



Edition 1.0 2011-11

Copyrighted material licensed to BR Demo by Thomson Reuters (Scientific), Inc., subscriptions.techstreet.com, downloaded on Nov-28-2014 by James Madison. No further reproduction or distribution is permitted. Uncontrolled when print

TECHNICAL REPORT

Dynamic modules – Part 6-8: Categorization study of dynamic performance requirements





THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2011 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester.

If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de la CEI ou du Comité national de la CEI du pays du demandeur. Si vous avez des guestions sur le copyright de la CEI ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de la CEI de votre pays de résidence.

IFC Central Office 3, rue de Varembé CH-1211 Geneva 20 Switzerland Email: inmail@iec.ch Web: www.iec.ch

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 corrigenda or an amendment might have been published.

Catalogue of IEC publications: <u>www.iec.ch/searchpub</u>

The IEC on-line Catalogue enables you to search by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, withdrawn and replaced publications.

IEC Just Published: <u>www.iec.ch/online_news/justpub</u> Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.

Electropedia: <u>www.electropedia.org</u>

The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.

Customer Service Centre: www.iec.ch/webstore/custserv

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:

Email: csc@iec.ch Tel.: +41 22 919 02 11 Fax: +41 22 919 03 00





Edition 1.0 2011-11

TECHNICAL REPORT

Dynamic modules – Part 6-8: Categorization study of dynamic performance requirements

INTERNATIONAL ELECTROTECHNICAL COMMISSION

PRICE CODE

ICS 33.180.20

ISBN 978-2-88912-745-0

CONTENTS

- 2 -

| FO | DREWORD | 3 | | | |
|-----|---|---|--|--|--|
| 1 | Scope | | | | |
| 2 | Categorization background | | | | |
| 3 | Categorization levels | | | | |
| | 3.1 Level –1 | 5 | | | |
| | 3.2 Level –2 | 6 | | | |
| | 3.3 Level –3 | 6 | | | |
| 4 | Examples of categorization | 8 | | | |
| 5 | 5 Conclusion | | | | |
| Bib | oliography | 9 | | | |
| Fig | gure 1 – A schematic illustration of Level–0 | 5 | | | |
| Fig | gure 2 – A schematic illustration of Level-1 complexity | 6 | | | |
| Fig | gure 3 – A schematic illustration of Level-2 complexity | 6 | | | |
| Fig | gure 4 – A schematic illustration of Level-3 complexity | 7 | | | |
| Tal | ble 1 – Examples of categorization | 8 | | | |

INTERNATIONAL ELECTROTECHNICAL COMMISSION

DYNAMIC MODULES –

Part 6-8: Categorization study of dynamic performance requirements

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.
- 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.

The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC 62343-6-8, which is a technical report, has been prepared by subcommittee SC86C: Fibre optic systems and active devices, of IEC technical committee TC86: Fibre optics.

The text of this technical report is based on the following documents:

| Enquiry draft | Report on voting |
|---------------|------------------|
| 86C/1009/DTR | 86C/1033/RVC |

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

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

A list of all parts in 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 publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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

A bilingual version of this publication may be issued at a later date.

DYNAMIC MODULES –

Part 6-8: Categorization study of dynamic performance requirements

1 Scope

This technical report outlines the categorization of dynamic performance requirements for dynamic modules. There are many kinds of dynamic modules in the marketplace with many different transient performance requirements. First, they are distinguished between the performance requirements for steady state and the transient state behaviour. Next are the requirements for transient characteristics during the transition period. Finally, a three-level categorization for the transient performance requirements is presented.

2 Categorization background

The most important feature of dynamic modules is that their optical performance can be changed by sending external commands and/or requests. Before and after receiving the command, the dynamic module should maintain its optical performance in the steady state as shown in Figure 1. This condition is called Level-0. During this steady state, any performance requirements, such as optical performance, reliability, and measurement method, are the same as those of completely passive devices. In contrast, the performance requirements with respect to the transient characteristics have been insufficiently studied and may vary according to the system applications. In this report, the requirements for the transient characteristics during transition period are categorized into three levels of complexity.



IEC 2398/11

Figure 1 – A schematic illustration of Level–0

3 Categorization levels

3.1 Level –1

This level is the least complex. The transient characteristics during the transition period are free from any restriction. For example, in the case of a variable optical attenuator (VOA) with a 1×2 optical switch used for the redundancy, some overshoot or undershoot is acceptable. Because the signal is shut down by the optical switch during the time from t0 to t1, as

indicated in Figure 2, only the transient time is determined. The optical switch is on at t1 after the VOA is set to State B.

- 6 -





3.2 Level –2

At this level of complexity, the performance shall be lower or higher than the constant value. A typical example is seen in the hitless function of wavelength selective switches (WSS). For the wavelength channel of interest, the transient optical power fluctuation is of no concern. However, the leaked crosstalk power of the channel of interest to the other channel shall be lower than a predetermined value even in the transient state. A schematic illustrating this level of complexity is shown in Figure 3.





3.3 Level -3

This level of complexity has the tightest requirement for optical performance in the transient state. Figure 4(a) shows the transient characteristics during the transition period in the time domain. For example, in case of the input power change to the optical receiver, the VOA

TR 62343-6-8 © IEC:2011(E)

- 7 -

before the optical receiver is controlled to keep the input power level to the optical receiver at an appropriate value. However a sudden change of input power causes signal errors. The optical performance in the transient state shall be in the predetermined region to avoid introducing such errors. The transient performance requirements for wavelength selective switches or optical amplifiers in DWDM systems are other examples of Level-3. The acceptable transient performance behaviours are precisely determined in other IEC standards. Another expression of this requirement is provided by the frequency-domain view shown in Figure 4(b). In this case, the 3-dB down frequency is determined in order to avoid certain undesired rapid changes in optical performance. The time and frequency domain expressions are physically the same and can be transformed into the other by employing Fourier transformation. Users or manufacturers can select the appropriate domain at their convenience.



(b) Frequency domain view

Figure 4 – A schematic illustration of Level-3 complexity

4 Examples of categorization

Typical dynamic modules in the marketplace are categorized into these three levels of complexity as shown in Table 1. Here, each column under transition time indicates the required time range. It is anticipated that this table will need to be updated with the development of new technologies.

| | Transition time | | | | | | | |
|--------------------------------------|---|--|---|----------------|--|--|--|--|
| Levels | > 1 s | ~ 100 ms | ~ 10 ms | <1 ms | | | | |
| 1 | DGE, DGTE, OCM,TDC (pre-equalization use),VOA | OCM, 1xN SW (monitor switching use) | OCM, TF (wavelength monitor use) | | | | | |
| 2 | MxN Matrix SW, WSS (port-switching) | MxN Matrix SW, WSS (port-switching) | MxN Matrix SW, WSS (port-switching) | | | | | |
| 3 | WB, WSS (changing attenuation) | TDC (adaptive equalization use), WB, WSS (changing attenuation) | 1xN SW (system redundancy use), TDC (adaptive equalization use), VOA (MUX use) | VOA (EDFA use) | | | | |
| DGE: dynamic gain equalizer | | | | | | | | |
| DGTE: dynamic gain tilt equalizer | | | | | | | | |
| EDFA: erbium-doped fibre amplifier | | | | | | | | |
| M: number of switch input ports | | | | | | | | |
| MUX: multiplexer | | | | | | | | |
| N: number of switch output ports | | | | | | | | |
| OCM: optical channel monitor | | | | | | | | |
| TDC: tuneable dispersion compensator | | | | | | | | |
| TF: tuneable filter | | | | | | | | |
| SW: switch | | | | | | | | |
| WB: wavelength blocker | | | | | | | | |
| WSS: wavelength-selective switch | | | | | | | | |

Table 1 – Examples of categorization

5 Conclusion

There is a variety of dynamic modules with differing transient requirements. When the transient characteristics during the transition period are considered, it is very important to define and understand which level of complexity is required at an early stage of development. The subsequent discussions will be efficient and effective. If early consideration of the complexity level is not addressed, it will be difficult to come to an agreement between supplier and user.

Bibliography

IEC 61300-3-21:1998, Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-21: Examinations and measurements – Switching time and bounce time

IEC 62343-5-1:2009, Dynamic modules – Test methods – Part 5-1: Dynamic gain tilt equalizer – Response time measurement

Copyrighted material licensed to BR Demo by Thomson Reuters (Scientific), Inc., subscriptions.techstreet.com, downloaded on Nov-28-2014 by James Madison. No further reproduction or distribution is permitted. Uncontrolled when print

Copyrighted material licensed to BR Demo by Thomson Reuters (Scientific), Inc., subscriptions.techstreet.com, downloaded on Nov-28-2014 by James Madison. No further reproduction or distribution is permitted. Uncontrolled when print

INTERNATIONAL ELECTROTECHNICAL COMMISSION

3, rue de Varembé PO Box 131 CH-1211 Geneva 20 Switzerland

Tel: + 41 22 919 02 11 Fax: + 41 22 919 03 00 info@iec.ch www.iec.ch