1.5 Recommandations pour dispositifs optoélectroniques

Halbleiter-Bauelemente: Einzelhalbleiter und integrierte Schaltungen
Teil 1. Einzelhalbleiter
Abschnitt 1.5 Empfehlungen für optoelektronische Bauelemente

British Standards Institution

BS 6493 : Section 1.5 : 1985

National foreword

This British Standard has been prepared under the direction of the Electronic Components Standards Committee. It is identical with IEC Publication 747-5 'Semiconductor devices. Discrete devices and integrated circuits Part 5 : Opto-electronic devices', published in 1984 by the International Electrotechnical Commission (IEC).

This British Standard constitutes Section 1.5 of the British Standard for semiconductor devices (BS 6493). (See national foreword of BS 6493 : Section 1.1 : 1984.)

Terminology and conventions. The text of the international standard has been approved as suitable for publication as a British Standard without deviation. Some terminology and certain conventions are not identical with those used in British Standards.

Cross-references

International standard	Corresponding British Standard
IEC 50	*BS 4727 Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms
IEC 68	†BS 2011 Basic environmental testing procedures
IEC 747-1 : 1983	BS 6493 Semiconductor devices: discrete devices and integral circuits Section 1.1 : 1984 General (Identical)

The Technical Committee has reviewed the provisions of IEC 306 to which reference is made in the text and has decided that they are acceptable for use in conjunction with this standard.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

*Issued in a series of separately published documents, many of which are technically equivalent to or related to the IEC 50 series.

†Issued in a series of separately published documents the majority of which are identical to the IEC 68 series.

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British Standard

Semiconductor devices: discrete devices and integrated circuits

Part 1. Discrete devices

Section 1.5 Recommendations for optoelectronic devices

CHAPTER I: GENERAL

1. Introductory note

As a rule, it will be necessary to use Publication 747-1 together with the present publication. In 747-1, the user will find all basic information on:

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

2. Scope

The present publication gives standards for the following categories or sub-categories of devices:

- Semiconductor photoemitters, including:
 - semiconductor optoelectronic displays (under consideration);
 - light-emitting diodes (LEDs);
 - infrared-emitting diodes (IREDS);
 - semiconductor lasers (under consideration).
- Semiconductor photosensitive devices, including:
 - photodiodes;
 - phototransistors;
 - photothyristors (under consideration).
- Photocouplers, optocouplers.

The sequence of the different chapters is in accordance with Publication 747-1, Chapter III, Sub-clause 2.1.

CHAPTER II: TERMINOLOGY AND LETTER SYMBOLS

Note. — A number of additional terms of interest for optoelectronic devices, e.g. for radiometric, photometric and spectrophotometric quantities, appear in Chapter 45 of the IEC.

1. Types of devices

1.1 *Semiconductor optoelectronic device*

A semiconductor device that is responsive to, or that emits or modifies coherent or non-coherent electromagnetic radiation in the visible, infrared and/or ultraviolet spectral regions; or a device that utilizes such electromagnetic radiation for its internal operation.

1.2 *Semiconductor photoemitter*

A semiconductor optoelectronic device that directly converts electric energy into optical radiant energy.

1.3 *Semiconductor optoelectronic display*

A semiconductor photoemitter designed for the presentation of visual information.

1.4 *Light-emitting diode (LED)*

A diode capable of emitting radiant energy in the visible region of the spectrum, resulting from the recombination of electrons and holes.

Note. — The acronym VLED is deprecated.

1.5 *Infrared-emitting diode (IRED)*

A diode capable of emitting radiant energy in the infrared region of the spectrum, resulting from the recombination of electrons and holes.

Note. — The expression "infrared LED" is deprecated.

1.6 *Semiconductor laser*

A semiconductor optoelectronic device that emits coherent radiant energy through stimulated emission resulting from the recombination of electrons and holes.

1.7 *Semiconductor photosensitive device*

A semiconductor device that is responsive to electromagnetic radiation in the visible, infrared and/or ultraviolet spectral regions.

1.8 *Photoelectric receptor, photocell (IEV 45-30-225)*

Physical receptor that depends for its action on an external or internal photoelectric effect.

1.9 *Photoconductive cell (IEV 45-30-240)*

Photoelectric receptor utilizing a semiconductor in which absorption of radiation gives rise to an increase in conductivity by the internal photoelectric effect.

1.10 *Photovoltaic cell* (IEV 45-30-245)

Photoelectric receptor in which absorption of radiation in the neighbourhood of a PN junction between two semiconductors, or of a contact between a semiconductor and a metal, produces an electromotive force.

1.11 *Photodiode*

A semiconductor diode having a PN junction between two types of semiconductors or between a semiconductor and a metal, in which the absorption of radiation in the neighbourhood of the junction produces:

- an internal photoelectric effect when the diode is reverse biased, and
- a photovoltaic effect when the diode is forward biased.

1.12 *Phototransistor*

A transistor in which the photoelectric effect is utilized.

1.13 *Photothyristor*

A thyristor that is intended to be responsive to radiant energy as a triggering source.

1.14 *Photocoupler, optocoupler*

A semiconductor optoelectronic device designed for the transfer of electrical signals by utilizing radiant energy to provide coupling with electrical isolation between the input and the output.

2. Terms related to ratings and characteristics

2.1 *Peak-emission wavelength (λ_p)*

The wavelength at which the spectral radiant intensity is a maximum.

2.2 *Peak-sensitivity wavelength*

The wavelength at which the spectral sensitivity is a maximum.

2.3 *Spectral radiation bandwidth ($\Delta\lambda$)*

The wavelength interval in which the spectral concentration of a radiometric quantity is greater or equal to half of its maximum value.

2.4 *Radiation diagram*

A diagram that characterizes the distribution (actual or expected) in space of a radiation emitted by an emitting optoelectronic device.

2.5 *Sensitivity diagram*

A diagram graphically expressing sensitivity versus angle with respect to a defined mechanical axis and using either polar or rectangular co-ordinates.

2.6 *Half-intensity (beam) angle*

The full cone angle within which the radiant intensity is greater or equal to half of the maximum intensity.

2.7 *Photoelectric current* (IEV 45-30-260)

That part of the electric current in a photoelectric receptor which is produced by the photoelectric effect.

2.8 *Dark current* (IEV 45-30-265)

That part of the electric current in a photoelectric receptor which still flows when the receptor receives no radiation capable of producing a photoelectric effect.

2.9 *Optical axis*

A line about which the principal radiant-energy or sensitivity pattern is centred.

- Notes 1. — The radiant-energy or sensitivity pattern may be non-symmetrical.
2. — The optical axis may deviate from the mechanical axis.

2.10 *Photodiodes*

2.10.1 *Reverse current under irradiation* ($I_{R(H)}$ or $I_{R(e)}$)

The total reverse current through a photodiode when it is exposed to radiant energy.

Note. — These term and definition are under revision.

2.11 *Phototransistors*

2.11.1 *Collector current under irradiation* ($I_{C(H)}$ or $I_{C(e)}$)

The total collector current through a phototransistor when it is exposed to radiant energy.

Note. — These term and definition are under revision.

2.12 *Photocouplers, optocouplers*

2.12.1 *Input-to-output capacitance* (C_{io})

The internal capacitance between all input terminals connected together and all output terminals connected together.

2.12.2 *Isolation resistance* (r_{io})

The resistance between all input terminals connected together and all output terminals connected together.

2.12.3 *Isolation voltage*

The voltage between any of the input terminals and any of the output terminals.

a) *Continuous (direct) isolation voltage* (V_{io})

The value of the constant isolation voltage.

b) Repetitive peak isolation voltage (V_{IORM})

The highest instantaneous value of the isolation voltage including all repetitive transient voltages, but excluding all non-repetitive transient voltages.

Note. — A repetitive transient voltage is usually a function of the circuit.

A non-repetitive transient voltage is usually due to an external cause and it is assumed that its effect has completely disappeared before the next non-repetitive transient voltage arrives.

c) Surge isolation voltage (V_{IOSM})

The highest instantaneous value of an isolation voltage pulse of short-time duration and of specified waveshape.

2.12.4 Current transfer ratio

The ratio of the direct (continuous) or alternating output current to the direct (continuous) or alternating input current, the output voltage being held constant.

Note. — Abbreviation: CTR.

a) Static value of the (forward) current transfer ratio ($h_{F(ctr)}$, h_F)

The ratio of the direct (continuous) output current to the direct (continuous) input current, the output voltage being held constant.

Note. — Abbreviation: CTR(dc).

b) Small-signal short-circuit (forward) current transfer ratio ($h_{f(ctr)}$, h_f)

The ratio of the alternating output current to the sinusoidal input current producing it under small-signal conditions, the output being short-circuited to a.c.

Note. — Abbreviation: CTR(ac).

2.12.5 Cut-off frequency (f_{ctr})

The frequency at which the modulus of the small-signal current transfer ratio has decreased to $\frac{1}{\sqrt{2}}$ of its low-frequency value.

3. Letter symbols**3.1 General**

The general rules of Publication 747-1, Chapter V, apply.

3.2 List of letter symbols

The symbols contained in the following table are recommended for use in the field of optoelectronic devices; they have been compiled in accordance with the general rules.

Name and designation	Letter symbol	Remarks
Peak-emission wavelength	λ_p	
Spectral radiation bandwidth	$\Delta\lambda$	
Reverse current under irradiation (photo-diodes)	$I_{R(H)}$ or $I_{R(e)}$	
Collector current under irradiation (photo-transistors)	$I_{C(H)}$ or $I_{C(e)}$	
Input-to-output capacitance (photocouplers)	C_{io}	
Isolation resistance (photocouplers)	r_{io}	
Continuous isolation voltage (photo-couplers)	V_{io}	
Repetitive peak isolation voltage (photo-couplers)	V_{IORM}	
Surge isolation voltage (photocouplers)	V_{IOSM}	
Static value of the current transfer ratio (photocouplers)	$h_{F(ct)}, h_F$	
Small-signal short-circuit current transfer ratio (photocouplers)	$h_{f(ct)}, h_f$	
Cut-off frequency (photocouplers)	f_{ctr}	

CHAPTER III: ESSENTIAL RATINGS AND CHARACTERISTICS

SECTION ONE — LIGHT-EMITTING DIODES

1. Type

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

2. Semiconductor material

Gallium arsenide-phosphide, etc.

3. Colour

4. Details of outline and encapsulation

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

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

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

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

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

5.2 Minimum and maximum operating ambient or case temperatures (T_{amb} or T_{case}).

5.3 Maximum reverse voltage (V_{R}).

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

5.4 Maximum continuous forward current (I_{F}) at an ambient or case temperature of 25 °C and derating curve or derating factor.

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