



IEC 62037-4

Edition 1.0 2012-07

INTERNATIONAL STANDARD

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



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2012 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.

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

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
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.

Useful links:

IEC publications search - www.iec.ch/searchpub

The advanced search enables you 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It also gives information on projects, replaced and withdrawn publications.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 on-line and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary (IEV) on-line.

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: csc@iec.ch.



IEC 62037-4

Edition 1.0 2012-07

INTERNATIONAL STANDARD

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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE

K

ICS 33.040.20

ISBN 978-2-83220-287-6

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD	3
1 Scope	5
2 Normative references	5
3 Abbreviations	5
4 Test fixtures	5
5 Procedure.....	7
5.1 General	7
5.2 Dynamic test procedure – Clamped cable loop	8
5.3 Dynamic test – Flexing tool	8
5.4 Static test.....	9
Annex A (informative) General test considerations	10
Figure 1 – Dynamic test using clamped "U" bend in cable	6
Figure 2 – Dynamic test using flexing tool.....	6
Table 1 – Dimensions of the flexing tool.....	7
Table 2 – Groove diameter	7

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**PASSIVE RF AND MICROWAVE DEVICES,
INTERMODULATION LEVEL MEASUREMENT –****Part 4: Measurement of passive intermodulation in coaxial 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.

International Standard IEC 62037-4 has been prepared by technical committee 46: Cables, wires, waveguides, R.F. connectors, R.F. and microwave passive components and accessories.

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

FDIS	Report on voting
46/418/FDIS	46/434/RVD

Full information on the voting for the approval of this standard 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 62037 series, published under the general title *Passive r.f. and microwave devices, intermodulation level measurement* 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.

PASSIVE RF AND MICROWAVE DEVICES, INTERMODULATION LEVEL MEASUREMENT –

Part 4: Measurement of passive intermodulation in coaxial cables

1 Scope

This part of IEC 62037 defines test fixtures and procedures recommended for measuring levels of passive intermodulation generated by coaxial cables. Two dynamic test methods and a static test method are defined.

All coaxial cables are subjected to the static and clamped cable loop dynamic test.

Cables classified as flexible or semi-flexible are additionally subjected to the flexing tool dynamic test.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 r.f. and microwave devices, intermodulation level measurement – Part 1: General requirements and measuring methods*

IEC 62037-3, *Passive r.f. and microwave devices, intermodulation level measurement – Part 3: Measurement of passive intermodulation in coaxial connectors*

3 Abbreviations

DUT Device under test

IM Intermodulation

4 Test fixtures

For the dynamic tests, appropriate test fixtures are required. For the clamped cable loop test (see 5.2), a method shall be provided for laterally moving the cable and for clamping the cable each side of the region of movement, as shown schematically in Figure 1. Design of the clamps shall be such as to firmly support the cable at the required points without causing damage to the cable by crushing or kinking.

In the moving test using the flexing tool (see 5.3), the cable is flexed by a fixture through which the cable is threaded as shown in Figure 2. General design for the fixture is shown in Figure 2, and the detailed dimensions for different cable sizes (and different specified bend radii) are listed in Table 1 and Table 2.

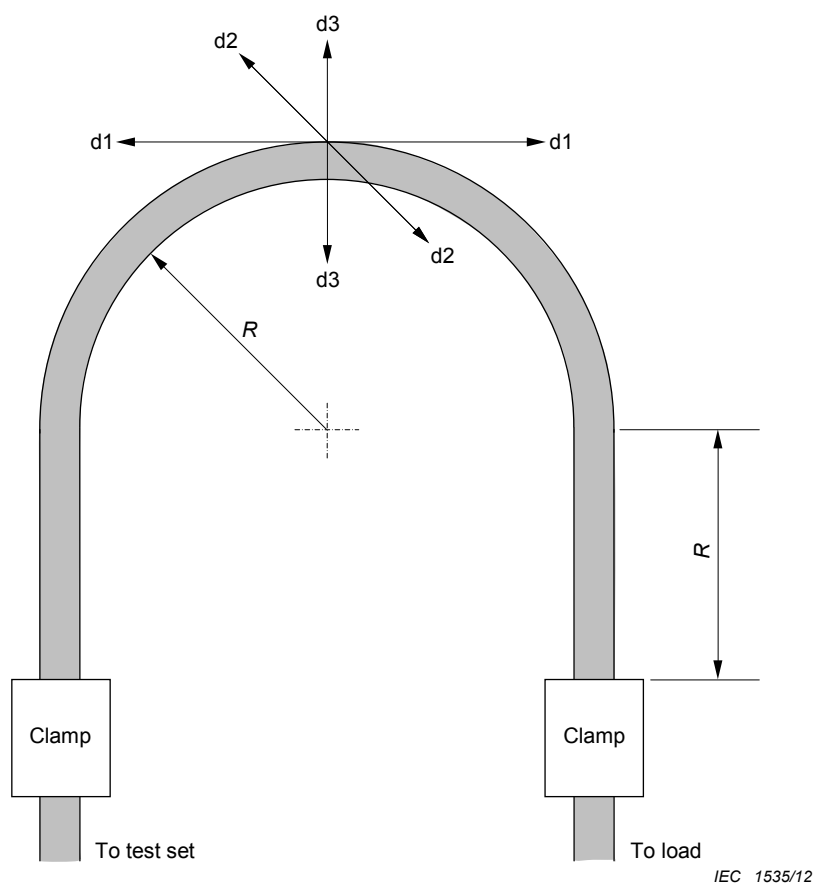


Figure 1 – Dynamic test using clamped "U" bend in cable

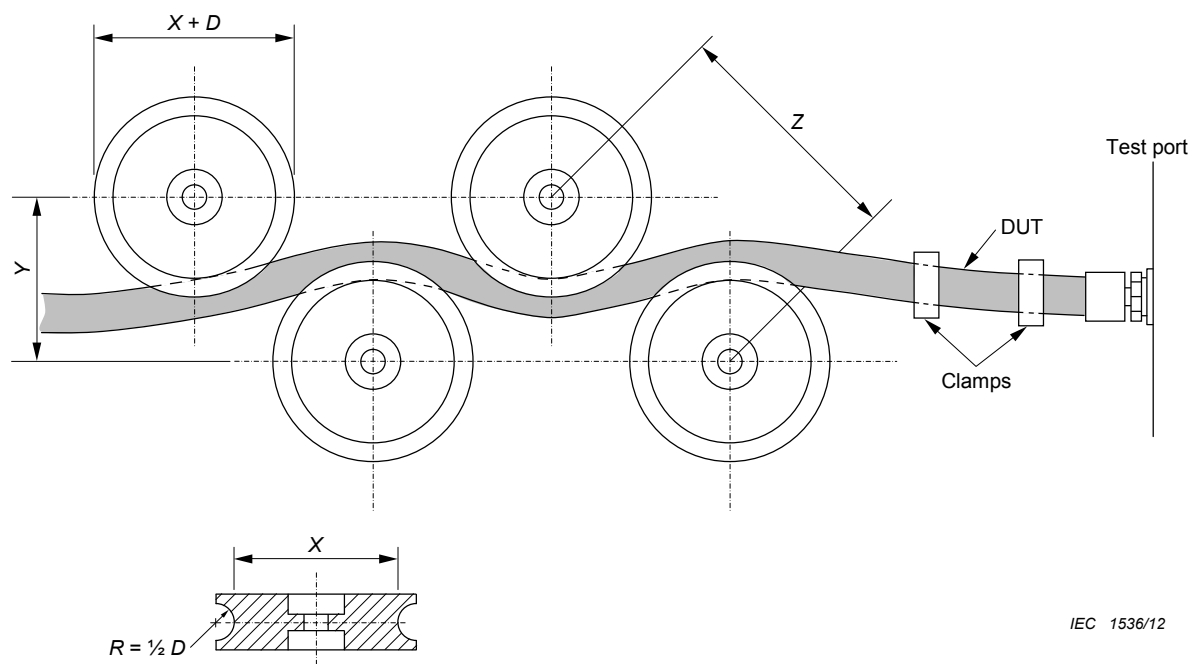


Figure 2 – Dynamic test using flexing tool

D is equal to or greater than the nominal diameter of the cable under test.

Values X , Y and Z depend on minimum bend radius of the cable for repeated bending.

Table 1 – Dimensions of the flexing tool

D	\geq diameter of the cable
R_{\min}	Minimum bend radius of the cable for repeated bending
X	See Table 2
Y	$2 \times R_{\min}$
Z	$X + 2,5 \times$ cable diameter

Table 2 – Groove diameter

Minimum bending radius of cable under test	Groove diameter X mm
$R_{\min} \leq 33$ mm	66
$33 \text{ mm} < R_{\min} \leq 47$ mm	94
$47 \text{ mm} < R_{\min} \leq 68$ mm	136
$68 \text{ mm} < R_{\min} \leq 100$ mm	200

Other values may be used if agreed upon by the customer and supplier or specified by the manufacturer.

5 Procedure

5.1 General

The test method of IEC 62037-1 shall be used.

Intermodulation in long cables is measured using the reverse set-up because of the significant attenuation of these cables. If the cable to be measured is long enough, i.e. with a one-way insertion loss of 10 dB or greater, it is required only to connectorize the end to be tested.

Use connectors with known low IM performance relative to the DUT. Soldered joints are preferred. Similarly, if a termination is required, this shall also be of known low IM performance relative to the DUT. See IEC 62037-3 for additional information.

Perform the required tests for the appropriate cable type as described in 5.2, 5.3 and 5.4.

5.2 Dynamic test procedure – Clamped cable loop

The procedure is as follows:

- a) Connect the cable to be tested to the IM test set, and to the low IM termination if used (for short cables) as shown in Figure 1. Bend the cable into a "U" shape and position clamps on the limbs of the "U" as shown.
 - b) Adjust the radius of the "U" bend and the positions of the clamps so that dimensions "R" are at the minimum bend radius for the cable under test. Then firmly clamp the cable on both sides of the movement region, so that mechanical stresses resulting from cable movement are not transmitted to the test set or load connections, possibly creating high IM conditions.
 - c) The test described in item b) shall also be conducted on another sample, except done at the multiple bend radius. Prior to conducting the test, the cable shall be subjected to multiple bends.
 - d) Record the level of passive intermodulation generated in the static condition.
 - e) Apply movement to the cable in each of three directions, d1, d2, d3, as shown in Figure 1. The movement may be applied by hand, or by suitable mechanical means. If mechanical means is used, this shall cause no damage to the cable (e.g. by kinking or crushing) at the point of application or elsewhere.
 - The amplitude of movement in each direction for the cable size under test shall be a minimum of 20 mm.
 - The amplitude may be of a higher value if specified.

A minimum of 3 cycles (movement in both directions) per axis shall be performed; each cycle shall be between 1 s and 5 s duration.
 - f) Record the maximum level of passive intermodulation generated during movement.
- NOTE If using a spectrum analyser, it is helpful to use the "max-hold" function.
- g) Finally, record the level of passive intermodulation generated in the static condition after movement has ceased.

5.3 Dynamic test – Flexing tool

The procedure is as follows:

- a) Thread the cable to be tested through the flexing tool, and connect the ends to the IM test set, and to the low IM termination if used (for short cables) as shown in Figure 2. Fasten clamps at the ends of the cable length, so that mechanical stresses resulting from cable movement are not transmitted to the test set or load connections, possibly creating high IM conditions.
 - b) Record the level of passive intermodulation generated in the static condition.
 - c) Move the flexing tool along the length of the cable, so that the cable is flexed along the whole test length as it passes the wheels of the tool. Care shall be taken that mechanical strains are not transmitted to the test set or the terminating load (if used). Rotate the fixture 90° about the axis of the cable length (to test the orthogonal plane) and move the flexing tool back along the length of the cable.
 - d) Record the maximum level of passive intermodulation generated during movement and the length of the cable that the test was performed on.
- NOTE If using a spectrum analyser, it is helpful to use the "max-hold" function to record the maximum level of passive intermodulation.
- e) Finally, record the level of passive intermodulation generated in the static condition after movement has ceased.

5.4 Static test

The procedure is as follows:

- a) Connect the cable to be tested to the test equipment. For large diameter feeder cables (16 mm nominal diameter and larger) with high inherent stiffness, the cable under test should be connected to the IM test equipment via a short flexible jumper cable of known and suitably low IM performance.
- b) Record the level of passive intermodulation generated.

Annex A (informative)

General test considerations

For flexible and semi flexible cables, dynamic tests involve lateral cable movement (bending and flexing), and are suitable for initial cable qualification of smaller cables (up to 16 mm in diameter), and cables designed for use in jumper applications (which may be up to 28 mm in diameter over the cable sheath). One dynamic test involves moving a clamped cable loop in different directions, and is suitable for rapidly testing stability against flexure in different planes. In the second dynamic test, the cable is flexed through a set of wheels, which allows for a greater length of cable to be tested, but just in a single plane per traverse. This test using the flexing tool is suitable for use with cables up to 18 mm in diameter.

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

3, rue de Varembé
PO Box 131
CH-1211 Geneva 20
Switzerland

Tel: + 41 22 919 02 11
Fax: + 41 22 919 03 00
info@iec.ch
www.iec.ch