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Edition 2.0 2004-01

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Infrared free air applications

Applications infrarouges en mode non guidé

IEC 61920:2004

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INFRARED FREE AIR APPLICATIONS

FOREWORD

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International Standard IEC 61920, has been prepared by technical area 3, Infrared systems and applications, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

This second edition cancels and replaces the first edition published in 1998. This edition constitutes a technical revision.

This bilingual version (2012-08) corresponds to the monolingual English version, published in 2004-01.

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

FDIS	Report on voting
100/717/FDIS	100/749/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.

The French version of this standard has not been voted upon.

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

The committee has decided that the contents of this publication will remain unchanged until 2006. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

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INFRARED FREE AIR APPLICATIONS

1 Scope and object

This International Standard describes the classification of IR devices into groups and classes in order to identify and clarify problems caused by mutual interference. Mutual interference is caused by the increasing parallel application of different infrared (IR) systems.

Due to its physical characteristics, the possibility of local limitation is a special feature of IR radiation.

In this standard, the wavelength range from 700 nm to 1 600 nm is considered. All systems based on free air application which intentionally or unintentionally use IR radiation in this range, are included. Products which unintentionally emit IR radiation, such as illumination equipment are not deemed to be IR application systems. They are, however, integrated into this standard in order to enable facility planners to take into consideration and to foresee provisions against disturbance of IR application systems by such unintentionally emitted radiation.

The object of this standard is to prevent or at least to minimize mutual interference and to allow the coexistence of different IR products. It is intended to identify each IR product by its characteristics, according to the classification criteria.

It is not the object of this standard to describe the consequences of interference between IR systems or safety aspects of optical radiation.

All applications of fibre-optic technology are excluded.

In this context "free air" means freely radiated IR in indoor or outdoor applications.

If the IR systems are used for information transmission, this standard is only relevant in connection with the physical layer of the open systems interconnection (OSI) reference model (ISO 7498-1).

NOTE The reader should be aware that a risk of interference between different infrared systems as assessed by this standard is based on general parameters and therefore cannot take all the parameters involved into account. In many cases the practical results may differ from those expected, for example the positioning of sender and receiver and the choice of advanced coding and decoding schemes. All these factors beyond the physical layer may have an effect on the final result.

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 60050-713:1998, *International Electrotechnical Vocabulary (IEV) – Part 713: Radiocommunications: transmitters, receivers, networks and operation*

IEC 60050-845:1987, *International Electrotechnical Vocabulary (IEV) – Chapter 845: Lighting*

IEC 60417-DB:2002[1], *Graphical symbols for use on equipment*

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[1] DB' refers to the IEC on-line database.

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

ISO/IEC 7498-1:1994, *Information technology – Open systems interconnection – Basic reference model: The basic model*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply:

3.1
bandwidth (of a receiver, amplifier or network)
extent of a continuous range of electrical frequencies or optical wavelengths over which the response does not differ from its nominal value by more than a specified amount

[IEV 713-06-19, modified]

3.2
directivity
defined by two angles β_A and β_B for describing the dependence of the receiver's sensitivity from the direction of incidence. The direction in which the receiver output V [mV] is maximum might be called optical receiver axis.

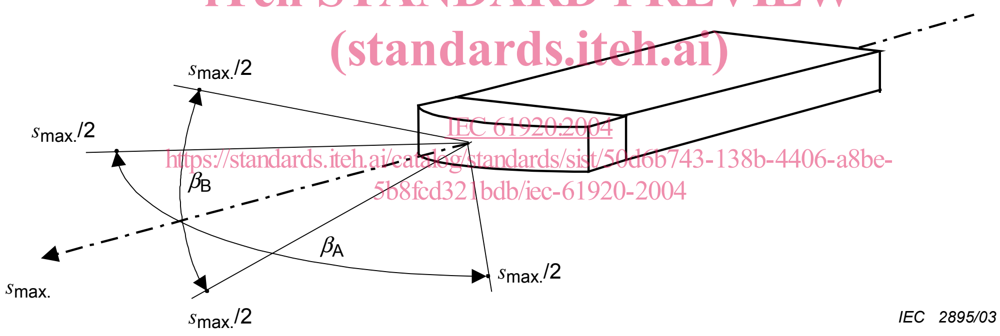


Figure 1 – Directivity and related characteristics

In a sensitivity diagram, the two angles β_A and β_B within which the sensitivity is greater than or equal to half of the maximum sensitivity (see Figure 1) characterize the directivity

[IEC 60747-5-1, 6.3.5.2, modified]

3.3
fluorescent lamp
discharge lamp of the low pressure mercury type in which most of the light is emitted by one or several layers of phosphors excited by the ultraviolet radiation from the discharge

[IEV 845-07-26]

3.4
harmonic
integer multiple of a basic frequency

3.5
interference
disturbance experienced in the reception of a wanted signal, caused by an unwanted signal or noise

3.6
infrared radiation
optical radiation for which the wavelengths are longer than those for visible radiation

[IEV 845-01-04]

NOTE For infrared radiation, the range between 780 nm and 1 mm is commonly subdivided into:

IR-A 780 nm to 1 400 nm;
IR-B 1,4 µm to 3 µm;
IR-C 3 µm to 1 mm.

3.7
infrared system
system which uses IR radiation in free air application consisting of IR radiator and IR receiver

3.8
irradiance
E
irradiance (at a point of a surface) is the quotient of the radiant flux $d\Phi_e$ incident on an element of the surface containing the point, by the area dA of that element
$E = d\Phi_e / dA$

NOTE Irradiance is expressed in [mW/m²].

[IEV 845-01-37]

3.9
modulation frequency
electrical signal frequency which modulates the IR radiation

3.10
peak intensity
I_p
maximum intensity I_p [mW/sr] of the optical radiation inside the optical radiation pattern

NOTE It should be taken into account that a different radiation pattern may occur in different wavelength ranges in the same application.

3.11
radiant intensity
I_e
quotient of the radiant flux $d\Phi_e$ leaving the source and propagated in the element of solid angle $d\Omega$ containing the given direction, by the element of solid angle

$$I_e = d\Phi_e / d\Omega$$

NOTE Radiant intensity is expressed in [mW/sr].

[IEV 845-01-30]

3.12
radiation characteristic
defined by two angles α_A and α_B for describing the beam characteristic of IR emission. References are the points of half optical radiant intensity. α_A is the angle of maximum divergence, α_B is the angle perpendicular to the plane expanded by α_A, where $\alpha_A \geq \alpha_B$ (similar to 3.2)

3.13
relative spectral electrical output
V_{rf}
of a receiver is its output V_f [mV/Hz] as a function of the frequency f divided through its maximum value V_{max} [mV/Hz]

$$V_{rf} = V_f / V_{max} \times 100$$

NOTE Relative spectral electrical output is expressed in [%].

3.14
relative spectral sensitivity
$s_{r\lambda}$
ratio of the sensitivity s_λ of the detector at wavelength λ to a given reference value s_{max}

$$s_{r\lambda} = s_\lambda / s_{max} \times 100$$

NOTE Relative spectral sensitivity is expressed in [%].

[IEV 845-05-57, modified]

3.15
(maximum) spectral sensitivity
s(max)
quotient of the (maximum) current of the photo diode $I_{(max)}$ [µA/nm] and the irradiance E [mW/m²] as a function of the wavelength λ

$$s_{max} = I_{max} / E$$

NOTE Spectral sensitivity is expressed in [(µA × m²)/(mW × nm)].

[IEV 845-05-56, modified]

3.16
steradian
SI unit of solid angle. Solid angle that, having its vertex at the centre of a sphere, cuts off an area of the surface of the sphere equal to that of a square with sides of length equal to the radius of the sphere

[IEV 845-01-20]

3.17
wavelength
distance in the direction of propagation of a periodic wave between two successive points at which the phase is the same

[IEV 845-01-14]

3.18
radiator
IR emitting source, consisting of one or more emitter components, with a specific radiation characteristic

3.19
(selective) receiver
one or more IR detectors, which are mostly embedded in signal processing components and representing a specific IR receiving directivity

NOTE Selective receivers have a limited spectral bandwidth within the whole IR spectrum.

4 Symbols

4.1 General

As this document is concerned with interference, commonly between two different IR systems (for example between the radiators of a system 1 and the receivers of a system 2), symbols of similar or equal meaning such as bandwidths B_i, wavelengths λ_i or frequencies f_i shall be identified in the following by the index 1 for radiators (⇒ system 1) and index 2 for receivers (⇒ system 2).

4.2 Radiators

B_{1f}	electrical bandwidth [kHz]
$B_{1\lambda}$	optical bandwidth [nm]
f_1	modulation frequency [kHz]
f_p	frequency at the modulated peak intensity I_{pf} [kHz]
f_{1l}	lower band limiting frequency [kHz]
f_{1u}	upper band limiting frequency [kHz]
I_o	time averaged total optical radiant intensity [mW/sr]
I_p	total optical peak intensity [mW/sr]
$I_{p\lambda}$	spectral optical peak intensity [mW/(sr × nm)]
$I_{e\lambda}$	spectral optical radiant intensity [mW/(sr × nm)]
I_{ef}	spectral modulated radiant intensity [mW/(sr × Hz)]
I_{pf}	spectral modulated peak intensity [mW/(sr × Hz)]
sr	steradian
α_A	angle of maximum divergence
α_B	angle perpendicular to α_A
λ_1	wavelength [nm]
λ_p	wavelength at the optical peak intensity $I_{p\lambda}$ [nm]
λ_{1l}	lower band limiting wavelength [nm]
λ_{1u}	upper band limiting wavelength [nm]

4.3 Receivers

B_{2f}	electrical bandwidth [kHz]
$B_{2\lambda}$	optical bandwidth [nm]
f_2	received frequency [kHz]
f_{max}	frequency at maximum response [kHz]
f_{2l}	lower band limiting frequency [kHz]
f_{2u}	upper band limiting frequency [kHz]
E	irradiance [mW/m²]
I_{max}	maximum photo current [µA/nm]
$s_{r\lambda}$	relative spectral sensitivity [%]
s_{max}	maximum spectral sensitivity [µA m²/mW × nm]
V_{rf}	relative spectral electrical output [%]

V_{max}	maximum spectral electrical output [mV/Hz]
β_A	angle of maximum reception
β_B	angle perpendicular to β_A
λ_2	wavelength [nm]
λ_{max}	wavelength at maximum sensitivity [nm]
λ_{2l}	lower band limiting wavelength [nm]
λ_{2u}	upper band limiting wavelength [nm]

5 Classification

5.1 General

The classification considers four main aspects for description of IR systems consisting of radiators and receivers:

– physical characteristics of radiators (see 5.2);
– physical characteristics of receivers (see 5.3);
– product groups (see 5.5);
– user areas (see 5.6).

5.2 Physical characteristics of radiators

5.2.1 General

There are five criteria, 1 to 5, on which the classification for physical characteristics of radiators is based. They are operating characteristics, selected from the rated values given by the manufacturer (see Table 1).

5.2.2 Ranges of wavelength (criterion 1)

The lower (λ_{1l}) and the upper (λ_{1u}) optical wavelengths determine the optical range of an IR radiator. Both the lower and the upper optical wavelengths of an IR radiator are defined by the reduction of the peak intensity $I_{p\lambda}$ by 3 dB, taking into account the effects of temperature and component deviations (see Figure 2).

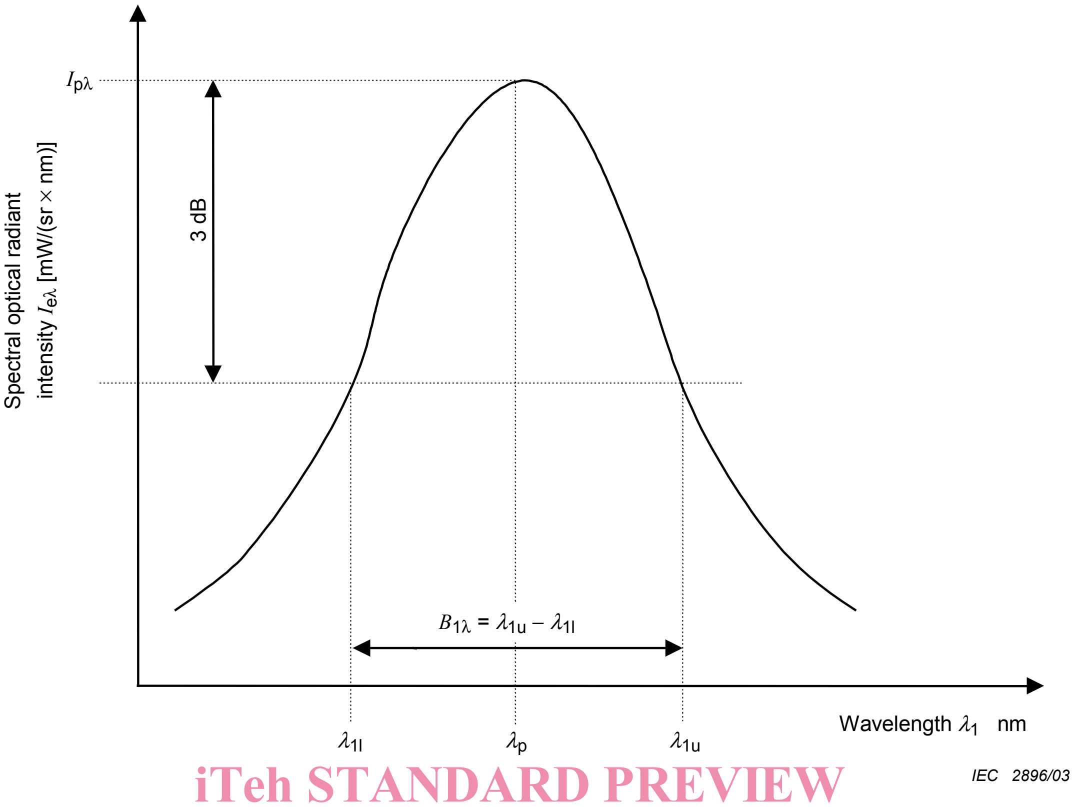


Figure 2 – Spectral emission and definition of optical bandwidth

5.2.3 Ranges of frequency (criterion 2)

The lower (f_{1l}) and upper (f_{1u}) modulation frequencies determine the bandwidth B_{1f} of the modulated IR radiant intensity. These frequencies are defined as those two utmost frequencies including any harmonics and measured with a meter having a bandwidth of at least 10 times the operating frequency, at which the intensity is 10 dB below the modulated peak intensity I_{pf} (see Figure 3).

Harmonics greater than 1/10 of the highest intensity I_{pf} should be taken into account, notably with respect to the influences of temperature and component tolerances. For criterion 2 it is only important to know the upper and lower band limiting frequencies; the possible influence of modulation is not taken into account in this definition.

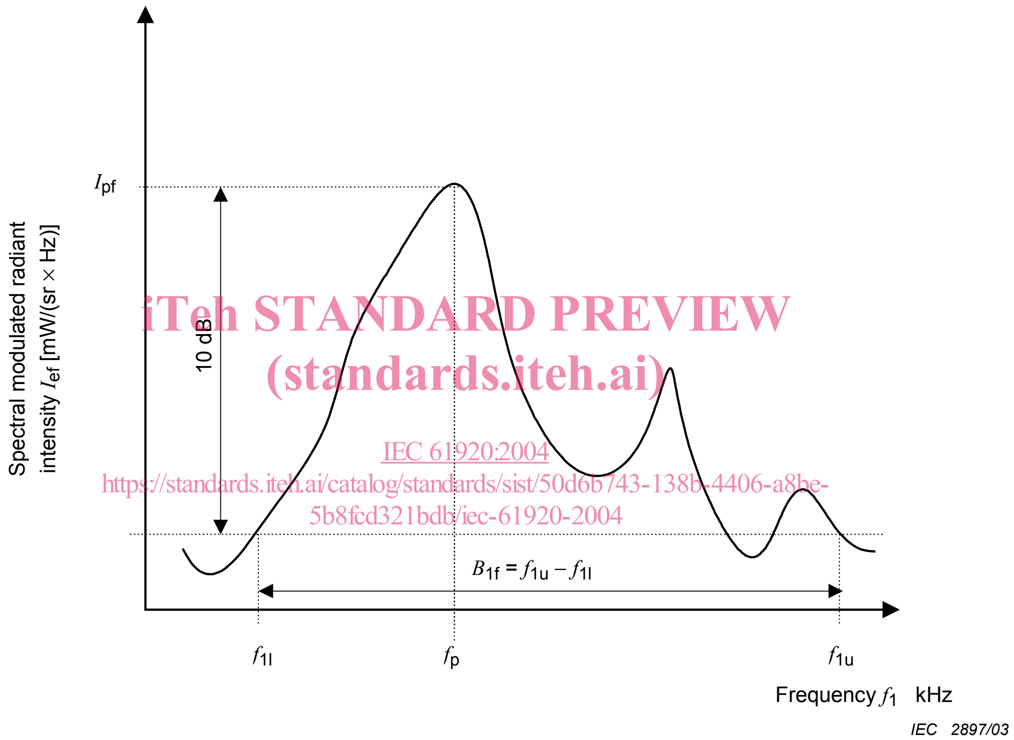


Figure 3 – Spectral emission and definition of electrical bandwidth

5.2.4 Radiant intensity (criterion 3)

The intensity of IR radiators is characterized by the time averaged total optical radiant intensity I_o [mW/sr] and the total optical peak intensity I_p [mW/sr].

5.2.5 Angle of radiation (criterion 4)

The angle of radiation α is related to the points of half intensity of beam divergence. This is the angle between the directions which are specified by points of half radiant intensity. Two angles α_A and α_B lying in two planes perpendicular to each other define the radiation characteristic of the IR radiator.

5.2.6 Duration of radiation (criterion 5)

The time characteristic of IR radiation is described by its duration. If an IR transmission is the consequence of a momentary operation, the result is called a short duration radiation (repetition in case of error handling included). Long duration operation occurs when the IR system is working in a continuous mode.

5.2.7 Identification example for a radiator

In order to illustrate the application of the characteristics introduced in 5.2.1 to 5.2.5, an example is given for the radiator of a home and building electronic system having the following characteristics:

Illumination control with

λ_{1l} = 930 nm

λ_{1u} = 980 nm

f_{1l} = 38 kHz

f_{1u} = 60 kHz

I_p = 45 mW/sr

I_o = 20 mW/sr

α_A = 60°

α_B = 30°

Class S: momentary activation of a push button

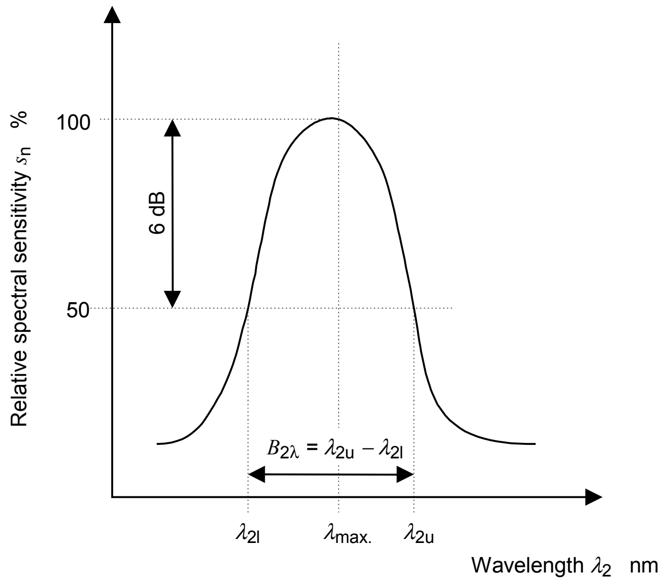
5.3 Physical characteristics of receivers

5.3.1 General

There are another 4 criteria (6 to 9) on which the classification for physical characteristics of receivers is based. They are operating characteristics selected from the rated values given by the manufacturers (see Table 2).

5.3.2 Ranges of wavelength and selectivity (criterion 6)

The lower (λ_{2l}) and the upper (λ_{2u}) optical wavelength determine the optical range of an IR receiver. They are defined by the reduction of the maximum sensitivity s_{max} by 6 dB (50 %) taking into account the effects of temperature and component deviations. Figure 4 shows the spectral sensitivity in terms of relative values $s_{r\lambda} = s_\lambda / s_{max} \times 100$ [%]. The optical bandwidth $B_{2\lambda}$ is a measure for the selectivity of the IR receiver.



IEC 2898/03

Figure 4 – Spectral sensitivity and definition of optical bandwidth