IEC 61300-3-21

Edition 3.0 2019-09
REDLINE VERSION

INTERNATIONAL STANDARD

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

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

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IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 33.180.20

ISBN 978-2-8322-7436-1

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 3-21: Examinations and measurements – Switching time

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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- withdrawn,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.

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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 ~~is~~ describes a method to measure the switching time and related performance parameters of ~~an optical~~ 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 61300-1, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 1: General and guidance*~~

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 ~~of the output power~~ from the time the actuation energy is applied for a ~~normally-on~~ normally-off switch or is removed for a ~~normally-off~~ normally-on switch

~~[SOURCE: IEC 60876-1:2012, 3.3.4.1, modified – "for a normally-on switch or is removed for a normally-off switch" has been added.]~~

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 ~~of the output power~~ from the time the actuation energy is removed for a ~~normally-on~~ normally-off switch or is applied for a ~~normally-off~~ 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.

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~~[SOURCE: IEC 60876-1:2012, 3.3.4.2, modified – "for a normally-on switch or is removed for a normally-off switch" and Note 1 to entry have been added.]~~

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

~~[SOURCE: IEC 60876-1:2012, 3.3.5, modified – "conducting" has been added.]~~

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

~~[SOURCE: IEC 60876-1:2012, 3.3.6, modified – "conducting" has been added.]~~

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 ~~of the output power~~ from the first time the output power of a specified output port reaches 90 % of its steady-state value of the output power

~~[SOURCE: IEC 60876-1:2012, 3.3.7.1]~~

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

~~[SOURCE: IEC 60876-1:2012, 3.3.7.2]~~

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

~~[SOURCE: IEC 60876-1:2012, 3.3.8.1]~~

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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

~~[SOURCE: IEC 60876-1:2012, 3.3.8.2]~~

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 Excitation unit (E)**~~

~~This is a special launch fibre or imaging system designed to achieve the required launch conditions. The excitation unit shall follow IEC 61300-1.~~

4.3 Detector (D)

The detector produces an electrical signal proportional to the input optical power. The detector shall have sufficient ~~speed~~ 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.

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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, ~~referred to~~ 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 ~~for~~ 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 ~~(APC)~~ 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 ~~may~~ 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 ~~integral~~ fibre optic pigtails without connectors (configuration A switch, see IEC 60876-1). For switches configured with fibre optic connectors ~~on the pigtails or housing~~ plugs or receptacles (configurations B or C), the appropriate fibre ~~cords and connectors~~ 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 10 % and 90 % power levels, determine the switching time t_s, rise time t_r or fall time t_f, and bounce time t_b, as shown in Figure 2.~~ 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.

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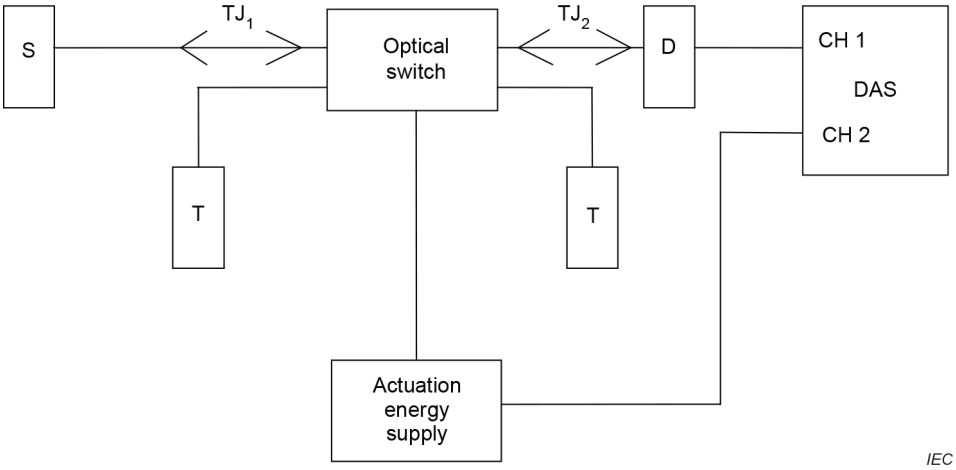


Key

S optical source

TJ temporary joint

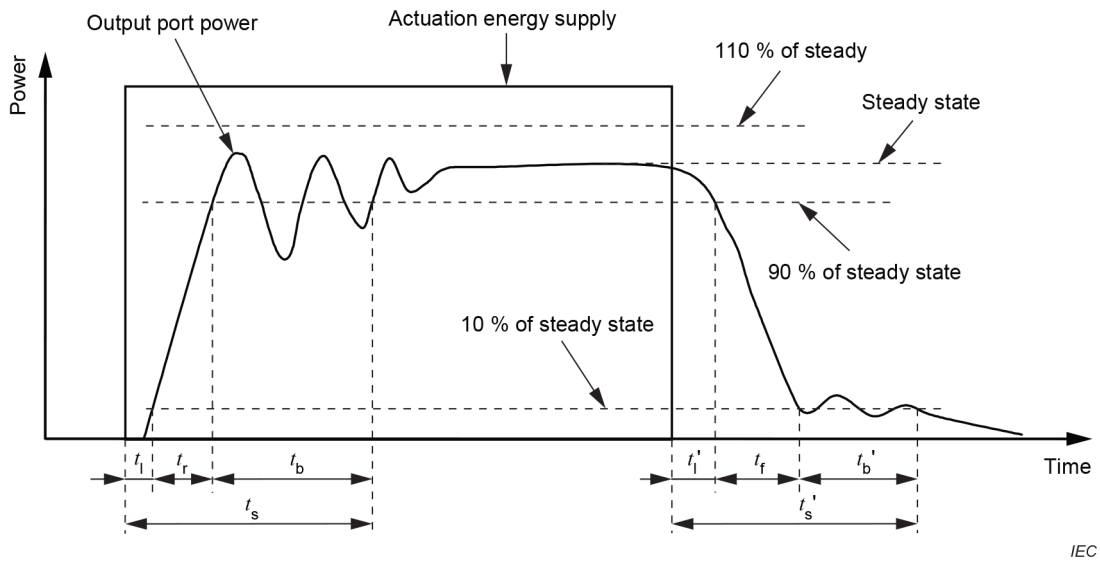
T termination

D detector

T termination

DAS data acquisition system

Figure 1 – Measurement set-up using a 2-channel ~~oscilloscope as~~ 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

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