

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Connectors for electrical and electronic equipment – Tests and measurements – Part 23-3: Screening and filtering tests – Test 23c: Shielding effectiveness of connectors and accessories – Line injection method

Connecteurs pour équipements électriques et électroniques – Essais et mesures –

Partie 23-3: Essais d'écrantage et de filtrage – Essai 23c: Efficacité de blindage des connecteurs et des accessoires – Méthode de la ligne d'injection



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2018 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 l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

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

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

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

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.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - webstore.iec.ch/advsearchform

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 It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing 21 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Catalogue IEC - webstore.iec.ch/catalogue

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC -

webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient 21 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

67 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Connectors for electrical and electronic equipment – Tests and measurements – Part 23-3: Screening and filtering tests – Test 23c: Shielding effectiveness of connectors and accessories – Line injection method

Connecteurs pour équipements électriques et électroniques – Essais et mesures – Partie 23-3: Essais d'écrantage et de filtrage – Essai 23c: Efficacité de blindage des connecteurs et des accessoires – Méthode de la ligne d'injection

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 31.220.01

ISBN 978-2-8322-6319-8

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	3
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references	8
3 Terms and definitions	8
4 Test method	9
4.1 Test requirements	9
4.2 Applicable frequency range.....	9
5 Test equipment.....	9
6 Preparation of the test specimen	10
6.1 General.....	10
6.2 Circular connectors.....	10
6.3 Rectangular connectors	11
6.4 Connectors for printed boards.....	11
6.5 Impedance matching of primary and secondary circuits.....	12
6.5.1 General.....	12
6.5.2 Preparation of the secondary circuit.....	12
6.5.3 Adaptation of the primary circuit.....	12
6.6 Calibration of test set-up.....	12
7 Measurement of shielding effectiveness	13
7.1 Measurement.....	13
7.2 Method of calculating shielding effectiveness <i>SE</i> (attenuation) from surface transfer impedance Z_T	13
8 Requirements	14
9 Details to be specified	14
Bibliography.....	15
Figure 1 – Principle of line injection method.....	8
Figure 2 – Installation of test set-up.....	10
Figure 3 – Example of test set-up for shielded circular connectors.....	11
Figure 4 – Example of test set-up for shielded rectangular connectors.....	11
Figure 5 – Example of test set-up for shielded printed board connectors.....	12
Figure 6 – Calibration test set-up	13
Figure 7 – Example of a shielding attenuation (shielding effectiveness) plot	14

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**CONNECTORS FOR ELECTRICAL AND ELECTRONIC
EQUIPMENT – TESTS AND MEASUREMENTS –****Part 23-3: Screening and filtering tests – Test 23c: Shielding effectiveness
of connectors and accessories – Line injection method**

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.

International Standard IEC 60512-23-3 has been prepared by subcommittee 48B: Electrical connectors, of IEC technical committee 48: Electrical connectors and mechanical structures for electrical and electronic equipment.

This second edition cancels and replaces the first edition, published in 2000. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) an introduction has been added to provide some guidance to this document in view of concurrent test method 23g in the same family;

- b) the frequency range for which this test method is considered reliable moved from 1 GHz to 3 GHz, to be consistent with Figure 7 (unchanged) and current industry practice and need;
- c) update to IEC 62153-4-6:2017 of former normative reference IEC 60096-4-1:1990, withdrawn and incorrect (should have been IEC 61196-1:1995, also withdrawn);
- d) update to current subclause numbers of IEC 62153-4-6:2017 what were the previous subclause numbers referenced in IEC 61196-1:1995 (wrongly attributed to IEC 60096-4-1:1990). For immediate understanding the title of these subclauses has been added;
- e) alignment of title to the current scope of SC 48B (connectors) and inclusion of electrical equipment as target application of said connectors (per current scope of TC 48) and explicit reference to the method – line injection – for the measurement of transfer impedance;
- f) symbols SE for shielding effectiveness and Z_T for surface transfer impedance added throughout the document;
- g) list of connectors to which the test method is applicable – previously in 3.2 – moved in scope;
- h) former name of AECMA organization changed to the current ASD-STAN;
- i) “specimen” used instead of “sample” throughout the document;
- j) clarification in the title of what transfer impedance is described in Table 3 and editorial improvement of the same;
- k) “dielectric constant” changed into the updated term “relative permittivity”;
- l) added a note to warn about the fact that this test method requires in 6.6 a TDR with more stringent rise time of less than 100 ps than the value of less than 350 ps specified both in IEC 62153-4-6 and in EN 50289-1-6 for the similar line injection method applied to screened cables, whereas test 23g of IEC 60512-23-3 specifies for the same purpose a TDR with a rise time of less than 200 ps;
- m) adoption of term “*connector housing*” [IEV 581-27-10] instead of “*shell*” to address the connector accessory providing the shielding;
- n) title “Transfer impedance Z_T [Ω]” added to the ordinate axis on the left side of double log diagram of Figure 7;
- o) explanatory note to clarify the conversion formula for SE from Z_T added.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
48B/2631/CDV	48B/2670/RVC

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.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

A list of all parts in the IEC 60512 series, published under the general title *Connectors for electrical and electronic equipment – Tests and measurements*, 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.

Currently in preview, click buy full version

INTRODUCTION

This document is part of the IEC 60512 series within the group of standards identified as *Part 23: Screening and filtering tests*.

It covers a method to measure the shielding (screening) effectiveness of shielded connectors or of shielding accessories for connectors that are non-inherently shielded, e.g. connector shielded housings and/or connector EMC cable glands, by measurement of the surface transfer impedance Z_T (Ω) as a function of the frequency. By using a formula, Z_T is then converted in shielding effectiveness SE (dB).

In Part 23 there is another document, IEC 60512-23-7, *Connectors for electronic equipment – Tests and measurements – Part 23-7 – Screening and filtering tests – Test 23g: Effective transfer impedance of connectors*, that provides test 23g.

The first difference between the method described in this document and test 23g is that here in test 23c, in the measurement of the transfer impedance Z_T the capacitive coupling phenomena covered by the capacity coupling impedance Z_F are considered negligible, while test 23g includes these effects to measure the effective surface transfer impedance Z_{TE} .

This test 23c is applicable to a wide range of applications: it covers circular connectors, rectangular connectors and connectors for PCBs, as well as connector shielding accessories, i.e. those accessories such as connector shielded housings and/or metal shielding plates, providing shielding properties to a non-inherently shielded connector.

Test 23g is a variant of the triaxial test method for screened cables of IEC 62153-4-7, it addresses more specifically non-circular screened (shielded) connectors, it requires as DUT a complete cable assembly, i.e. a short piece of screened cable terminated by two connectors to be tested, and it requires also two adaptors plus a specific test jig.

More differences will be clear by a comparative read of the two test methods (this test 23c and test 23g) for the choice of the most suitable test to be indicated by the connector (or accessory) product detail specification or the manufacturer specification.

For further guidance regarding EMC testing of connectors and cable assemblies with screened cables and connectors, see also IEC TS 62513-4-1.

CONNECTORS FOR ELECTRICAL AND ELECTRONIC EQUIPMENT – TESTS AND MEASUREMENTS –

Part 23-3: Screening and filtering tests – Test 23c: Shielding effectiveness of connectors and accessories – Line injection method

1 Scope

This part of IEC 60512 defines a standard test method for measuring the shielding effectiveness SE of a shielded connector, or of a connector not provided with integral shield once fitted with a shielding accessory and terminated with a screened cable.

The complete assembly has a continuous 360° shielding capability throughout its length.

NOTE 1 Practically, continuous 360° shielding is not always achievable based on the geometry of the connector.

NOTE 2 "Shielding" is used in this document with the same meaning as "screening".

This test method can be applied to shielded connectors and to connector accessories with shielding capability. The following different connector designs can be tested:

- circular connectors;
- rectangular connectors;
- connectors for printed boards;
- connector shielding accessories.

NOTE 3 For the definition of "accessory" see IEC 60512-24-0. A shielding accessory i.e. an accessory that confers shielding to a non-inherently shielded connector, include a suitable set of shielded housings providing electrical continuity, along the mated connector set, between the screen of the (screened) cable at the cable outlet of the free cable connector housing and the metallic mounting surface for the fixed connector housing. The free connector housing is provided with a cable screen clamp.

This test method utilizes the principle that the intrinsic shielding property of the connector/accessory/cable assembly is its surface transfer impedance Z_T which can be expressed as the longitudinal voltage inside the shield, relative to the current flow on the outside shell.

This test method is based on two impedance-matched circuits. See Figure 1 for the measurement principle. The connector specimen under test is integrated into the secondary circuit 02. The impedance-matched injection line of the primary circuit 01, which activates the electromagnetic field, runs parallel to the surface of the specimen under test.

This test is also suitable for measuring the shielding effectiveness of a connector fitted with triaxial contacts terminated with shielded, twisted pair cables, as used in data bus systems.

NOTE 4 This standard has been adopted by ASD-STAN (formerly known as AECMA) as EN 2591-212.