IEC 61587-3

Edition 2.0 2013-02

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Mechanical structures for electronic equipment – Tests for IEC 60917 and IEC 60297 –
Part 3: Electromagnetic shielding performance tests for cabinets and subracks

Structures mécaniques pour équipement électronique – Essais pour la CEI 60917 et la CEI 60297 –
Partie 3: Essais de performance du blindage électromagnétique pour les baies et les bacs à cartes

IEC 61587-3:2013

IEC Central Office
3, rue de Varembé
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It also gives information on projects, replaced and withdrawn publications.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.

A propos de la CEI

La Commission Electrotechnique Internationale (CEI) 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 CEI

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

Liens utiles:

Recherche de publications CEI - www.iec.ch/searchpub

La recherche avancée vous permet de trouver des publications CEI 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.

Just Published CEI - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications de la CEI. 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 au monde de termes électroniques et électriques. Il contient plus de 30 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (VEI) en ligne.

Service Clients - webstore.iec.ch/csc

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

IEC 61587-3

Edition 2.0 2013-02

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Mechanical structures for electronic equipment – Tests for IEC 60917 and IEC 60297 – Part 3: Electromagnetic shielding performance tests for cabinets and subracks

Structures mécaniques pour équipement électronique – Essais pour la CEI 60917 et la CEI 60297 – Partie 3: Essais de performance du blindage électromagnétique pour les baies et les bacs à cartes

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX **N**

ICS 31.240
ISBN 978-2-83220-640-9

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

____

MECHANICAL STRUCTURES FOR ELECTRONIC EQUIPMENT – TESTS FOR IEC 60917 AND IEC 60297 –

Part 3: Electromagnetic shielding performance tests for cabinets and subracks

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 61587-3 has been prepared by subcommittee 48D: Mechanical structures for electronic equipment, of IEC technical committee 48: Electromechanical components and mechanical structures for electronic equipment.

This second edition cancels and replaces the first edition issued in 2006. It constitutes a technical revision.

The main technical changes with regard to the previous edition are as follows.

This edition corrects the errors of EM code descriptions and the frequency range for the shielding performance is extended up to 3 000 MHz.

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

FDIS	Report on voting
48D/527/FDIS	48D/534/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 parts of IEC 61587 series, under the general title *Mechanical structures for electronic equipment – Tests for IEC 60917 and IEC 60297*, 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.

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.

MECHANICAL STRUCTURES FOR ELECTRONIC EQUIPMENT – TESTS FOR IEC 60917 AND IEC 60297 –

Part 3: Electromagnetic shielding performance tests for cabinets and subracks

1 Scope and object

This part of IEC 61587 specifies the tests for empty cabinets and subracks concerning electromagnetic shielding performance, in the frequency range of 30 MHz to 3 000 MHz. Stipulated attenuation values are chosen for the definition of the shielding performance level of cabinets and subracks for the IEC 60297 and IEC 60917 series. The shielding performance levels are chosen with respect to the requirements of the typical fields of industrial application. They will support the measures to achieve electromagnetic compatibility but cannot replace the final testing of compliance of the equipped enclosure.

The purpose of this standard is to ensure physical integrity and environmental performance of cabinets and subracks, taking into account the need for different levels of performance in different applications. It is intended to give the user a level of confidence in the selection of products to meet his specific needs. This standard in whole or in part applies only to the empty enclosures, for example cabinets and subracks according to IEC 60297 and IEC 60917 and does not apply to the enclosures when electronic equipment is installed. Chassis may be tested in the same way as subracks and cases may be tested in the same way as cabinets.

This standard was developed in close relationship to IEC 61000-5-7 but with the specific focus on subracks and cabinets and the determination of performance levels at the chosen frequency range.

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 60297 (all parts), *Mechanical structures for electronic equipment – Dimensions of mechanical structures of the 482,6 mm (19 in) series*

IEC 60917 (all parts), *Modular order for the development of mechanical structures for electronic equipment practices*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-5-7, *Electromagnetic compatibility (EMC) – Part 5-7: Installation and mitigation guidelines – Degrees of protection provided by enclosures against electromagnetic disturbances (EM code)*

CISPR 16-1 (all parts), *Specification for radio disturbance and immunity measuring apparatus and methods*

3 Electromagnetic shielding performance test

3.1 Electromagnetic shielding performance tests for cabinets and subracks

Various levels of shielding performance can be achieved depending upon the construction of the cabinet or subrack. Although shielding performance measurements are of limited value in predicting the final overall system performance, consistent measurement techniques are vital to ensure any measure of repeatability. The aim of this standard is to provide comparable shielding performance testing results from one test laboratory to another (see IEC 61000-4-3). The test result is valid only for cabinets or subracks determined by equal dimensions and contents, for example removable covers, door, etc. The standard should be used for the evaluation of design variations.

3.2 Test condition

All testing shall be performed in a semi-anechoic or full anechoic chamber or open field test site as illustrated in the figures. When the semi-anechoic chamber or the open field test site is used, the chamber shall meet the vertical and horizontal site attenuation test described in CISPR 16-1. For the test set-up in the open field or an anechoic chamber, see Figures 3 to 8.

3.3 Test configuration

3.3.1 Calibration of the reference antenna

The purpose of calibration is to check the characteristics of the reference antenna, which is the output level of a transmitting antenna and the sensitivity level of a receiving antenna.

The test shall be performed by setting the transmitting antenna facing the receiving antenna.

The direction of the transmitting antenna is at 0° and the radiated field strength is maximum.

The height of the transmitting antenna shall be set at 1,1 m.

The receiving antenna shall be positioned 1 m high and 3 m in distance from the transmitting antenna. The frequency is 100 MHz and 500 MHz.

Calibration shall be made using both horizontal and vertical antenna polarities.

3.3.2 Transmitting antenna

The transmitting source shall be a Spherical Dipole Antenna (SDA) see Annex A or similar (see Note 1 in Table 1). The size of the transmitting antenna should be equal or smaller than 150 mm in diameter. The equivalency to the SDA should be evaluated by an analysis of the radiation pattern of the alternative antenna. Annex A illustrates the application of a spherical dipole antenna (SDA). It is necessary to confirm whether sufficient power level of the transmitting antenna can be ensured.

The transmitting antenna should be connected to the sender equipment located in outside of the test specimen without affecting the shielding integrity of the test specimen.

The distance of the transmitting antenna to the metal wall of the enclosure should be at least the diameter of the spherical antenna. The dynamic range of the measuring equipment should be determined with the appropriate level above the expected attenuation level as shown in Table 1.

3.3.3 Receiving antenna

The receiving antenna shall be one of the following types:

– 30 MHz to 200(300) MHz biconical antenna;
– 200(300) MHz to 1 000 MHz log periodic antenna.

The change from biconical to the log periodic may be at 200 MHz or 300 MHz (see Note 1 in Table 1).

Alternatively, a combined biconical/logarithmic-periodic antenna for the whole frequency range up to 1 000 MHz may be used.

For the frequency range 1 000 MHz to 3 000 MHz, horn antennas should be used.

3.3.4 Reference measurement

Reference measurements E_1 (dBμV) are made without the test specimen. The transmitting antenna shall be placed at the position in which it will be once the test specimen is present. The transmitting antenna shall be positioned at 3 m distance from the receiving antenna and the two antennas shall face each other in the same direction as that of the calibration.

Measurements shall use both horizontal and vertical polarities. Transmitting and receiving antenna shall be polarized in the same manner. Frequency sweeps shall be in increments of not greater than 5 MHz between 30 MHz and 3 000 MHz. The receiving antenna shall be swept through heights of 1 m to 4 m. The greatest signal strength E_1 for each frequency shall be recorded (see Figures 3 and 6).

3.3.5 Transmitting antenna set-up

The transmitting antenna shall be placed in the centre inside the test specimen in the same direction as that of the reference measurement and suspended by non-conductive material (see Note 1 in Table 1).

3.3.6 Test specimen set-up

In the case of a floor-standing cabinet, there shall be an insulation between the cabinet and the reference plane of the chamber of 100 mm (±5 %). A table top test specimen shall be placed at a height of 800 mm (±5 %) from the reference plane.

3.4 Test requirements

Measurements shall be made by using both horizontal and vertical antenna polarities. Both transmitting and receiving antennas shall be polarized in the same manner. Frequency increment measurements shall be made.

The equipment under test shall be rotated 360° through its vertical axis (via a turntable or other means) and the maximum signal strength determined in increments of 90°, i.e. a minimum of four reading points in the frequency range of 30 MHz to 200(300) MHz, 45° in the frequency range of 200(300) MHz to 1 000 MHz and 30° in the frequency range of 1 000 MHz to 3 000 MHz.

Frequency sweeps shall be made in increments of not greater than 5 MHz between 30 MHz and 3 000 MHz. The receiving antenna shall be swept through heights of 1 m to 4 m. The greatest signal strength E_2 (dBμV) from the combined sweep of the turntable and antenna height shall be recorded for each frequency. For the typical test equipment configuration, see Figure 1.

3.5 Test results

3.5.1 General

The enclosure shielding performance is the difference between the appropriate reference measurement (Figure 3 or 6) and the associated measurement with the antenna within the cabinet or subrack. Refer to Table 1 for the appropriate test results.

The shielding performance is calculated in decibels as the difference between E_1 and E_2. For the shielding performance levels, defined by attenuation values dependent on the frequency range, see Table 1. A typical graph of a measurement data (E_1-E_2) (dB) presentation is shown in Figure 2.

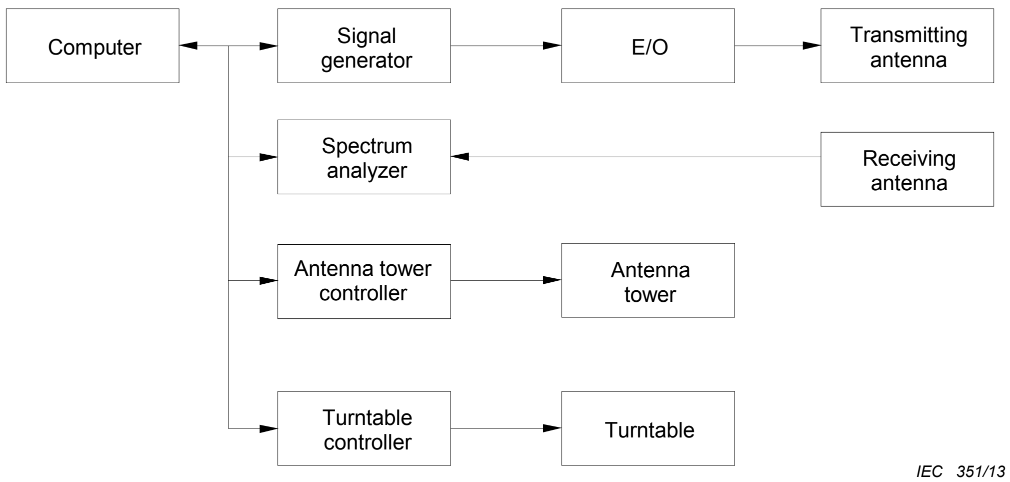
Attenuation requirements are based upon the final cabinet/subrack configuration with all vents, panels, openings, etc., present. For a definition of the minimum shielding performance, see Note 2 in Table 1.

Table 1 – Electric field attenuation levels

Performance level	Minimum shielding performance		
	Frequency range 30 MHz to 230 MHz dB	Frequency range 230 MHz to 1 000 MHz dB	Frequency range 1 000 MHz to 3 000 MHz dB
1	20	10	0
2	40	30	20
3	60	50	40

NOTE 1 For the receiving antenna, biconical or log periodic antennas should be used for the frequency range between 30 MHz and 1 000 MHz and horn antennas should be used for the frequency range between 1 000 MHz and 3 000 MHz. A spherical dipole antenna (SDA) may be used especially for the installation within the relatively small subrack as the transmitting antenna. Equivalent SDA can be used. See Annex A on SDA.

NOTE 2 The minimum shielding performance will exclude cavity resonance.



NOTE 1 Electromagnetic shielding in accordance to IEC 61000-5-7,

performance level 1: EMxx20xx (EM code is not fully equivalent to level 1)

performance level 2: EMxx42xx (EM code is not fully equivalent to level 2)

performance level 3: EMxx64xx (EM code is not fully equivalent to level 3)

NOTE 2 E/O is used for fibre optical cable connection.

Figure 1 – Typical test equipment configuration

The antenna, as detailed in Figures 3 to 8, shall be selected as described in 3.5.2 and 3.5.3.

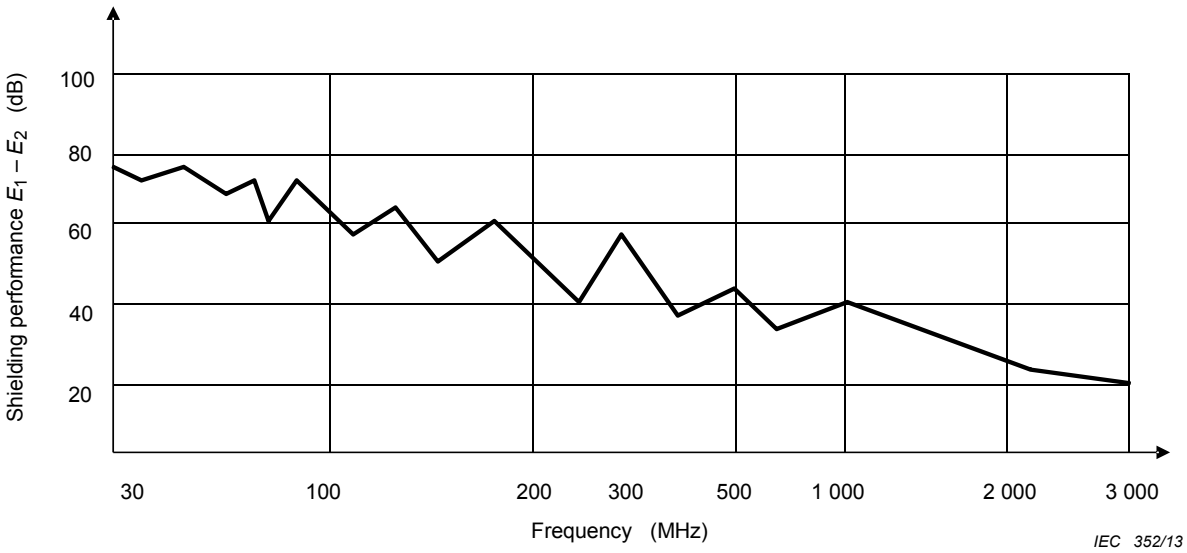


Figure 2 – Example of a measurement data presentation

The graph in Figure 2 shows a typical plot from test results.

3.5.2 Open field test sites

Fibre optical cable connection between a sender equipment and a transmitting antenna is an example for using the SDA.

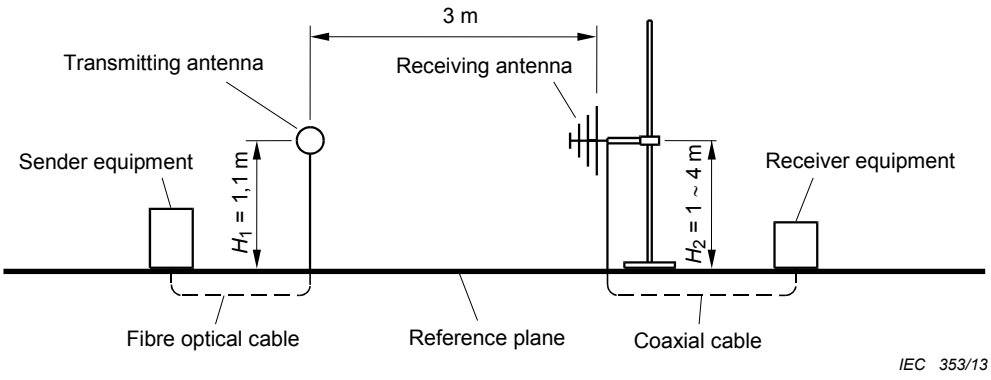


Figure 3 – Set-up for measurement of reference field strength E_1

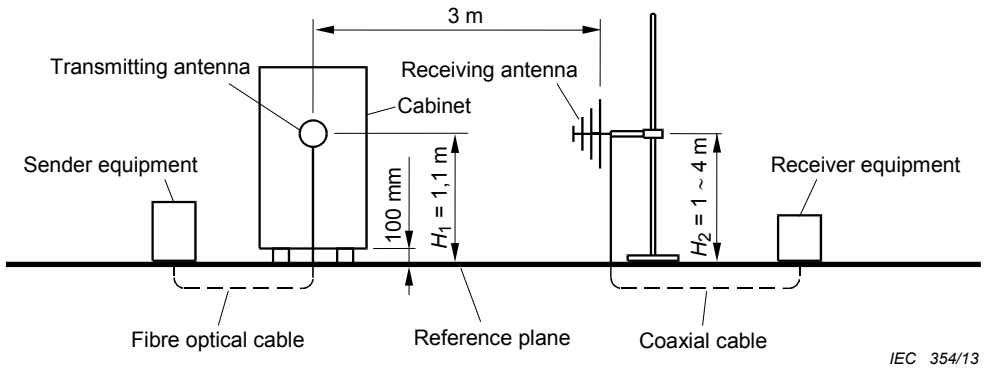


Figure 4 – Set-up for measurement of reference field strength E_2 (cabinet)

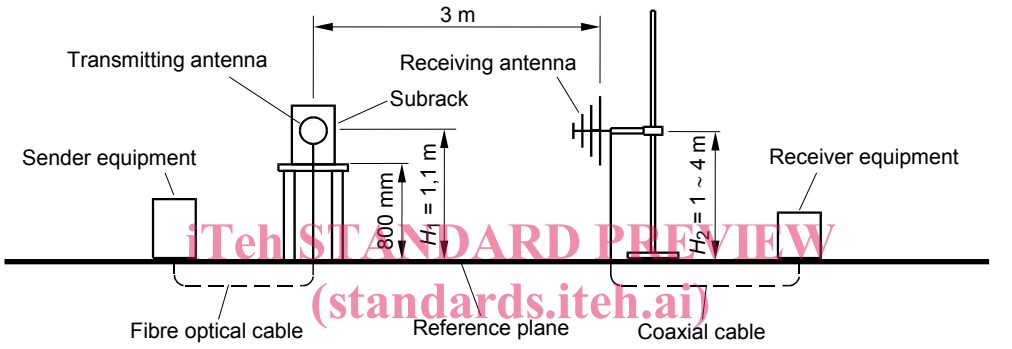


Figure 5 – Set-up for measurement of reference field strength E_2 (subrack)

3.5.3 Semi-anechoic or full anechoic chambers

Fibre optical cable connection between a sender equipment and a transmitting antenna is an example for using the SDA.

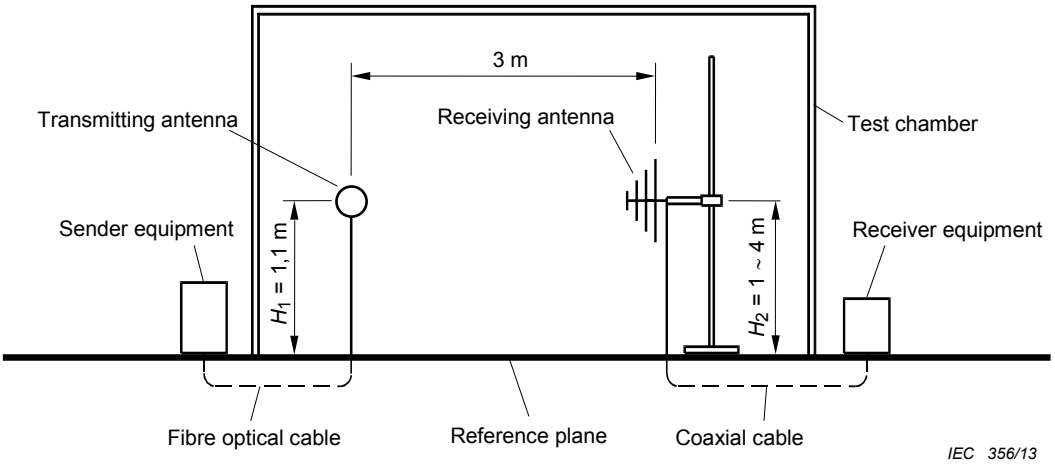


Figure 6 – Set-up for measurement of reference field strength E_1