IS 16101 (2012): General Lighting - LEDs and LED Modules - Terms and Definitions [ETD 23: Electric Lamps and their Auxiliaries]

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सामान्य प्रकाश — एल ई डी और एल ई डी मॉडयूल — शब्दावली और परिभाषाएँ

Indian Standard

GENERAL LIGHTING — LEDs AND LED MODULES — TERMS AND DEFINITIONS

ICS 29.140.40

BUREAU OF INDIAN STANDARDS
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Price Group 6

Electric Lamps and Their Auxiliaries Sectional Committee, ETD 23

NATIONAL FOREWORD

This Indian Standard which is identical with IEC/TS 62504 : 2011 'General lighting — LEDs and LED modules — Terms and definitions' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendation of the Electric Lamps and Their Auxiliaries Sectional Committee and approval of the Electrotechnical Division Council.

The text of IEC Standard/Technical Specification has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, references appear to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards, which are to be substituted in their respective places are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
IEC 60050-845 : 1987 International Electrotechnical Vocabulary — Chapter 845: Lighting	IS 1885 (Part 16/Sec 1) : 1968 Electrotechnical vocabulary: Part 16 Lighting, Section 1 General aspects	Modified
IEC 60061-1 Lamp caps and holders together with gauges for the control of interchangeability and safety — Part 1: Lamp caps	IS 9206 : 1979 Dimensions of caps for tungsten filament general service electric lamps	do

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

GENERAL LIGHTING — LEDs AND LED MODULES — TERMS AND DEFINITIONS

1 Scope

This Technical Specification presents terms and definitions relevant for lighting with LED light sources. It provides both descriptive terms (such as “built-in LED module”) and measurable terms (such as “luminance”).

NOTE Annex A gives an overview of systems composed of LED modules and control gear.

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 60050-845:1987, *International Electrotechnical Vocabulary – Chapter 845: Lighting*

IEC 60061-1, *Lamp caps and holders together with gauges for the control of interchangeability and safety – Part 1: Lamp caps*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-845 and the following apply.

3.1
ambient temperature
t_{amb}
average temperature of air or another medium in the vicinity of the LED or LED module

NOTE 1 During the measurement of the ambient temperature, the measuring instrument/probe should be shielded from draughts and radiant heating.

[IEC 60050-826:2004, definition 826-10-03, modified]

[see also CIE 127, Subclause 2.2.5]

NOTE 2 Ambient temperature is expressed in Celsius degrees.

3.2
angular subtense
α
angle subtended by an apparent source as viewed from a point in space

The angle extension is determined by the observation distance, but at no distance smaller than the minimum distance of accommodation.

NOTE 1 The location and angular subtense of the apparent source depends on the viewing position in the beam.

NOTE 2 The angular subtense of an apparent source is only applicable in the wavelength range from 380 nm to 1 400 nm, where eye hazard exists.

NOTE 3 The angular subtense of the source should not be confused with the beam divergence. The angular subtense of the source cannot be larger than the divergence of the beam, but it is usually smaller than the divergence of the beam

NOTE 4 In terms of optical radiation safety, the LED radiation source is a “middle sized source”, whose images are projected on the retina under angles between 1,5 mrad and 100 mrad, i.e. the diameter of the retina image extends between about 25 μm and 1 700 μm. For such sources, particularly, the hazard is strongly related to the angular subtense on the observer’s retina.

[IEC 60825-1:2007, 3.7, modified]

NOTE 5 The angular subtense is expressed in degrees (°).

3.3
apparent source
for a given evaluation location of the retinal hazard, the real or virtual object that forms the smallest possible retinal image (considering the accommodation range of the human eye)

NOTE 1 The accommodation range of the eye is assumed to be variable from 100 mm to infinity. The location of the apparent source for a given viewing position in the beam is that location to which the eye accommodates to produce the most hazardous retinal irradiance condition.

NOTE 2 This definition is used to determine, for a given evaluation position, the location of the apparent origin of laser radiation in the wavelength range of 380 nm to 1 400 nm. In the limit of vanishing divergence, i.e. in the case of a well collimated beam, the location of the apparent source goes to infinity.

[IEC 60825-1:2007, 3.10, modified]

3.4
beam angle
angle between two imaginary lines in a plane through the optical beam axis, such that these lines pass through the centre of the front face of the lamp and through points at which the luminous intensity is 50 % of the centre beam intensity

[IEC/TR 61341:2010, 2.4]

NOTE The beam angle is expressed in degrees (°).

3.5
bin
restricted range of LED performance characteristics used to delimit a subset of LEDs near a nominal LED performance as identified by photometric performance and forward voltage

NOTE As the result of small but meaningful variations in the manufacturing process of LED wafers and subsequent dies, the electrical and photometric characteristics of LEDs may vary from LED to LED, even when the dies are from the same wafer. LEDs are sorted or binned in accordance with these characteristics, but there is no existing standard for binning.

3.6
built-in LED module
LED module, generally designed to form a replaceable part built into a luminaire, a box, an enclosure or the like and not intended to be mounted outside a luminaire, etc. without special precautions

3.7
built-in self-ballasted LED module
self-ballasted LED module, generally designed to form a replaceable part built into a luminaire, a box, an enclosure or the like and not intended to be mounted outside a luminaire, etc. without special precautions

3.8
chromaticity coordinates
ratio of each of a set of three tristimulus values to their sum

NOTE 1 As the sum of the three chromaticity coordinates equals 1, two of them are sufficient to define a chromaticity.

NOTE 2 In the CIE standard colorimetric systems, the chromaticity coordinates are represented by the symbols x, y, z and x_{10}, y_{10}, z_{10}.

[CEI 60050-845:1987, definition 845-03-33]

3.9
CIE 1974 general colour rendering index
***R*a**
mean of the CIE 1974 special colour rendering indices for a specified set of eight test colour samples

[CEI 60050-845:1987, definition 845-02-63]

NOTE New definition of R_a for LED is under study.

3.10
dominant wavelength (of a colour stimulus)
λ_{dom}
wavelength of the monochromatic stimulus at 25 °C ambient temperature that when additively mixed in suitable portions with the specified achromatic stimulus, matches the colour stimulus considered

For characterising LED modules the reference achromatic stimulus should be illuminant E which has the chromaticity coordinates x_E = 0,3333, y_E = 0,3333.

NOTE 1 A value for dominant wavelength should only be stated for coloured modules. For white modules no meaningful value for dominant wavelength can be given.

NOTE 2 Figure 12 in CIE 127 shows the relationship between colour locus C of LED and value of dominant wavelength D. N is the locus of achromatic stimulus E.

NOTE 3 Deviating from the peak emission wavelength, the dominant wavelength determines visual impression.

[IEC 60050-845:1987, definition 845-03-44, modified]

NOTE 4 The dominant wavelength is expressed in nm.

3.11
forward direction
direction of current that results when the P-type semiconductor region connected to one terminal is at positive potential relative to the N-type region connected to the other terminal

NOTE If temperature compensation diodes are included, these are ignored in the determination of forward direction.

[IEC 60747-3:1985, 1.3 dans la Section 2]

3.12
forward voltage
***U*F**
potential difference pertaining to the forward direction, dependent on the forward current at 25 °C ambient temperature

NOTE The forward voltage is expressed in V.

3.13
illuminance (at a point of a surface)
***E*, E_v**
quotient of the luminous flux $d\Phi_v$ incident on an element of the surface containing the point, by the area dA of that element

Equivalent definition: Integral, taken over the hemisphere visible from the given point of the expression $L_v \cdot \cos\Theta \cdot d\Omega$, where L_v is the luminance at the given point in the various directions of the incident elementary beams of solid angle $d\Omega$, and Θ is the angle between any of these beams and the normal to the surface at the given point.

$$E_V = d\Phi_V/dA = \int_{2\Pi sr} (L_V \times \cos\Theta \times d\Omega)$$

[IEC 60050-845:1987, definition 845-01-38]

NOTE Illuminance is expressed in $lm \times m^{-2}$.

3.14
independent LED module
LED module, so designed that it can be mounted or placed separately from a luminaire, an additional box or enclosure or the like

The independent LED module provides all the necessary protection with regard to safety according to its classification and marking.

NOTE The control gear must not necessarily be integrated in the module.

3.15
independent self-ballasted LED module
self-ballasted LED module, so designed that it can be mounted or placed separately from a luminaire, an additional box or enclosure or the like

The independent LED module provides all the necessary protection with regard to safety according to its classification and marking.

NOTE The control gear may be integrated in the module.

3.16
integral LED module
LED module, generally designed to form a non-replaceable part of a luminaire

3.17
integral self-ballasted LED module
self-ballasted LED module, generally designed to form a non-replaceable part of a luminaire

3.18
LED module
unit supplied as a light source. In addition to one or more LEDs it may contain further components, e.g. optical, mechanical, electrical, and electronic, but excluding the control gear

3.19
life time of the LED related to junction temperature
t_{nLED}
time period at 25 °C ambient temperature and rated forward current, determined by a minimum level of n % of the measured initial photometric parameter

The corresponding junction temperature has to be indicated. The use of forced cooling to achieve the specified junction temperature must be stated.

NOTE The life time of the LED is expressed in hours.

3.20
life time of LED module related to t_C
$t_{nLED\ module}$
length of time during which n% ($t_{nLED\ module}$) of the measured initial luminous flux value are provided, as a function of t_C

The use of forced cooling to achieve the specified junction temperature must be stated.

NOTE The life time of the LED module is expressed in hours.

3.21
light colour designation
three digit number, the first digit representing the first digit of the general colour rendering index R_a [IEV 60050-845:1987, 845-02-63], and the second and third digit representing the first two digits (thousands and hundreds) of the CCT of the light source

NOTE 1 The first digit of the light colour designation covers also the closest R_a value decreased by 3. Its highest value is 9.

NOTE 2 The second and the third digit of the light colour designation cover also CCT values 49 K higher and 50 K below. This method works only for CCT below 9.999 K.

3.22
light emitting diode
LED
solid state device embodying a p-n junction, emitting optical radiation when excited by an electric current

[IEC 60050-845:1987, definition 845-04-40]

NOTE This definition is independent from the existence of enclosure(s) and of terminals.

3.23
luminance (in a given direction, at a given point of a real or imaginary surface)
L_V, L
quantity defined by the formula

$$L_V = \mathrm{d}\Phi_V/(\mathrm{d}A \times \cos\Theta \times \mathrm{d}\Omega)$$

where $\mathrm{d}\Phi_V$ is the luminous flux transmitted by an elementary beam passing through the given point and propagating in the solid angle $\mathrm{d}\Omega$ containing the given direction; $\mathrm{d}A$ is the area of a section of that beam containing the given point; Θ is the angle between the normal to that section and the direction of the beam

[IEC 60050-845:1987, definition 845-01-35]

NOTE The luminance is expressed in $\mathrm{cd} \times \mathrm{m}^{-2} = \mathrm{lm} \times \mathrm{m}^{-2} \times \mathrm{sr}^{-1}$.

3.24
luminous efficacy of a source
η_V, η
quotient of the luminous flux emitted by the electric power consumed by the source

[IEC 60050-845:1987, definition 845-01-55 modified]

NOTE The luminous efficacy is expressed in $\mathrm{lm} \times \mathrm{W}^{-1}$.

3.25
luminous flux
Φ_V, Φ
quantity derived from radiant flux Φ_e by evaluating the radiation according to its action upon the CIE standard photometric observer

For photopic vision

$$\Phi_V = K_m \int_{360}^{830} (\mathrm{d}\Phi_e(\lambda)/\mathrm{d}\lambda) \times V(\lambda)\mathrm{d}\lambda$$

where $d\Phi_e(\lambda)/d\lambda$ is the spectral distribution of the radiant flux and $V(\lambda)$ is the spectral luminous efficiency.

NOTE 1 For the values of K_m (photopic vision) and K'_m (scotopic vision), see IEV 845-01-56.

[IEC 60050-845:1987, definition 845-01-25, modified]

NOTE 2 The luminous flux of a LED is usually expressed in groups into which they are sorted.

NOTE 3 The luminous flux is expressed in lm.

3.26
luminous intensity (of a source, in a given direction)
I_V; I
quotient of the luminous flux $d\Phi_V$ leaving the source and propagated in the element of solid angle $d\Omega$ containing the given direction, by the element of solid angle

$I_V = d\Phi_V/d\Omega$

[IEC 60050-845:1987, definition 845-01-31]

NOTE 1 The luminous intensity of LEDs is expressed according to CIE 127:2007 measurement procedure.

NOTE 2 The luminous intensity is expressed in cd = lm × sr^{-1}.

3.27
maximum permissible forward current
$I_{F,max}$
continuous maximum permissible current in forward direction

NOTE The maximum permissible forward current is expressed in mA.

3.28
maximum permissible power consumption
P_{tot}
maximum permissible input power

NOTE The maximum permissible power consumption is expressed in W.

3.29
maximum permissible reverse voltage
U_R
maximum permissible potential difference pertaining to the reverse direction

NOTE The maximum permissible reverse voltage is expressed in V.

3.30
rated maximum temperature
t_C
highest permissible temperature which may occur on the outer surface of the LED module (at the indicated position, if marked) under normal operating conditions and at the rated voltage/current/power or the maximum of the rated voltage/current/power range

[IEC 61347-1:2007, definition 3.16, modified]

NOTE The rated maximum temperature is expressed in degrees Celsius.

3.31
maximum permissible temperature of solder point
t_S
maximum permissible temperature at the solder point of the LED on the module during declared life

NOTE 1 Not to be confused with the temperature during the soldering procedure.

NOTE 2 The maximum permissible temperature of solder point is expressed in degrees Celsius.

3.32
non-ballasted single-capped LED lamp
single-capped LED lamp configured in a form in which the control gear and the LED lamp are separated from each other

3.33
operating temperature range
t_{op}
ambient temperature range within which the LED or LED module with regard to the specification can be operated

NOTE The operating temperature range is expressed in degrees Celsius.

3.34
peak emission wavelength
λ_p
wavelength at the maximum of the spectral distribution

[CIE 127, modified]

NOTE The peak emission wavelength is expressed in nm.

3.35
rated current
I_{rated}
value of the current for specified operating conditions

The value and the conditions are specified in the relevant standard or by the manufacturer or responsible vendor.

NOTE The rated current is expressed in mA.

3.36
rated power
P_{rated}
value of the power for specified operating conditions

The value and the conditions are specified in the relevant standard or by the manufacturer or responsible vendor.

NOTE The rated power is expressed in degrees W.

3.37
rated voltage
value of the voltage for specified operating conditions

The value and the conditions are specified in the relevant standard or by the manufacturer or responsible vendor.

NOTE The rated voltage is expressed in V.

3.38
reverse direction
direction of current that results when the N-type semiconductor region connected to one terminal is at a positive potential relative to the P-type region connected to the other terminal

NOTE If temperature compensation diodes are included, these are ignored in the determination of reverse direction.

[IEC 60747-3:1985, 1.4 in Section 2]

3.39
self-ballasted LED lamp
unit which cannot be dismantled without being permanently damaged, provided with a lamp cap conforming with IEC 60061-1 and incorporating a LED light source and any additional elements necessary for stable operation of the light source

3.40
self-ballasted LED module
LED module, including control gear, designed for connection to the supply voltage

NOTE If the LED module which includes the control gear is equipped with a lamp cap, it is regarded to be a self-ballasted lamp.

3.41
storage temperature range
t_{stg}
ambient temperature range within which a non-operated LED or LED module can be stored, when the claims of the specification are maintained

NOTE The storage temperature range is expressed in degrees Celsius.

3.42
temperature coefficient of the dominant wavelength
$tc_{\lambda dom}$
change in dominant wavelength at a fixed forward current as a function of the ambient temperature

NOTE 1 The definition applies for independent LED modules without control gear.

NOTE 2 The definition applies to LED components, not to LED modules.

NOTE 3 The temperature coefficient of the dominant wavelength is expressed in nm × K^{-1}.

3.43
temperature coefficient of the forward voltage
tc_V
change in forward voltage at a fixed current as a function of the ambient temperature

NOTE The temperature coefficient of the forward voltage is expressed in mV × K^{-1}.

3.44
temperature coefficient of the photometric parameter
tc_Φ
change in photometric parameter at a fixed forward current as a function of the ambient temperature

NOTE 1 The definition applies for independent LED modules without control gear.

NOTE 2 The temperature coefficient of the photometric parameter is expressed in lm × K^{-1}, cd × K^{-1} or cd × $(m^2 K)^{-1}$.

3.45
thermal resistance of a LED module
R_Θ
the ratio of temperature difference to the corresponding power dissipation

NOTE 1 Measurement points should be at the junction, slug, board or ambient, the location of which to be determined by the manufacturer or responsible vendor

NOTE 2 For better understanding, drawings of a part of the LED module and a schematic chain of thermal resistors are shown in Figure 1.

NOTE 3 Thermal resistance is expressed in $K \times W^{-1}$.

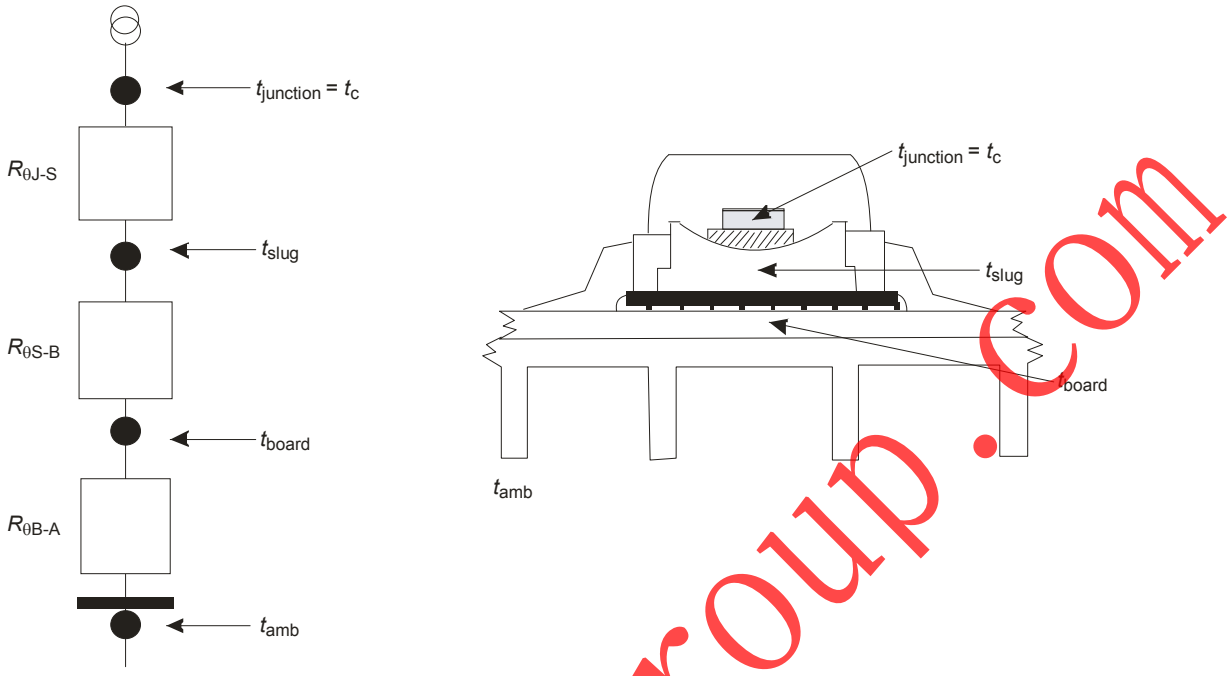
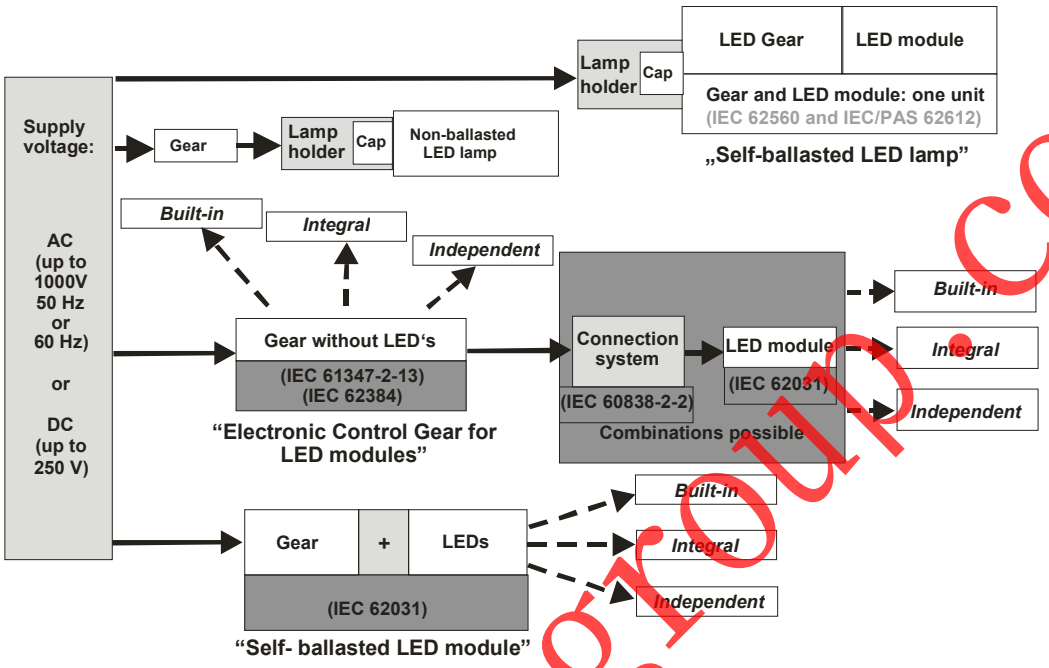


Figure 1 – Schematic drawing of the chain of thermal resistors

Annex A
(informative)

Overview of systems composed of LED modules and control gear



NOTE Supply voltage does not mean necessarily mains voltage, e.g. 230 V / 50 Hz. A "Self-ballasted LED lamp" can also be driven on a supply voltage with 12 V a.c. or d.c.. The "LED Gear" mentioned in the above sketch of a "Self-ballasted LED lamp" then provides the conversion of 12 V a.c. or d.c. to a special current and voltage to power up the LED or LED module inside the "Self-ballasted LED lamp".

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Review of Indian Standards

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