IEC TR 63099-1

Edition 1.0 2017-08

TECHNICAL REPORT

colour inside

Transmitting equipment for radiocommunication – Radio-over-fibre technologies for electromagnetic-field measurement – Part 1: Radio-over-fibre technologies for antenna measurement

IEC TR 63099-1:2017-08(en)

Documents
Document Sharing Hub

Full document details: IEC TR 63099-1 2017

THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2017 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 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.

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 - www.iec.ch/searchpub
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 It also gives information on projects, replaced and withdrawn publications.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 20 000 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
65 000 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: csc@iec.ch.

AVA Documents
Document Sharing Hub

Full document details: IEC TR 63099-1 2017

IEC TR 63099-1

Edition 1.0 2017-08

TECHNICAL REPORT

colour inside

Transmitting equipment for radiocommunication – Radio-over-fibretechnologies for electromagnetic-field measurement – Part 1: Radio-over-fibre technologies for antenna measurement

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 33.060.20: 33.180.99

ISBN 978-2-8322-4659-7

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

® Registered trademark of the International Electrotechnical Commission

Documents
Document Sharing Hub

Full document details: IEC TR 63099-1 2017

CONTENTS

FOREWORD 4
INTRODUCTION 6
1 Scope 7
2 Normative references 7
3 Terms, definitions and abbreviated terms 7
3.1 Terms and definitions 7
3.2 Abbreviated terms 8
4 Practical applications 8
4.1 List of applications 8
4.2 Antenna gain measurement system using a radio-over-fibre transceiver 8
4.2.1 Overview 8
4.2.2 Features 8
4.2.3 System configuration 9
4.2.4 Example of measurement results 12
4.3 Millimetre-wave antenna pattern measurement system using a nested type LN-MZM and a UTC-PD 14
4.3.1 Overview 14
4.3.2 Features 15
4.3.3 System configuration 15
4.3.4 Specifications 17
4.3.5 Example of measurement results 18
4.4 Very-near-field antenna pattern measurement using a photonic sensor 19
4.4.1 Overview 19
4.4.2 Features 19
4.4.3 System configuration 20
4.4.4 Specifications 22
4.4.5 Example of measurement results 23
Bibliography 25

Figure 1 – System configuration of antenna gain measurement system using a radio-over-fibre transceiver 9
Figure 2 – System configuration of antenna gain measurement system using bi-directional type radio-over-fibre transceiver specifications 10
Figure 3 – Appearance of a pair of radio-over-fibre transceivers 12
Figure 4 – $S_{21}(\omega)$ measurement result of two LPDAs 13
Figure 5 – Measurement gain of LPDA using a radio-over-fibre transceiver 14
Figure 6 – $S_{21}(\omega)$ measurement result of two VULB9160s 14
Figure 7 – System configuration for mm-wave antenna pattern measurement system using nested type LN-MZM and UTC-PD 16
Figure 8 – Appearance of mm-wave antenna pattern measurement system using nested type LN-MZM and UTC-PD 16
Figure 9 – Appearance of mm-wave transmitting part of mm-wave antenna pattern measurement system using nested type LN-MZM and UTC-PD 17
Figure 10 – Frequency characteristics and dynamic range of system using a nested LN-MZM modulator and a UTC-PD 18
Figure 11 – Measured antenna radiation pattern in the E-plane at 120 GHz 19

AVA Documents
Document Sharing Hub
Full document details: IEC TR 63099-1 2017

Figure 12 – System configuration of planar very-near-field antenna pattern measurement system using a photonic sensor 20
Figure 13 – System configuration of cylindrical very-near-field antenna pattern measurement system using a photonic sensor 21
Figure 14 – System configuration of spherical very-near-field antenna pattern measurement system using a photonic sensor 21
Figure 15 – Appearance of very-near-field antenna pattern measurement system using an LN-MZM photonic sensor 22
Figure 16 – Photonic sensor using an LN-MZM 22
Figure 17 – Measured and calculated near-field electric field distribution using planar very-near-field antenna pattern measurement system using an LN-MZM photonic sensor 23
Figure 18 – E-plane antenna pattern of Horn-antenna measured by planar very-near-field antenna pattern measurement system using an LN-MZM photonic sensor 24

Table 1 – Specification of a radio-over-fibre transceiver 11
Table 2 – Specification of an LN-MZM 17
Table 3 – Specification of a UTC-PD 18
Table 4 – Specification of an LN-MZM photonic sensor 23

Documents
Document Sharing Hub
Full document details: IEC TR 63099-1 2017

INTERNATIONAL ELECTROTECHNICAL COMMISSION

TRANSMITTING EQUIPMENT FOR RADIOCOMMUNICATION – RADIO-OVER-FIBRE TECHNOLOGIES FOR ELECTROMAGNETIC-FIELD MEASUREMENT –

Part 1: Radio-over-fibre technologies for antenna measurement

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 TR 63099-1, which is a Technical Report, has been prepared by IEC technical committee 103: Transmitting equipment for radiocommunication.

Documents
Document Sharing Hub

Full document details: IEC TR 63099-1 2017

The text of this Technical Report is based on the following documents:

Enquiry draft	Report on voting
103/156/DTR	103/162/RVDTR

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 document has been drafted in accordance with the ISO/IEC Directives, Part 2.

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.

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.

Documents
Document Sharing Hub

Full document details: IEC TR 63099-1 2017

INTRODUCTION

This document provides information on the current and latest applications for antenna measurement using radio-over-fibre technology. Antenna gain and antenna pattern measurement systems are covered, which are practically in use or will be used soon. It will be beneficial to system developers and system users in the fields of antenna measurement. As a Technical Report, this document contains no requirements and is informative only.

Documents
Document Sharing Hub

Full document details: IEC TR 63099-1 2017

TRANSMITTING EQUIPMENT FOR RADIOCOMMUNICATION – RADIO-OVER-FIBRE TECHNOLOGIES FOR ELECTROMAGNETIC-FIELD MEASUREMENT –

Part 1: Radio-over-fibre technologies for antenna measurement

1 Scope

The purpose of this document is to provide information about the current and latest applications for antenna measurement that use radio-over-fibre technologies. Antenna gain and the antenna radiation pattern measurement system are covered, which are practically in use and will be used soon. Basic concepts, system configurations and measurement examples of the systems are included. The theoretical background of antenna measurement is beyond the scope of this document.

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.

IEEE Std. 145-2013, *IEEE Standard for Definitions of Terms for Antennas*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEEE Std. 145-2013 and the following apply.

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

3.1.1
Mach-Zehnder modulator
optical modulator used for controlling the amplitude of an optical wave

3.1.2
UTC-PD
uni-travelling-carrier photo-diode
high-speed photo-diode that can generate millimeter-wave and THz wave

3.1.3
log-periodic dipole array antenna
LPDA antenna
antenna having wideband characteristics due to logarithmic periodically aligned dipole elements

Documents
Document Sharing Hub
Full document details: IEC TR 63099-1 2017