IEC/TR 61156-1-3

Edition 1.0 2011-04

TECHNICAL REPORT

colour inside

Multicore and symmetrical pair/quad cables for digital communications – Part 1-3: Electrical transmission parameters for modelling cable assemblies using symmetrical pair/quad cables

INTERNATIONAL ELECTROTECHNICAL COMMISSION

PRICE CODE U

ICS 33.120.20

ISBN 978-2-88912-429-9

® Registered trademark of the International Electrotechnical Commission

CONTENTS

FOREWORD 3
1 Scope 5
2 Normative references 5
3 Terms, definitions, symbols, units and abbreviated terms 6
3.1 Terms and definitions 6
3.2 Symbols, units and abbreviated terms 6
4 Traditional length correction formulae 7
4.1 Introduction 7
4.2 Length correction formulae in IEC 61156-1 7
4.3 The development of the traditional cross-talk length correction formulae NEXT and EL FEXT [3] 8
5 Using traditional cross-talk length correction formulae 16
5.1 Background (see [4]) 16
5.2 Example (see [5], [6]) Length and frequency dependency of direct near-end crosstalk attenuation 17
6 On length concatenation of measured cables, using scattering and scattering transfer parameters, see informative reference [7]. 21
7 Matrix (model) status, comparison of different calculations [8] 24
8 Recommendations for applying length correction formulae to modelling cross-talk in cable assemblies 25
Bibliography 26

Figure 1 – Coupling between two circuits due to unbalances of the primary parameters 9
Figure 2 – Integration of the coupled near- and far-end currents over the length of the cable 13
Figure 3 – Delta A_2 at different frequencies as a function of length 19
Figure 4 – Delta A_2 for different lengths as a function of frequency 20
Figure 5 – Delta A for different lengths as a function of frequency (= Delta A_1 + Delta A_2) f_0 = 500 MHz 21
Figure 6 – Typical port assignment resulting out of the numbering of the VNA measuring ports 21
Figure 7 – Incident and reflected waves, schematically represented for a 2n × 2n multiport network 23

Table 1 – Delta A_2 as a function of length or frequency, the other being a parameter 19
Table 2 – Delta A as a function of frequency (= Delta A_1 + Delta A_2) 20

INTERNATIONAL ELECTROTECHNICAL COMMISSION

MULTICORE AND SYMMETRICAL PAIR/QUAD CABLES FOR DIGITAL COMMUNICATIONS –

Part 1-3: Electrical transmission parameters for modelling cable assemblies using symmetrical pair/quad cables

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.

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/TR 61156-1-3, which is a technical report, has been prepared by subcommittee 46C: Wires and symmetric cables, of IEC technical committee 46: Cables, wires, waveguides, R.F. connectors, R.F. and microwave passive components and accessories.

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

Enquiry draft	Report on voting
46C/924/DTR	46C/932/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 the parts in the IEC 61156 series, published under the general title *Multicore and symmetrical pair/quad cables for digital communications*, 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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

MULTICORE AND SYMMETRICAL PAIR/QUAD CABLES FOR DIGITAL COMMUNICATIONS –

Part 1-3: Electrical transmission parameters for modelling cable assemblies using symmetrical pair/quad cables

1 Scope

This technical report is a supplement to IEC 61156-1 Edition 3 (2007): Multicore and symmetrical pair/quad cables for digital communications – Part 1: Generic specification.

This technical report covers the following topics following this standard:

– the near-end crosstalk test methods and length correction procedures of 6.3.5;
– the far-end crosstalk test methods and length correction procedures of 6.3.6;
– the concatenation of measured cable segments, even if they are of different design.

The final objective of this technical report is to describe the mathematics involved to model the concatenation of cable sections of different length, not based upon measurements but based upon the specification limits of the cables involved. This is required as a base foundation of the complete channel modelling, involving also the connectivity covered by IEC SC48B towards channels, as required and requested by ISO/IEC JTC1/SC25 WG3 for incorporation into ISO/IEC 11801:2002 [1] [1].

This TR is informative and contains observations and recommendations applicable to using the length correction formulas for either measurements or modelling of balanced cables.

2 Normative references

The following referenced documents are indispensable for the application 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 60050-726, *International Electrotechnical Vocabulary – Part 726: Transmission lines and waveguides*

IEC 61156-1:2007, *Multicore and symmetrical pair/quad cables for digital communications – Part 1: Generic specification*

IEC/TR 61156-1-2, *Multicore and symmetrical pair/quad cables for digital communications – Part 1-2: Electrical transmission characteristics and test methods of symmetrical pair/quad cables*

IEC 61156-5, *Multicore and symmetrical pair/quad cables for digital communications – Part 5: Symmetrical pair/quad cables with transmission characteristics up to 1 000 MHz – Horizontal floor wiring – Sectional specification*

---

1 The figures in square brackets refer to the Bibliography.

IEC 61156-6, *Multicore and symmetrical pair/quad cables for digital communications – Part 6: Symmetrical pair/quad cables with transmission characteristics up to 1 000 MHz – Work area wiring – Sectional specification*

IEC/TR 62152, *Transmission properties of cascaded two-ports or quadripols – Background of terms and definitions*