IEC 61300-3-21

Edition 3.0 2019-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Fibre optic interconnecting devices and passive components – Basic test and measurement procedures –
Part 3-21: Examinations and measurements – Switching time

Dispositifs d'interconnexion et composants passifs fibroniques – Procedures fondamentales d'essais et de mesures –
Partie 3-21: Examens et mesures – Temps de commutation

IEC 61300-3-21:2019-09(en-fr)

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

Electropedia - www.electropedia.org
The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary
67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

A propos de l'IEC
La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC
Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC - webstore.iec.ch/advsearchform
La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,…). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished
Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc
Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

Electropedia - www.electropedia.org
Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary
67 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

IEC 61300-3-21

Edition 3.0 2019-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Fibre optic interconnecting devices and passive components – Basic test and measurement procedures –
Part 3-21: Examinations and measurements – Switching time

Dispositifs d'interconnexion et composants passifs fibroniques – Procedures fondamentales d'essais et de mesures –
Partie 3-21: Examens et mesures – Temps de commutation

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 33.180.20

ISBN 978-2-8322-7376-0

Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.

CONTENTS

FOREWORD 3
1 Scope 5
2 Normative references 5
3 Terms and definitions 5
4 Apparatus 6
4.1 General description 6
4.2 Optical source (S) 7
4.3 Detector (D) 7
4.4 Actuation energy supply (AS) 7
4.5 Data acquisition system (DAS) 7
4.6 Termination (T) 7
4.7 Temporary joint (TJ) 7
5 Procedure 8
6 Details to be specified 9
Bibliography 10

Figure 1 – Measurement set-up using a 2-channel DAS to measure a single output port 8
Figure 2 – Example of a port moving to an on-state or off-state 9

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – BASIC TEST AND MEASUREMENT PROCEDURES –

Part 3-21: Examinations and measurements – Switching time

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.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61300-3-21 has been prepared by subcommittee 86B: Fibre optic interconnecting devices and passive components, of IEC technical committee 86: Fibre optics.

This third edition cancels and replaces the second edition published in 2014. This edition constitutes a technical revision.

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

a) changes to remove redundant overlap with IEC 60876-1;
b) clarifications to definitions and diagrams;
c) generalization of the detection apparatus beyond an oscilloscope.

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

FDIS	Report on voting
86B/4218/FDIS	86B/4230/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

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

A list of all parts in the IEC 61300 series, published under the general title, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures,* 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 "http://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.

FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – BASIC TEST AND MEASUREMENT PROCEDURES –

Part 3-21: Examinations and measurements – Switching time

1 Scope

This part of IEC 61300 describes a method to measure the switching time and related performance parameters of a fibre optic spatial switch when the actuation energy is applied or removed to change the state of the switch.

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 61300-3-4, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-4: Examinations and measurements – Attenuation*

3 Terms and definitions

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

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

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

3.1
latency time
<switching from isolated state to conducting state> elapsed time until the output power of a specified output port reaches 10 % of its steady-state value from the time the actuation energy is applied for a normally-off switch or is removed for a normally-on switch

3.2
latency time
<switching from conducting state to isolated state> elapsed time until the output power of a specified output port reaches 90 % of its steady-state value from the time the actuation energy is removed for a normally-off switch or is applied for a normally-on switch

Note 1 to entry: For a latch type optical switch, when switching from conducting state to isolated state, actuation energy is applied or removed.

3.3
rise time
elapsed time for the output power of the specified output port to rise from 10 % of the steady-state conducting value to 90 % of the steady-state conducting value

3.4
fall time
elapsed time for the output power of the specified output port to fall from 90 % of the steady-state conducting value to 10 % of the steady-state conducting value

3.5
bounce time
<switching from isolated state to conducting state> elapsed time until the output power of a specified output port is maintained between 90 % and 110 % of its steady-state value from the first time the output power of a specified output port reaches 90 % of its steady-state value of the output power

3.6
bounce time
<switching from conducting state to isolated state> time until the output power of a specified output port is maintained between 0 % and 10 % of its steady-state conducting value from the first time the output power of a specified output port reaches 10 % of its steady-state conducting value of the output power

3.7
switching time
<switching from isolated state to conducting state>
t_s

$$t_s = t_l + t_r + t_b$$

where

t_l is the latency time;

t_r is the rise time;

t_b is the bounce time

3.8
switching time
<switching from conducting state to isolated state>
$t_{s'}$

$$t_s = t_{l'} + t_f + t_{b'}$$

where

$t_{l'}$ is the latency time;

t_f is the fall time;

$t_{b'}$ is the bounce time

4 Apparatus

4.1 General description

For each optical path through the switch that is to be tested, a stable optical signal from an optical source is applied to the input port(s), and the time-dependent optical signal level at the output port(s) is measured with respect to the time when the actuation energy specified in the relevant specification is applied or removed.

4.2 Optical source (S)

The source output power shall be sufficiently stable over the time required to perform the measurements. Unless otherwise specified, the optical power stability shall follow IEC 61300-3-4. The source shall be capable of producing the spectral characteristics (both wavelength and spectral width) defined in the relevant specification. The ouput power required shall consider the power range of the detection system and the loss of the device under test (DUT).

In the case that the optical source is polarized, as is usual for laser sources, then the measurement and especially the steady-state conducting value of the output power will be influenced by any polarization dependence in the switch, joints, or detector. Stable environmental conditions and fibre positioning are recommended to avoid changes in the polarization state during the measurement.

4.3 Detector (D)

The detector produces an electrical signal proportional to the input optical power. The detector shall have sufficient fast response time to measure the switching time and bounce time to the accuracy specified in the relevant specification. The response time of the detector should be less than or equal to one tenth the rise time or fall time to be measured. The detector shall have sufficient large dynamic range to make the measurement and have linear response of < 0,05 dB over the optical power levels expected to be encountered. The detector shall have sufficiently high return loss to prevent impact on the measurements. The return loss of the measurement system should be 30 dB or higher. Multiple detectors may be used to measure multiple optical ports simultaneously.

4.4 Actuation energy supply (AS)

The rise time and fall time of the actuation energy supply should be less than or equal to one tenth the rise time or fall time of the optical switch specification. The duration of the actuation energy shall be sufficiently longer than the anticipated bounce time, for non-latch type optical switches.

4.5 Data acquisition system (DAS)

The data acquisition system records the time-dependence of the optical power, from the time that the actuation energy is applied or removed. It shall have sufficient large data storage capacity, bandwidth and accuracy and shall have the capability of at least two traces, or one trace that is synchronized by a hardware or software trigger to the actuation energy. An oscilloscope may be used for data acquisition or the detector, and data acquisition functions may be integrated in a data-logging optical power meter.

4.6 Termination (T)

These terminations are components or techniques to suppress reflected light from the device under test (DUT) output ports. Impairment of the measurement by reflections at the fibre output to the detector(s) should also be avoided. Fibre optic connectors with angled polished contacting face are usually sufficient to achieve > 60 dB return loss. If the switch under test has non-angled-polished connectors, they can be terminated by connecting to a cord with a non-angled-polished connector and an angled-polished connector at the other end.

4.7 Temporary joint (TJ)

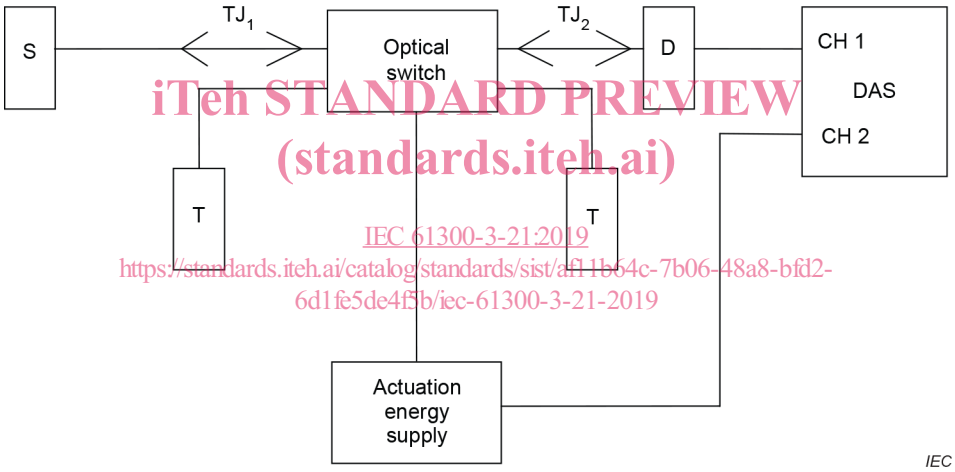
A method, device, or mechanical fixture for temporarily aligning two fibre ends into a reproducible, low loss joint. It can be, for example, a precision V-groove vacuum chuck, micro-manipulator, or a fusion or mechanical splice. The attenuation and return loss stability of the temporary joint shall be compatible with the measurement precision required.

5 Procedure

The procedure is illustrated here for a switch containing fibre optic pigtails without connectors (configuration A switch, see IEC 60876-1). For switches configured with fibre optic connector plugs or receptacles (configurations B or C), the appropriate fibre optic patchcords or adaptors shall be used in the place of the temporary joints. When multiple output ports are measured, each may be connected to a detector and it should be assured that impairment from reflections is avoided.

a) Configure the switching time and bounce time measurement set-up as shown in Figure 1. Connect the detector output to channel 1 of the data acquisition system. Additional detectors may be used in the same way. Connect the actuation energy supply to the optical switch and to channel 2 or the trigger input of the data acquisition system, as shown in Figure 1.

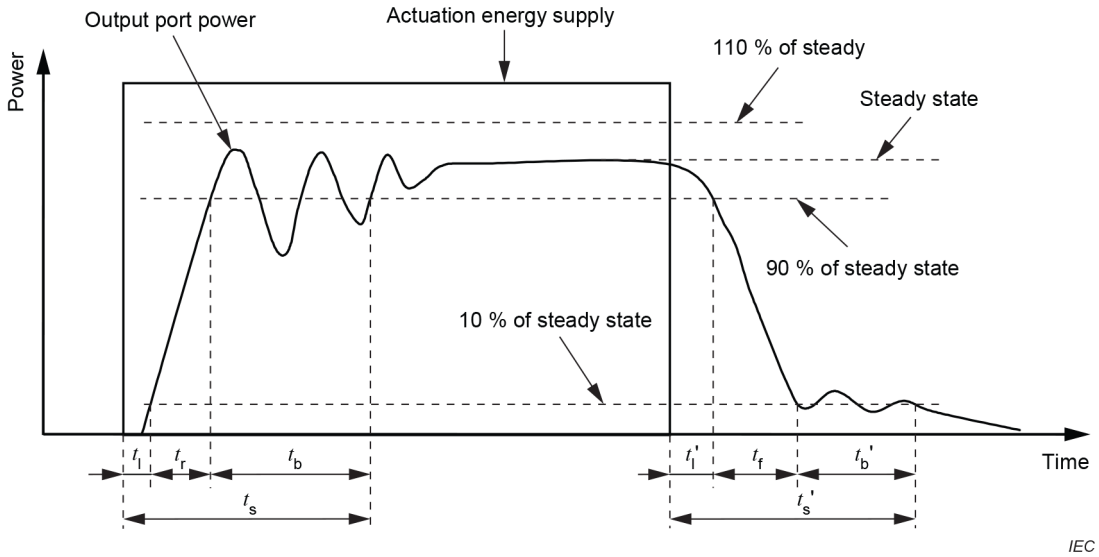
b) When the actuation energy specified in the relevant specification is supplied or removed, record the change in the optical power level over enough time to establish the steady-state optical power level. Using the 0 %, 10 % and 90 % power levels, determine the latency time t_l, the rise time t_r or fall time t_f, the bounce time t_b, and the switching time t_s as shown in Figure 2. In the case in which, for any reason, the steady-state power of the isolated state is not zero, the power levels should be normalized by subtracting from them the steady-state power of the isolated state, before determining the switching time parameters.



Key

S	optical source
TJ	temporary joint
T	termination
D	detector
T	termination
DAS	data acquisition system

Figure 1 – Measurement set-up using a 2-channel DAS to measure a single output port



Key

t_s, t_s'	switching time
t_l, t_l'	latency time
t_r	rise time
t_f	fall time
t_b, t_b'	bounce time

NOTE Figure 2 is valid for normally-off configuration. For a normally-on example, refer to IEC 60876-1:2014.

Figure 2 – Example of a port moving to an on-state or off-state

6 Details to be specified

The following details, as applicable, shall be specified in the relevant specification:

– source S: type of optical source, power, wavelength range, spectral width, power stability, and degree of polarization;

– detector D: sensitivity, response frequency or response time, and polarization dependence, linearity;

– data acquistion system DAS: DAS structure, specification, time resolution, relative signal uncertainty and linearity;

– temporary joint: types of temporary joint, connection attenuation, and return loss;

– actuation energy supply: characteristic of applied actuation energy and rise and fall times;

– termination: type and return loss of terminations;

– performance requirement;

– deviation from standard test procedure;

– measurement uncertainty.