IEC 62037-3

Edition 2.0 2021-11

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Passive RF and microwave devices, intermodulation level measurement – Part 3: Measurement of passive intermodulation in coaxial connectors

Dispositifs RF et à micro-ondes passifs, mesure du niveau d'intermodulation – Partie 3: Mesure de l'intermodulation passive dans les connecteurs coaxiaux

IEC 62037-3:2021-11(en-fr)

IEC Central Office
3, rue de Varembé
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 corrigendum or an amendment might have been published.

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 It also gives information on projects, replaced and withdrawn publications.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 once a month by email.

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.

IEC online collection - oc.iec.ch
Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org
The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 18 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

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.

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 une fois par mois par email.

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.

IEC online collection - oc.iec.ch
Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org
Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

IEC 62037-3

Edition 2.0 2021-11

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Passive RF and microwave devices, intermodulation level measurement – Part 3: Measurement of passive intermodulation in coaxial connectors

Dispositifs RF et à micro-ondes passifs, mesure du niveau d'intermodulation – Partie 3: Mesure de l'intermodulation passive dans les connecteurs coaxiaux

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 33.040.20 ISBN 978-2-8322-1049-1

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

INTERNATIONAL ELECTROTECHNICAL COMMISSION

____

PASSIVE RF AND MICROWAVE DEVICES, INTERMODULATION LEVEL MEASUREMENT –

Part 3: Measurement of passive intermodulation in coaxial connectors

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.

IEC 62037-3 has been prepared by IEC technical committee 46: Cables, wires, waveguides, RF connectors, RF and microwave passive components and accessories. It is an International Standard.

This second edition cancels and replaces the first edition published in 2012. This edition constitutes a technical revision.

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

a) impact method changed to utilize a steel ball rather than a brass rod;
b) impact energy required to test each connector type added;
c) method added to calculate impact energy for connector types not listed in the document.

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

Draft	Report on voting
46/836/FDIS	46/857/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all the parts in the IEC 62037 series, published under the general title *Passive RF and microwave devices, intermodulation level measurement* 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 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.

IMPORTANT – The "colour inside" logo on the cover page of this document 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.

PASSIVE RF AND MICROWAVE DEVICES, INTERMODULATION LEVEL MEASUREMENT –

Part 3: Measurement of passive intermodulation in coaxial connectors

1 Scope

This part of IEC 62037 defines the impact test on coaxial connectors to evaluate their robustness against weak connections and particles inside the connector, as independently as possible from the effects of cable PIM (passive intermodulation).

For other connectors (e.g. panel mounted connectors), the cable can be replaced by an adequate transmission-line (e.g. airline, stripline). In order to evaluate the effects of mechanical stresses on the connectors, a series of impacts is applied to the connectors while measuring the PIM.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 62037-1, *Passive RF and microwave devices, intermodulation level measurement – Part 1: General requirements and measuring methods*

IEC 62037-4, *Passive RF. and microwave devices, intermodulation level measurement – Part 4: Measurement of passive intermodulation in coaxial cables*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.2 Abbreviated terms

DUT Device under test

IM Intermodulation

PIM Passive intermodulation

4 Test method

4.1 Samples for testing

One of the two following set-ups may be used.

NOTE Correct assembly methods and techniques are critical to the proper operation of the connector on the cable.

a) Set-up 1 – Multi-port DUT

In order to minimize the effect of the transmission line, a short assembly should be tested. Identical connectors should be assembled at each end. An assembly, as short as physically practical, should be constructed.

b) Set-up 2 – One-port DUT

A single connector can be assembled on a length of transmission line for which it is designed that exhibits at least 10 dB of attenuation in one direction at the lowest frequency in the receive band.

4.2 Connection of unit

The unit shall be connected as described in IEC 62307-1.

4.3 Set-up 1 – Fixed frequency test considerations

Due to the phase interaction of the connectors and the length of the transmission line (configuration A) when measured in the reverse (reflected) mode, the frequency at which maximum PIM occurs within the band can vary and shall be determined.

An accepted method of sweeping is to fix f_1 at the low end of the transmit band and step f_2 down, starting at the top of the band for all combinations of frequencies that result in IM in the receive band. If desired, this procedure can be reversed by fixing f_2 at the highest frequency in the transmit band and then stepping f_1 up, starting at the bottom of the band.

If fixed frequency is used, assemblies of varying lengths shall be made to ensure that the PIM adds in-phase. Assemble two additional DUTs. The first one is to be $\lambda/6$ longer and the second one is to be $\lambda/3$ longer at the receive frequency of the test. The PIM of the three (3) assemblies is measured to determine which DUT exhibits maximum PIM. The impact test shall be performed on this DUT.

Multiple fixed frequencies may be used in lieu of varying the cable length.

The impact test is to be conducted at the frequency where the maximum PIM is measured.

The cable used as a load shall be verified as having suitable PIM performance prior to being used in testing as measured by IEC 62037-4.

4.4 Set-up 2 considerations

The cable used as a load shall be verified as having suitable PIM performance prior to being used in testing as measured by IEC 62037-4.

4.5 Impacts

Mount the DUT as shown in Figure 1. A minimum of five (5) impacts in accordance with Table 1 shall be applied. (See Figure 1 for impact set-up.)

The drop mass is a steel ball, ensuring that no sharp edge will damage the DUT and minimizing variation in the impact force. The steel ball is remotely released via a solenoid to prevent impact force variation due to manual operation.

The points of impact should cover as many different areas along the length of the connector as possible, but it is not necessary to rotate or otherwise disconnect and reposition the DUT.

The PIM is measured prior to, during, and after the impact.

Table 1 – Impact information for some popular connectors

Connector interface	Connector nominal hex dimension mm	Impact energy J	Steel ball diameter mm	Mass g	Drop height (min.) mm
7-16	31,8	0,083	19	28,4	300
4.3-10	22,2	0,058	19	28,4	210
N	19,1	0,050	19	28,4	180
TNC	14,3	0,037	19	28,4	130
SMA	7,9	0,021	19	28,4	75

Different steel ball diameters and drop heights may be used as long as equivalent impact energy is maintained. See Annex A for guidelines for calculating equivalent impact energy.

Other connector types can be tested in accordance with this document. The required impact energy for different connector types can be calculated as specified in Annex B.

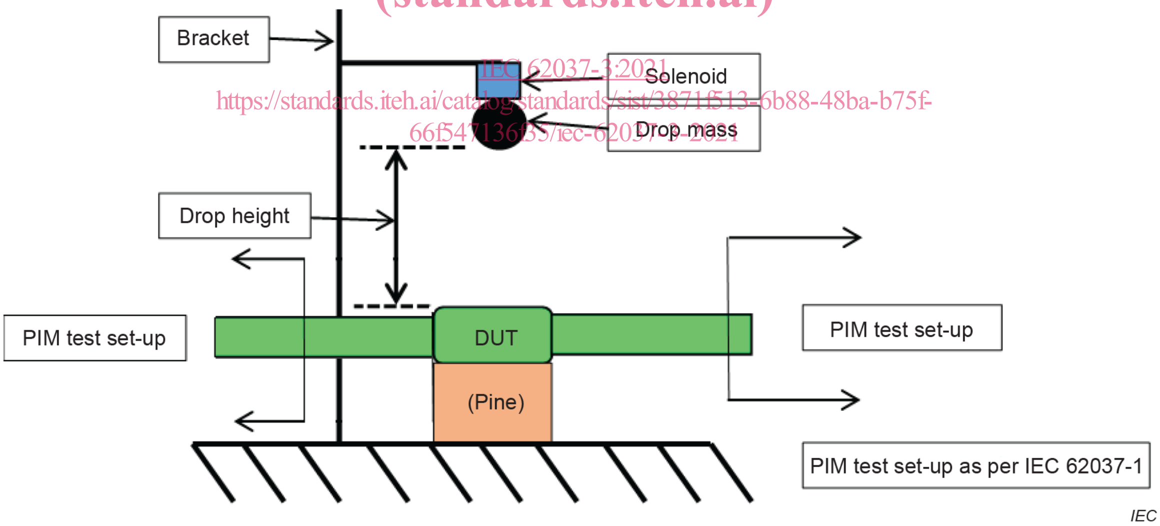

Figure 1 – Impact test illustration

5 Report

The report should document the drop height, steel ball mass and impact energy if different from Table 1 and the peak PIM values prior to, during, and after each impact.

Annex A
(normative)

Calculating equivalent impact energy

Impact energy in Joules = potential energy = PE = $m \times g \times h$

where:

m is the mass of the steel ball (kg);

g is the acceleration due to gravity = 9,8 m/s^2;

h is the drop height (m).

Using an average density for carbon steel of 7,9 g/cm^3, the mass of the steel ball can be calculated based on the volume of the steel ball.

Table A.1 provides the estimated mass of various diameter steel balls.

Table A.1 – Estimated mass of various diameter steel balls

Diameter mm	**Mass** kg
10	0,004 14
11	0,005 51
12	0,007 15
13	0,009 09
14	0,011 35
15	0,013 96
16	0,016 94
17	0,020 32
18	0,024 12
19	0,028 37
20	0,033 09

EXAMPLE: If a 12 mm diameter ball is used to test an SMA connector instead of the 19 mm diameter ball and in order to calculate a drop height that yields an equivalent impact energy, then:

Algebra is used to re-arrange the formula:

h = PE / ($m \times g$)

h = 0,021 kg m^2/s^2 / (0,007 15 kg × 9,8 m/s^2)

h = 0,299 7 m = 299,7 mm, which rounds to 300 mm

Annex B
(normative)

Calculating impact energy for different connector types

The energy at impact is intended to mechanically shock the DUT by accelerating the connector body. Since the mass of a connector is roughly proportional to the physical size of the connector, the impact energy can be scaled based on the size of the connector. Distance across the wrench flats for the male connector can be used as a basis of comparison. For round connectors, the diameter of the male connector's outer housing can be used.

Using the 7-16 DIN connector as a reference, the impact energy for other connector styles can be calculated by multiplying the specified impact energy for the 7-16 DIN connector by the ratio in size between connectors. Table B.1 demonstrates this calculation for the RF connector types shown in Table 1.

Table B.1 – Impact energy calculation for RF connector type

Connector interface	Connector nominal hex dimension mm	Size ratio compared to 7-16 connector	Calculated impact energy J
7-16	31,8	1,00	1,00 × 0,083 J = 0,083 J
4,3-10	22,2	0,70	0,70 × 0,083 J = 0,058 J
N	19,1	0,60	0,60 × 0,083 J = 0,050 J
TNC	14,3	0,45	0,45 × 0,083 J = 0,037 J
SMA	7,9	0,25	0,25 × 0,083 J = 0,021 J