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REDLINE VERSION

# INTERNATIONAL STANDARD

Dynamic modules – ~~General and guidance~~ Generic specification



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# INTERNATIONAL STANDARD



colour inside

## Dynamic modules – ~~General and guidance~~ Generic specification

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# DYNAMIC MODULES – ~~GENERAL AND GUIDANCE~~ GENERIC SPECIFICATION

## FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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**This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 62343:2017. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.**

IEC 62343 has been prepared by subcommittee 86C: Fibre optic systems and active devices, of IEC technical committee 86: Fibre optics. It is an International Standard.

This third edition cancels and replaces the second edition published in 2017. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) addition of terms and definitions for optical multicast switches (3.8);
b) revision of Clause 4, listing the requirements for standards in the IEC 62343 series;
c) addition of Clause 6 (Safety requirements).

The text of this International Standard is based on the following documents:

| Draft | Report on voting |
|---|---|
| 86C/1803/CDV | 86C/1827/RVC |

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts of the IEC 62343 series, published under the general title *Dynamic modules*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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



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# INTRODUCTION

This document applies to dynamic devices as defined in IEC TS 62538. This document contains general guidance for the IEC 62343 series related to dynamic devices and definitions which apply to dynamic devices. The dynamic module (DM), or device, has two distinguishing characteristics: dynamic and module.

"Dynamic" highlights the functions of the products to include "tuning, varying, switching, configuring, and other continuous optimization," often accomplished by electronics, firmware, software or their combinations. The dynamic device usually has a certain level of intelligence to monitor or measure ~~the situation~~ its configuration or settings and make decisions for necessary (optimization) actions. The behaviour of dynamic modules ~~may~~ can be characterized by transient characteristics as the dynamic module undergoes tuning, switching, configuring, and other continuous optimization. Characterization of transient characteristics will be considered in individual dynamic module standards.

"Module" defines that products covered by this document are the integration of active and passive components (either or both), through interconnecting materials or devices. The controlling electronics can be inside or outside the optical package that contains all or most of the optical components and interconnection. The product can be a small printed wiring board (PWB) or child-board with mounted optical module, or it can be a small box (e.g., housing) with optical components and electronics enclosed. In the former case, it is more like an assembly (i.e., generally not packaged in a box or housing) than a module (i.e., generally packaged in a box or housing).

For historical reasons and convenience, a dynamic module or device is referred to as a dynamic module in the IEC 62343 series.

The number of dynamic modules and devices is rapidly growing as optical communications networks evolve. The following list provides some examples of the products covered by the IEC 62343 series. It should be noted that the list is not exhaustive and the products to be covered are not limited by the listed examples:

- channel gain equalizer;
- dynamic channel equalizer;
- dynamic gain tilt equalizer;
- dynamic slope equalizer;
- tuneable chromatic dispersion compensator;
- polarization mode dispersion compensator;
- reconfigurable optical add-drop multiplexer;
- switch with monitoring and controls;
- variable optical attenuator with monitoring and controls;
- optical channel monitor;
- wavelength selective switch;
- optical multicast ~~optical~~ switch.

The IEC 62343 series covers performance templates, performance standards, reliability qualification requirements, hardware and software interfaces, and related testing methods.

The structure of the IEC 62343 series, under the general title *Dynamic modules,* is as follows:

- IEC 62343-1 series Part 1: Performance standards
- IEC 62343-2 series Part 2: Reliability qualification
- IEC 62343-3 series Part 3: Performance specification templates
- IEC 62343-4 series Part 4: Software and hardware interface
- IEC 62343-5 series Part 5: Test methods
- IEC 62343-6 series Part 6: Design ~~guides~~ guidelines

A complete set of standards related to a dynamic module or device should include the following:

- optical performance standards;
- reliability qualification standards;
- optical performance specification templates;
- hardware and software interface standards;
- test methods;
- technical reports.

The safety standards related to dynamic modules are mostly optical power considerations, which are covered by ~~IEC TC 76: Optical radiation safety and laser equipment~~ the IEC 60825 series.

Only those dynamic modules for which standards are complete or in preparation are included in Clause 3. To reflect the rapidly growing market for dynamic modules, additional terms and definitions will be added in subsequent revisions as the series expands.

It should be noted that optical amplifiers could be regarded as dynamic modules. They are not included in the IEC 62343 series but are covered in their own series of IEC standards.

# DYNAMIC MODULES – ~~GENERAL AND GUIDANCE~~ GENERIC SPECIFICATION

## 1 Scope

This document applies to all commercially available optical dynamic modules and devices. It describes the products covered by the IEC 62343 series, defines terminology, fundamental considerations and basic approaches.

The object of this document is to

- establish uniform requirements for operation, reliability and environmental properties of dynamic modules (DMs) to be implemented in the appropriate DM standard, and
- provide assistance to the purchaser in the selection of consistently high-quality DM products for their particular applications, as well as in the consultation of the appropriate specific DM standard(s).

This document covers performance templates, performance standards, reliability qualification requirements, hardware and software interfaces and related testing methods.

Since a dynamic module integrates an optical module/device, printed wiring board, and software/firmware, the standards developed in the series will mimic appropriate existing standards. On the other hand, since "dynamic module" is a relatively new product category, the dynamic module standards series will not be bound by the existing practices where requirements differ.

The safety standards as related to dynamic modules are mostly optical power considerations, which is covered by ~~IEC TC 76: Optical radiation safety and laser equipment~~ the IEC 60825 series (see Clause 6).

## 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 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 60050-731, *International Electrotechnical Vocabulary – Chapter 731: Optical fibre communication* (available at www.electropedia.org)

IEC TR 61931, *Fibre optic – Terminology*

~~IEC Guide 107, *Electromagnetic compatibility – Guide to the drafting of electromagnetic compatibility publications*~~

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-731, IEC TR 61931, and the following apply.

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

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

NOTE 1 Some terms and definitions included in this document were first published in the IEC 62343 series. After publication of this document, these terms and definitions will be removed from the IEC 62343 series when the series is revised, and reference will be made to IEC 62343.

NOTE 2 The terms and definitions listed in Clause 3 refer to the meaning of the terms and definitions used in the specifications of dynamic modules. Only those parameters listed in the appropriate performance standard in the IEC 62343-1 series and performance specification templates in the IEC 62343-3 series are intended to be specified.

NOTE 3 The list of parameter definitions for dynamic modules given in Clause 3 is divided into subclauses according to the type of dynamic module.

## 3.1 General terms and definitions

### 3.1.1
**optical dynamic device**
optical device designed to monitor and control dynamically some characteristics of one or more optical signals, by means of suitable electronic controls, in order to improve or to maintain definite performances of the system in which it is intended to be inserted

Note 1 to entry: Said characteristics may include optical paths, optical intensities, spectral characteristics, polarization states, dispersion, etc.

Note 2 to entry: Optical dynamic devices may comprise optical active and optical passive elements or components.

Note 3 to entry: The control/response time of optical dynamic devices is much larger than the signal time characteristics and typically may range from few microseconds to tens of seconds.

[SOURCE: IEC TS 62538:2008, 2.1.1]

### 3.1.2
**optical module**
packaged integration of optical components and/or elements, accomplishing defined functionality, typically repairable and re-workable

[SOURCE: IEC TS 62538:2008, 2.2.5, modified – The notes to entry have been omitted.]

## 3.2 Dynamic module terms and definitions

### 3.2.1
**channel**
signal at wavelength, $\lambda$, that corresponds to ITU grid (ITU-T Recommendation G.694.1) within the range of operating wavelength range

~~[SOURCE: IEC 62343-3-3:2014, 3.4]~~

### 3.2.2
**operating wavelength range**
specified range of wavelengths from $\lambda_{imin}$ to $\lambda_{imax}$ about a nominal operating wavelength $\lambda_{I}$, within which a dynamic optical module is designed to operate with a specified performance

### 3.2.3
**channel frequency range**
frequency range within which a device is expected to operate with a specified performance

Note 1 to entry: For a particular nominal channel central frequency, $f_{nomi}$, the channel frequency range is from $f_{imin} = (f_{nomi} - \Delta f_{max})$ to $f_{imax} = (f_{nomi} + \Delta f_{max})$, where $\Delta f_{max}$ is the maximum channel central frequency deviation.

**3.2.4**
**channel spacing**
centre-to-centre difference in frequency (or wavelength) between adjacent channels in a device

## 3.3 Dynamic channel equalizer (DCE) terms and definitions

**3.3.1**
**dynamic channel equalizer**
**DCE**
device capable of transforming, by internal or external automatic control, a multichannel input signal with time-varying averaged powers into an output signal in which all working channel powers are nominally equal or are set for a required level of pre-emphasis

Note 1 to entry: A DCE may also provide the extinction of one or more of the input channels.

**3.3.2**
**channel non-uniformity**
difference between the powers of the channel with the most power (in dBm) and the channel with the least power (in dBm)

Note 1 to entry: The channel non-uniformity applies to a multichannel signal across the operating wavelength range.

Note 2 to entry: Channel non-uniformity is expressed in dB.

**3.3.3**
**in-band extinction ratio**
difference, within the operating wavelength range, between the minimum power of the non-extinguished channels (in dBm) and the maximum power of the extinguished channels (in dBm)

Note 1 to entry: In-band extinction ratio is expressed in dB.

**3.3.4**
**out-of-band attenuation**
attenuation of channels that fall outside of the operating wavelength range

Note 1 to entry: Out-of-band attenuation is expressed in dB.

**3.3.5**
**ripple**
peak-to-peak difference in insertion loss within a channel frequency (or wavelength) range

**3.3.6**
**channel response time**
elapsed time it takes a device to transform a channel from a specified initial power level to a specified final power level desired state, when the resulting output channel non-uniformity tolerance is met, measured from the time the actuation energy is applied or removed

## 3.4 Tuneable dispersion compensator (TDC) or dynamic chromatic dispersion compensator (DCDC) terms and definitions

**3.4.1**
**tuneable dispersion compensator**
**TDC**
**dynamic chromatic dispersion compensator**
**DCDC**
two-port in-line device that is capable of transforming, by internal or external automatic control, an input signal with time-varying dispersion into an output signal in which an output channel dispersion value is set for a required level of value

**3.4.2**
**insertion loss ripple**
maximum peak-to-peak variation of the insertion loss within a channel frequency (or wavelength) range

**3.4.3**
**dispersion tuning time**

longest elapsed time it takes a module to change a dispersion setting from an arbitrary initial dispersion value to a desired final dispersion value, when the resulting dispersion target tolerance is met

## 3.5 Dynamic gain tilt equalizer (DGTE) terms and definitions

**3.5.1**
**dynamic spectral equalizer**
**DSE**
two port in-line dynamic module that converts an input signal with time-varying spectral shape into an output signal in which spectral shape is nominally flat, or is set for a required spectral shape for pre-emphasis

**3.5.2**
**dynamic gain tilt equalizer**
**DGTE**
dynamic spectral equalizer used in an optical amplifier that converts input signals with time-varying gain tilt into output signals in which gain tilt is nominally flat, or is set for a required gain tilt

**3.5.3**
**dynamic gain tilt range**
difference between the maximum and minimum deviation of attenuation over operating wavelength range, to which the dynamic gain tilt equalizer can be set

**3.5.4**
**positive slope type**
type of DGTE for which dynamic gain tilt range can be set for positive gain tilt

**3.5.5**
**negative slope type**
type of DGTE for which dynamic gain tilt range can be set for negative gain tilt

**3.5.6**
**both slope type**
type of DGTE to which dynamic gain tilt range can be set for both positive and negative gain tilt

**3.5.7**
**slope linearity**
maximum deviation of attenuation between the spectral shape by dynamic gain tilt equalizer and linear slope over the operating wavelength range

**3.5.8**
**response time**
<dynamic gain tilt equalizer> longest elapsed time it takes a dynamic gain tilt equalizer to change a gain tilt setting from an arbitrary initial gain tilt value to a desired final gain tilt value, when the resulting gain tilt target tolerance is met

## 3.6 Optical channel monitor (OCM) terms and definitions

**3.6.1**
**input channel plan**
entire set of ITU channels on which the optical channel monitor is reporting

**3.6.2**
**input channel frequency spacing tolerance**
centre-to-centre difference in frequency (or wavelength) between adjacent channels in a device

**3.6.3**
**input channel power dynamic range**
full range of input power per channel between the saturation and sensitivity limits

**3.6.4**
**input channel non-uniformity**
difference between the powers of the channel with the most power (in dBm) and the channel with the least power (in dBm) during one measurement within the response time

Note 1 to entry: Input channel non-uniformity applies to a multichannel signal across the operating wavelength range.

Note 2 to entry: Input channel non-uniformity is expressed in dB.

**3.6.5**
**input adjacent channel non-uniformity**
difference between the powers of adjacent channels present during one measurement within the response time

Note 1 to entry: The input adjacent channel non-uniformity applies to a multichannel signal across the operating wavelength range.

Note 2 to entry: In-band extinction ratio is expressed in dB.

**3.6.6**
**input channel non-uniformity for channel identification**
difference between the powers of the channel with the most power and the channel with the least power during one measurement within the response time for positively identifying all channels present and not falsely identifying channels that are not present

Note 1 to entry: Input channel non-unformity for channel identification applies to a multichannel signal across the operating wavelength range.

Note 2 to entry: In-band extinction ratio is expressed in dB.

**3.6.7**
**input adjacent channel non-uniformity for channel identification**
difference between the powers of adjacent channels present during one measurement within the response time for positively identifying all channels present and not falsely identifying channels that are not present

Note 1 to entry: Input adjacent channel non-uniformity for channel identification applies to a multichannel signal across the operating wavelength range.

Note 2 to entry: In-band extinction ratio is expressed in dB.

**3.6.8**
**input total band power dynamic range for channel measurements**
full range of input total band power between the saturation or sensitivity limits of channel measurements

**3.6.9**
**input total band power dynamic range for total band power measurements**
full range of input total band power between the saturation or sensitivity limits of total band power measurements

**3.6.10**
**input optical signal-noise ratio (OSNR) dynamic range**
full range of input OSNR per channel within which the power, total band power and OSNR measurements remain within their respectively specified error limits

**3.6.11**
**input channels bit rates**
list of bit rates to which any channel may be modulated

**3.6.12**
**reference measurement bandwidth**
integration bandwidth of the optical power measurement

**3.6.13**
**noise equivalent bandwidth**
integration bandwidth of the optical noise measurement

**3.6.14**
**channel power absolute error**
maximum difference between the measured channel power and the calibrated reference channel power, within the specified measurement integration bandwidth, during one measurement within the response time, specified over all input and operating ranges

**3.6.15**
**channel power relative error**
maximum variation of the channel power absolute error, during one measurement within the response time, specified over all input and operating ranges

**3.6.16**
**channel power variability**
maximum variation of the channel power absolute error over the repeatability time interval at a given input and operating condition, specified over all input and operating ranges

**3.6.17**
**channel power resolution interval**
smallest increment of the reported channel power measurement value

**3.6.18**
**channel power polarization dependent error**
maximum power measurement difference over all polarization states at a given input and operating condition, during one measurement within the response time, specified over all input and operating ranges

**3.6.19**
**total band power absolute error**
difference between the measured total power and the calibrated total power reference, each integrated over the frequency band, during one measurement within the response time, specified over all input and operating ranges

**3.6.20**
**total band power relative error**
maximum variation of the total band absolute error, during one measurement within the response time, specified over all input and operating ranges

**3.6.21**
**total band power variability**
maximum variation of the total band power absolute error over the repeatability time interval at given input and operating conditions, specified over all input and operating ranges

**3.6.22**
**total band power resolution interval**
smallest increment of the reported total band power measurement value

**3.6.23**
**frequency absolute error**
maximum difference between the measured frequency and the calibrated reference frequency, during one measurement within the response time, specified over all input and operating ranges

**3.6.24**
**frequency relative error**
maximum variation of the frequency absolute error, during one measurement within the response time, specified over all input and operating ranges

**3.6.25**
**frequency variability**
maximum variation of the frequency absolute error over the repeatability time interval at given input and operating conditions, specified over all input and operating ranges

**3.6.26**
**frequency resolution interval**
smallest increment of the reported frequency measurement value

**3.6.27**
**frequency polarization dependent error**
maximum frequency measurement difference over all polarization states at given input and operating conditions, during one measurement within the response time, specified over all input and operating ranges

**3.6.28**
**OSNR absolute error**
maximum difference between the measured and the calibrated reference OSNR, during one measurement within the response time, specified over all input and operating ranges

**3.6.29**
**OSNR relative error**
maximum variation of the OSNR absolute error, during one measurement within the response time, specified over all input and operating ranges

**3.6.30**
**OSNR variability**
maximum variation of the OSNR absolute error over the repeatability time interval at given input and operating conditions, specified over all input and operating ranges

**3.6.31**
**OSNR resolution interval**
smallest increment of the reported OSNR measurement value

**3.6.32**
**OSNR polarization dependent error**
maximum OSNR measurement difference over all polarization states at given input and operating conditions, during one measurement within the response time, specified over all input and operating ranges

**3.6.33**
**back reflection**
fraction of the optical signal reflected at the input optical port over the entire band, specified over all input and operating ranges

**3.6.34**
**response time**
<optical channel monitor> time required to perform the specified measurements for all channels and transfer these values over the communications interface to the external controller that issues a measurement request, specified over all input and operating ranges

**3.6.35**
**repeatability time interval**
minimum time interval over which a given measurement repeatability is performed

## 3.7 Wavelength selective switch (WSS) terms and definitions

**3.7.1**
**wavelength selective switch**
**WSS**
dynamic module with one or more input ports and one or more output ports, which is mainly used in a reconfigurable optical add drop multiplexer (ROADM) system to switch each wavelength signal on each input port independently to its required output port in dense wavelength division multiplexing (DWDM) networks

Note 1 to entry: A WSS is electrically controlled with software.

Note 2 to entry: Optical paths through the WSS operate bi-directionally, thus ports can be configured as either input or output ports.

Note 3 to entry: Each wavelength signal can be independently attenuated.

[SOURCE: IEC 62343-4-1:2016, 3.1.1, modified – Note 2 to entry has been replaced by a new note.]

**3.7.2**
**insertion loss**
*IL*
value of the reduction in optical power at a particular wavelength between the two conducting ports

Note 1 to entry: The insertion loss is the reduction in optical power between an input and output port of a module expressed in decibels.

$$IL = -10 \log_{10} (P_{out}/P_{in})$$

where

$P_{in}$ is the optical power launched into input port;

$P_{out}$ is the optical power received from the output port.

~~[SOURCE: IEC 62343-3-3:2014, 3.7]~~

**3.7.3**
**insertion loss uniformity**
difference between the maximum and minimum insertion loss at the output for a specified set of input ports

~~[SOURCE: IEC 62343-3-3:2014, 3.8]~~

**3.7.4**
**insertion loss ripple**
maximum peak-to-peak variation of the insertion loss within a channel frequency (or wavelength) range

~~[SOURCE: IEC 62343-3-3:2014, 3.9]~~

**3.7.5**
***X*-dB passband width**
width of a channel centred about the channel central wavelength within which the optical attenuation is within $X$ dB

Note 1 to entry: The terms "operating wavelength range" or "channel passband" are used and have the same meaning as "passband" for DWDM devices. The $X$-dB bandwidth is defined through the spectral dependence of $a_{ij}$ (where $i \neq j$) as the minimum wavelength range centred about the operating wavelength $\lambda_h$ within which the variation of $a_{ij}$ is less than $X$ dB. The minimum wavelength range is determined considering thermal wavelength shift, polarization dependence and long-term aging shift (refer to Figure 1).

Note 2 to entry: It is recommended that the passband width be specified as 0,5 dB, 1 dB and 3 dB ($X$ = 0,5, 1 and 3).

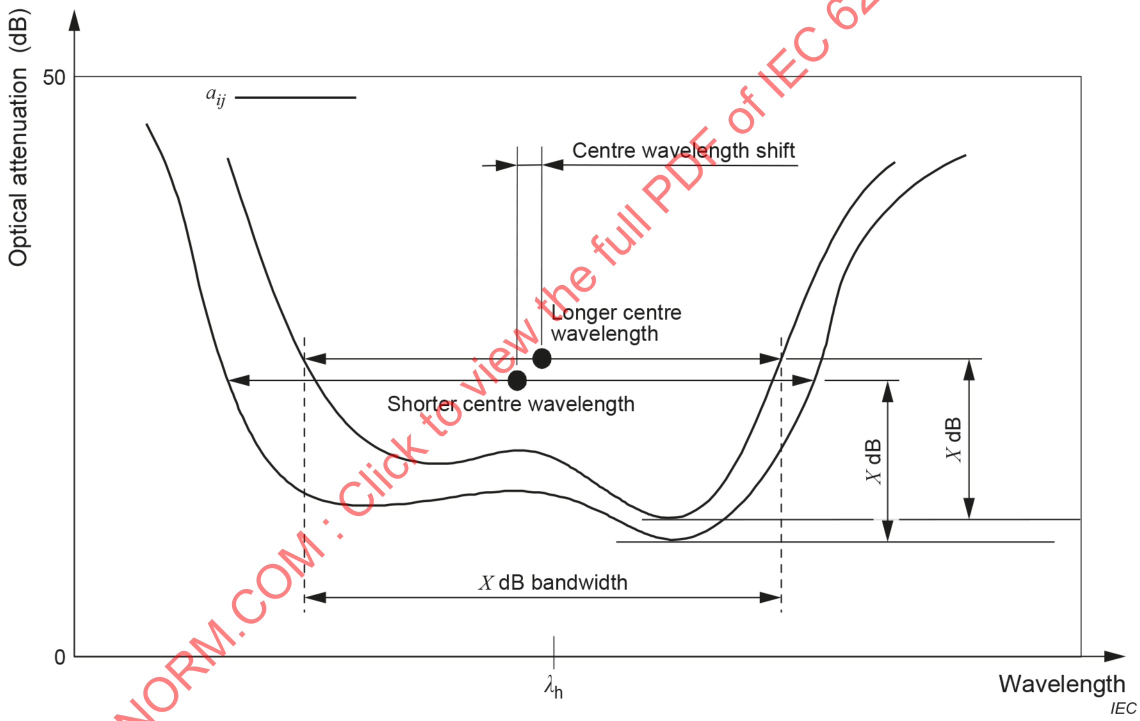



**Figure 1 – Illustration of *X*-dB bandwidth**

~~[SOURCE: IEC 62343-3-3:2014, 3.10]~~

**3.7.6**
**return loss**
*RL*
fraction of input power that is returned from any port of a module expressed in decibels and defined in the following formula at the particular wavelength between two conducting ports:

$$RL = -10 \log_{10} (P_{refl}/P_{in})$$

where

$P_{in}$ is the optical power launched into port;

$P_{refl}$ is the optical power received back from the same port

Note 1 to entry: The module can be a wavelength selective switch or an optical multicast switch.

~~[SOURCE: IEC 62343-3-3:2014, 3.11]~~

**3.7.7**
**adjacent channel crosstalk**
crosstalk restricted to the channels immediately adjacent to the (channel) wavelength number associated with output port

Note 1 to entry: Adjacent channel crosstalk is a negative value in dB (see Figure 2).

Note 2 to entry: The adjacent channel crosstalk is different from adjacent channel isolation. In Figure 2, an up pointing arrow shows positive, a down-pointing arrow negative. Generally, there are two adjacent channel crosstalks for the shorter wavelength (higher frequency) side and a longer wavelength (lower frequency) side.

Note 3 to entry: The terms "crosstalk" and "isolation" are often used with almost the same meaning. However, care should be taken not to confuse crosstalk and isolation. Crosstalk is defined so that, for wavelength selective branching devices, the value of the ratio between the optical power of the specified signal and the specified noise is a negative value in dB. The crosstalk is defined for each output port. Crosstalk for wavelength selective branching devices is defined for a DEMUX (1 × $N$ × wavelength division multiplexing (WDM) device). The crosstalk for port $o$ to port $j$ is the subtraction from the insertion loss of port $i$ to $o$ (conducting port pair) to the isolation of port $j$ to $o$ (isolated port pair). For wavelength selective branching devices having three or more ports, the crosstalk should be specified as the maximum value of the crosstalk for each output port in dB.

~~[SOURCE: IEC 62343-3-3:2014, 3.12, modified – The admitted term "adjacent channel isolation" has been deleted, the definition and notes have been rephrased, and Figure 2 has been deleted.]~~

**3.7.8**
**adjacent channel isolation**
isolation restricted to the channels immediately adjacent to the (channel) wavelength number associated with output port

Note 1 to entry: Adjacent channel isolation is a positive value in dB (see Figure 2).

Note 2 to entry: The adjacent channel isolation is different from adjacent channel crosstalk. In Figure 2, an up pointing arrow shows positive, a down-pointing arrow negative. Generally, there are two adjacent channel isolations for the shorter wavelength (higher frequency) side and a longer wavelength (lower frequency) side.

Note 3 to entry: The terms "crosstalk" and "isolation" are often used with almost the same meaning. However, care should be taken not to confuse crosstalk and isolation. Isolation is the minimum value of $a_{ij}$ (where $i \neq j$) within isolation wavelength range for isolated port pair. Isolation is positive value in dB.

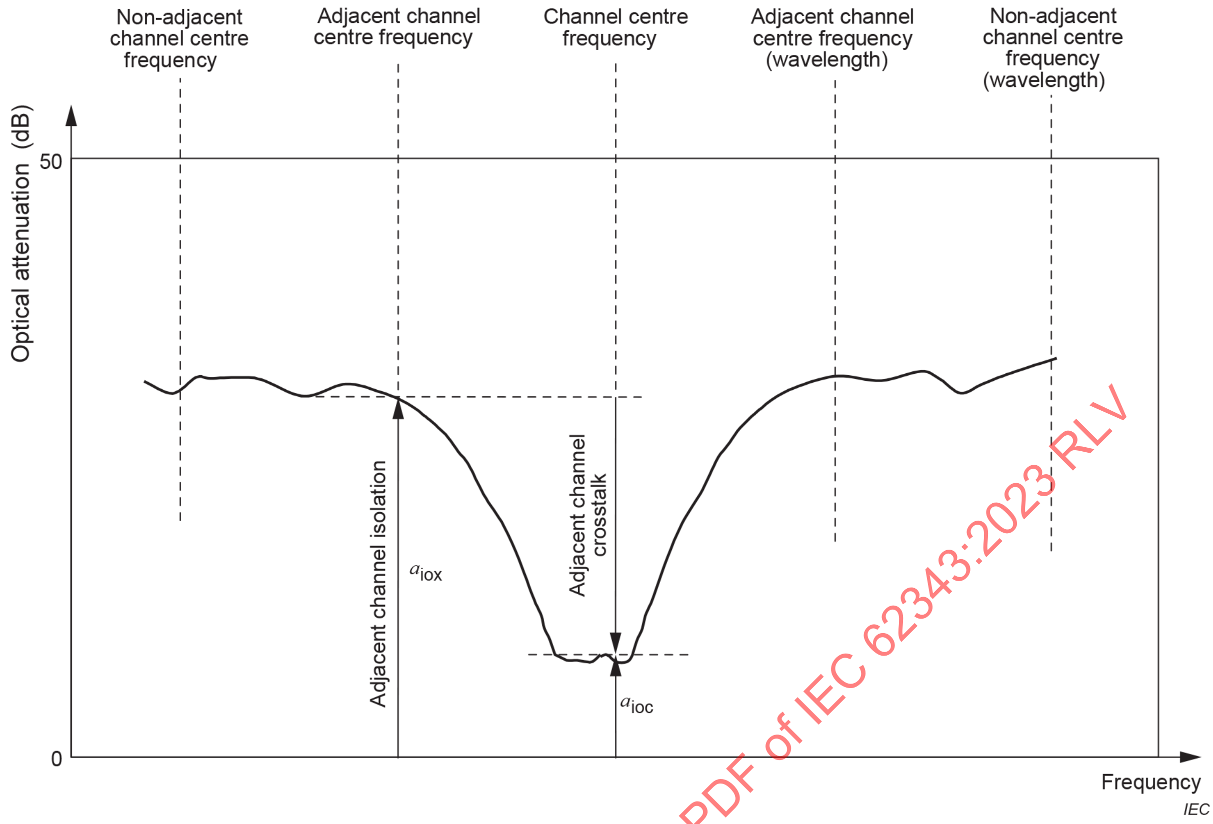



**Figure 2 – Illustration of adjacent channel crosstalk and adjacent channel isolation**

~~[SOURCE: IEC 62343-3-3:2014, 3.12, modified – The preferred term "adjacent channel crosstalk" has been deleted, the definition and Note 1 have been rephrased, and Note 3 has been replaced by a new note.]~~

**3.7.9**
**non-adjacent channel crosstalk**
crosstalk restricted to each of the channels not immediately adjacent to the channel associated with output port

Note 1 to entry: Non-adjacent channel crosstalk is different from non-adjacent channel isolation. In Figure 3, up-pointing arrow shows positive, down-pointing arrow negative.

~~[SOURCE: IEC 62343-3-3:2014, 3.13, modified – The admitted term "non-adjacent channel isolation" has been deleted, the definition has been rephrased and Figure 3 has been deleted.~~

**3.7.10**
**non-adjacent channel isolation**
isolation restricted to each of the channels not immediately adjacent to the channel associated with output port

Note 1 to entry: The non-adjacent channel isolation is different from non-adjacent channel crosstalk. In Figure 3, up-pointing arrow shows positive, down-pointing arrow negative.

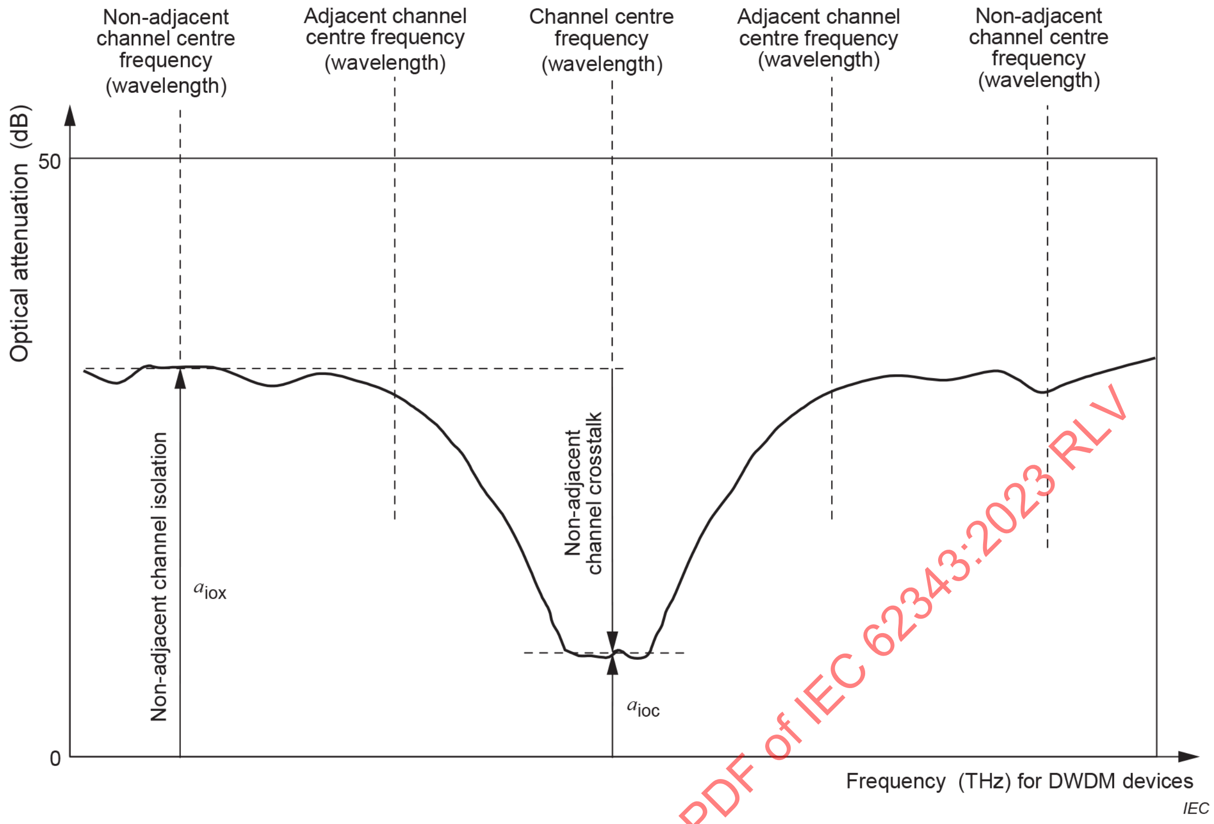



**Figure 3 – Illustration of non-adjacent channel crosstalk**

~~[SOURCE: IEC 62343-3-3:2014, 3.13, modified – The preferred term "non-adjacent channel crosstalk" has been deleted, and the definition and note have been rephrased.]~~

**3.7.11**
**total channel crosstalk**
total channel isolation
cumulative isolation due to the contributions at all the isolation wavelengths (frequencies) and transfer matrix coefficient for ports $i$ and $j$, $t_{ij}$ for any two ports $i$ and $j$ (where $i \neq j$)

Note 1 to entry: The total channel crosstalk is the ratio defined as

$$XT_{\text{tot}} = -10 \times \log_{10} \left[ \frac{t_{ij}(\lambda_h)}{\sum\limits_{k(k \neq h)}^{N} t_{ij}(\lambda_k)} \right]$$

where

$N$ is the number of channels of the device;

$\lambda_h$ is the nominal operating wavelength (frequency) for the two of ports, $i$ and $j$;

$\lambda_k$ are the nominal isolation wavelengths (frequencies) for the same pair of ports.

Note 2 to entry: Total channel crosstalk is also expressed by total channel isolation as in the following formula:

$$XT_{\text{tot}} = a_{ij}\left(\lambda_h\right) - I_{\text{tot}}$$

Note 3 to entry: Total channel crosstalk is a negative value in dB. For a WDM device, total channel crosstalk shall be specified as the maximum value of total channel crosstalk of all channels.

~~[SOURCE: IEC 62343-3-3:2014, 3.14]~~

**3.7.12**
**transient crosstalk**
transient isolation
transient directivity
crosstalk that is attributed to both channel crosstalk (due to same wavelength and/or other wavelengths) and port isolation, predicted to change during switching operation in WSS module

Note 1 to entry: Hitless operation means that there is no influence on other performance during switching operation.

~~[SOURCE: IEC 62343-3-3:2014, 3.15]~~

**3.7.13**
**channel blocking attenuation**
attenuation value when a particular channel is set in the blocking state (possible maximum attenuation)

~~[SOURCE: IEC 62343-3-3:2014, 3.16]~~

**3.7.14**
**attenuation without power**
attenuation value when electric power for driving the attenuation is not supplied

~~[SOURCE: IEC 62343-3-3:2014, 3.17]~~

**3.7.15**
**variable attenuation range**
attenuation value that can be changed with channel-by-channel independently controlled by driving circuit with software

~~[SOURCE: IEC 62343-3-3:2014, 3.18]~~

**3.7.16**
**variable attenuation resolution**
resolution of the setting of attenuation value

~~[SOURCE: IEC 62343-3-3:2014, 3.19]~~

**3.7.17**
**attenuation accuracy**
precision of attenuation value once set by driving circuit with software and includes the point of view of both repeatability and stability in the timeframe

Note 1 to entry: The attenuation accuracy is important when used in open loop operation.

~~[SOURCE: IEC 62343-3-3:2014, 3.20]~~

**3.7.18**
**response time for attenuation**
elapsed time to change the attenuation value of any channel from an initial value to the desired value, measured from the time the actuation energy is applied

~~[SOURCE: IEC 62343-3-3:2014, 3.21]~~

**3.7.19**
**out-of-band attenuation**
minimum attenuation of channels that fall outside of the operating wavelength range

Note 1 to entry: Out-of-band attenuation is expressed in dB.

~~[SOURCE: IEC 62343-3-3:2014, 3.22]~~

**3.7.20**
**switching time**
$t_s$
time necessary for switching from isolated state to conducting state, defined as follows:

$$t_s = t_l + t_r + t_b$$

where

$t_l$ is the latency time;

$t_r$ is the rise time;

$t_b$ is the bounce time

Note 1 to entry: When switching from conducting state to isolated state, switching time ($t_s$') is defined as follows:

$$t_s' = t_l' + t_f + t_b'$$

where

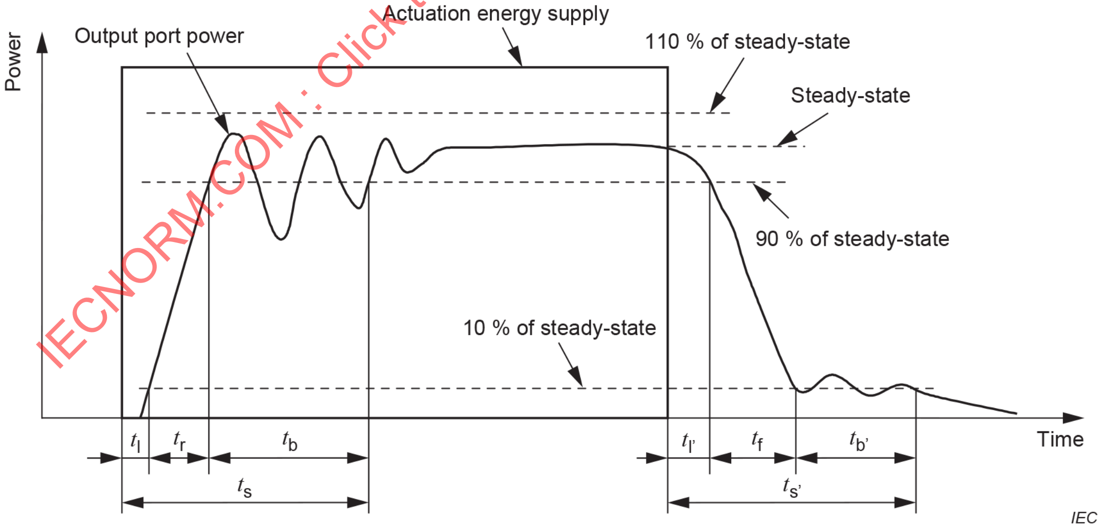
$t_l$' is the latency time;

$t_f$ is the fall time;

$t_b$' is the bounce time.

Note 2 to entry: See Figure 4 for an illustration of the latency, rise, bounce and switching times.






**Key**

| | |
|---|---|
| $t_s$, $t_s$' | switching times |
| $t_l$, $t_l$' | latency times |
| $t_r$ | rise time |
| $t_f$ | fall time |
| $t_b$, $t_b$' | bounce times |

**Figure 4 – Illustration of latency, rise, fall, bounce, and switching times**

Note 3 to entry: If, for any reason, the steady-state power of the isolated state is not zero, all the power levels leading to the definitions of latency time, rise time, fall time, bounce time, and thus of switching time, should be normalized subtracting from them the steady-state power of the isolated state, before applying such definitions.

~~[SOURCE: IEC 62343-3-3:2014, 3.23, modified – The symbol "$t_s$" has been added as second preferred term, and the definition has been rephrased.]~~

**3.7.21**
**polarization dependent loss**
**PDL**
maximum variation of insertion loss due to a variation of the state of polarization (SOP) over all the SOPs

~~[SOURCE: IEC 62343-3-3:2014, 3.24]~~

**3.7.22**
**polarization mode dispersion**
PMD
change in the shape and RMS width of a pulse due to the average delay of the travelling time between the two principal states of polarization (PSP), differential group delay (DGD), and/or to the waveform distortion for each PSP

Note 1 to entry: PMD, together with polarization dependent loss (PDL) and polarization dependent gain (PDG), when applicable, may introduce waveform distortion leading to unacceptable bit error ratio increase.

~~[SOURCE: IEC 62343-3-3:2014, 3.25]~~

**3.7.23**
**group delay ripple**
maximum peak-to-peak variation of the group delay approximated by a desired function as wavelength (or frequency), typically a linear fit, within a channel wavelength (or frequency) range

~~[SOURCE: IEC 62343-3-3:2014, 3.26]~~

**3.7.24**
**phase ripple**
maximum peak-to-peak variation in measured phase spectrum when compared to a quadratic fit within a channel wavelength (or frequency) range

Note 1 to entry: Phase ripple (unit: radian) is calculated as the product of a peak-to-peak group delay ripple (unit: s) and a period of group delay ripple (unit: Hz). Refer to IEC 61300-3-38.

~~[SOURCE: IEC 62343-3-3:2014, 3.27]~~

**3.7.25**
**chromatic dispersion**
group delay difference between two closely spaced wavelengths inside an optical signal going through a pair of conducting ports of a DWDM device

Note 1 to entry: Chromatic dispersion corresponds to the difference between the arrival times of these two closely spaced wavelengths. Chromatic dispersion is defined as the variation (first order derivative) of this group delay over a range of wavelengths especially over the channel operating wavelength range at the given time, temperature, pressure and humidity. It is expressed in terms of units of ps/nm or ps/GHz, and it is a predictor of the broadening of a pulse transmitted through the module.

~~[SOURCE: IEC 62343-3-3:2014, 3.28]~~

**3.7.26**
**maximum input power**
<single channel> allowable optical power which causes no damage by the optical power, such as degradation of adhesive or fibre fuse, as for a particular channel

~~[SOURCE: IEC 62343-3-3:2014, 3.29]~~

**3.7.27**
**maximum input power**
<single port> allowable optical power which causes no damage by the optical power, such as degradation of adhesive or fibre fuse, as for a particular port

~~[SOURCE: IEC 62343-3-3:2014, 3.30]~~

### 3.8 Optical multicast switch (MCS) terms and definitions

**3.8.1**
**optical multicast switch**
**MCS**
dynamic module, which has port configuration of $N$ x $M$, including $N$ of 1 x $M$ non-wavelength selective branching devices and $M$ of $N$ x 1 optical switches

Note 1 to entry: The optical switches are electrically controlled via software.

Note 2 to entry: $N \geq 2$ and $M \geq 2$, in general.

Note 3 to entry: There can be one or two $N$ x $M$ function blocks in the dynamic module. When two blocks are in one module case, one block is prepared for drop signal connection from the ROADM, and the other block is prepared for add signal connection to the ROADM.

Note 4 to entry: Generally, an add/drop functional block is connected to the $N$ port side, and a transponder functional block is connected to the $M$ port side. If required, a tuneable optical filter functional block can be inserted between the module and the transponder functional block.

Note 5 to entry: The MCS has an electrical interface to control the switches.

Note 6 to entry: Non-blocking optical switches are employed for the $N$ x 1 optical switches.

Note 7 to entry: A general functional block diagram is shown in Figure 5. It consists primarily of two optical blocks. Block 1 is configured to drop signals and block 2 to add signals.

Note 8 to entry: Generally, this module works optically in both directions: $N$ side to $M$ side as well as $M$ side to $N$ side.

Note 9 to entry: Generally, a blocking state is supported for each $M$ side port, either by a blocking state of the $N$ x 1 optical switch or by similar techniques.

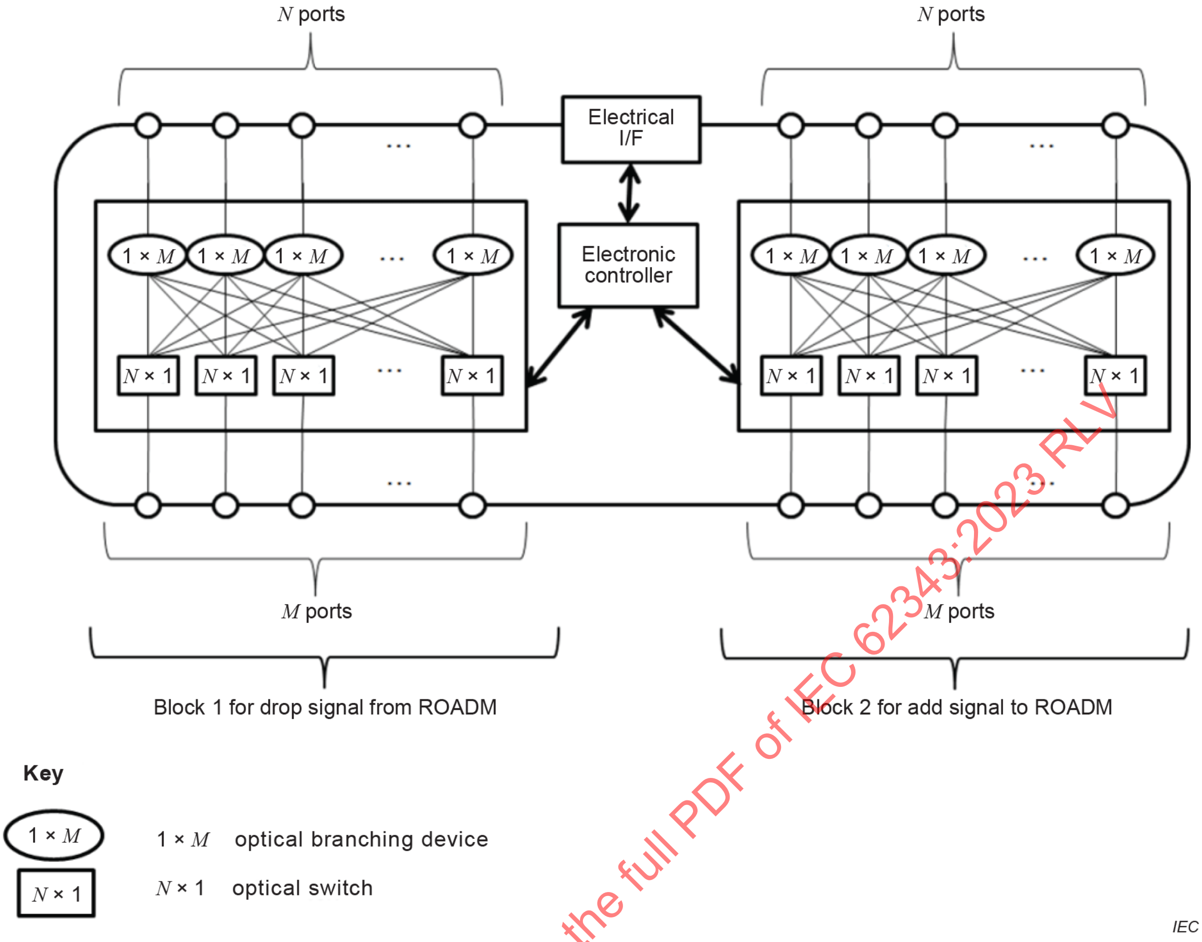



**Figure 5 – Functional block diagram of the MCS**

[SOURCE: IEC 62343-3-4:2018, 3.1, modified – The term has been changed from “multicast optical switch” to “optical multicast switch” and the notes to entry have been replaced by new ones]

**3.8.2**
***N* side insertion loss difference between different ports**
$IL_{\text{diffN}}$
difference between the maximum and minimum insertion loss at an *N* side port for a specified set of an *M* side port set of input ports

[SOURCE: IEC 62343-3-4:2018, 3.2, modified – The words "set of input ports" have been added.]

**3.8.3**
***M* side insertion loss difference between different ports**
$IL_{\text{diffM}}$
difference between the maximum and minimum insertion loss at an *M* side port for a specified set of an *N* side port set of input ports

[SOURCE: IEC 62343-3-4:2018, 3.3, modified – The words "set of input ports" have been added.]

**3.8.4**
**crosstalk**
ratio of the output power at a given output port originating from a signal applied to an isolated input port to the output power at the same output port originating from a signal of the same power applied to the conducting input port

[SOURCE: IEC 62343-3-4:2018, 3.4, modified – The definition has been rephrased.]

**3.8.5**
**cumulative crosstalk**
ratio of the output power originating from the cumulative signal power applied to all relevant isolated input ports to the output power originating from the signal power applied to the conducting input port

EXAMPLE Assume output port $k$ has relevant input ports 1, 2, 3, ..., $N$ , and the conductive port pair is only input port $i$ to output port $k$, and the other input ports are in a non-conductive state relative to output port $k$. The same optical input power is applied to all input ports. The output power appearing at output port $k$ from input port $i$ is expressed as $P_i$. With this condition, cumulative crosstalk for the optical path from input port $i$ to output port $k$ is calculated as:

$$-10\log_{10}\left(\frac{\sum_{j\neq i}^{N} P_j}{P_i}\right)$$

where

$P_i$ is the optical power measured at output port $k$ with signal applied to the conductive input port $i$;

$P_j$ is the optical power measured at output port $k$ with signal applied to an isolated input port $j$.

Note 1 to entry: Generally, in an $N$ x $M$ module, cumulative crosstalk has different values for different signal directions: $N$ side to $M$ side versus $M$ side to $N$ side.

Note 2 to entry: Defined for optical input signals with averaged polarization state and same wavelength.

[SOURCE: IEC 62343-3-4:2018, 3.5, modified – The definition has been rephrased and clarifications added.]

**3.8.6**
**dynamic crosstalk**
crosstalk that is attributed to both channel crosstalk (due to same wavelength and/or other wavelengths) and port isolation, predicted to change during switching operation in MCS module

Note 1 to entry: Hitless operation means that there is no impact on other performance during the switching operation.

[SOURCE: IEC 62343-3-4:2018, 3.6]

**3.8.7**
**latency time**

**3.8.7.1**
**latency time**
$t_l$
<switching from isolated state to conducting state> elapsed time for the output power of a specified output port to reach 10 % of its steady-state value from the time the actuation energy is applied, when switching from an isolated state to conducting state, normally-off for a non-latching switch, or a latching switch optical power attenuation at the particular wavelength for the conducting port pair

Note 1 to entry: See Figure 6 (a), (b) and (c) for illustrations of the latency times in normally-off non-latching switches, normally-on non-latching switches, and latching switches.

[SOURCE: IEC 60876-1:2014, 3.3.5.1, modified – The words "optical power attenuation at the particular wavelength for the conducting port pair" have been added to the definition, and the reference to the figure has been replaced with a note to entry.]

**3.8.7.2**
**latency time**
$t_l$’
<switching from conducting state to isolated state, normally-off for a non-latching switch> elapsed time for the output power of a specified output port to reach 90 % of its steady-state value from the time the actuation energy is removed

Note 1 to entry: See Figure 6 (a) for an illustration of the latency time in a normally-off non-latching switch.

[SOURCE: IEC 60876-1:2014, 3.3.5.2, modified – The words "when switching from a conducting state to isolated state, normally-off for a non-latching switch" have been removed from the definition, and the reference to the figure has been replaced with a note to entry.]

**3.8.7.3**
**latency time**
$t_l$’
<switching from conducting state to isolated state, for a latching switch> elapsed time when the output power of a specified output port reaches 90 % of its steady-state value from the time the actuation energy is applied

Note 1 to entry: See Figure 6 (c) for an illustration of the latency time in a latching switch.

[SOURCE: IEC 60876-1:2014, 3.3.5.3 – The words "when switching from a conducting state to isolated state, for a latching switch" have been removed from the definition, the reference to the figure has been deleted, and the note to entry has been replaced with a new one.]

**3.8.8**
**rise time**
$t_r$
elapsed time when the output power of the specified output port rises from 10 % of the steady-state value to 90 % of the steady-state value

[SOURCE: IEC 60876-1:2014, 3.3.6]

**3.8.9**
**fall time**
$t_f$
elapsed time when the output power of the specified output port falls from 90 % of the steady-state value to 10 % of the steady-state value

[SOURCE: IEC 60876-1:2014, 3.3.7]

**3.8.10**
**bounce time**

**3.8.10.1**
**bounce time**
$t_b$
<switching from isolated state to conducting state> elapsed time when the output power of a specified output port maintains between 90 % and 110 % of its steady-state value from the first time the output power of a specified output port reaches to 90 % of its steady-state value

Note 1 to entry: See Figure 6 (a), (b) and (c) for illustrations of the bounce times in normally-off non-latching switches, normally-on non-latching switches, and latching switches.

[SOURCE: IEC 60876-1:2014, 3.3.8.1, modified – The reference to the figure has been replaced with a note to entry.]

**3.8.10.2**
**bounce time**
$t_b$'
<switching from conducting state to isolated state> elapsed time when the output power of a specified output port maintains between 0 % and 10 % of its steady-state value from the first time the output power of a specified output port reaches 10 % of its steady-state value

Note 1 to entry: See Figure 6 (a), (b) and (c) for illustrations of the bounce times in normally-off non-latching switches, normally-on non-latching switches, and latching switches.

[SOURCE: IEC 60876-1:2014, 3.3.8.2, modified – The reference to the figure has been replaced with a note to entry.]



**3.8.11**
**switching time**

**3.8.11.1**
**switching time**
$t_s$
<switching from isolated state to conducting state> sum of latency time, rise time, and bounce time, defined as

$$t_s = t_l + t_r + t_b$$

where

$t_l$ is the latency time;

$t_r$ is the rise time;

$t_b$ is the bounce time

Note 1 to entry: See Figure 6 (a), (b) and (c) for illustrations of the switching times in normally-off non-latching switches, normally-on non-latching switches, and latching switches.

[SOURCE: IEC 60876-1:2014, 3.3.9.1, modified – Rephrased and note 1 to entry added.]

**3.8.11.2**
**switching time**
$t_s$'
<switching from conducting state to isolated state> sum of latency time, fall time, and bounce time, defined as

$$t_s' = t_l' + t_f + t_b'$$

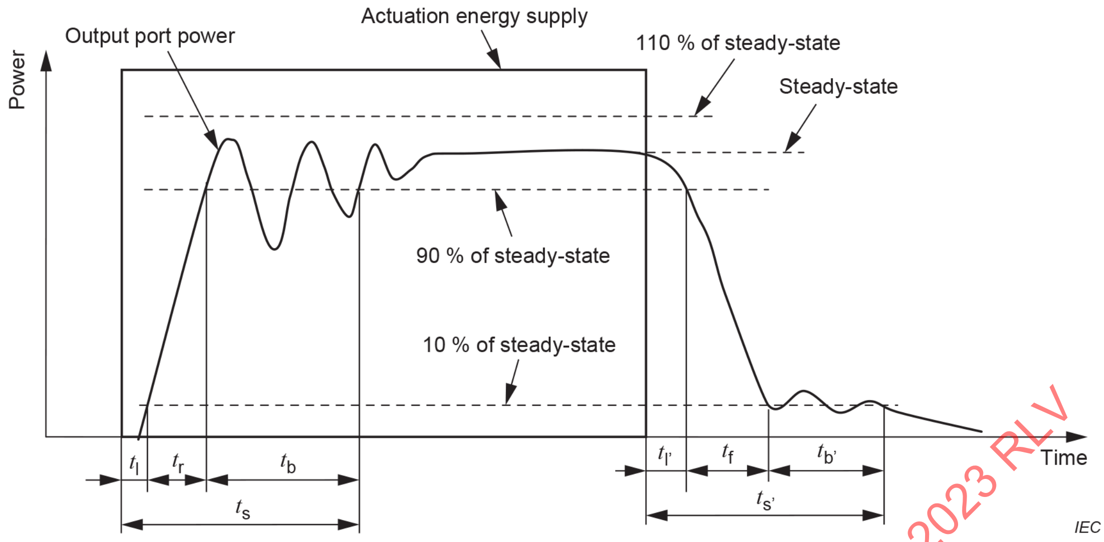
where

$t_l$' is the latency time;

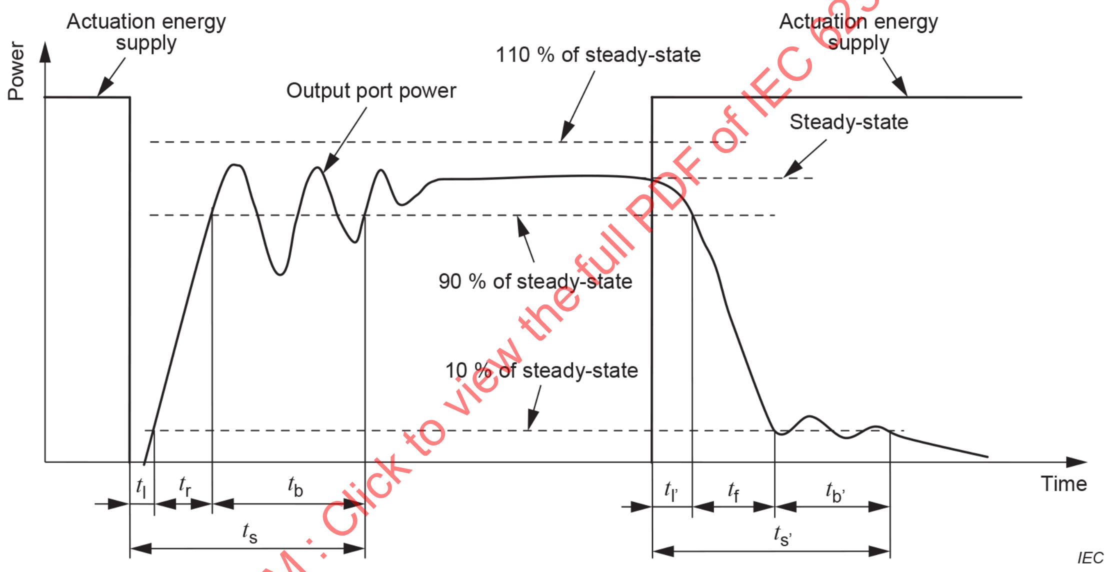
$t_f$ is the fall time;

$t_b$' is the bounce time

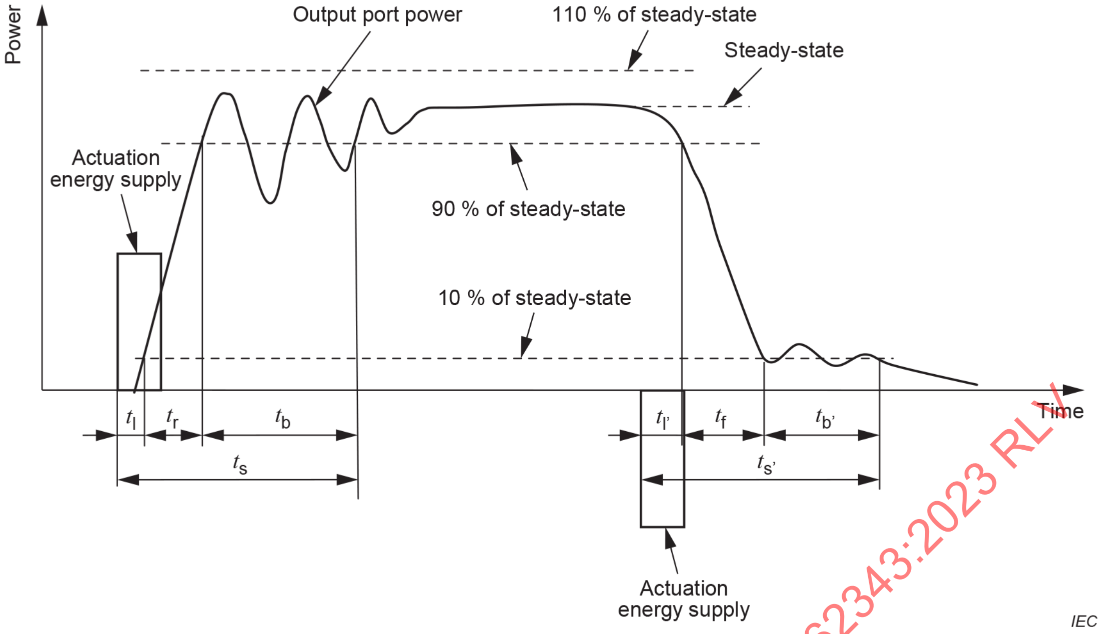
Note 1 to entry: See Figure 6 (a), (b) and (c) for illustrations of the switching times in normally-off non-latching switches, normally-on non-latching switches, and latching switches.




**(a) Non-latching switch, normally-off**




**(b) Non-latching switch, normally-on**




**(c) Latching switch**

**Key**

| | |
|---|---|
| $t_s$, $t_s$' | switching times |
| $t_l$, $t_l$' | latency times |
| $t_r$ | rise time |
| $t_f$ | fall time |
| $t_b$, $t_b$' | bounce times |

**Figure 6 – Illustration of latency, rise, fall, bounce, and switching times**

Note 2 to entry: If for any reason, the steady-state power of the isolated state is not zero, all the power levels leading to the definitions of latency time, rise time, fall time, bounce time and, thus, of switching time should be normalized, subtracting from them the steady-state power of the isolated state, before applying such definitions.

[SOURCE: IEC 60876-1:2014, 3.3.9.2, modified – Rephrased and note 2 to entry added.]

**3.8.12**
**switching time matrix**
matrix of coefficients in which each coefficient $S_{ij}$ is the longest switching time to turn path $ij$ on or off from any initial state

[SOURCE: IEC 60876-1:2014, 3.3.10, modified – The figure and note to entry have been deleted.]

**3.8.13**
**phase ripple**
maximum peak-to-peak variation in measured phase spectrum when compared to a quadratic fit within a channel wavelength (or frequency) range

Note 1 to entry: Phase ripple (unit: radian) is calculated as the product of a peak-to-peak group delay ripple (unit: s) and a period of group delay ripple (unit: Hz). Refer to IEC 61300-3-38.

**3.8.14**
**chromatic dispersion**
group delay difference between two closely spaced wavelengths inside an optical signal going through a pair of conducting ports of a DWDM device

Note 1 to entry: The chromatic dispersion corresponds to the difference between the arrival times of these two closely spaced wavelengths. Chromatic dispersion is defined as the variation (first order derivative) of this group delay over a range of wavelengths especially over the channel operating wavelength range at the given time, temperature, pressure and humidity. It is expressed in terms of units of ps/nm or ps/GHz and it is a predictor of the broadening of a pulse transmitted through the module.

**3.8.15**
**maximum input power to single port**
allowable optical power applied to a particular port that causes no damage of the MCS by the optical signal, such as degradation of adhesives or fibre fuse

[SOURCE: IEC 62343-3-4:2018, 3.17, modified – The definition has been rephrased.]



## ~~4 Preparation of standards~~

### ~~4.1 General~~

~~In the preparation of a performance standard, the following items shall be considered and instructions pertaining to them included:~~

- ~~product definition;~~
- ~~tests;~~
- ~~details;~~
- ~~requirements;~~
- ~~sample size;~~
- ~~sample definition;~~
- ~~groupings/sequences;~~
- ~~pass/fail criteria;~~
- ~~reference product definition;~~
- ~~performance standard test report.~~

### ~~4.2 Product definition~~

~~The product to which the performance standard relates shall be clearly defined.~~

### ~~4.3 Tests~~

~~The tests to be carried out on the product in order for it to meet the performance standard shall be clearly defined. No ambiguity or options shall be allowed.~~

~~The test method to be used shall be clearly defined for each test. Wherever possible, the test method shall be selected from IEC referenced tests. Where this is not possible, other test methods may be defined. If an undefined test method is used, the test method and details to be specified shall be included in the appropriate annex of the performance standard.~~

### ~~4.4 Details~~

~~Details to be considered shall be given for all tests and measurements presented in a performance standard. These should be directly related to the requirements specified for a product location within an operating or service environment to which the performance standard is intended to correspond. No ambiguity or options shall be allowed.~~

~~4.5 Requirements~~

~~The performance requirements that shall be satisfied in order for the product to comply with the performance standard shall be specified for each test and/or measurement. No ambiguities shall be allowed.~~

~~4.6 Sample size~~

~~The sample size for each test shall be defined in an annex of the performance standard.~~

~~4.7 Sample definition~~

~~The sample to be tested shall be defined in the relevant performance standard.~~

~~4.8 Groupings/sequences~~

~~Test groups and test sequences shall be defined in the appropriate annex of the performance standard as required by the user, user group or manufacturer. The number of samples for each test group shall also be defined in the annex.~~

~~4.9 Pass/fail criteria~~

~~The pass/fail criteria shall be unambiguously stated for each test within the performance standard. No deviation or exceptions shall be allowed.~~

~~4.10 Reference product definition~~

~~Where a performance standard requires the use of a reference product or component, the reference product shall be clearly defined in the appropriate annex of the performance standard.~~

~~4.11 Performance standard test report~~

~~Conformance to a performance standard shall be supported by a test report. The test report shall clearly demonstrate that the tests were carried out in accordance with the requirements of the performance standard and provide full details of the tests together with a pass/fail declaration. All test and measurement requirements shall be satisfied before a component may be declared to be in compliance with the performance standard.~~

~~The failure of any product to comply with a particular test or sequence of tests shall be reported in the performance standard test report. An analysis of the cause of the failure shall be undertaken and any corrective actions taken shall be described.~~

~~If no design changes are made to the product, the test or test sequence where the failure occurred shall be rerun with the results of both tests reported.~~

~~If design changes are made, another complete performance standard test programme shall be undertaken. Any tests previously completed successfully shall be repeated with new samples.~~



## 4 Requirements

### 4.1 General

The IEC 62343 series comprises various parts, each of which addresses a different standardization aspect, as shown in Table 1. Each part consists of a subseries of documents.

**Table 1 – Document structure of the IEC 62343 series**

| Part number | Title of subseries |
|---|---|
| IEC 62343-1 | Performance standards |
| IEC 62343-2 | Reliability qualification standards |
| IEC 62343-3 | Performance specification templates |
| IEC 62343-4 | Software and hardware interface standards |
| IEC 62343-5 | Test methods |
| IEC TR 62343-6 | Design guidelines [a] |
| [a] Original title: "Design guides". | |

### 4.2 Performance standards and performance specification templates

Performance standards (IEC 62343-1 subseries) shall contain the following items:

– test;
– test report;
– performance requirements;
  i) dimensions;
  ii) sample size (and test sequence if necessary);
  iii) test details and requirements (i.e. performance parameters with units, pass/fail criteria, and measurement methods, if possible).

Other items may be added as needed.

Performance specification templates (IEC 62343-3 subseries) shall contain templates listing:

– performance parameters with units;
– measurement methods (if possible).

Other items may be added as needed.

### 4.3 Quality assessment

Reliability qualifications are standardized in the IEC 62343-2 subseries.

### 4.4 Control interface standards

Control interface standards (IEC 62343-4 subseries) shall contain the following items:

– basic configurations (if necessary);
– software interfaces (if used);
– hardware interfaces (including electrical connectors, if necessary).

Other items may be added as needed.

### 4.5 Test methods

Test methods standards (IEC 62343-5 subseries) shall contain the following items:

– test apparatus;
– measurement conditions (if necessary);
– test procedure;

- calculations (if necessary);
- test or measurement report.

Other items may be added as needed.

### 4.6 Operating, storage and transportation conditions

Operating, storage and transportation conditions are described in IEC 62343-1.

### 4.7 Product identification for storage and shipping

The following items shall be defined in the relevant specifications (e.g. product specifications):

- product marking and/or labelling;
- identification of manufacturing and/or shipping date (year/month/week);
- port identification (if necessary);
- packaging.

Other items may be added as needed.

## 5 Electromagnetic compatibility (EMC) requirements

The devices and assemblies addressed by the IEC 62343 series shall comply with suitable requirements for electromagnetic compatibility (in terms of both emission and immunity), depending on specific usage and environment in which they are intended to be installed or integrated. ~~IEC Guide 107 shall be used for the drafting of such EMC requirements. Guidance for electrostatic discharge (ESD) is still under study.~~ EMC requirements are standardized in the IEC 61000 series.

## 6 Safety requirements

The devices and assemblies addressed by the IEC 62343 series shall comply with suitable requirements for safety including laser radiation safety. Safety requirements for audio/video, information, and communication technology equipment are standardized in the IEC 62368 series, and laser safety requirements are standardized in the IEC 60825 series.

# Bibliography

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IEC 60876-1:2014, *Fibre optic interconnecting devices and passive components – Fibre optic spatial switches – Part 1: Generic specification*

IEC 61000 (all parts), *Electromagnetic compatibility (EMC)*

IEC 61290 (all parts), *Optical amplifiers – Test methods*

IEC 61291 (all parts), *Optical amplifiers*

IEC TR 61292 (all parts), *Optical amplifiers* ~~*– Technical reports*~~

IEC 61300 (all parts), *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures*

IEC 61300-3-38, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-38: Examinations and measurements – Group delay, chromatic dispersion and phase ripple*

IEC 61753 (all parts), *Fibre optic interconnecting devices and passive components – Performance standard*

IEC 62343 (all parts), *Dynamic modules*

IEC 62343-1 (all parts), *Dynamic modules* ~~*– Optical*~~ *Performance standards*

IEC 62343-2-1, *Dynamic modules – Part 2-1: Reliability qualification – Test template*

IEC 62343-3 (all parts), *Dynamic modules* ~~*– Optical*~~ *Performance specification templates*

IEC 62343-3-1:2016, *Dynamic modules – Part 3-1: Performance specification templates – Dynamic channel equalizers*

IEC 62343-3-2:2016, *Dynamic modules – Part 3-2: Performance specification templates – Optical channel monitor*

IEC 62343-3-3:~~2014~~2020, *Dynamic modules – Part 3-3: Performance specification templates – Wavelength selective switches*

IEC 62343-3-4:2018, *Dynamic modules – Part 3-4: Performance specification templates – Multicast optical switches*

IEC 62343-4 (all parts), *Dynamic modules – Part 4: Software and hardware interface*

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IEC 62343-5 (all parts), *Dynamic modules – Part 5: Test methods*

IEC 62343-6 (all parts), *Dynamic modules – Part 6: Design guides*

IEC 62368 (all parts), *Audio/video, information and communication technology equipment*

IEC TS 62538:2008, *Categorization of optical devices*

IEC TS 62627-09:2016, *Fibre optic interconnecting devices and passive components – Vocabulary for passive optical devices*

ITU-T G.694.1, *Spectral grids for WDM applications: DWDM frequency grid*

ITU-T G.692, *Optical interfaces for multichannel system with optical amplifiers*

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IEC 62343

Edition 3.0 2023-01

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

**Dynamic modules – Generic specification**

**Modules dynamiques – Spécification générique**



IEC 62343:2023-01(en-fr)

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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# DYNAMIC MODULES – GENERIC SPECIFICATION

## FOREWORD



IEC 62343 has been prepared by subcommittee 86C: Fibre optic systems and active devices, of IEC technical committee 86: Fibre optics. It is an International Standard.

This third edition cancels and replaces the second edition published in 2017. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) addition of terms and definitions for optical multicast switches (3.8);

b) revision of Clause 4, listing the requirements for standards in the IEC 62343 series;

c) addition of Clause 6 (Safety requirements).

The text of this International Standard is based on the following documents:

| Draft | Report on voting |
|---|---|
| 86C/1803/CDV | 86C/1827/RVC |

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts of the IEC 62343 series, published under the general title *Dynamic modules*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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

# INTRODUCTION

This document applies to dynamic devices as defined in IEC TS 62538. This document contains general guidance for the IEC 62343 series related to dynamic devices and definitions which apply to dynamic devices. The dynamic module (DM), or device, has two distinguishing characteristics: dynamic and module.

"Dynamic" highlights the functions of the products to include "tuning, varying, switching, configuring, and other continuous optimization," often accomplished by electronics, firmware, software or their combinations. The dynamic device usually has a certain level of intelligence to monitor or measure its configuration or settings and make decisions for necessary (optimization) actions. The behaviour of dynamic modules can be characterized by transient characteristics as the dynamic module undergoes tuning, switching, configuring, and other continuous optimization. Characterization of transient characteristics will be considered in individual dynamic module standards.

"Module" defines that products covered by this document are the integration of active and passive components (either or both), through interconnecting materials or devices. The controlling electronics can be inside or outside the optical package that contains all or most of the optical components and interconnection. The product can be a small printed wiring board (PWB) or child-board with mounted optical module, or it can be a small box (e.g., housing) with optical components and electronics enclosed. In the former case, it is more like an assembly (i.e., generally not packaged in a box or housing) than a module (i.e., generally packaged in a box or housing).

For historical reasons and convenience, a dynamic module or device is referred to as a dynamic module in the IEC 62343 series.

The number of dynamic modules and devices is rapidly growing as optical communications networks evolve. The following list provides some examples of the products covered by the IEC 62343 series. It should be noted that the list is not exhaustive and the products to be covered are not limited by the listed examples:

- channel gain equalizer;
- dynamic channel equalizer;
- dynamic gain tilt equalizer;
- dynamic slope equalizer;
- tuneable chromatic dispersion compensator;
- polarization mode dispersion compensator;
- reconfigurable optical add-drop multiplexer;
- switch with monitoring and controls;
- variable optical attenuator with monitoring and controls;
- optical channel monitor;
- wavelength selective switch;
- optical multicast switch.

The IEC 62343 series covers performance templates, performance standards, reliability qualification requirements, hardware and software interfaces, and related testing methods.

The structure of the IEC 62343 series, under the general title *Dynamic modules,* is as follows:

- IEC 62343-1 series Part 1: Performance standards
- IEC 62343-2 series Part 2: Reliability qualification
- IEC 62343-3 series Part 3: Performance specification templates
- IEC 62343-4 series Part 4: Software and hardware interface
- IEC 62343-5 series Part 5: Test methods
- IEC 62343-6 series Part 6: Design guidelines

A complete set of standards related to a dynamic module or device should include the following:

- optical performance standards;
- reliability qualification standards;
- optical performance specification templates;
- hardware and software interface standards;
- test methods;
- technical reports.

The safety standards related to dynamic modules are mostly optical power considerations, which are covered by the IEC 60825 series.

Only those dynamic modules for which standards are complete or in preparation are included in Clause 3. To reflect the rapidly growing market for dynamic modules, additional terms and definitions will be added in subsequent revisions as the series expands.

It should be noted that optical amplifiers could be regarded as dynamic modules. They are not included in the IEC 62343 series but are covered in their own series of IEC standards.

# DYNAMIC MODULES – GENERIC SPECIFICATION

## 1 Scope

This document applies to all commercially available optical dynamic modules and devices. It describes the products covered by the IEC 62343 series, defines terminology, fundamental considerations and basic approaches.

The object of this document is to

- establish uniform requirements for operation, reliability and environmental properties of dynamic modules (DMs) to be implemented in the appropriate DM standard, and
- provide assistance to the purchaser in the selection of consistently high-quality DM products for their particular applications, as well as in the consultation of the appropriate specific DM standard(s).

This document covers performance templates, performance standards, reliability qualification requirements, hardware and software interfaces and related testing methods.

Since a dynamic module integrates an optical module/device, printed wiring board, and software/firmware, the standards developed in the series will mimic appropriate existing standards. On the other hand, since "dynamic module" is a relatively new product category, the dynamic module standards series will not be bound by the existing practices where requirements differ.

The safety standards as related to dynamic modules are mostly optical power considerations, which is covered by the IEC 60825 series (see Clause 6).

## 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 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 60050-731, *International Electrotechnical Vocabulary – Chapter 731: Optical fibre communication* (available at www.electropedia.org)

IEC TR 61931, *Fibre optic – Terminology*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-731, IEC TR 61931, and the following apply.

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

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

NOTE 1 Some terms and definitions included in this document were first published in the IEC 62343 series. After publication of this document, these terms and definitions will be removed from the IEC 62343 series when the series is revised, and reference will be made to IEC 62343.

NOTE 2 The terms and definitions listed in Clause 3 refer to the meaning of the terms and definitions used in the specifications of dynamic modules. Only those parameters listed in the appropriate performance standard in the IEC 62343-1 series and performance specification templates in the IEC 62343-3 series are intended to be specified.

NOTE 3 The list of parameter definitions for dynamic modules given in Clause 3 is divided into subclauses according to the type of dynamic module.

## 3.1 General terms and definitions

**3.1.1**
**optical dynamic device**
optical device designed to monitor and control dynamically some characteristics of one or more optical signals, by means of suitable electronic controls, in order to improve or to maintain definite performances of the system in which it is intended to be inserted

Note 1 to entry: Said characteristics may include optical paths, optical intensities, spectral characteristics, polarization states, dispersion, etc.

Note 2 to entry: Optical dynamic devices may comprise optical active and optical passive elements or components.

Note 3 to entry: The control/response time of optical dynamic devices is much larger than the signal time characteristics and typically may range from few microseconds to tens of seconds.

[SOURCE: IEC TS 62538:2008, 2.1.1]

**3.1.2**
**optical module**
packaged integration of optical components and/or elements, accomplishing defined functionality, typically repairable and re-workable

[SOURCE: IEC TS 62538:2008, 2.2.5, modified – The notes to entry have been omitted.]

## 3.2 Dynamic module terms and definitions

**3.2.1**
**channel**
signal at wavelength, $\lambda$, that corresponds to ITU grid (ITU-T Recommendation G.694.1) within the range of operating wavelength range

**3.2.2**
**operating wavelength range**
specified range of wavelengths from $\lambda_{\text{imin}}$ to $\lambda_{\text{imax}}$ about a nominal operating wavelength $\lambda_{\text{I}}$, within which a dynamic optical module is designed to operate with a specified performance

**3.2.3**
**channel frequency range**
frequency range within which a device is expected to operate with a specified performance

Note 1 to entry: For a particular nominal channel central frequency, $f_{\text{nomi}}$, the channel frequency range is from $f_{\text{imin}} = (f_{\text{nomi}} - \Delta f_{\text{max}})$ to $f_{\text{imax}} = (f_{\text{nomi}} + \Delta f_{\text{max}})$, where $\Delta f_{\text{max}}$ is the maximum channel central frequency deviation.

**3.2.4**
**channel spacing**
centre-to-centre difference in frequency (or wavelength) between adjacent channels in a device

## 3.3 Dynamic channel equalizer (DCE) terms and definitions

**3.3.1**
**dynamic channel equalizer**
**DCE**
device capable of transforming, by internal or external automatic control, a multichannel input signal with time-varying averaged powers into an output signal in which all working channel powers are nominally equal or are set for a required level of pre-emphasis

Note 1 to entry: A DCE may also provide the extinction of one or more of the input channels.

**3.3.2**
**channel non-uniformity**
difference between the powers of the channel with the most power (in dBm) and the channel with the least power (in dBm)

Note 1 to entry: The channel non-uniformity applies to a multichannel signal across the operating wavelength range.

Note 2 to entry: Channel non-uniformity is expressed in dB.

**3.3.3**
**in-band extinction ratio**
difference, within the operating wavelength range, between the minimum power of the non-extinguished channels (in dBm) and the maximum power of the extinguished channels (in dBm)

Note 1 to entry: In-band extinction ratio is expressed in dB.

**3.3.4**
**out-of-band attenuation**
attenuation of channels that fall outside of the operating wavelength range

Note 1 to entry: Out-of-band attenuation is expressed in dB.

**3.3.5**
**ripple**
peak-to-peak difference in insertion loss within a channel frequency (or wavelength) range

**3.3.6**
**channel response time**
elapsed time it takes a device to transform a channel from a specified initial power level to a specified final power level desired state, when the resulting output channel non-uniformity tolerance is met, measured from the time the actuation energy is applied or removed

## 3.4 Tuneable dispersion compensator (TDC) or dynamic chromatic dispersion compensator (DCDC) terms and definitions

**3.4.1**
**tuneable dispersion compensator**
**TDC**
**dynamic chromatic dispersion compensator**
**DCDC**
two-port in-line device that is capable of transforming, by internal or external automatic control, an input signal with time-varying dispersion into an output signal in which an output channel dispersion value is set for a required level of value

**3.4.2**
**insertion loss ripple**
maximum peak-to-peak variation of the insertion loss within a channel frequency (or wavelength) range

**3.4.3**
**dispersion tuning time**

longest elapsed time it takes a module to change a dispersion setting from an arbitrary initial dispersion value to a desired final dispersion value, when the resulting dispersion target tolerance is met

## 3.5 Dynamic gain tilt equalizer (DGTE) terms and definitions

**3.5.1**
**dynamic spectral equalizer**
**DSE**
two port in-line dynamic module that converts an input signal with time-varying spectral shape into an output signal in which spectral shape is nominally flat, or is set for a required spectral shape for pre-emphasis

**3.5.2**
**dynamic gain tilt equalizer**
**DGTE**
dynamic spectral equalizer used in an optical amplifier that converts input signals with time-varying gain tilt into output signals in which gain tilt is nominally flat, or is set for a required gain tilt

**3.5.3**
**dynamic gain tilt range**
difference between the maximum and minimum deviation of attenuation over operating wavelength range, to which the dynamic gain tilt equalizer can be set

**3.5.4**
**positive slope type**
type of DGTE for which dynamic gain tilt range can be set for positive gain tilt

**3.5.5**
**negative slope type**
type of DGTE for which dynamic gain tilt range can be set for negative gain tilt

**3.5.6**
**both slope type**
type of DGTE to which dynamic gain tilt range can be set for both positive and negative gain tilt

**3.5.7**
**slope linearity**
maximum deviation of attenuation between the spectral shape by dynamic gain tilt equalizer and linear slope over the operating wavelength range

**3.5.8**
**response time**
<dynamic gain tilt equalizer> longest elapsed time it takes a dynamic gain tilt equalizer to change a gain tilt setting from an arbitrary initial gain tilt value to a desired final gain tilt value, when the resulting gain tilt target tolerance is met

## 3.6 Optical channel monitor (OCM) terms and definitions

**3.6.1**
**input channel plan**
entire set of ITU channels on which the optical channel monitor is reporting

**3.6.2**
**input channel frequency spacing tolerance**
centre-to-centre difference in frequency (or wavelength) between adjacent channels in a device

**3.6.3**
**input channel power dynamic range**
full range of input power per channel between the saturation and sensitivity limits

**3.6.4**
**input channel non-uniformity**
difference between the powers of the channel with the most power (in dBm) and the channel with the least power (in dBm) during one measurement within the response time

Note 1 to entry: Input channel non-uniformity applies to a multichannel signal across the operating wavelength range.

Note 2 to entry: Input channel non-uniformity is expressed in dB.

**3.6.5**
**input adjacent channel non-uniformity**
difference between the powers of adjacent channels present during one measurement within the response time

Note 1 to entry: The input adjacent channel non-uniformity applies to a multichannel signal across the operating wavelength range.

Note 2 to entry: In-band extinction ratio is expressed in dB.

**3.6.6**
**input channel non-uniformity for channel identification**
difference between the powers of the channel with the most power and the channel with the least power during one measurement within the response time for positively identifying all channels present and not falsely identifying channels that are not present

Note 1 to entry: Input channel non-unformity for channel identification applies to a multichannel signal across the operating wavelength range.

Note 2 to entry: In-band extinction ratio is expressed in dB.

**3.6.7**
**input adjacent channel non-uniformity for channel identification**
difference between the powers of adjacent channels present during one measurement within the response time for positively identifying all channels present and not falsely identifying channels that are not present

Note 1 to entry: Input adjacent channel non-uniformity for channel identification applies to a multichannel signal across the operating wavelength range.

Note 2 to entry: In-band extinction ratio is expressed in dB.

**3.6.8**
**input total band power dynamic range for channel measurements**
full range of input total band power between the saturation or sensitivity limits of channel measurements

**3.6.9**
**input total band power dynamic range for total band power measurements**
full range of input total band power between the saturation or sensitivity limits of total band power measurements

**3.6.10**
**input optical signal-noise ratio (OSNR) dynamic range**
full range of input OSNR per channel within which the power, total band power and OSNR measurements remain within their respectively specified error limits

**3.6.11**
**input channels bit rates**
list of bit rates to which any channel may be modulated

**3.6.12**
**reference measurement bandwidth**
integration bandwidth of the optical power measurement

**3.6.13**
**noise equivalent bandwidth**
integration bandwidth of the optical noise measurement

**3.6.14**
**channel power absolute error**
maximum difference between the measured channel power and the calibrated reference channel power, within the specified measurement integration bandwidth, during one measurement within the response time, specified over all input and operating ranges

**3.6.15**
**channel power relative error**
maximum variation of the channel power absolute error, during one measurement within the response time, specified over all input and operating ranges

**3.6.16**
**channel power variability**
maximum variation of the channel power absolute error over the repeatability time interval at a given input and operating condition, specified over all input and operating ranges

**3.6.17**
**channel power resolution interval**
smallest increment of the reported channel power measurement value

**3.6.18**
**channel power polarization dependent error**
maximum power measurement difference over all polarization states at a given input and operating condition, during one measurement within the response time, specified over all input and operating ranges

**3.6.19**
**total band power absolute error**
difference between the measured total power and the calibrated total power reference, each integrated over the frequency band, during one measurement within the response time, specified over all input and operating ranges

**3.6.20**
**total band power relative error**
maximum variation of the total band absolute error, during one measurement within the response time, specified over all input and operating ranges

**3.6.21**
**total band power variability**
maximum variation of the total band power absolute error over the repeatability time interval at given input and operating conditions, specified over all input and operating ranges

**3.6.22**
**total band power resolution interval**
smallest increment of the reported total band power measurement value

**3.6.23**
**frequency absolute error**
maximum difference between the measured frequency and the calibrated reference frequency, during one measurement within the response time, specified over all input and operating ranges

**3.6.24**
**frequency relative error**
maximum variation of the frequency absolute error, during one measurement within the response time, specified over all input and operating ranges

**3.6.25**
**frequency variability**
maximum variation of the frequency absolute error over the repeatability time interval at given input and operating conditions, specified over all input and operating ranges

**3.6.26**
**frequency resolution interval**
smallest increment of the reported frequency measurement value

**3.6.27**
**frequency polarization dependent error**
maximum frequency measurement difference over all polarization states at given input and operating conditions, during one measurement within the response time, specified over all input and operating ranges

**3.6.28**
**OSNR absolute error**
maximum difference between the measured and the calibrated reference OSNR, during one measurement within the response time, specified over all input and operating ranges

**3.6.29**
**OSNR relative error**
maximum variation of the OSNR absolute error, during one measurement within the response time, specified over all input and operating ranges

**3.6.30**
**OSNR variability**
maximum variation of the OSNR absolute error over the repeatability time interval at given input and operating conditions, specified over all input and operating ranges

**3.6.31**
**OSNR resolution interval**
smallest increment of the reported OSNR measurement value

**3.6.32**
**OSNR polarization dependent error**
maximum OSNR measurement difference over all polarization states at given input and operating conditions, during one measurement within the response time, specified over all input and operating ranges

**3.6.33**
**back reflection**
fraction of the optical signal reflected at the input optical port over the entire band, specified over all input and operating ranges

**3.6.34**
**response time**
<optical channel monitor> time required to perform the specified measurements for all channels and transfer these values over the communications interface to the external controller that issues a measurement request, specified over all input and operating ranges

**3.6.35**
**repeatability time interval**
minimum time interval over which a given measurement repeatability is performed

## 3.7 Wavelength selective switch (WSS) terms and definitions

**3.7.1**
**wavelength selective switch**
**WSS**
dynamic module with one or more input ports and one or more output ports, which is mainly used in a reconfigurable optical add drop multiplexer (ROADM) system to switch each wavelength signal on each input port independently to its required output port in dense wavelength division multiplexing (DWDM) networks

Note 1 to entry: A WSS is electrically controlled with software.

Note 2 to entry: Optical paths through the WSS operate bi-directionally, thus ports can be configured as either input or output ports.

Note 3 to entry: Each wavelength signal can be independently attenuated.

[SOURCE: IEC 62343-4-1:2016, 3.1.1, modified – Note 2 to entry has been replaced by a new note.]

**3.7.2**
**insertion loss**
*IL*
value of the reduction in optical power at a particular wavelength between the two conducting ports

Note 1 to entry: The insertion loss is the reduction in optical power between an input and output port of a module expressed in decibels.

$$IL = -10 \log_{10} (P_{out}/P_{in})$$

where

$P_{in}$ is the optical power launched into input port;

$P_{out}$ is the optical power received from the output port.

**3.7.3**
**insertion loss uniformity**
difference between the maximum and minimum insertion loss at the output for a specified set of input ports

**3.7.4**
**insertion loss ripple**
maximum peak-to-peak variation of the insertion loss within a channel frequency (or wavelength) range

**3.7.5**
***X*-dB passband width**
width of a channel centred about the channel central wavelength within which the optical attenuation is within *X* dB

Note 1 to entry: The terms "operating wavelength range" or "channel passband" are used and have the same meaning as "passband" for DWDM devices. The $X$-dB bandwidth is defined through the spectral dependence of $a_{ij}$ (where $i \neq j$) as the minimum wavelength range centred about the operating wavelength $\lambda_h$ within which the variation of $a_{ij}$ is less than $X$ dB. The minimum wavelength range is determined considering thermal wavelength shift, polarization dependence and long-term aging shift (refer to Figure 1).

Note 2 to entry: It is recommended that the passband width be specified as 0,5 dB, 1 dB and 3 dB ($X$ = 0,5, 1 and 3).

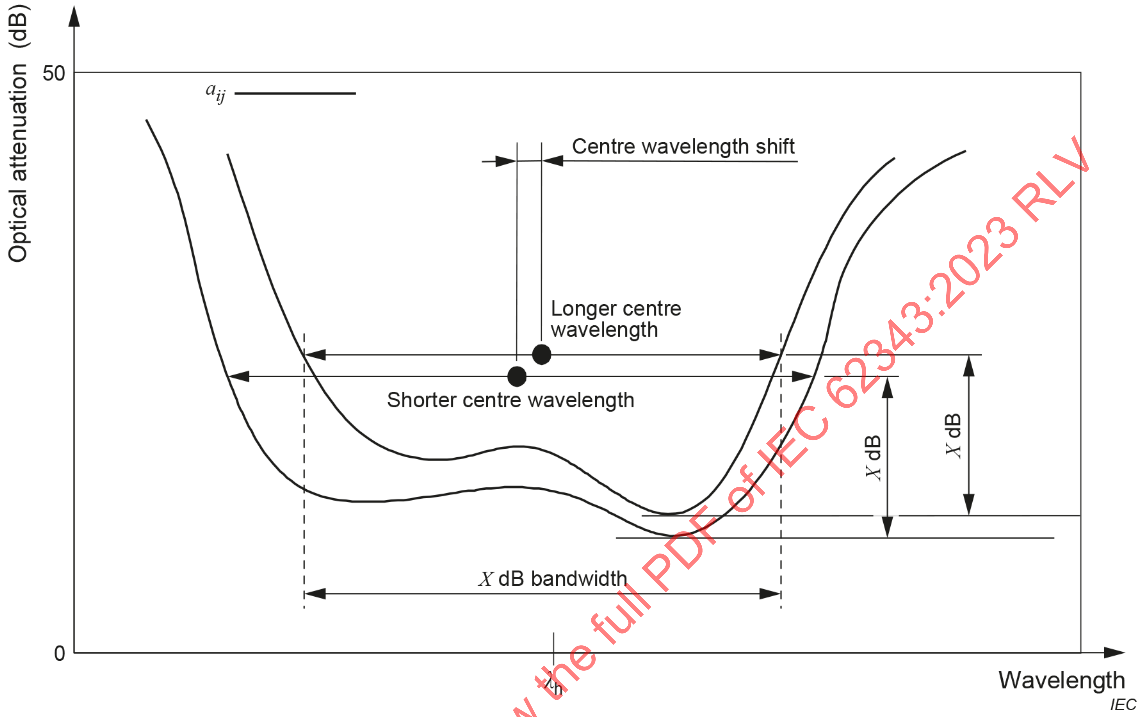



**Figure 1 – Illustration of $X$-dB bandwidth**

**3.7.6**
**return loss**
*RL*
fraction of input power that is returned from any port of a module expressed in decibels and defined in the following formula at the particular wavelength between two conducting ports:

$$RL = -10 \log_{10} (P_{\text{refl}}/P_{\text{in}})$$

where

$P_{\text{in}}$ is the optical power launched into port;

$P_{\text{refl}}$ is the optical power received back from the same port

Note 1 to entry: The module can be a wavelength selective switch or an optical multicast switch.

**3.7.7**
**adjacent channel crosstalk**
crosstalk restricted to the channels immediately adjacent to the (channel) wavelength number associated with output port

Note 1 to entry: Adjacent channel crosstalk is a negative value in dB (see Figure 2).

Note 2 to entry: The adjacent channel crosstalk is different from adjacent channel isolation. In Figure 2, an up pointing arrow shows positive, a down-pointing arrow negative. Generally, there are two adjacent channel crosstalks for the shorter wavelength (higher frequency) side and a longer wavelength (lower frequency) side.

Note 3 to entry: The terms "crosstalk" and "isolation" are often used with almost the same meaning. However, care should be taken not to confuse crosstalk and isolation. Crosstalk is defined so that, for wavelength selective branching devices, the value of the ratio between the optical power of the specified signal and the specified noise is a negative value in dB. The crosstalk is defined for each output port. Crosstalk for wavelength selective branching devices is defined for a DEMUX (1 × $N$ × wavelength division multiplexing (WDM) device). The crosstalk for port $o$ to port $j$ is the subtraction from the insertion loss of port $i$ to $o$ (conducting port pair) to the isolation of port $j$ to $o$ (isolated port pair). For wavelength selective branching devices having three or more ports, the crosstalk should be specified as the maximum value of the crosstalk for each output port in dB.

### 3.7.8
**adjacent channel isolation**
isolation restricted to the channels immediately adjacent to the (channel) wavelength number associated with output port

Note 1 to entry: Adjacent channel isolation is a positive value in dB (see Figure 2).

Note 2 to entry: The adjacent channel isolation is different from adjacent channel crosstalk. In Figure 2, an up pointing arrow shows positive, a down-pointing arrow negative. Generally, there are two adjacent channel isolations for the shorter wavelength (higher frequency) side and a longer wavelength (lower frequency) side.

Note 3 to entry: The terms "crosstalk" and "isolation" are often used with almost the same meaning. However, care should be taken not to confuse crosstalk and isolation. Isolation is the minimum value of $a_{ij}$ (where $i \neq j$) within isolation wavelength range for isolated port pair. Isolation is positive value in dB.



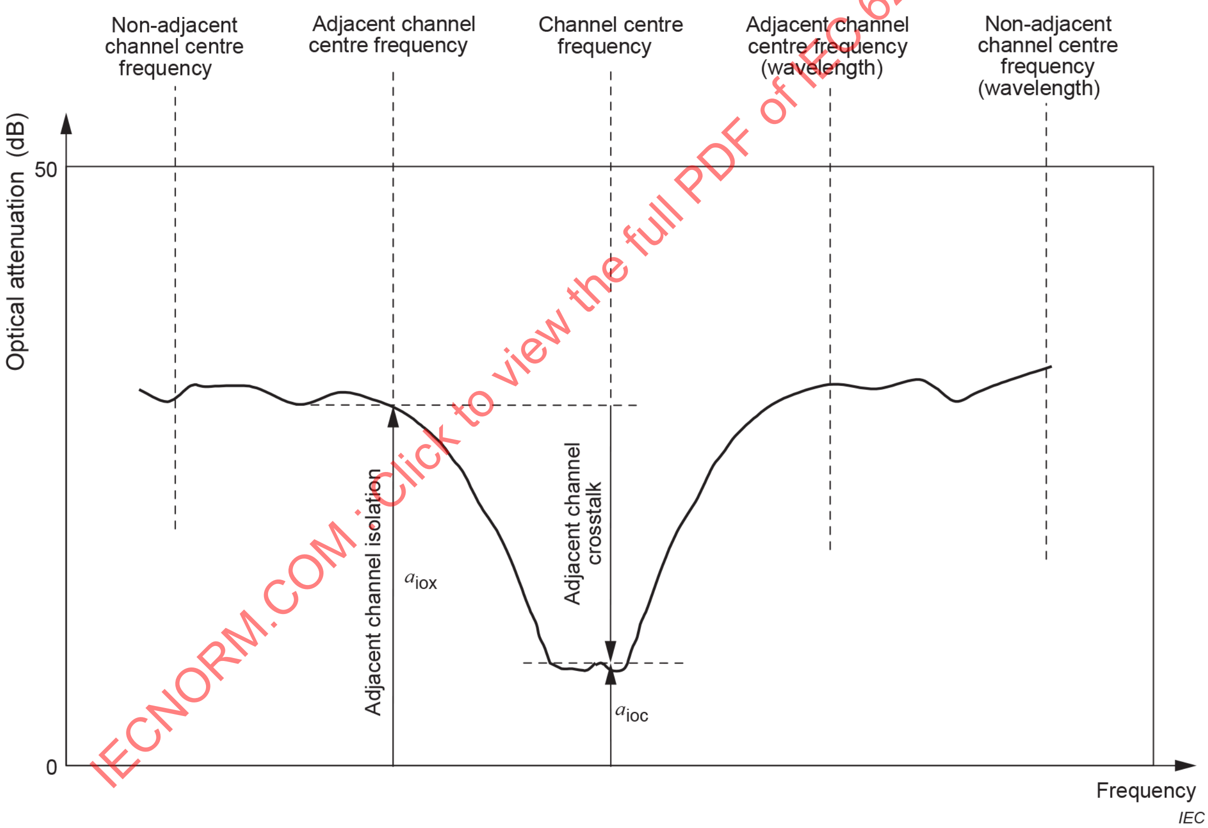



**Figure 2 – Illustration of adjacent channel crosstalk and adjacent channel isolation**

### 3.7.9
**non-adjacent channel crosstalk**
crosstalk restricted to each of the channels not immediately adjacent to the channel associated with output port

Note 1 to entry: Non-adjacent channel crosstalk is different from non-adjacent channel isolation. In Figure 3, up-pointing arrow shows positive, down-pointing arrow negative.

**3.7.10**
**non-adjacent channel isolation**
isolation restricted to each of the channels not immediately adjacent to the channel associated with output port

Note 1 to entry: The non-adjacent channel isolation is different from non-adjacent channel crosstalk. In Figure 3, up-pointing arrow shows positive, down-pointing arrow negative.

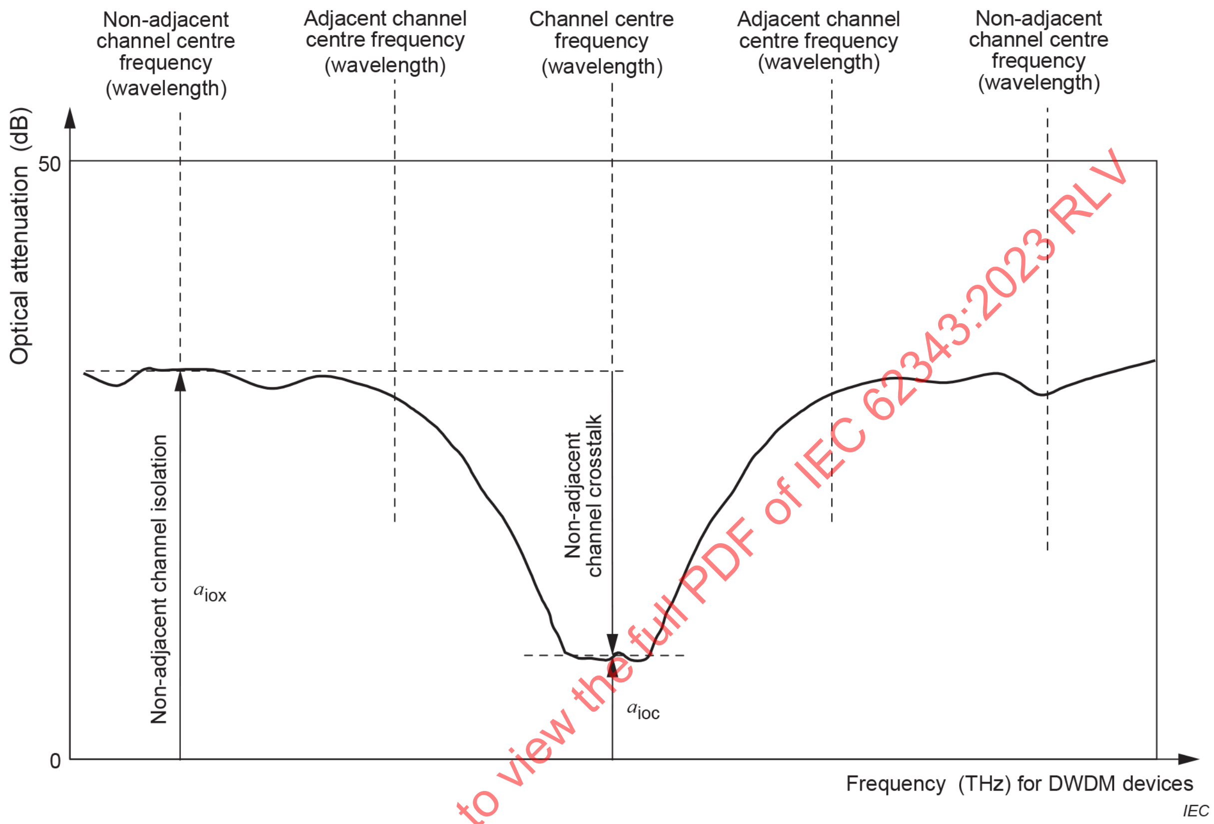



**Figure 3 – Illustration of non-adjacent channel crosstalk**



**3.7.11**
**total channel crosstalk**
total channel isolation
cumulative isolation due to the contributions at all the isolation wavelengths (frequencies) and transfer matrix coefficient for ports $i$ and $j$, $t_{ij}$ for any two ports $i$ and $j$ (where $i \neq j$)

Note 1 to entry: The total channel crosstalk is the ratio defined as

$$XT_{\text{tot}} = -10 \times \log_{10} \left[ \frac{t_{ij}(\lambda_h)}{\sum\limits_{k(k \neq h)}^{N} t_{ij}(\lambda_k)} \right]$$

where

$N$ is the number of channels of the device;

$\lambda_h$ is the nominal operating wavelength (frequency) for the two of ports, $i$ and $j$;

$\lambda_k$ are the nominal isolation wavelengths (frequencies) for the same pair of ports.

Note 2 to entry: Total channel crosstalk is also expressed by total channel isolation as in the following formula:

$$XT_{\text{tot}} = a_{ij}\left(\lambda_h\right) - I_{\text{tot}}$$

Note 3 to entry: Total channel crosstalk is a negative value in dB. For a WDM device, total channel crosstalk shall be specified as the maximum value of total channel crosstalk of all channels.

**3.7.12**
**transient crosstalk**
transient isolation
transient directivity
crosstalk that is attributed to both channel crosstalk (due to same wavelength and/or other wavelengths) and port isolation, predicted to change during switching operation in WSS module

Note 1 to entry: Hitless operation means that there is no influence on other performance during switching operation.

**3.7.13**
**channel blocking attenuation**
attenuation value when a particular channel is set in the blocking state (possible maximum attenuation)

**3.7.14**
**attenuation without power**
attenuation value when electric power for driving the attenuation is not supplied

**3.7.15**
**variable attenuation range**
attenuation value that can be changed with channel-by-channel independently controlled by driving circuit with software

**3.7.16**
**variable attenuation resolution**
resolution of the setting of attenuation value

**3.7.17**
**attenuation accuracy**
precision of attenuation value once set by driving circuit with software and includes the point of view of both repeatability and stability in the timeframe

Note 1 to entry: The attenuation accuracy is important when used in open loop operation.

**3.7.18**
**response time for attenuation**
elapsed time to change the attenuation value of any channel from an initial value to the desired value, measured from the time the actuation energy is applied

**3.7.19**
**out-of-band attenuation**
minimum attenuation of channels that fall outside of the operating wavelength range

Note 1 to entry: Out-of-band attenuation is expressed in dB.

**3.7.20**
**switching time**
$t_{\text{s}}$
time necessary for switching from isolated state to conducting state, defined as follows:

$$t_{\text{s}} = t_{\text{l}} + t_{\text{r}} + t_{\text{b}}$$

where

$t_l$ is the latency time;

$t_r$ is the rise time;

$t_b$ is the bounce time

Note 1 to entry: When switching from conducting state to isolated state, switching time ($t_s$') is defined as follows:

$$t_s' = t_l' + t_f + t_b'$$

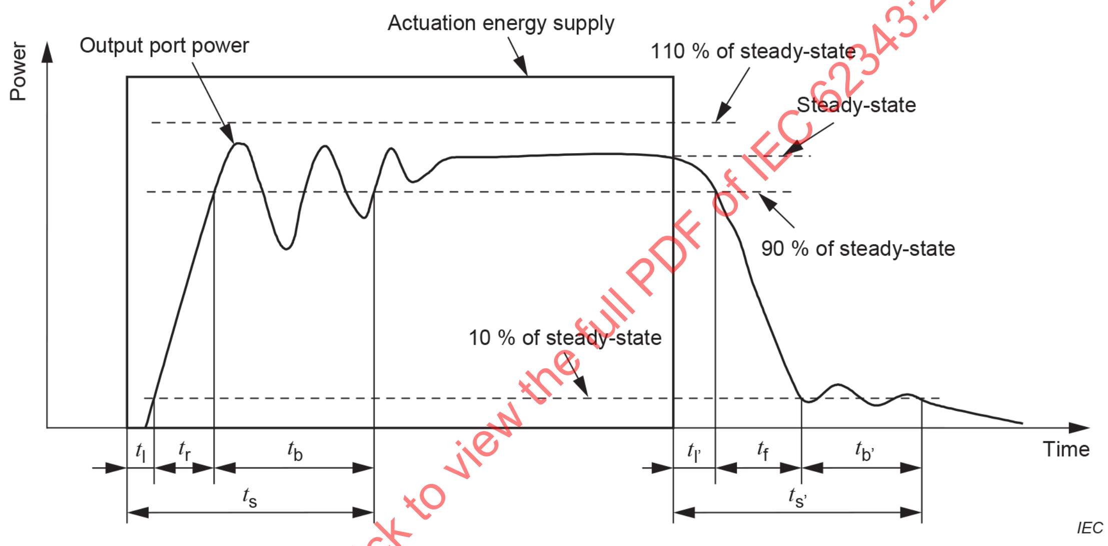
where

$t_l$' is the latency time;

$t_f$ is the fall time;

$t_b$' is the bounce time.

Note 2 to entry: See Figure 4 for an illustration of the latency, rise, bounce and switching times.




**Key**

| | |
|---|---|
| $t_s$, $t_s$' | switching times |
| $t_l$, $t_l$' | latency times |
| $t_r$ | rise time |
| $t_f$ | fall time |
| $t_b$, $t_b$' | bounce times |

**Figure 4 – Illustration of latency, rise, fall, bounce, and switching times**

Note 3 to entry: If, for any reason, the steady-state power of the isolated state is not zero, all the power levels leading to the definitions of latency time, rise time, fall time, bounce time, and thus of switching time, should be normalized subtracting from them the steady-state power of the isolated state, before applying such definitions.

**3.7.21**
**polarization dependent loss**
**PDL**
maximum variation of insertion loss due to a variation of the state of polarization (SOP) over all the SOPs

**3.7.22**
**polarization mode dispersion**
PMD
change in the shape and RMS width of a pulse due to the average delay of the travelling time between the two principal states of polarization (PSP), differential group delay (DGD), and/or to the waveform distortion for each PSP

Note 1 to entry: PMD, together with polarization dependent loss (PDL) and polarization dependent gain (PDG), when applicable, may introduce waveform distortion leading to unacceptable bit error ratio increase.

**3.7.23**
**group delay ripple**
maximum peak-to-peak variation of the group delay approximated by a desired function as wavelength (or frequency), typically a linear fit, within a channel wavelength (or frequency) range

**3.7.24**
**phase ripple**
maximum peak-to-peak variation in measured phase spectrum when compared to a quadratic fit within a channel wavelength (or frequency) range

Note 1 to entry: Phase ripple (unit: radian) is calculated as the product of a peak-to-peak group delay ripple (unit: s) and a period of group delay ripple (unit: Hz). Refer to IEC 61300-3-38.

**3.7.25**
**chromatic dispersion**
group delay difference between two closely spaced wavelengths inside an optical signal going through a pair of conducting ports of a DWDM device

Note 1 to entry: Chromatic dispersion corresponds to the difference between the arrival times of these two closely spaced wavelengths. Chromatic dispersion is defined as the variation (first order derivative) of this group delay over a range of wavelengths especially over the channel operating wavelength range at the given time, temperature, pressure and humidity. It is expressed in terms of units of ps/nm or ps/GHz, and it is a predictor of the broadening of a pulse transmitted through the module.

**3.7.26**
**maximum input power**
<single channel> allowable optical power which causes no damage by the optical power, such as degradation of adhesive or fibre fuse, as for a particular channel

**3.7.27**
**maximum input power**
<single port> allowable optical power which causes no damage by the optical power, such as degradation of adhesive or fibre fuse, as for a particular port

## 3.8 Optical multicast switch (MCS) terms and definitions

**3.8.1**
**optical multicast switch**
**MCS**
dynamic module, which has port configuration of $N$ x $M$, including $N$ of 1 x $M$ non-wavelength selective branching devices and $M$ of $N$ x 1 optical switches

Note 1 to entry: The optical switches are electrically controlled via software.

Note 2 to entry: $N \geq 2$ and $M \geq 2$, in general.

Note 3 to entry: There can be one or two $N$ x $M$ function blocks in the dynamic module. When two blocks are in one module case, one block is prepared for drop signal connection from the ROADM, and the other block is prepared for add signal connection to the ROADM.

Note 4 to entry: Generally, an add/drop functional block is connected to the $N$ port side, and a transponder functional block is connected to the $M$ port side. If required, a tuneable optical filter functional block can be inserted between the module and the transponder functional block.

Note 5 to entry: The MCS has an electrical interface to control the switches.

Note 6 to entry: Non-blocking optical switches are employed for the $N$ x 1 optical switches.

Note 7 to entry: A general functional block diagram is shown in Figure 5. It consists primarily of two optical blocks. Block 1 is configured to drop signals and block 2 to add signals.

Note 8 to entry: Generally, this module works optically in both directions: $N$ side to $M$ side as well as $M$ side to $N$ side.

Note 9 to entry: Generally, a blocking state is supported for each $M$ side port, either by a blocking state of the $N$ x 1 optical switch or by similar techniques.

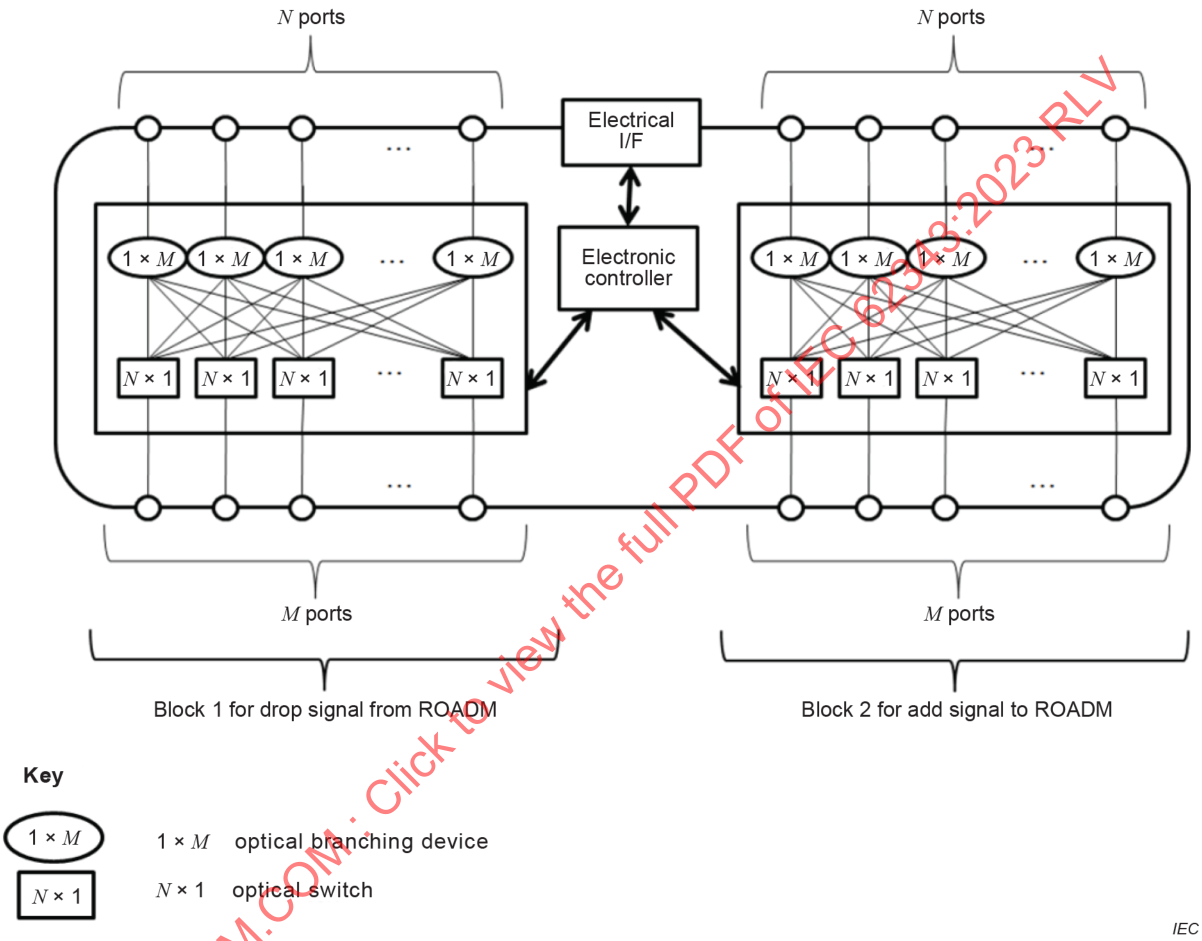



**Figure 5 – Functional block diagram of the MCS**



[SOURCE: IEC 62343-3-4:2018, 3.1, modified – The term has been changed from "multicast optical switch" to "optical multicast switch" and the notes to entry have been replaced by new ones]

**3.8.2**
***N* side insertion loss difference between different ports**
$IL_{\text{diffN}}$
difference between the maximum and minimum insertion loss at an $N$ side port for a specified set of an $M$ side port set of input ports

[SOURCE: IEC 62343-3-4:2018, 3.2, modified – The words "set of input ports" have been added.]

**3.8.3**
***M* side insertion loss difference between different ports**
$IL_{\mathrm{diffM}}$
difference between the maximum and minimum insertion loss at an $M$ side port for a specified set of an $N$ side port set of input ports

[SOURCE: IEC 62343-3-4:2018, 3.3, modified – The words "set of input ports" have been added.]

**3.8.4**
**crosstalk**
ratio of the output power at a given output port originating from a signal applied to an isolated input port to the output power at the same output port originating from a signal of the same power applied to the conducting input port

[SOURCE: IEC 62343-3-4:2018, 3.4, modified – The definition has been rephrased.]

**3.8.5**
**cumulative crosstalk**
ratio of the output power originating from the cumulative signal power applied to all relevant isolated input ports to the output power originating from the signal power applied to the conducting input port

EXAMPLE Assume output port $k$ has relevant input ports 1, 2, 3, ..., $N$ , and the conductive port pair is only input port $i$ to output port $k$, and the other input ports are in a non-conductive state relative to output port $k$. The same optical input power is applied to all input ports. The output power appearing at output port $k$ from input port $i$ is expressed as $P_i$. With this condition, cumulative crosstalk for the optical path from input port $i$ to output port $k$ is calculated as:

$$-10\log_{10}\left(\frac{\sum_{j\neq i}^{N} P_j}{P_i}\right)$$

where

$P_i$ is the optical power measured at output port $k$ with signal applied to the conductive input port $i$;

$P_j$ is the optical power measured at output port $k$ with signal applied to an isolated input port $j$.

Note 1 to entry: Generally, in an $N$ x $M$ module, cumulative crosstalk has different values for different signal directions: $N$ side to $M$ side versus $M$ side to $N$ side.

Note 2 to entry: Defined for optical input signals with averaged polarization state and same wavelength.

[SOURCE: IEC 62343-3-4:2018, 3.5, modified – The definition has been rephrased and clarifications added.]

**3.8.6**
**dynamic crosstalk**
crosstalk that is attributed to both channel crosstalk (due to same wavelength and/or other wavelengths) and port isolation, predicted to change during switching operation in MCS module

Note 1 to entry: Hitless operation means that there is no impact on other performance during the switching operation.

[SOURCE: IEC 62343-3-4:2018, 3.6]

**3.8.7**
**latency time**

**3.8.7.1**
**latency time**
$t_l$
<switching from isolated state to conducting state> elapsed time for the output power of a specified output port to reach 10 % of its steady-state value from the time the actuation energy is applied, when switching from an isolated state to conducting state, normally-off for a non-latching switch, or a latching switch optical power attenuation at the particular wavelength for the conducting port pair

Note 1 to entry: See Figure 6 (a), (b) and (c) for illustrations of the latency times in normally-off non-latching switches, normally-on non-latching switches, and latching switches.

[SOURCE: IEC 60876-1:2014, 3.3.5.1, modified – The words "optical power attenuation at the particular wavelength for the conducting port pair" have been added to the definition, and the reference to the figure has been replaced with a note to entry.]

**3.8.7.2**
**latency time**
$t_l'$
<switching from conducting state to isolated state, normally-off for a non-latching switch> elapsed time for the output power of a specified output port to reach 90 % of its steady-state value from the time the actuation energy is removed

Note 1 to entry: See Figure 6 (a) for an illustration of the latency time in a normally-off non-latching switch.

[SOURCE: IEC 60876-1:2014, 3.3.5.2, modified – The words "when switching from a conducting state to isolated state, normally-off for a non-latching switch" have been removed from the definition, and the reference to the figure has been replaced with a note to entry.]

**3.8.7.3**
**latency time**
$t_l'$
<switching from conducting state to isolated state, for a latching switch> elapsed time when the output power of a specified output port reaches 90 % of its steady-state value from the time the actuation energy is applied

Note 1 to entry: See Figure 6 (c) for an illustration of the latency time in a latching switch.

[SOURCE: IEC 60876-1:2014, 3.3.5.3 – The words "when switching from a conducting state to isolated state, for a latching switch" have been removed from the definition, the reference to the figure has been deleted, and the note to entry has been replaced with a new one.]

**3.8.8**
**rise time**
$t_r$
elapsed time when the output power of the specified output port rises from 10 % of the steady-state value to 90 % of the steady-state value

[SOURCE: IEC 60876-1:2014, 3.3.6]

**3.8.9**
**fall time**
$t_f$
elapsed time when the output power of the specified output port falls from 90 % of the steady-state value to 10 % of the steady-state value

[SOURCE: IEC 60876-1:2014, 3.3.7]

**3.8.10**
**bounce time**

**3.8.10.1**
**bounce time**
$t_b$
<switching from isolated state to conducting state> elapsed time when the output power of a specified output port maintains between 90 % and 110 % of its steady-state value from the first time the output power of a specified output port reaches to 90 % of its steady-state value

Note 1 to entry: See Figure 6 (a), (b) and (c) for illustrations of the bounce times in normally-off non-latching switches, normally-on non-latching switches, and latching switches.

[SOURCE: IEC 60876-1:2014, 3.3.8.1, modified – The reference to the figure has been replaced with a note to entry.]

**3.8.10.2**
**bounce time**
$t_b'$
<switching from conducting state to isolated state> elapsed time when the output power of a specified output port maintains between 0 % and 10 % of its steady-state value from the first time the output power of a specified output port reaches 10 % of its steady-state value

Note 1 to entry: See Figure 6 (a), (b) and (c) for illustrations of the bounce times in normally-off non-latching switches, normally-on non-latching switches, and latching switches.

[SOURCE: IEC 60876-1:2014, 3.3.8.2, modified – The reference to the figure has been replaced with a note to entry.]

**3.8.11**
**switching time**

**3.8.11.1**
**switching time**
$t_s$
<switching from isolated state to conducting state> sum of latency time, rise time, and bounce time, defined as

$$t_s = t_l + t_r + t_b$$

where

$t_l$ is the latency time;

$t_r$ is the rise time;

$t_b$ is the bounce time

Note 1 to entry: See Figure 6 (a), (b) and (c) for illustrations of the switching times in normally-off non-latching switches, normally-on non-latching switches, and latching switches.

[SOURCE: IEC 60876-1:2014, 3.3.9.1, modified – Rephrased and note 1 to entry added.]

**3.8.11.2**
**switching time**
$t_s'$
<switching from conducting state to isolated state> sum of latency time, fall time, and bounce time, defined as

$$t_s' = t_l' + t_f + t_b'$$

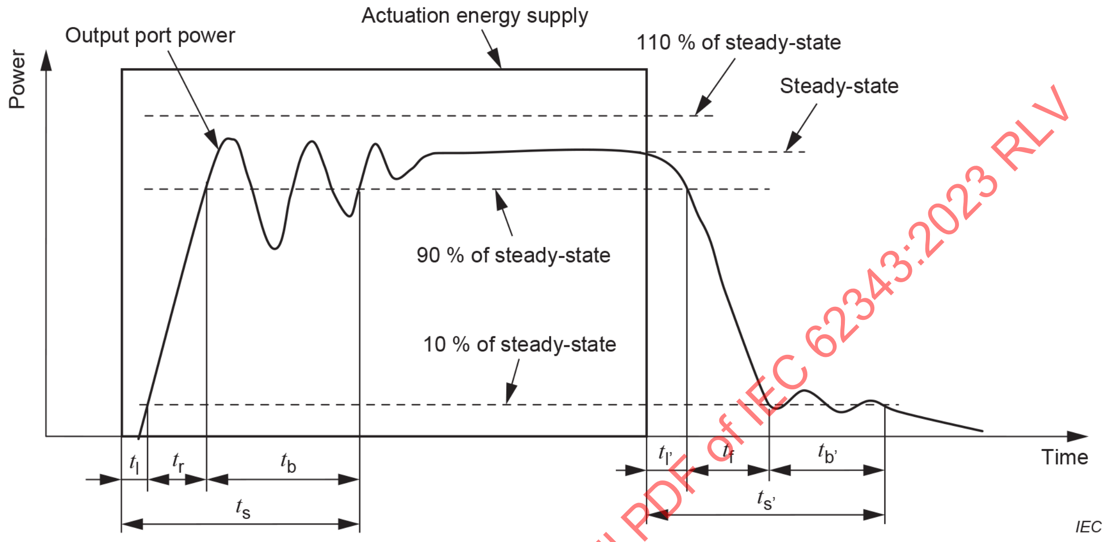
where

$t_l'$ is the latency time;

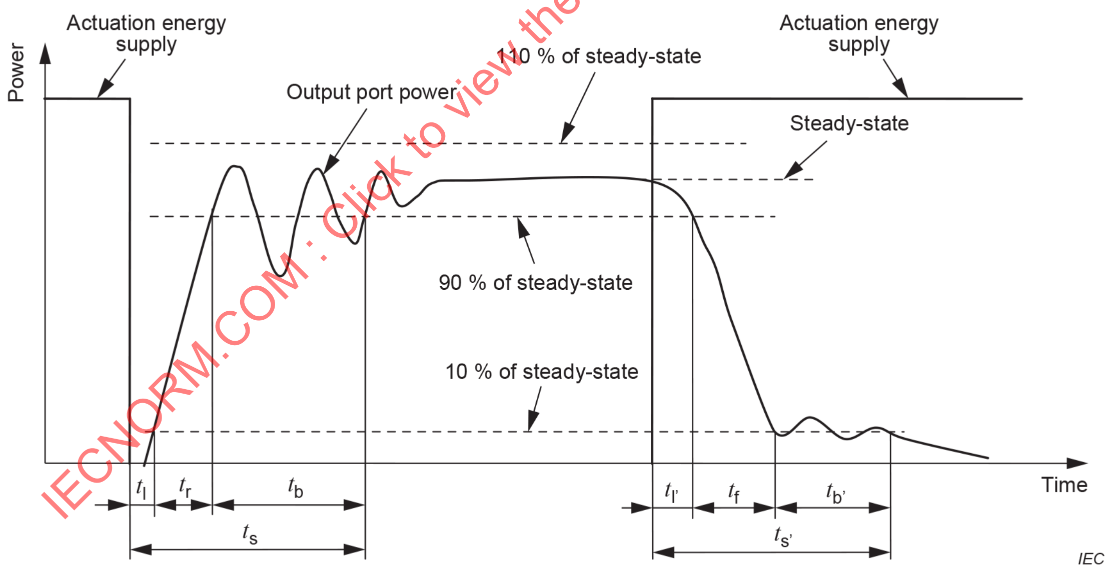
$t_f$ is the fall time;

$t_b'$ is the bounce time

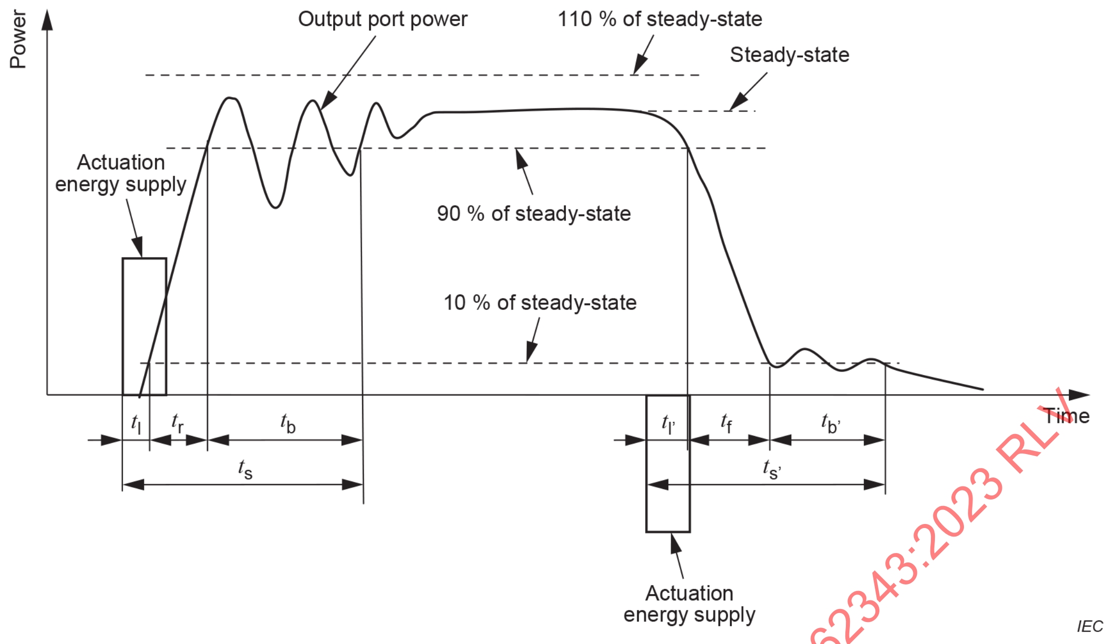
Note 1 to entry: See Figure 6 (a), (b) and (c) for illustrations of the switching times in normally-off non-latching switches, normally-on non-latching switches, and latching switches.




**(a) Non-latching switch, normally-off**




**(b) Non-latching switch, normally-on**




(c) **Latching switch**

**Key**

| | |
|---|---|
| $t_s$, $t_s$' | switching times |
| $t_l$, $t_l$' | latency times |
| $t_r$ | rise time |
| $t_f$ | fall time |
| $t_b$, $t_b$' | bounce times |

**Figure 6 – Illustration of latency, rise, fall, bounce, and switching times**

Note 2 to entry: If for any reason, the steady-state power of the isolated state is not zero, all the power levels leading to the definitions of latency time, rise time, fall time, bounce time and, thus, of switching time should be normalized, subtracting from them the steady-state power of the isolated state, before applying such definitions.

[SOURCE: IEC 60876-1:2014, 3.3.9.2, modified – Rephrased and note 2 to entry added.]

**3.8.12**
**switching time matrix**
matrix of coefficients in which each coefficient $S_{ij}$ is the longest switching time to turn path $ij$ on or off from any initial state

[SOURCE: IEC 60876-1:2014, 3.3.10, modified – The figure and note to entry have been deleted.]

**3.8.13**
**phase ripple**
maximum peak-to-peak variation in measured phase spectrum when compared to a quadratic fit within a channel wavelength (or frequency) range

Note 1 to entry: Phase ripple (unit: radian) is calculated as the product of a peak-to-peak group delay ripple (unit: s) and a period of group delay ripple (unit: Hz). Refer to IEC 61300-3-38.

**3.8.14**
**chromatic dispersion**
group delay difference between two closely spaced wavelengths inside an optical signal going through a pair of conducting ports of a DWDM device

Note 1 to entry: The chromatic dispersion corresponds to the difference between the arrival times of these two closely spaced wavelengths. Chromatic dispersion is defined as the variation (first order derivative) of this group delay over a range of wavelengths especially over the channel operating wavelength range at the given time, temperature, pressure and humidity. It is expressed in terms of units of ps/nm or ps/GHz and it is a predictor of the broadening of a pulse transmitted through the module.

**3.8.15**
**maximum input power to single port**
allowable optical power applied to a particular port that causes no damage of the MCS by the optical signal, such as degradation of adhesives or fibre fuse

[SOURCE: IEC 62343-3-4:2018, 3.17, modified – The definition has been rephrased.]

# 4 Requirements

## 4.1 General

The IEC 62343 series comprises various parts, each of which addresses a different standardization aspect, as shown in Table 1. Each part consists of a subseries of documents.

**Table 1 – Document structure of the IEC 62343 series**

| Part number | Title of subseries |
|---|---|
| IEC 62343-1 | Performance standards |
| IEC 62343-2 | Reliability qualification standards |
| IEC 62343-3 | Performance specification templates |
| IEC 62343-4 | Software and hardware interface standards |
| IEC 62343-5 | Test methods |
| IEC TR 62343-6 | Design guidelines [a] |
| [a] Original title: "Design guides". | |

## 4.2 Performance standards and performance specification templates

Performance standards (IEC 62343-1 subseries) shall contain the following items:

– test;
– test report;
– performance requirements;
  i) dimensions;
  ii) sample size (and test sequence if necessary);
  iii) test details and requirements (i.e. performance parameters with units, pass/fail criteria, and measurement methods, if possible).

Other items may be added as needed.

Performance specification templates (IEC 62343-3 subseries) shall contain templates listing:

– performance parameters with units;
– measurement methods (if possible).

Other items may be added as needed.

### 4.3 Quality assessment

Reliability qualifications are standardized in the IEC 62343-2 subseries.

### 4.4 Control interface standards

Control interface standards (IEC 62343-4 subseries) shall contain the following items:

– basic configurations (if necessary);
– software interfaces (if used);
– hardware interfaces (including electrical connectors, if necessary).

Other items may be added as needed.

### 4.5 Test methods

Test methods standards (IEC 62343-5 subseries) shall contain the following items:

– test apparatus;
– measurement conditions (if necessary);
– test procedure;
– calculations (if necessary);
– test or measurement report.

Other items may be added as needed.

### 4.6 Operating, storage and transportation conditions

Operating, storage and transportation conditions are described in IEC 62343-1.

### 4.7 Product identification for storage and shipping

The following items shall be defined in the relevant specifications (e.g. product specifications):

– product marking and/or labelling;
– identification of manufacturing and/or shipping date (year/month/week);
– port identification (if necessary);
– packaging.

Other items may be added as needed.

## 5 Electromagnetic compatibility (EMC) requirements

The devices and assemblies addressed by the IEC 62343 series shall comply with suitable requirements for electromagnetic compatibility (in terms of both emission and immunity), depending on specific usage and environment in which they are intended to be installed or integrated. EMC requirements are standardized in the IEC 61000 series.

## 6 Safety requirements

The devices and assemblies addressed by the IEC 62343 series shall comply with suitable requirements for safety including laser radiation safety. Safety requirements for audio/video, information, and communication technology equipment are standardized in the IEC 62368 series, and laser safety requirements are standardized in the IEC 60825 series.

# Bibliography


IEC 60825 (all parts), *Safety of laser products*

IEC 60876-1:2014, *Fibre optic interconnecting devices and passive components – Fibre optic spatial switches – Part 1: Generic specification*

IEC 61000 (all parts), *Electromagnetic compatibility (EMC)*

IEC 61290 (all parts), *Optical amplifiers – Test methods*

IEC 61291 (all parts), *Optical amplifiers*

IEC TR 61292 (all parts), *Optical amplifiers*

IEC 61300 (all parts), *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures*

IEC 61300-3-38, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-38: Examinations and measurements – Group delay, chromatic dispersion and phase ripple*

IEC 61753 (all parts), *Fibre optic interconnecting devices and passive components – Performance standard*

IEC 62343 (all parts), *Dynamic modules*

IEC 62343-1 (all parts), *Dynamic modules – Performance standards*

IEC 62343-2-1, *Dynamic modules – Part 2-1: Reliability qualification – Test template*

IEC 62343-3 (all parts), *Dynamic modules – Performance specification templates*

IEC 62343-3-1:2016, *Dynamic modules – Part 3-1: Performance specification templates – Dynamic channel equalizers*

IEC 62343-3-2:2016, *Dynamic modules – Part 3-2: Performance specification templates – Optical channel monitor*

IEC 62343-3-3:2020, *Dynamic modules – Part 3-3: Performance specification templates – Wavelength selective switches*

IEC 62343-3-4:2018, *Dynamic modules – Part 3-4: Performance specification templates – Multicast optical switches*

IEC 62343-4 (all parts), *Dynamic modules – Part 4: Software and hardware interface*

IEC 62343-4-1:2016, *Dynamic modules – Part 4-1: Software and hardware interface – 1 x 9 wavelength selective switch*

IEC 62343-5 (all parts), *Dynamic modules – Part 5: Test methods*

IEC 62343-6 (all parts), *Dynamic modules – Part 6: Design guides*

IEC 62368 (all parts), *Audio/video, information and communication technology equipment*

IEC TS 62538:2008, *Categorization of optical devices*

IEC TS 62627-09:2016, *Fibre optic interconnecting devices and passive components – Vocabulary for passive optical devices*

ITU-T G.694.1, *Spectral grids for WDM applications: DWDM frequency grid*

ITU-T G.692, *Optical interfaces for multichannel system with optical amplifiers*

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SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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# MODULES DYNAMIQUES – SPÉCIFICATION GÉNÉRIQUE

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9) L'attention est attirée sur le fait que certains des éléments de la présente Publication de l'IEC peuvent faire l'objet de droits de brevet. L'IEC ne saurait être tenue pour responsable de ne pas avoir identifié de tels droits de brevets.

L'IEC 62343 a été établie par le sous-comité 86C: Systèmes et dispositifs actifs à fibres optiques, du comité d'études 86 de l'IEC: Fibres optiques. Il s'agit d'une Norme internationale.

Cette troisième édition annule et remplace la deuxième édition parue en 2017. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) ajout de termes et de définitions relatifs aux commutateurs optiques multidiffusions (3.8);
b) révision de l'Article 4 énumérant les exigences relatives aux normes de la série IEC 62343;
c) ajout de l'Article 6 (Exigences de sécurité).

Le texte de cette Norme internationale est issu des documents suivants:

| Projet | Rapport de vote |
|---|---|
| 86C/1803/CDV | 86C/1827/RVC |

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/publications.

Une liste de toutes les parties de la série IEC 62343, publiées sous le titre général *Modules dynamiques*, se trouve sur le site web de l'IEC.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous webstore.iec.ch dans les données relatives au document recherché. A cette date, le document sera

- reconduit,
- supprimé,
- remplacé par une édition révisée, ou
- amendé.

# INTRODUCTION

Le présent docoument s'applique aux dispositifs dynamiques tels que définis dans l'IEC TS 62538. Le présent document contient les lignes directrices générales pour la série IEC 62343 portant sur les dispositifs dynamiques, et les définitions qui s'y appliquent. Un dispositif ou un module dynamique (DM) a deux caractéristiques distinctives: dynamique et module.

"Dynamique" indique que les fonctions des produits incluent "le réglage, la variation, la commutation, la configuration et d'autres optimisations continues", souvent réalisés par des circuits électroniques, des logiciels ou des microprogrammes, ou une combinaison des deux. Un dispositif dynamique a généralement un certain niveau d'intelligence pour contrôler ou mesurer sa configuration ou ses réglages et prendre des décisions sur les actions nécessaires (optimisation). Le comportement des modules dynamiques peut être caractérisé par des caractéristiques transitoires lorsque le module dynamique fait l'objet d'un réglage, d'une commutation, d'une configuration et d'autres optimisations continues. La caractérisation des caractéristiques transitoires est prise en considération dans chaque norme sur les modules dynamiques.

"Module" définit que les produits couverts par le présent document sont l'intégration de composants actifs et passifs (l'un ou l'autre ou les deux), en interconnectant des matériaux ou des dispositifs. L'électronique de commande peut être à l'intérieur ou à l'extérieur du boîtier optique qui contient la totalité ou la majeure partie des interconnexions et des composants optiques. Le produit peut être une petite carte imprimée ou une carte fille sur laquelle est monté un module optique, ou un petit boîtier enfermant les composants optiques et les composants électroniques. Dans le premier cas, il s'agit plutôt d'un ensemble (c'est-à-dire généralement non placé dans un boîtier) que d'un module (c'est-à-dire généralement placé dans un boîtier).

Pour des raisons historiques et par commodité, les dispositifs ou modules dynamiques sont appelés modules dynamiques dans la série IEC 62343.

Le nombre de modules et de dispositifs dynamiques augmente rapidement à mesure que les réseaux de communications optiques évoluent. La liste suivante présente des exemples de produits couverts par la série IEC 62343. Il convient de noter que la liste n'est pas exhaustive et que les produits à couvrir ne sont pas limités par les exemples donnés:

- égaliseur de gain de canal de transmission;
- égaliseur de canal de transmission dynamique;
- égaliseur dynamique de basculement de gain;
- égaliseur dynamique de pente;
- compensateur de dispersion chromatique réglable;
- compensateur de dispersion de mode de polarisation;
- multiplexeur optique d'insertion-extraction reconfigurable;
- commutateur avec contrôle et commande;
- affaiblisseur optique variable avec contrôle et commande;
- contrôleur de canal de transmission optique;
- commutateur sélectif en longueur d'onde;
- commutateur optique multidiffusion.

La série IEC 62343 couvre des modèles de performance, des normes de performance, des exigences relatives à la qualification de la fiabilité, des interfaces matérielles et logicielles et des méthodes d'essais associées.

La structure de la série IEC 62343, sous le titre général *Modules dynamiques,* est la suivante:

- Série IEC 62343-1 Partie 1: Normes de performance
- Série IEC 62343-2 Partie 2: Qualification de fiabilité
- Série IEC 62343-3 Partie 3: Modèles de spécification de performance
- Série IEC 62343-4 Partie 4: Interface logicielle et matérielle
- Série IEC 62343-5 Partie 5: Méthodes d'essai
- Série IEC 62343-6 Partie 6: Lignes directrices de conception

Il convient qu'un ensemble complet de normes relatif à un dispositif ou un module dynamique inclue les éléments suivants:

- normes de performance optique;
- normes de qualification de fiabilité;
- modèles de spécification de performance optique;
- normes d'interfaces matérielles et logicielles;
- méthodes d'essai;
- rapports techniques.

Les normes de sécurité se rapportant aux modules dynamiques sont principalement des considérations sur la puissance optique, traitées par la série IEC 60825.

Seuls les modules dynamiques pour lesquels des normes existent ou sont en cours d'établissement sont inclus dans l'Article 3. Pour refléter le marché des modules dynamiques se développant rapidement, d'autres termes et définitions sont amenés à être ajoutés dans des révisions suivantes à mesure que la série se développe.

Il convient de noter que les amplificateurs optiques peuvent être considérés comme des modules dynamiques. Ils ne sont pas inclus dans la série IEC 62343, mais ils sont couverts dans leur propre série de normes IEC.

# MODULES DYNAMIQUES – SPÉCIFICATION GÉNÉRIQUE

## 1 Domaine d'application

Le présent document s'applique à tous les dispositifs et modules dynamiques optiques disponibles dans le commerce. Elle décrit les produits couverts par la série IEC 62343, définit la terminologie, les considérations fondamentales et les approches de base.

Le présent document a pour objets:

- d'établir des exigences uniformes pour le fonctionnement, la fiabilité et les propriétés environnementales des modules dynamiques (DM) à intégrer dans la norme appropriée sur les modules dynamiques, et
- d'aider l'acheteur à choisir des produits à modules dynamiques de haute qualité dans le cadre de ses applications particulières et à consulter les normes appropriées sur les modules dynamiques spécifiques.

Le présent document couvre les modèles de performance, les normes de performance, les exigences sur la qualification de la fiabilité, les interfaces matérielles et logicielles et les méthodes d'essais associées.

Puisqu'un module dynamique intègre un module ou un dispositif optique, une carte imprimée et un logiciel ou un microprogramme, les normes développées dans la série calquent des normes existantes appropriées. D'autre part, un "module dynamique" étant une catégorie de produit relativement nouvelle, la série de normes sur les modules dynamiques n'est pas limitée par les pratiques existantes dans lesquelles les exigences diffèrent.

Les normes de sécurité se rapportant aux modules dynamiques sont principalement des considérations sur la puissance optique, qui sont traitées par la série IEC 60825 (voir l'Article 6).



## 2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60050-731, *Vocabulaire Electrotechnique International – Chapitre 731: Télécommunications par fibres optiques* (disponible sous www.electropedia.org)

IEC TR 61931, *Fibres optiques – Terminologie*

## 3 Termes et définitions

Pour les besoins du présent document, les termes et les définitions de l'IEC 60050-731, l'IEC TR 61931 ainsi que les suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse https://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse https://www.iso.org/obp

NOTE 1 Certains termes et définitions inclus dans le présent document ont d'abord été publiés dans la série IEC 62343. Après la publication du présent document, ces termes et définitions vont être supprimés de la série IEC 62343 lors de la révision de la série et une référence va être faite à l'IEC 62343.

NOTE 2 Les termes et définitions indiqués à l'Article 3 se rapportent à la signification des termes et définitions utilisés dans les spécifications des modules dynamiques. Il est prévu que seuls les paramètres énumérés dans la norme de performance appropriée de la série IEC 62343-1 et dans les modèles de spécification de performance de la série IEC 62343-3 sont spécifiés.

NOTE 3 La liste des définitions de paramètres de modules dynamiques données à l'Article 3 est divisée en paragraphes en fonction du type de module dynamique.

## 3.1 Termes et définitions généraux

**3.1.1**
**dispositif dynamique optique**
dispositif optique conçu pour contrôler et commander de manière dynamique certaines caractéristiques d'un ou de plusieurs signaux optiques, au moyen de commandes électroniques appropriées, afin d'améliorer ou de maintenir des performances définies du système dans lequel il est destiné à être inséré

Note 1 à l'article: Lesdites caractéristiques peuvent inclure des chemins optiques, des intensités optiques, des caractéristiques spectrales, des états de polarisation, de la dispersion, etc.

Note 2 à l'article: Les dispositifs dynamiques optiques peuvent comporter des éléments ou des composants optiques passifs et actifs.

Note 3 à l'article: Le temps de réponse ou de commande des dispositifs dynamiques optiques est bien plus grand que les caractéristiques temporelles des signaux et peut typiquement se trouver dans une plage allant de quelques microsecondes à des dizaines de secondes.

[SOURCE: En anglais, IEC TS 62538:2008, 2.1.1]

**3.1.2**
**module optique**
boîtier comprenant des composants et/ou des éléments optiques réalisant une fonctionnalité définie, typiquement réparable et retouchable

[SOURCE: En anglais, IEC TS 62538:2008, 2.2.5]

## 3.2 Termes et définitions relatifs aux modules dynamiques

**3.2.1**
**canal**
signal à la longueur d'onde, $\lambda$, qui correspond à la grille UIT (Recommandation UIT-T G.694.1) dans la plage de longueurs d'onde de fonctionnement

**3.2.2**
**plage de longueurs d'onde de fonctionnement**
intervalle spécifié de longueurs d'onde de $\lambda_{\text{imin}}$ à $\lambda_{\text{imax}}$ autour d'une longueur d'onde de fonctionnement nominale $\lambda_{\text{I}}$, dans lequel un module optique dynamique est conçu pour fonctionner avec des performances spécifiées

**3.2.3**
**plage de fréquences du canal de transmission**
plage de fréquences à l'intérieur de laquelle un dispositif est destiné à fonctionner avec des performances spécifiées

Note 1 à l'article: Pour une fréquence centrale du canal de transmission nominale particulière, $f_{\text{nomi}}$, la fréquence du canal va de $f_{\text{imin}} = (f_{\text{nomi}} - \Delta f_{\text{max}})$ à $f_{\text{imax}} = (f_{\text{nomi}} + \Delta f_{\text{max}})$, $\Delta f_{\text{max}}$ étant l'écart maximal de la fréquence centrale du canal de transmission.

**3.2.4**
**espacement entre canaux de transmission**
différence centre-à-centre en fréquence (ou longueur d'onde) entre des canaux de transmission adjacents à l'intérieur d'un dispositif

## 3.3 Termes et définitions relatifs à l'égaliseur de canal de transmission dynamique (DCE)

**3.3.1**
**égaliseur de canal de transmission dynamique**
**DCE**
dispositif capable de transformer, par commande automatique interne ou externe, un signal d'entrée multicanal de transmission avec des puissances moyennées qui varient dans le temps en un signal de sortie dans lequel toutes les puissances de canal de transmission de travail sont nominalement égales ou réglées pour un niveau exigé de préaccentuation

Note 1 à l'article: Un DCE peut aussi assurer l'extinction d'un ou de plusieurs canaux de transmission d'entrée.

Note 2 à l'article: L'abréviation "DCE" est dérivée du terme anglais développé correspondant "dynamic channel equalizer".

**3.3.2**
**manque d'uniformité du canal de transmission**
différence entre les puissances du canal de transmission ayant la plus grande puissance (en dBm) et du canal de transmission ayant la puissance la plus faible (en dBm)

Note 1 à l'article: Le manque d'uniformité du canal de transmission s'applique à un signal multicanal de transmission sur la plage de longueurs d'onde de fonctionnement.

Note 2 à l'article: Le manque d'uniformité du canal de transmission est exprimé en dB.

**3.3.3**
**rapport d'extinction intrabande**
différence, dans la plage de longueurs d'onde de fonctionnement, entre la puissance minimale des canaux de transmission non éteints (en dBm) et la puissance maximale des canaux de transmission éteints (en dBm)

Note 1 à l'article: Le rapport d'extinction intrabande est exprimé en dB.

**3.3.4**
**affaiblissement hors bande**
affaiblissement des canaux de transmission qui sont hors des limites de la plage de longueurs d'onde de fonctionnement

Note 1 à l'article: L'affaiblissement hors bande est exprimé en dB.

**3.3.5**
**ondulation**
différence crête-à-crête de perte d'insertion à l'intérieur d'une plage de fréquences (ou de longueurs d'onde) de canal de transmission

**3.3.6**
**temps de réponse du canal de transmission**
temps nécessaire pour qu'un dispositif transforme un canal de transmission d'un niveau de puissance initial spécifié à un niveau de puissance final spécifié désiré, lorsque la tolérance de manque d'uniformité du canal de transmission de sortie qui en résulte est satisfaite, mesuré à partir du moment où l'énergie de mise en œuvre est appliquée ou retirée

## 3.4 Termes relatifs au compensateur de dispersion réglable (TDC) ou compensateur de dispersion chromatique dynamique (DCDC)

**3.4.1**
**compensateur de dispersion réglable**
**TDC**
**compensateur de dispersion chromatique dynamique**
**DCDC**
dispositif à deux accès alignés capable de transformer, par une commande automatique interne ou externe, un signal d'entrée avec une dispersion variable dans le temps en un signal de sortie pour lequel une valeur de dispersion de canal de transmission de sortie est établie pour un niveau exigé de valeur

Note 1 à l'article: L'abréviation "TDC" est dérivée du terme anglais développé correspondant "tuneable dispersion compensator" et "DCDC" de "dynamic chromatic dispersion compensator".

**3.4.2**
**variation de perte d'insertion**
variation crête-à-crête maximale de la perte d'insertion dans une plage de fréquences (ou de longueurs d'onde) de canal de transmission

**3.4.3**
**temps de réglage de la dispersion**
temps le plus long écoulé nécessaire pour qu'un module change un réglage de dispersion pour passer d'une valeur de dispersion initiale arbitraire à une valeur de dispersion finale souhaitée, lorsque la tolérance cible de dispersion qui en résulte est atteinte

## 3.5 Termes et définitions relatifs à l'égaliseur dynamique de basculement de gain (DGTE)

**3.5.1**
**égaliseur spectral dynamique**
**DSE**
module dynamique à deux accès en ligne qui convertit un signal d'entrée dont la forme spectrale varie dans le temps en un signal de sortie dans lequel la forme spectrale est nominalement plate ou est réglée pour une forme spectrale exigée de préaccentuation

Note 1 à l'article: L'abréviation "DSE" est dérivée du terme anglais développé correspondant "dynamic spectral equalizer".

**3.5.2**
**égaliseur dynamique de basculement de gain**
**DGTE**
égaliseur spectral dynamique utilisé dans un amplificateur optique qui convertit des signaux d'entrée dont le basculement de gain varie dans le temps en signaux de sortie dans lesquels le basculement de gain est nominalement plat ou est réglé pour un basculement de gain exigé

Note 1 à l'article: L'abréviation "DGTE" est dérivée du terme anglais développé correspondant "dynamic gain tilt equalizer".

**3.5.3**
**plage de basculement de gain dynamique**
différence entre l'écart maximal et l'écart minimal d'affaiblissement, sur une plage de longueurs d'onde de fonctionnement sur laquelle l'égaliseur dynamique de basculement de gain peut être réglé

**3.5.4**
**type de pente positive**
type de DGTE pour lequel la plage de basculement de gain dynamique peut être réglée sur un basculement de gain positif

**3.5.5**
**type de pente négative**
type de DGTE pour lequel la plage de basculement de gain dynamique peut être réglée sur un basculement de gain négatif

**3.5.6**
**type à deux pentes**
type de DGTE pour lequel la plage de basculement de gain dynamique peut être réglée sur un basculement de gain positif et un basculement de gain négatif

**3.5.7**
**linéarité de la pente**
écart maximal d'affaiblissement entre la forme spectrale introduite par l'égaliseur dynamique de basculement de gain et la pente linéaire, sur la plage de longueurs d'onde de fonctionnement

**3.5.8**
**temps de réponse**
<égaliseur dynamique de basculement de gain> temps le plus long nécessaire pour qu'un égaliseur dynamique de basculement de gain modifie un réglage de basculement de gain pour passer d'une valeur initiale arbitraire à une valeur finale souhaitée, lorsque la tolérance cible de basculement de gain qui en résulte est atteinte

## 3.6 Termes et définitions relatifs au contrôleur de canal de transmission optique (OCM)

**3.6.1**
**plan du canal d'entrée**
ensemble des canaux de transmission selon l'UIT sur lesquels porte le rapport du contrôleur de canal de transmission optique

**3.6.2**
**tolérance sur l'espacement de fréquence du canal d'entrée**
différence centre-à-centre en fréquence (ou longueur d'onde) entre des canaux de transmission adjacents à l'intérieur d'un dispositif

**3.6.3**
**plage dynamique de puissance du canal d'entrée**
plage entière de puissance d'entrée par canal de transmission entre les limites de saturation et de sensibilité

**3.6.4**
**manque d'uniformité des canaux d'entrée**
différence entre les puissances du canal de transmission ayant la plus grande puissance (en dBm) et du canal de transmission ayant la puissance la plus faible (en dBm) pendant une mesure dans le temps de réponse

Note 1 à l'article: Le manque d'uniformité des canaux d'entrée s'applique à un signal multicanal de transmission sur la plage de longueurs d'onde de fonctionnement.

Note 2 à l'article: Le manque d'uniformité des canaux d'entrée est exprimé en dB.

**3.6.5**
**manque d'uniformité de canaux d'entrée adjacents**
différence entre les puissances de canaux de transmission adjacents présents pendant une mesure dans le temps de réponse

Note 1 à l'article: Le manque d'uniformité de canaux d'entrée adjacents s'applique à un signal multicanal de transmission sur la plage de longueurs d'onde de fonctionnement.

Note 2 à l'article: Le rapport d'extinction intrabande est exprimé en dB.

**3.6.6**
**manque d'uniformité des canaux d'entrée concernant l'identification de canaux de transmission**
différence entre les puissances du canal de transmission ayant la plus grande puissance et du canal de transmission ayant la puissance la plus faible pendant une mesure dans le temps de réponse pour identifier positivement tous les canaux de transmission présents et ne pas identifier à tort des canaux de transmission qui ne sont pas présents

Note 1 à l'article: Le manque d'uniformité des canaux d'entrée concernant l'identification de canaux de transmission s'applique à un signal multicanal de transmission sur la plage de longueurs d'onde de fonctionnement.

Note 2 à l'article: Le rapport d'extinction intrabande est exprimé en dB.

**3.6.7**
**manque d'uniformité de canaux d'entrée adjacents concernant l'identification de canaux de transmission**
différence entre les puissances de canaux de transmission adjacents présents pendant une mesure dans le temps de réponse pour identifier positivement tous les canaux de transmission présents et ne pas identifier à tort des canaux de transmission qui ne sont pas présents

Note 1 à l'article: Le manque d'uniformité de canaux d'entrée adjacents concernant l'identification de canaux de transmission s'applique à un signal multicanal de transmission sur la plage de longueurs d'onde de fonctionnement.

Note 2 à l'article: Le rapport d'extinction intrabande est exprimé en dB.

**3.6.8**
**plage dynamique de puissance de la bande totale d'entrée concernant les mesures d'un canal de transmission**
plage entière de puissance de la bande totale d'entrée entre les limites de saturation et de sensibilité des mesures d'un canal de transmission

**3.6.9**
**plage dynamique de puissance de la bande totale d'entrée concernant les mesures de puissance de la bande totale**
plage entière de puissance de la bande totale d'entrée entre les limites de saturation et de sensibilité des mesures de puissance de la bande totale

**3.6.10**
**plage dynamique de rapport signal/bruit optique (OSNR) d'entrée**
plage entière d'OSNR d'entrée par canal de transmission dans laquelle les mesures de puissance, de puissance de la bande totale et d'OSNR ne dépassent pas leurs limites d'erreur spécifiées respectivement

**3.6.11**
**débits binaires des canaux d'entrée**
liste des débits binaires auxquels n'importe quel canal de transmission peut être modulé

**3.6.12**
**largeur de bande de la mesure de référence**
largeur de bande d'intégration de la mesure de la puissance optique

**3.6.13**
**largeur de bande équivalente de bruit**
largeur de bande d'intégration de la mesure du bruit optique

**3.6.14**
**erreur absolue de puissance d'un canal de transmission**
différence maximale entre la puissance d'un canal de transmission mesurée et la puissance d'un canal de transmission de référence étalonnée, dans la largeur de bande d'intégration de mesure spécifiée, pendant une mesure dans le temps de réponse, spécifiée sur toutes les plages d'entrée et de fonctionnement

**3.6.15**
**erreur relative de puissance d'un canal de transmission**
variation maximale de l'erreur absolue de puissance d'un canal de transmission, pendant une mesure dans le temps de réponse, spécifiée sur toutes les plages d'entrée et de fonctionnement

**3.6.16**
**variabilité de la puissance d'un canal de transmission**
variation maximale de l'erreur absolue de puissance d'un canal de transmission sur l'intervalle de temps de répétabilité dans des conditions d'entrée et de fonctionnement données, spécifiée sur toutes les plages d'entrée et de fonctionnement

**3.6.17**
**intervalle de résolution de puissance d'un canal de transmission**
plus petit incrément de la valeur de mesure de puissance d'un canal de transmission rapportée

**3.6.18**
**erreur dépendant de la polarisation de la puissance d'un canal de transmission**
différence maximale de mesure de puissance sur tous les états de polarisation dans des conditions d'entrée et de fonctionnement données, pendant une mesure dans le temps de réponse, spécifiée sur toutes les plages d'entrée et de fonctionnement

**3.6.19**
**erreur absolue de puissance de la bande totale**
différence entre la puissance totale mesurée et la référence de puissance totale étalonnée, chacune intégrée sur la bande de fréquences, pendant une mesure dans le temps de réponse, spécifiée sur toutes les plages d'entrée et de fonctionnement

**3.6.20**
**erreur relative de puissance de la bande totale**
variation maximale de l'erreur absolue de la bande totale, pendant une mesure dans le temps de réponse, spécifiée sur toutes les plages d'entrée et de fonctionnement

**3.6.21**
**variabilité de puissance de la bande totale**
variation maximale de l'erreur absolue de puissance de la bande totale sur l'intervalle de temps de répétabilité dans des conditions d'entrée et de fonctionnement données, spécifiée sur toutes les plages d'entrée et de fonctionnement

**3.6.22**
**intervalle de résolution de puissance de la bande totale**
plus petit incrément de la valeur de mesure de puissance de la bande totale rapportée

**3.6.23**
**erreur de fréquence absolue**
différence maximale entre la fréquence mesurée et la fréquence de référence étalonnée, pendant une mesure dans le temps de réponse, spécifiée sur toutes les plages d'entrée et de fonctionnement

**3.6.24**
**erreur de fréquence relative**
variation maximale de l'erreur absolue de fréquence, pendant une mesure dans le temps de réponse, spécifiée sur toutes les plages d'entrée et de fonctionnement

**3.6.25**
**variabilité de fréquence**
variation maximale de l'erreur de fréquence absolue sur l'intervalle de temps de répétabilité dans des conditions d'entrée et de fonctionnement données, spécifiée sur toutes les plages d'entrée et de fonctionnement

**3.6.26**
**intervalle de résolution de fréquence**
plus petit incrément de la valeur de mesure de fréquence rapportée

**3.6.27**
**erreur dépendant de la polarisation de la fréquence**
différence maximale de mesure de fréquence sur tous les états de polarisation dans des conditions d'entrée et de fonctionnement données, pendant une mesure dans le temps de réponse, spécifiée sur toutes les plages d'entrée et de fonctionnement

**3.6.28**
**erreur d'OSNR absolue**
différence maximale entre l'OSNR mesuré et l'OSNR de référence étalonné, pendant une mesure dans le temps de réponse, spécifiée sur toutes les plages d'entrée et de fonctionnement

**3.6.29**
**erreur d'OSNR relative**
variation maximale de l'erreur d'OSNR absolue, pendant une mesure dans le temps de réponse, spécifiée sur toutes les plages d'entrée et de fonctionnement

**3.6.30**
**variabilité d'OSNR**
variation maximale de l'erreur d'OSNR absolue sur l'intervalle de temps de répétabilité dans des conditions d'entrée et de fonctionnement données, spécifiée sur toutes les plages d'entrée et de fonctionnement

**3.6.31**
**intervalle de résolution d'OSNR**
plus petit incrément de la valeur de mesure d'OSNR rapportée

**3.6.32**
**erreur dépendant de la polarisation de l'OSNR**
différence maximale de mesure d'OSNR sur tous les états de polarisation dans des conditions d'entrée et de fonctionnement données, pendant une mesure dans le temps de réponse, spécifiée sur toutes les plages d'entrée et de fonctionnement

**3.6.33**
**rétroréflexion**
fraction du signal optique réfléchie au niveau de l'accès optique d'entrée sur la bande entière, spécifiée sur toutes les plages d'entrée et de fonctionnement

**3.6.34**
**temps de réponse**
<contrôleur de canal de transmission optique> temps exigé pour effectuer les mesures spécifiées pour tous les canaux de transmission et pour transférer ces valeurs sur l'interface de communication vers le contrôleur externe qui délivre une demande de mesure, spécifié sur toutes les plages d'entrée et de fonctionnement

**3.6.35**
**intervalle de temps de répétabilité**
intervalle de temps minimal sur lequel une répétabilité de mesure donnée est effectuée

## 3.7 Termes et définitions relatifs au commutateur sélectif en longueur d’onde (WSS)

**3.7.1**
**commutateur sélectif en longueur d’onde**
**WSS**
module dynamique, avec un ou plusieurs accès d’entrée et un ou plusieurs accès de sortie, utilisé principalement dans un système de multiplexage optique d’insertion-extraction reconfigurable (ROADM) pour commuter indépendamment chaque longueur d’onde d’un signal depuis chaque accès d’entrée vers la sortie exigée dans des réseaux de multiplexage en longueur d’onde dense (DWDM, Dense Wavelength Division Multiplexing)

Note 1 à l’article: Un WSS est contrôlé électriquement avec un logiciel.

Note 2 à l’article: Les chemins optiques passant par le WSS étant bidirectionnels, les accès peuvent être configurés comme des accès d’entrée ou de sortie.

Note 3 à l’article: Chaque longueur d’onde particulière du signal peut être affaiblie indépendamment.

Note 4 à l'article: L’abréviation "WSS" est dérivée du terme anglais développé correspondant "wavelength selective switch".

[SOURCE: IEC 62343-4-1:2016, 3.1.1, modifié – Dans la définition, "port" a été remplacé par "accès"; la Note 2 à l’article a été remplacée par une nouvelle note.]

**3.7.2**
**perte d’insertion**
*IL*
valeur de la réduction de puissance optique à une longueur d’onde particulière entre les deux accès connectés entre eux

Note 1 à l’article: La perte d'insertion est la réduction de puissance optique entre un accès d’entrée et un accès de sortie d’un module, exprimée en décibels.

$$IL = -10 \log_{10} (P_{out}/P_{in})$$

où

$P_{in}$ est la puissance optique injectée dans l’accès d’entrée;

$P_{out}$ est la puissance optique reçue de l’accès de sortie.

Note 2 à l'article: L’abréviation "IL" est dérivée du terme anglais développé correspondant "insertion loss".

**3.7.3**
**uniformité de perte d’insertion**
différence entre la perte d’insertion maximale et la perte d’insertion minimale en sortie pour un ensemble d’accès d’entrée spécifié

**3.7.4**
**variation de perte d’insertion**
variation crête-à-crête maximale de la perte d’insertion dans une plage de fréquences (ou de longueurs d’onde) de canal de transmission

**3.7.5**
**largeur de bande passante *X*-dB**
largeur d’un canal centrée autour de la longueur d’onde centrale du canal dans laquelle l’affaiblissement optique se situe dans les limites de $X$ dB

Note 1 à l’article: Les termes "plage de longueurs d’onde de fonctionnement" ou "bande passante de canal" sont utilisés et ont le même sens que "bande passante" pour les dispositifs DWDM. La largeur de bande $X$-dB est définie par la dépendance de $a_{ij}$ (où $i \neq j$) par rapport au spectre de fréquence, comme la plage de longueurs d’onde minimale centrée autour de la longueur d’onde de fonctionnement $\lambda_h$ dans laquelle la variation de $a_{ij}$ est inférieure à $X$ dB. La plage de longueurs d’onde minimale est déterminée en prenant en compte la dérive de la longueur d’onde par rapport à la température, la dépendance par rapport à la polarisation et la dérive due au vieillissement à long terme (voir la Figure 1).