IEC/TR 62652

Edition 1.0 2010-03

TECHNICAL REPORT

colour inside

Effects of engaging and separating under electrical load on connector interfaces in cabling used to support IEEE 802.3af (power-over-ethernet) applications

INTERNATIONAL ELECTROTECHNICAL COMMISSION

PRICE CODE U

ICS 31.220.10

ISBN 2-8318-1087-3

® Registered trademark of the International Electrotechnical Commission

CONTENTS

FOREWORD 4
INTRODUCTION 6
1 Scope 7
2 Normative references 7
3 Abbreviations 7
4 General 8
5 Telecommunications industry information 8
6 Technical information 9
6.1 Electrical discharges 9
6.2 Surface plating. long and short term effects 10
6.3 IEEE 802.3af – Power-over-Ethernet environment (PoE) 11
6.4 Factors affecting the connector durability and definition of a nominal contact zone 12
6.5 Acceptance criteria 13
7 Test procedures, test set-up description and results 14
7.1 General 14
7.2 Tests 1A and 2A – Evaluation of the mechanical damage 15
7.3 Tests 3A 15
7.4 Test 4A – Comparison of different IEC 60603-7 connectors 17
7.4.1 General 17
7.4.2 Tests – Visual inspection of contacts 17
7.4.3 Results and observations to test 4A 17
7.5 Test 5A – Resistive test setup simulating PoE power stress 19
7.5.1 General 19
7.5.2 Test setup 19
7.5.3 Tests – Visal inspection of contacts 19
7.5.4 Results and observations to test 5A 19
7.6 Test 6A – Engaging and separating with IEEE 802.3af hardware 20
7.6.1 PoE hardware 20
7.6.2 Tests – Visual inspection of contacts 21
7.6.3 Results – Test 6A 21
7.7 Test 7A and 8A – Effect of speed of contact separation 22
7.8 Tests 9A, 10A and 11A – Effect of the cord length 22
7.9 Test 12A – Effect of polarity 23
7.10 Test 13 A – Investigation of IEC 60603-7-7 or IEC 61076-3-110 connecting hardware 24
7.11 Tests 14A and 15 A. 100 m long cable test 25
8 Conclusions 26
9 Future work 26
Bibliography 28

Figure 1 – Illustration of a typical shielded 8-way connector according IEC 60603-7 9
Figure 2 – Illustration of an IEC 60603-7-7 or IEC 61076-3-110 connector 9
Figure 3 – Connecting hardware contacts 10
Figure 4 – Endspan PSE – Alternative A according to IEEE 802.3af 11

Figure 5 – Midspan PSE – Alternative B according to IEEE 802.3af 11
Figure 6 – Cables used in the study 12
Figure 7 – Illustration of contact engaging cycle 13
Figure 8 – Illustration of a nominal contact area concept 13
Figure 9 – Illustration of a low level contact resistance (bulk) test 14
Figure 10 – IEC 60603-7-7 connector contacts 15
Figure 11 – Test circuit A 16
Figure 12 – Test results of tests 1A and 3A 16
Figure 13 – Test circuit B 17
Figure 14 – Damage due to electrical discharges 18
Figure 15 – Test 4A – Changes in LLCR 18
Figure 16 – Test circuit C 19
Figure 17 – Test 5A observations 20
Figure 18 – Test 5A results show little change in LLCR 20
Figure 19 – Test circuit D 21
Figure 20 – Test results test 6A 21
Figure 21 – Test circuit E 22
Figure 22 – LLCR (bulk) change 22
Figure 23 – Test circuit F 23
Figure 24 – Test 12A – Observed minor damage to the plug connector surface 24
Figure 25 – Discharge effects for the IEC 60603-7-7 connector 25
Figure 26 – Test results test 13A 25
Figure 27 – Change in the LLCR due to electrical and mechanical discharge for IEC 60603-7 connectors including 2 m, 10 m, and 100 m cables combined 26

Table 1 – Some factors affecting the connecting hardware durability 12
Table 2 – Selected parameters of the test set up and procedures 14

INTERNATIONAL ELECTROTECHNICAL COMMISSION

EFFECTS OF ENGAGING AND SEPARATING UNDER ELECTRICAL LOAD ON CONNECTOR INTERFACES IN CABLING USED TO SUPPORT IEEE 802.3af (POWER-OVER-ETHERNET) APPLICATIONS

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.

Technical Report IEC 62652 has been prepared by subcommittee 48B: Connectors, of IEC technical committee 48: Electromechanical components and mechanical structures for electronic equipment.

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

The text of this standard is based on the following documents:

DTR	Report on voting
48B/2076/DTR	48B/2146/RVC

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.

INTRODUCTION

The ISO/IEC/JTC1/SC25 subcommittee requested IEC SC 48B to prepare an engaging and separating under electrical load test method to be referenced in their standards. This test method standard was published as IEC 60512-9-3:2006. The experts of SC 48B/WG5 were concerned about the effect of engaging/separating under electrical load on the IEC 60603-7 series connector interfaces that would be typically used in the IEEE 802.3af (PoE) applications. The experts developed a set of tests to evaluate the effects, the results of which are reported in this Technical Report.

NOTE "Engaging" and "Separating" are terms used in most IEC TC 48 publications to describe the physical mating or un-mating of connectors.

IEC 60050-581:1978, 581-08-08[1] defines the terms as follows:

engaging and separating force
connector mating and unmating force (deprecated)
The force required to engage fully or separate a pair of mating components including the effect of a coupling, locking or similar device.

The IEC 60603-7 series of standards use the terms mating and un-mating throughout. To avoid confusion in reading this Technical Report and also the IEC 60603-7 series of standards, it is important to know that the term "engaging" is equivalent to "mating" and the term "separating" is equivalent to "un-mating".

---

1 IEC 60050-581:1978, *International Electrotechnical Vocabulary – Chapter 581: Electromechanical components for electronic equipment*

EFFECTS OF ENGAGING AND SEPARATING UNDER ELECTRICAL LOAD ON CONNECTOR INTERFACES IN CABLING USED TO SUPPORT IEEE 802.3af (POWER-OVER-ETHERNET) APPLICATIONS

1 Scope

This Technical Report is intended to provide information on the effects of engaging and separating under electrical load on the connector interfaces in cabling, used to support IEEE 802.3af (Power-over-Ethernet (PoE)) applications.

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 60512-9-3:2006, *Connectors for electronic equipment – Tests and measurements – Part 9-3: Endurance tests – Test 9c: Mechanical operation (engaging/separating) with electrical load*

IEC 60603-7, *Connectors for electronic equipment – Part 7: Detail specification for 8-way, unshielded, free and fixed connectors*

IEC 60603-7-7, *Connectors for electronic equipment – Part 7-7: Detail specification for 8-way, shielded, free and fixed connectors, for data transmissions with frequencies up to 600 MHz*

IEC 61076-3-110, *Connectors for electronic equipment – Product requirements – Part 3-110: Detail specification for shielded, free and fixed connectors for data transmission with frequencies up to 1 000 MHz*

IEC 61156 (all parts), *Multicore and symmetrical pair/quad cables for digital communications*

ISO/IEC 11801:2002, *Information technology – Generic cabling for customer premises*

Amendment 1 (2008)

IEEE 802.3af, *"Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications – Data Terminal Equipment (DTE) Power Via Media Dependent Interface (MDI),"*