

TECHNICAL REPORT



Case studies supporting IEC 62232 – Determination of RF field strength and SAR in the vicinity of radiocommunication base stations for the purpose of evaluating human exposure



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2011 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 la CEI ou du Comité national de la CEI du pays du demandeur.

Si vous avez des questions sur le copyright de la CEI ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de la CEI de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

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.

- Catalogue of IEC publications: www.iec.ch/searchpub

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 It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: www.iec.ch/online_news/justpub

Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.

- Electropedia: www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.

- Customer Service Centre: www.iec.ch/webstore/custserv

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:

Email: csc@iec.ch
Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00

TECHNICAL REPORT



Case studies supporting IEC 62232 – Determination of RF field strength and SAR in the vicinity of radiocommunication base stations for the purpose of evaluating human exposure

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE

ICS 13.280; 17.240

ISBN 978-2-88912-528-9

CONTENTS

FOREWORD.....	3
INTRODUCTION.....	5
1 Scope.....	6
2 Normative references	6
3 Terms, definitions, symbols and abbreviated terms.....	6
4 Overview of case studies.....	6
4.1 Case study synopsis	6
4.2 Micro cell case study.....	7
4.3 Roof-top case study with nearby apartment buildings	8
4.4 Roof-top / tower case study in residential area	9
4.5 Roof-top case study with direct access to antennas.....	10
4.6 Roof-top case study with large antennas and no direct access	11
4.7 Circular cylindrical compliance boundary determination case study with large antennas and no direct access	11
4.8 Tower case study in parkland	12
4.9 Multiple towers case study at sports venue.....	13
4.10 In-building base station case study.....	14
Annex A (informative) Micro cell case study.....	16
Annex B (informative) Roof-top case study with nearby apartments	41
Annex C (informative) Roof-top / tower case study in residential area.....	68
Annex D (informative) Roof-top case study with direct access to antennas	98
Annex E (informative) Roof-top case study with no direct access to antennas.....	126
Annex F (informative) Circular cylindrical compliance boundary determination case study	143
Annex G (informative) Tower case study in parkland.....	155
Annex H (informative) Tower case study at sports venue.....	170
Annex I (informative) In-building base station case study.....	191
Annex J (informative) Evaluation template and sample uncertainty table.....	212
Figure 1 – Micro cell case study.....	7
Figure 2 – Roof-top case study with nearby apartment buildings	8
Figure 3 – Roof-top / tower case study in residential area	9
Figure 4 – Roof-top case study with direct access to antennas	10
Figure 5 – Roof-top case study with large antennas and no direct access	11
Figure 6 – Cylindrical compliance boundary determination for dual band antenna on building.....	12
Figure 7 – Tower case study in parkland.....	13
Figure 8 – Multiple towers case study at sports venue	14
Figure 9 – Office building IBC case study	15

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**CASE STUDIES SUPPORTING IEC 62232 –
DETERMINATION OF RF FIELD STRENGTH AND SAR IN THE VICINITY
OF RADIOCOMMUNICATION BASE STATIONS FOR THE PURPOSE
OF EVALUATING HUMAN EXPOSURE**

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.

The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC 62669, which is a technical report, has been prepared by IEC technical committee 106: Methods for the assessment of electric, magnetic and electromagnetic fields associated with human exposure.

This publication contains attached files in the form of a CD-ROM for the paper version and embedded files for the electronic version. These files are intended to be used as a complement and do not form an integral part of the technical report.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
106/199/DTR	106/208/RVC

Full information on the voting for the approval of this technical report 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.

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

This technical report contains a series of case studies for the evaluation of electromagnetic (EM) sources in the frequency range 100 kHz - 300 GHz to support the methods detailed in the international standard IEC 62232, *Determination of RF field strength and SAR in the vicinity of radiocommunication base stations for the purpose of evaluating human exposure*. Using the methods detailed in the standard, each case study has been chosen to illustrate a typical radio base station (RBS) evaluation scenario.

This document is a preview generated by EVS

CASE STUDIES SUPPORTING IEC 62232 – DETERMINATION OF RF FIELD STRENGTH AND SAR IN THE VICINITY OF RADIOCOMMUNICATION BASE STATIONS FOR THE PURPOSE OF EVALUATING HUMAN EXPOSURE

1 Scope

This technical report presents a series of case studies in which electromagnetic (EM) fields are evaluated in accordance with IEC 62232. It also provides a reporting template cross referenced to IEC 62232.

Each case study has been chosen to illustrate a typical radio base station (RBS) evaluation scenario and employs the methods detailed in IEC 62232. Some of the case studies demonstrate more than one evaluation method. However, in most situations only one method would be required to complete an evaluation.

The case studies documented in this report are provided for guidance only and are not a substitute for a thorough understanding of the requirements of IEC 62232.

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 62232: *Determination of RF field strength and SAR in the vicinity of radiocommunication base stations for the purpose of evaluating human exposure*

3 Terms, definitions, symbols and abbreviated terms

For the purposes of this document, the terms, definitions, symbols and abbreviated terms given in IEC 62232 apply.

4 Overview of case studies

4.1 Case study synopsis

This clause provides a summary of worked evaluation examples at a number of RBS sites using a range of methods described in IEC 62232. The example sites include roof-tops, towers, poles, micro cells and in-building cells.

The case studies have been chosen to illustrate typical RBS sites and common evaluations. Some of the case studies demonstrate multiple evaluation methods. However in most situations only one method would be required to complete an evaluation.

NOTE The coloured left-side page margins in the annexes indicates the pages are unchanged versions of sample RF exposure evaluation reports contributed by TC 106 project team members.