IEC TR 63352

Edition 1.0 2022-04

TECHNICAL REPORT

colour inside

Transmitting and receiving equipment for radiocommunication – Radio spectrum measurement method – 300-GHz spectrum measurement equipment

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 33.060.20

ISBN 978-2-8322-1096-0

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

® Registered trademark of the International Electrotechnical Commission

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 7
4 Background to measurement up to 300 GHz 8
4.1 IEEE Std 802.15.3d 8
4.2 FOD radar 8
4.3 Experimental frequency license above 95 GHz 8
4.4 ITU WRC-19 agenda item 1.15 9
4.5 Issue of conventional spectrum measurement for mmWave 9
5 300-GHz band spectrum measurement 10
5.1 Overview 10
5.2 300-GHz spectrum analyser configuration 11
5.3 mmWave pre-selector 13
5.4 Performance of mmWave spectrum analyser 15
5.4.1 General 15
5.4.2 Signal source for calibration and test 16
5.4.3 Spectrum measurement 17
5.4.4 Unwanted response 18
5.4.5 Displayed average noise level 20
5.4.6 Third-order intercept point 20
6 Spectrum analyser overall performance 21
6.1 General 21
6.2 Measurement examples 21
6.3 Integrated spectrum measurement system evaluation 22
6.4 Propagation loss measurement results 23
6.5 Evaluation with integrated spectrum measurement system 24
6.6 Discussion of evaluation results 27
Bibliography 29

Figure 1 – IEEE Std 802.15.3d-2017 (Amendment 2) frequency plan 8
Figure 2 – Spectrum observed by spectrum analyser without pre-selector 10
Figure 3 – External appearance of 300-GHz band spectrum analyser 11
Figure 4 – Standard spectrum analyser configuration 11
Figure 5 – 300-GHz spectrum analysis system with optical local signal generation 12
Figure 6 – 300-GHz spectrum analysis system with electrical local signal generation 12
Figure 7 – Standard spectrum-analyser configuration 13
Figure 8 – Image response mechanism 14
Figure 9 – Conventional preselection method 14
Figure 10 – Filter-bank type pre-selector 15
Figure 11 – Measurement results 15

Figure 12 – Measurement set-up 16
Figure 13 – System set-up for level calibration 16
Figure 14 – Signal source for level calibration and evaluation 16
Figure 15 – Signal source output power 17
Figure 16 – Signal source spurious performance 17
Figure 17 – Spectrum measurement result from 255 GHz to 315 GHz 18
Figure 18 – Relationship between input RF signal and displayed frequency 19
Figure 19 – Comparison of spurious response with and without pre-selector (RBW = 1 MHz, Detection = Positive/Negative) 19
Figure 20 – Displayed average noise level 20
Figure 21 – Third-order intercept point 20
Figure 22 – TOI measurement results (Span 0 Hz, ATT 0 dB, RBW 300 Hz) 21
Figure 23 – Integrated spectrum measurement system 22
Figure 24 – Integrated spectrum measurement system evaluation 23
Figure 25 – Propagation loss measurement system 23
Figure 26 – Propagation loss (propagation distance d = 500 mm) 24
Figure 27 – Spectrum evaluation in OTA measurement environment 25
Figure 28 – Integrated spectrum measurement system monitoring screens 26
Figure 29 – Output signal directivity 28

Table 1 – Frequency bands covered by spectrum analyser 10
Table 2 – J-band spectrum analyser target specifications 11
Table 3 – Comparison of two local signal generation methods 13
Table 4 – Frequency bands covered by spectrum analyser 21
Table 5 – Standard gain horn antenna specifications 23
Table 6 – 12 Multiplier specifications 25
Table 7 – Output signal and spurious frequency (11,75 GHz input frequency) 25

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

TRANSMITTING AND RECEIVING EQUIPMENT FOR RADIOCOMMUNICATION – RADIO SPECTRUM MEASUREMENT METHOD – 300-GHz SPECTRUM MEASUREMENT EQUIPMENT

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 TR 63352 has been prepared by IEC technical committee 103: Transmitting equipment for radiocommunication. It is a Technical Report.

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

Draft	Report on voting
103/206/DTR	103/223/RVDTR

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 Technical Report 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.

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.

INTRODUCTION

This document describes a high-dynamic-range spectrum measurement system to measure spectra in the frequency range 140 GHz to 300 GHz. Although millimeter-wave (mmWave) technology has high potential for both industries and users, there are no developed techniques for evaluating spectra suppressing the unwanted response generated in the measurement system. In addition, the commercialized spectrum analyser for this frequency band cannot accurately measure low power input signals due to the insufficient dynamic range while high power signals are input to the spectrum analyser simultaneously. This document describes the high-dynamic-range spectrum measurement system with low unwanted response for measuring spectra in the frequency range 140 GHz to 300 GHz, and proposes an mmWave pre-selector to suppress the unwanted response generated in the measurement system.

TRANSMITTING AND RECEIVING EQUIPMENT FOR RADIOCOMMUNICATION – RADIO SPECTRUM MEASUREMENT METHOD – 300-GHz SPECTRUM MEASUREMENT EQUIPMENT

1 Scope

This document specifies spectrum measurement methods in the frequency range 140 GHz to 300 GHz. This document also provides background information, describes system configurations, key mmWave pre-selector technology, as well as some examples of the spurious measurement of antennas under test (AUTs) over the air.

2 Normative references

There are no normative references in this document.