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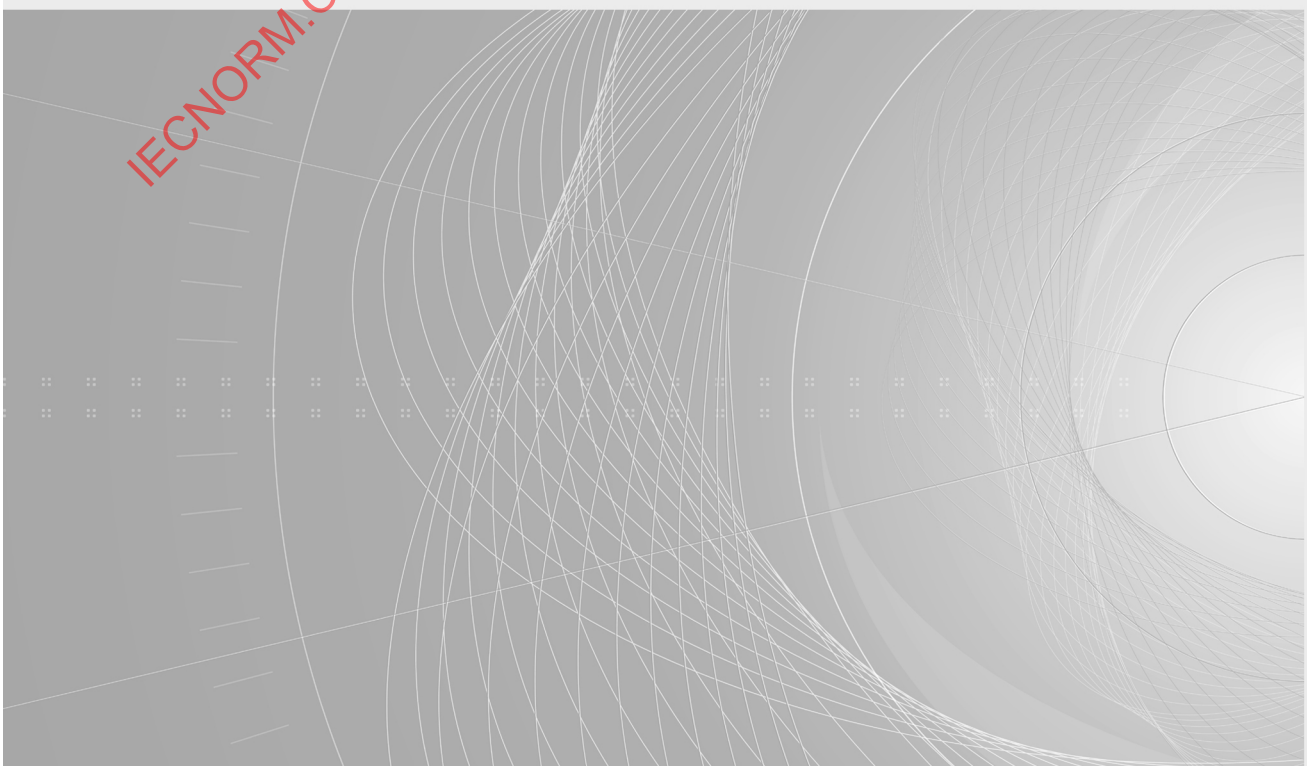
Edition 1.0 2011-11

TECHNICAL REPORT

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



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FOREWORD

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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- withdrawn,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.

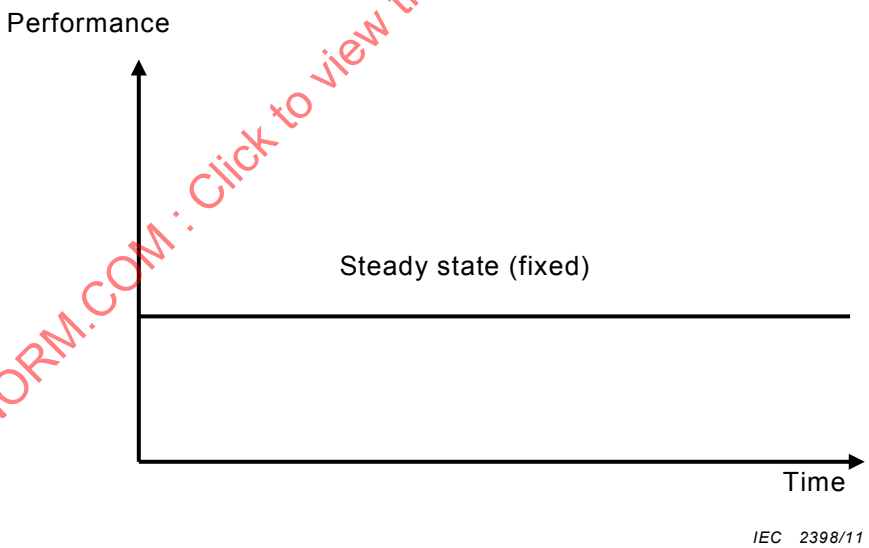


Figure 1 – A schematic illustration of Level–0

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.

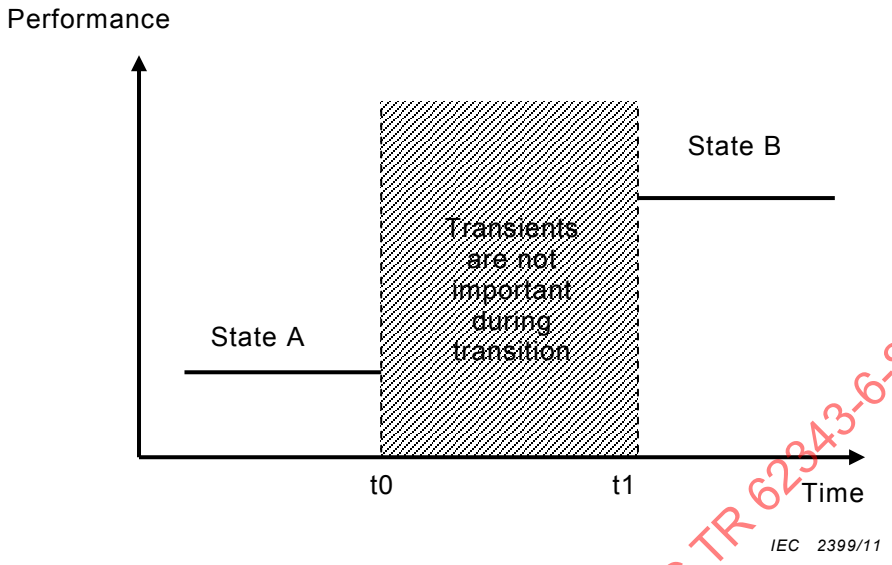


Figure 2 – A schematic illustration of Level–1 complexity

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.

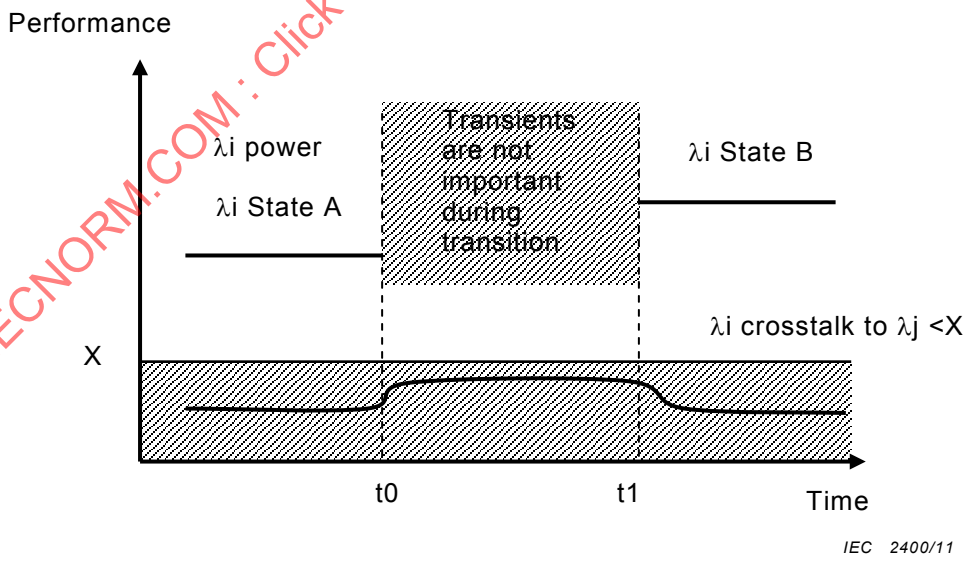
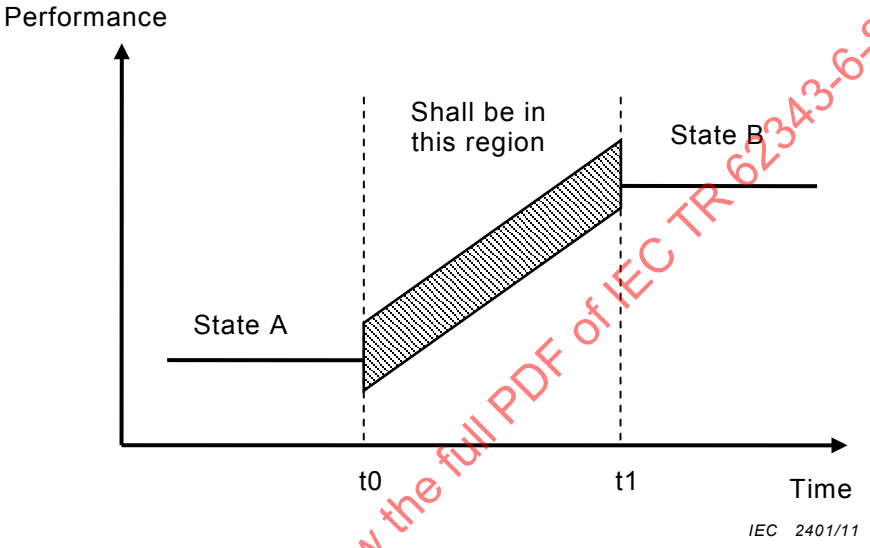


Figure 3 – A schematic illustration of Level–2 complexity

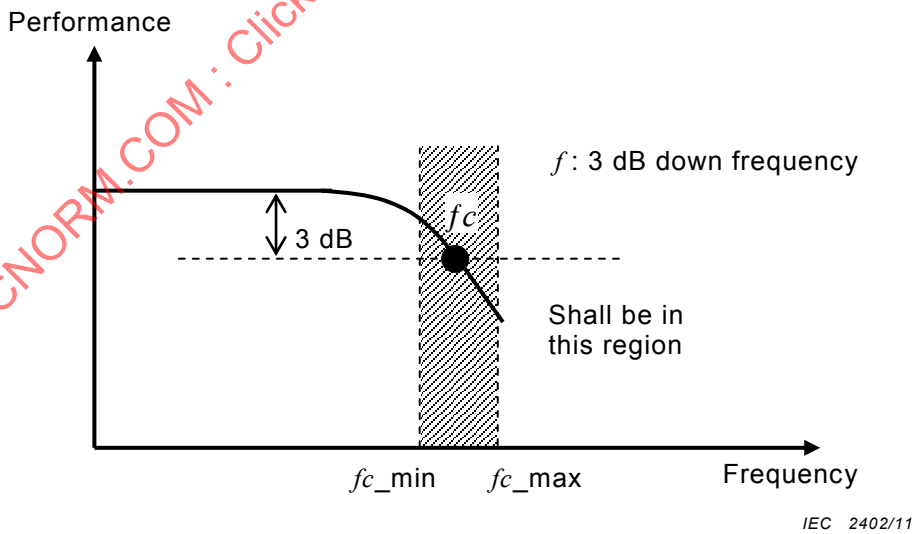
3.3 Level –3

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

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.



(a) Time domain view



(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.

Table 1 – Examples of categorization

	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

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.

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