
Integrated optics — Vocabulary —
Part 2:
Terms used in classification

Optique intégrée — Vocabulaire —
Partie 2: Termes utilisés pour la classification

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 172 *Optics and photonics*, Subcommittee SC 9, *Laser and electro optical systems*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 123, *Lasers and photonics*, in accordance with the agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 11807-2:2001), which has been technically revised. The main changes compared to the previous edition are as follows:

- Terminologies that have not been frequently used over the last 5 to 10 years are revised to those matching to current trends.
- In particular, in [3.1](#) types of component configuration, *configuration* is revised by adding a new configuration, component, while "chip" is replaced for "component" and "module."
- In [3.2](#) "controllable" is replaced by "dynamic," which is placed between passive and active.
- In the revision process, terminologies and definitions are compared to similar terminology definition in IEC and harmonized.

A list of all parts in the ISO 11807 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Integrated optical devices are classified using three major fields based on user-oriented criteria. In the following text, the attribute “integrated optical” will usually be omitted.

The first criterion for classification is that the devices may be single-mode or multi-mode components.

Secondly, integrated optical devices are classified according to complexity of the configuration (see [Clause 3](#) and [Figure 1](#): elements, components, modules and devices).

The third criterion for classification is the function of the component. In [3.2](#), components are classified according to a general definition of the function, (passive, dynamic, active). In [3.3](#), more specific subclassification is made according to functional criteria. The functional classification is defined for integrated optical elements, but can also be used in a similar manner for components, modules and devices. In the latter cases, the classification refers to the element of highest functional complexity (i.e. passive, dynamic, active).

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Integrated optics — Vocabulary —

Part 2: Terms used in classification

1 Scope

This document defines terms used in the classification of integrated optical elements, integrated optical components and integrated optical devices, which find applications, for example, in the fields of optical communications and sensors.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 11807-1, *Integrated optics — Vocabulary — Part 1: Basic terms and symbols*

ISO 14881, *Integrated optics — Interfaces — Parameters relevant to coupling properties*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 11807-1 and ISO 14881 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 Types of component configuration

3.1.1

integrated optical element

optical element which performs a basic function of integrated optics

Note 1 to entry: See [Figure 1](#).

3.1.2

integrated optical component

integrated unit which contains an *integrated optical element* (3.1.1)

Note 1 to entry: See [Figure 1](#).

3.1.3

integrated optical module

integrated unit containing one or more optical components and accomplishing defined functionality

Note 1 to entry: See [Figure 1](#).

Note 2 to entry: The term chip focuses on the physical structure, the term module on the optical function.

3.1.4

integrated optical device

generic optical unit containing at least an optical element, an optical component, an optical assembly, an optical sub-assembly, or an optical module and its optical, electrical, or other interfaces

Note 1 to entry: See [Figure 1](#).

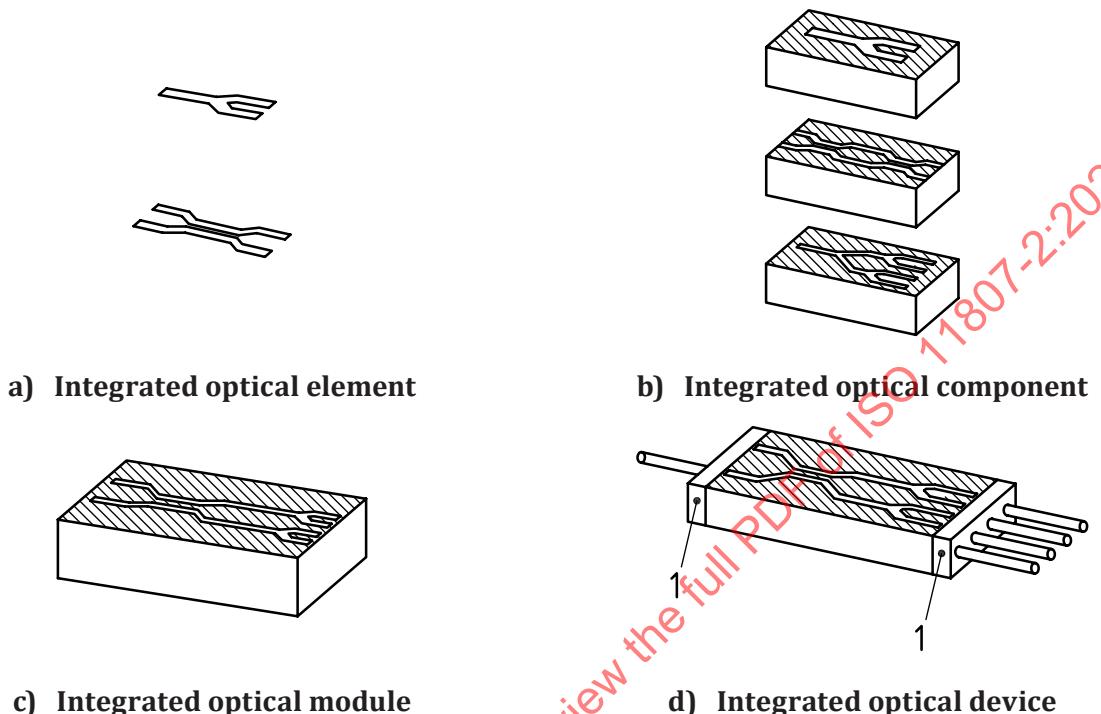


Figure 1 — Illustration of the classification into elements, components, modules and devices

3.2 Types of function

Note 1 to entry: The types of function defined here are specified for elements, whereby they are valid for all corresponding component configurations.

3.2.1

passive integrated optical element

element based on the principle of waveguiding and radiation interference, respectively, without external influence on the refractive index and fitted exclusively with optical inputs and outputs

Note 1 to entry: This element is employed for changing the direction, distributing, combining, transforming and filtering of guided lightwaves.

3.2.2

dynamic integrated optical element

element using optical effects to change the (complex) refractive index

Note 1 to entry: The effects include electro-optical, acousto-optical, piezo-optical, thermo-optic or electro-absorptive effects.

3.2.3**active integrated optical element**

element based on photo-effect and photo emission

Note 1 to entry: Functions in this category include the generation of optical signals (conversion of electrical signals into optical signals), amplification or detection (conversion of optical signals into electrical signals) of guided lightwaves.

Note 2 to entry: Included in this category are diode lasers, optical amplifiers and photodetectors integrated with waveguides.

3.3 Passive elements, components and modules

3.3.1**slab waveguide**

waveguide which confines the optical field between two light guiding parallel surfaces

Note 1 to entry: See ISO 11807-1:2021, Figure A.1, where the Cartesian coordinate system is indicated for defining the several terminologies relating to waveguides.

Note 2 to entry: In the previous edition "planar waveguide" was used as a synonym.

[SOURCE: ISO 11807-1:2021, 3.2.2, modified — "ISO 11807-1:2021," was added in Note 1 to entry.]

3.3.2**strip waveguide****channel waveguide**

waveguide which confines the optical field in a two-dimensional cross-sectional area perpendicular to the lightwave propagating direction (wave vector) along a one-dimensional path

Note 1 to entry: In general, the core or, in the case of a graded index profile, the corresponding core area, may be formed as:

- embedded channel [see [Figure 2 a](#)] or buried channel [see [Figure 2 b](#)];
- ridge on a substrate [see [Figure 2 c](#)];
- ridge in a waveguide layer [see [Figure 2 d](#)] or ridge on a waveguiding layer [strip-loaded waveguide; see [Figure 2 e](#)].

[SOURCE: ISO 11807-1:2021, 3.2.3, modified — Note 1 to entry was added.]

3.3.3**branch**

element which divides an input *strip waveguide* ([3.3.2](#)) into multiple output *strip waveguides* ([3.3.2](#))

Note 1 to entry: Depending on the application, a distinction is made between a divider usually a $1 \times M$ divider and a combiner, usually a $N \times 1$ combiner.

3.3.4**tap**

element which couples a given portion of lightwave out of a *strip waveguide* ([3.3.2](#)) into another waveguide branching out of the side of the original waveguide

3.3.5**Y-branch**

element which divides the power of a guided lightwave into two lightwaves, usually of the same power and phase shift

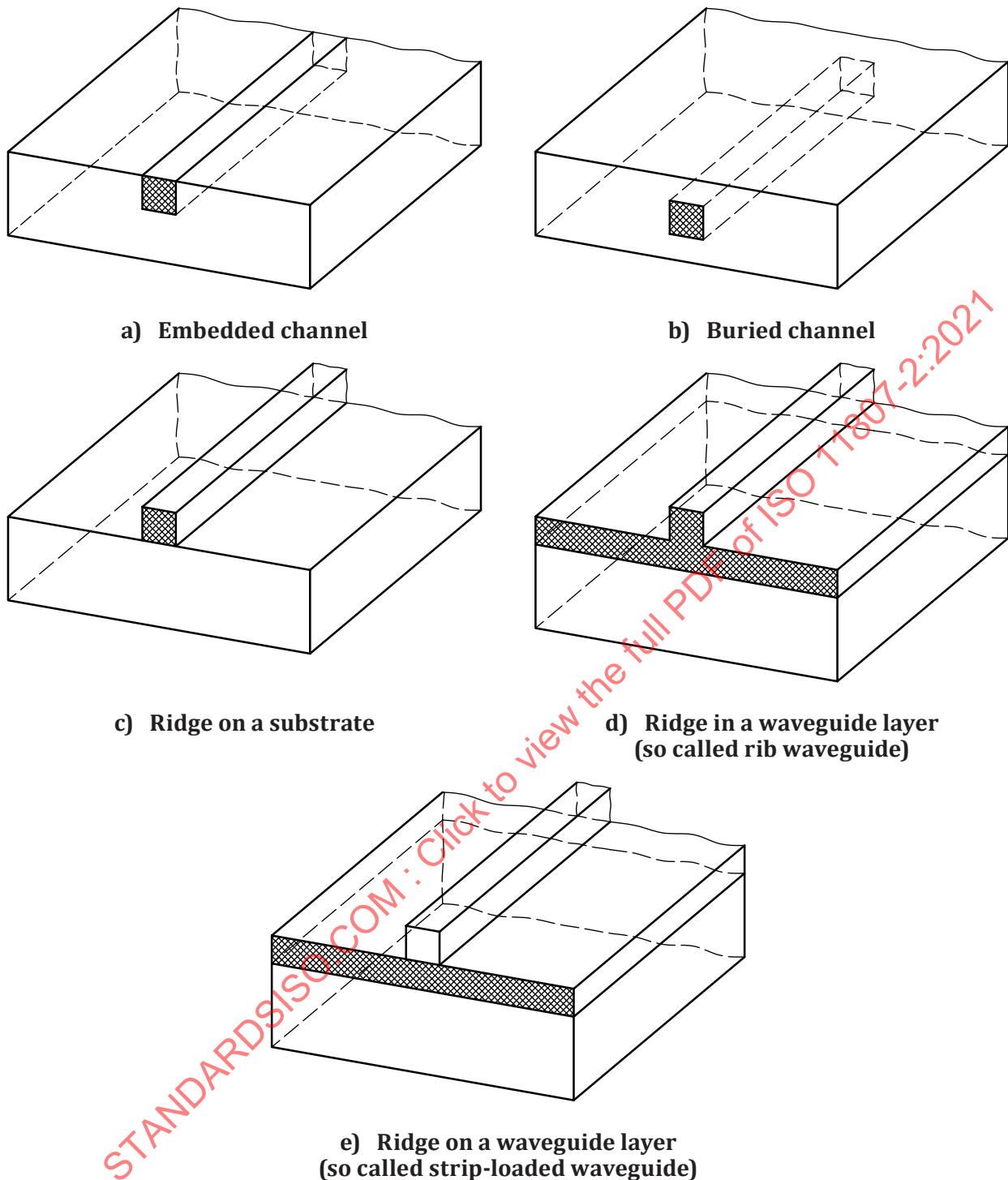


Figure 2 — Schematic view for different configurations of strip waveguides

3.3.6

directional coupler

four-port element consisting of a pair of *strip waveguides* (3.3.2) in which the optical fields are mutually coupled and the input and output ends diverge from one another

Note 1 to entry: The two waveguides may be closely spaced.

Note 2 to entry: The function is based on the principle of periodic coupling of propagating modes. They can be fabricated as either a passive or dynamic element.

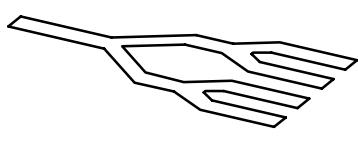
3.3.7**3-dB coupler**

four-port element which divides the entering power of lightwave equally between both output waveguides

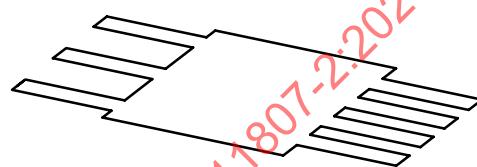
3.3.8 **$N \times M$ star coupler**

element in which the optical power of N input waveguides is distributed equally amongst M output waveguides

Note 1 to entry: The star coupler can be configured from networked Y-branches and/or 3-dB couplers or a multi-mode waveguide section. See [Figure 3](#).



a) **1×4 networked Y-branches**



b) **3×4 multimode waveguide section**

Figure 3 — Schematic view for star couplers

3.3.9**waveguide crossing**

element consisting of two *strip waveguides* ([3.3.2](#)) which intersect one another

Note 1 to entry: If the angle of intersection is large enough (ideal case 90°), no mutual interference occurs between the guided waves in the individual waveguides.

Note 2 to entry: If the angle of intersection is small, coupling occurs (see [3.3.6](#)); this element is then referred to as an X-coupler. See [Figure 4](#).

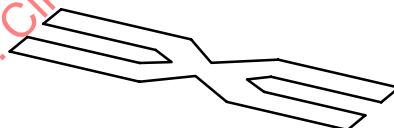


Figure 4 — Schematic view for waveguide crossing

3.3.10**waveguide offset**

abrupt lateral displacement of the waveguide border which can lead to a disturbance of the propagated modes or, at the transition between waveguide sections of different or opposite curvature, can be used to improve field overlapping

3.3.11**taper**

waveguide in which the cross section varies along the length of the waveguide, giving rise to either a continuous graded widening or narrowing of the cross section

Note 1 to entry: A taper serves to adapt the spot size, for example, to connect integrated optical elements with modes of differing near-field shapes.

3.3.12**polarization converter**

element in which at least a part of the input (TE-, TM-) eigenmode of the waveguide, is transformed into the orthogonal eigenmode

Note 1 to entry: A polarisation converter usually contains a birefringent waveguide.

Note 2 to entry: In a TE/TM-converter, a complete conversion from one eigenmode into the orthogonal eigenmode takes place.

3.3.13**TE/TM mode splitter**

element which splits the TE- and TM-modes at the input waveguide and which guides them into corresponding output waveguides

Note 1 to entry: The relationship between the optical power P_t at the selected output to optical power P_f at the non-selected output is given by the mode splitting ratio, on a logarithmic scale with $S = 10 \lg(P_t/P_f)$ dB.

3.3.14**integrated optical isolator**

two-port element having much greater attenuation in one direction of propagation than in the opposite direction

3.3.15**waveguide mirror**

mirror with a flat or curved surface, which reflects the lightwave in the input waveguide into an output waveguide usually of different direction or vertically out of the substrate

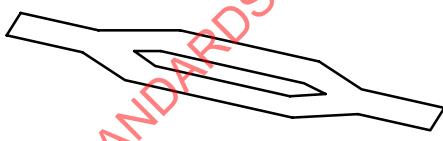
Note 1 to entry: For example, for detector or laser input coupling

Note 2 to entry: A loop mirror is an element consisting of a directional coupler with connected output ports, which couples signals at certain wavelengths back to the same input port.

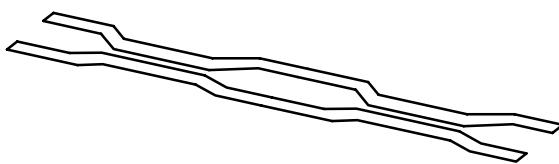
3.3.16**integrated optical Mach-Zehnder interferometer**

element consisting of two Y-branches (3.3.5) or directional couplers (3.3.6) (usually 3-dB couplers (3.3.7)) arranged opposite to one another and connected by two strip waveguides (3.3.2)

Note 1 to entry: Phase shifts between the lightwaves in both arms caused by either electro-optical or some other external physical effects lead to interference and hence modulation of the optical intensity in the output waveguide. See [Figure 5](#).



a) Two Y-branches type



b) Two directional coupler type

Figure 5 — Schematic view for integrated optical Mach-Zehnder interferometer

3.3.17**integrated optical ring resonator**

element in which the guided lightwave propagates in a closed waveguide path, resulting in frequency-dependent resonance effects