CISPR 11

Edition 6.0 2015-06
REDLINE VERSION

# INTERNATIONAL STANDARD

colour inside

INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE

## Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement

Documents
Document Sharing Hub

CISPR 11:2015-06 RLV(en)

Full document details: CISPR 11 2015 RLV

**THIS PUBLICATION IS COPYRIGHT PROTECTED**

**Copyright © 2015 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
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 - webstore.iec.ch/advsearchform**
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 It also gives information on projects, replaced and withdrawn publications.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 21 000 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**
67 000 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: sales@iec.ch.

Documents
Document Sharing Hub

Full document details: CISPR 11 2015 RLV

CISPR 11

Edition 6.0 2015-06
REDLINE VERSION

# INTERNATIONAL STANDARD

colour inside

INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE

## Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 33.100.10

ISBN 978-2-8322-2742-8

**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: CISPR 11 2015 RLV

CONTENTS

FOREWORD ..... 8
INTRODUCTION ..... 11
1 Scope ..... 12
2 Normative references ..... 12
3 Terms and definitions ..... 13
4 Frequencies designated for ISM use ..... 16
5 Classification of ~~ISM~~ equipment ..... 17
5.1 Separation into groups ..... 17
5.2 Division into classes ..... 17
5.3 ~~Information~~ Documentation for the user ..... 17
6 Limits of electromagnetic disturbances ..... 18
6.1 General ..... 18
6.2 Group 1 equipment measured on a test site ..... 18
6.2.1 Limits ~~of terminal disturbance voltage~~ for conducted disturbances ..... 18
6.2.2 Limits of electromagnetic radiation disturbance ..... 21
6.3 Group 2 equipment measured on a test site ..... 22
6.3.1 Limits ~~of terminal disturbance voltage~~ for conducted disturbances ..... 22
6.3.2 Limits of electromagnetic radiation disturbance ..... 24
6.4 Group 1 and group 2 class A equipment measured *in situ* ..... 31
6.4.1 Limits ~~of terminal disturbance voltage~~ for conducted disturbances ..... 31
6.4.2 Limits of electromagnetic radiation disturbance ..... 31
7 Measurement requirements ..... 33
7.1 General ..... 33
7.2 Ambient noise ..... 33
7.3 Measuring equipment ..... 34
7.3.1 Measuring instruments ..... 34
7.3.2 Artificial ~~mains~~ network (AN) ..... 35
7.3.3 Voltage probe ..... 35
7.3.4 Antennas ..... 36
7.3.5 Artificial hand ..... 36
7.4 Frequency measurement ..... 36
7.5 Configuration of equipment under test ..... 37
7.5.1 General ..... 37
7.5.2 Interconnecting cables ..... 39
7.5.3 Connection to the electricity supply network on a test site ..... 40
7.6 Load conditions of equipment under test ..... 42
7.6.1 General ..... 42
7.6.2 Medical equipment ..... 43
7.6.3 Industrial equipment ..... 44
7.6.4 Scientific, laboratory and measuring equipment ..... 45
7.6.5 Microwave cooking appliances ..... 45
7.6.6 Other equipment in the frequency range 1 GHz to 18 GHz ..... 45
~~7.6.7 Single and multiple-zone induction cooking appliances ..... 46~~
7.6.7 Electric welding equipment ..... 46
7.6.8 ISM RF lighting equipment ..... 47

AVA Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

7.6.9 Medium voltage (MV) and high voltage (HV) switchgear ....47
7.6.10 Grid connected power converters ....47
7.7 Recording of test-site measurement results ....47
7.7.1 General ....47
7.7.2 Conducted emissions ....48
7.7.3 Radiated emissions ....48
8 Special provisions for test site measurements (9 kHz to 1 GHz) ....48
8.1 Ground planes ....48
8.2 Measurement of ~~mains terminal disturbance voltage~~ conducted disturbances ....48
8.2.1 General ....48
8.2.2 Measurements on grid connected power converters ....49
8.2.3 Handheld equipment which are normally operated without an earth connection ....53
8.3 Radiation test site for 9 kHz to 1 GHz ....54
8.3.1 General ....54
8.3.2 Validation of the radiation test site (9 kHz to 1 GHz) ....55
8.3.3 Disposition of equipment under test (9 kHz to 1 GHz) ....55
8.3.4 Radiation measurements (9 kHz to 1 GHz) ....55
8.4 Alternative radiation test sites for the frequency range 30 MHz to 1 GHz ....55
9 Radiation measurements: 1 GHz to 18 GHz ....56
9.1 Test arrangement ....56
9.2 Receiving antenna ....56
9.3 Validation and calibration of test site ....56
9.4 Measuring procedure ....56
9.4.1 General ....56
9.4.2 Operating conditions of the EUT ....57
9.4.3 Preliminary measurement ....57
9.4.4 Final measurement ....58
10 Measurement *in situ* ....59
11 Safety precautions for emission measurements on ISM RF equipment ....60
~~12 Assessment of conformity of equipment ....~~
~~12.1 General ....~~
~~12.2 Statistical assessment of compliance of series produced equipment ....~~
~~12.3 Equipment in small scale production ....~~
~~12.4 Equipment produced on an individual basis ....~~
12~~.5~~ Measurement uncertainty ....61
~~13 Figures and flowcharts ....~~
Annex A (informative) Examples of equipment classification ....62
Annex B (informative) Precautions to be taken in the use of a spectrum analyzer (see 7.3.1) ....64
Annex C (normative) Measurement of electromagnetic radiation disturbance in the presence of signals from radio transmitters ....65
Annex D (informative) Propagation of interference from industrial radio-frequency equipment at frequencies between 30 MHz and 300 MHz ....66
Annex E (informative) Recommendations of CISPR for protection of certain radio services in particular areas ....67
E.1 ~~Introduction~~ General ....67
E.2 Recommendations for protection of safety-related radio services ....67

AVA Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

E.3 Recommendations for protection of specific sensitive radio services ..... 67
Annex F (informative) Frequency bands allocated for safety-related radio services ..... 68
Annex G (informative) Frequency bands allocated for sensitive radio services ..... 69
Annex H (informative) Statistical assessment of series produced equipment against the requirements of CISPR standards ..... 71
H.1 Significance of a CISPR limit ..... 71
H.2 Type tests ..... 71
H.3 Statistical assessment of series produced equipment ..... 71
H.3.1 Assessment based on a general margin to the limit ..... 71
H.3.2 Assessment based on the non-central *t*-distribution ..... 72
H.3.3 Assessment based on the binomial distribution ..... 74
H.3.4 Equipment produced on an individual basis ..... 74
Annex I (normative) Artificial Network (AN) for the assessment of disturbance voltages at d.c. power ports of semiconductor power converters ..... 75
I.1 General information and purpose ..... 75
I.2 Structures for a DC-AN ..... 75
I.2.1 AN suitable for measurement of unsymmetrical mode (UM) disturbances ..... 75
I.2.2 AN suitable for measurement of common mode (CM) and differential mode (DM) disturbances ..... 75
I.2.3 AN suitable for measurement of UM, CM and DM disturbances ..... 76
I.3 Employment of DC-ANs for compliance measurements ..... 76
I.3.1 General ..... 76
I.3.2 Pseudo V-AN ..... 76
I.3.3 Delta-AN ..... 76
I.4 Normative technical requirements for the DC-AN ..... 77
I.4.1 Parameters and associated tolerances in the range 150 kHz to 30 MHz ..... 77
I.4.2 Parameters and associated tolerances in the range 9 kHz to 150 kHz ..... 78
I.5 Examples of practical implementations of DC-ANs ..... 78
Annex J (informative) Measurements on Grid Connected Power Converters (GCPC) – Setups for an effective test site configuration ..... 81
J.1 General information and purpose ..... 81
J.2 Setup of the test site ..... 81
J.2.1 Block diagram of test site ..... 81
J.2.2 DC power supply ..... 82
J.2.3 AC power source ..... 82
J.2.4 Other components ..... 83
J.3 Other test setups ..... 83
J.3.1 Configuration comprising laboratory AC power source and resistive load ..... 83
J.3.2 Configuration in case of reverse power flow to the AC mains ..... 84
Annex K (informative) Test site configuration and instrumentation – Guidance on prevention of saturation effects in mitigation filters of transformer-less power converters during type tests according to this standard ..... 86
K.1 General information and purpose ..... 86
K.2 Recommendations for avoidance of saturation effects in the range 9 kHz to 150 kHz ..... 87
K.3 Detailed advice ..... 87
K.3.1 General ..... 87
K.3.2 Insert of series inductors (or common mode chokes) in the laboratory's d.c. power supply chain ..... 88

AVA Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

K.3.3 Employment of additional common mode decoupling capacitors at the interface between the AE port of the DC-AN and the laboratory d.c. power supply port allocated in the test environment ..... 89
K.4 Background information ..... 90
Bibliography ..... 92

Figure ~~4~~ 1 – Circuit for disturbance voltage measurements on mains supply ~~(see 7.3.3)~~ ..... 35
Figure ~~6~~ 2 – Artificial hand, RC element ~~(see 7.3.5)~~ ..... 36
Figure 3 – Example for a typical cable arrangement for measurements of radiated disturbances in 3 m separation distance, Table-top EUT ..... 38
Figure 4 – Example for a typical test set up for measurement of conducted and/or radiated disturbances from a floor standing EUT, 3D view ..... 39
Figure ~~3~~ 5 – Disposition of medical (capacitive type) and dummy load ~~(see 7.6.2.1)~~ ..... 43
Figure 6 – Typical arrangement for measurement of conducted disturbances at LV d.c. power ports with the DC-AN used as termination and decoupling unit to the laboratory d.c. power source ..... 51
Figure 7 – Typical arrangement for measurement of conducted disturbances at LV d.c. power ports with the DC-AN used as termination and voltage probe ..... 51
Figure 8 – Typical arrangement for measurement of conducted disturbances at LV d.c. power ports with the DC-AN used as voltage probe and with a current probe – 2D diagram ..... 52
Figure 9 – Typical arrangement for measurement of conducted disturbances at LV d.c. power ports with a DC-AN used as voltage probe and with a current probe – 3D diagram ..... 53
Figure ~~1~~ 10 – Test site ..... 54
Figure ~~2~~ 11 – Minimum size of metal ground plane ..... 54
Figure ~~5~~ 12 – Decision tree for the measurement of emissions from 1 GHz to 18 GHz of ~~class B,~~ group 2 ~~ISM~~ equipment operating at frequencies above 400 MHz ..... 57
Figure H.1 – An example of possible difficulties ..... 74
Figure I.1 – Practical implementation of a 150 Ω DC-AN suitable for measurement of UM disturbances (Example) ..... 78
Figure I.2 – Practical implementation of a 150 Ω DC-AN suitable for measurement of CM and DM disturbances (Example, see also Figure A.2 in CISPR 16-1-2:2014) ..... 79
Figure I.3 – Practical implementation of a 150 Ω DC-AN suitable for measurement of UM, or CM and DM disturbances (Example 1) ..... 79
Figure I.4 – Practical implementation of a 150 Ω DC-AN suitable for measurement of UM, or CM and DM disturbances (Example 2) ..... 80
Figure I.5 – Practical implementation of a 150 Ω DC-AN suitable for measurement of UM, or CM and DM disturbances (Example 3) ..... 80
Figure J.1 – Setup of the test site (Case 1) – 2D diagram ..... 81
Figure J.2 – Setup of the test site (Case 1) – 3D diagram ..... 82
Figure J.3 – Setup of the test site (Case 2) – 2D diagram ..... 83
Figure J.4 – Setup of the test site (Case 2) – 3D diagram ..... 84
Figure J.5 – Setup of the test site (Case 3) – 2D diagram ..... 85
Figure J.6 – Setup of the test site (Case 3) – 3D diagram ..... 85
Figure K.1 – Flow of the common mode RF current at test site configuration level ..... 88
Figure K.2 – Blocking of flow of common mode RF current by insert of series inductors ..... 89
Figure K.3 – Blocking of flow of common mode RF current by employment of additional CM decoupling capacitors ..... 89

Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

Figure K.4 – CM termination impedance at the EUT port of a DC-AN – Magnitude-versus-frequency characteristic in the range 3 kHz to 30 MHz, Example ..... 90

Figure K.5 – Prevention of saturation of mitigation filters by use of additional decoupling capacitors ..... 91

Figure K.6 – Change in the resonant frequency caused by the increase and decrease in the decoupling capacitor's capacitance ..... 91

Figure K.7 – DC-AN circuit example where capacitance of blocking capacitors of the LC decoupling circuit can be increased or decreased ..... 91

Table 1 – Frequencies in the radio-frequency (RF) range designated by ITU for use as fundamental ISM frequencies ..... 16

Table 2 – ~~Mains terminal~~ Disturbance voltage limits for class A group 1 equipment measured on a test site (a.c. mains power port) ..... 19

Table 3 – Limits for conducted disturbances of class A group 1 equipment measured on a test site (d.c. power port) ..... 20

Table ~~3~~ 4 – ~~Mains terminal~~ Disturbance voltage limits for class B group 1 equipment measured on a test site (a.c. mains power port) ..... 20

Table 5 – Disturbance voltage limits for class B group 1 equipment measured on a test site (d.c. power port) ..... 20

Table ~~4~~ 6 – Electromagnetic radiation disturbance limits for class A group 1 equipment measured on a test site ..... 21

Table ~~5~~ 7 – Electromagnetic radiation disturbance limits for class B group 1 equipment measured on a test site ..... 22

Table ~~6~~ 8 – ~~Mains terminal~~ Disturbance voltage limits for class A group 2 equipment measured on a test site (a.c. mains power port) ..... 23

Table ~~7~~ 9 – ~~Mains terminal~~ Disturbance voltage limits for class B group 2 equipment measured on a test site (a.c. mains power port) ..... 23

~~Table 8 – Mains terminal disturbance voltage limits for induction cooking appliances ..... ~~

Table ~~9~~ 10 – Electromagnetic radiation disturbance limits for class A group 2 equipment measured on a test site ..... 26

Table ~~10~~ 11 – Electromagnetic radiation disturbance limits for class A EDM and arc welding equipment measured on a test site ..... 27

Table ~~11~~ 12 – Electromagnetic radiation disturbance limits for class B group 2 equipment measured on a test site ..... 27

~~Table 12 – Limits of the magnetic field strength for induction cooking appliances intended for commercial use ..... ~~

~~Table 13 – Limits of the magnetic field induced current in a 2 m loop antenna for induction cooking appliances for domestic use ..... ~~

Table ~~14~~ 13 – Electromagnetic radiation disturbance peak limits for group 2 equipment ~~producing CW type disturbances and~~ operating at frequencies above 400 MHz ..... 29

~~Table 15 – Electromagnetic radiation disturbance peak limits for class B group 2 equipment producing fluctuating disturbances other than CW and operating at frequencies above 400 MHz ..... ~~

Table ~~16~~ 14 – Electromagnetic radiation disturbance weighted limits for ~~class B~~ group 2 equipment ~~producing fluctuating disturbances other than CW~~ and operating at frequencies above 400 MHz ..... 29

Table 15 – Electromagnetic radiation disturbance APD level corresponding to $10^{-1}$ limits for class B group 2 equipment operating at frequencies above 400 MHz ..... 30

Table ~~17~~ 16 – Electromagnetic radiation disturbance limits for class A group 1 equipment measured *in situ* ..... 31

AVA Documents
Document Sharing Hub

Full document details: CISPR 11 2015 RLV

Table ~~18~~ 17 – Electromagnetic radiation disturbance limits for class A group 2 equipment measured *in situ* ..... 32
Table 18 – Frequency sub-ranges to be used for weighted measurements ..... 59
Table E.1 – Limits for electromagnetic radiation disturbances for *in situ* measurements to protect specific safety-related radio services in particular areas ..... 67
Table H.1 – General margin to the limit for statistical evaluation ..... 71
Table H.2 – The non-central $t$-distribution factor $k$ as a function of the sample size $n$ ..... 73
Table H.3 – Application of the binomial distribution ..... 74
Table I.1 – Parameters and associated tolerances in the range 150 kHz to 30 MHz ..... 77
Table I.2 – Parameters and associated tolerances in the range 9 kHz to 150 kHz ..... 78

Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

INTERNATIONAL ELECTROTECHNICAL COMMISSION

INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE

# INDUSTRIAL, SCIENTIFIC AND MEDICAL EQUIPMENT – RADIO-FREQUENCY DISTURBANCE CHARACTERISTICS – LIMITS AND METHODS OF 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.

**This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.**

Documents
Document Sharing Hub

Full document details: CISPR 11 2015 RLV

International Standard CISPR 11 has been prepared by CISPR Subcommittee B: Interference relating to industrial, scientific and medical radio-frequency apparatus, to other (heavy) industrial equipment, to overhead power lines, to high voltage equipment and to electric traction.

This sixth edition cancels and replaces the fifth edition published in 2009 and its Amendment 1 published in 2010. It constitutes a technical revision.

It introduces and permits type testing on components of power electronic equipment, systems and installations. Its emission limits apply now to low voltage (LV) a.c. and d.c. power ports, irrespective of the direction of power transmission. Several limits were adapted to the practical test conditions found at test sites. They are also applicable now to power electronic ISM RF equipment used for wireless power transfer (WPT), for instant power supply and charging purposes. The limits in the range 1 GHz to 18 GHz apply now to CW-type disturbances and to fluctuating disturbances in a similar, uniform and technology-neutral way. For these measurements, two alternative methods of measurement are available, the traditional log-AV method and the new APD method.

For measurements at LV d.c. power ports of power electronic equipment, a modern implementation of the 150 Ω Delta-network specified in CISPR 16-1-2 has been made available.

This International Standard CISPR 11 has the status of a Product Family EMC standard in accordance with IEC Guide 107, *Electromagnetic compatibility – Guide to the drafting of electromagnetic compatibility publications (2014)*.

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

| FDIS | Report on voting |
|---|---|
| CISPR/B/628/FDIS | CISPR/B/631/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.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website 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.**

Documents
Document Sharing Hub

Full document details: CISPR 11 2015 RLV

The main content of this standard is based on CISPR Recommendation No. 39/2 given below:

RECOMMENDATION No. 39/2

**Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment**

The CISPR

CONSIDERING

a) that ISM RF equipment is an important source of disturbance;

b) that methods of measuring such disturbances have been prescribed by the CISPR;

c) that certain frequencies are designated by the International Telecommunication Union (ITU) for unrestricted radiation from ISM equipment,

RECOMMENDS

that the latest edition of CISPR 11 be used for the application of limits and methods of measurement of ISM equipment.

Documents
Document Sharing Hub

Full document details: CISPR 11 2015 RLV

# INTRODUCTION

This CISPR publication contains, amongst common requirements for the control of RF disturbances from equipment intended for use in industrial, scientific, and medical ~~(ISM)~~ electrical applications, specific requirements for the control of RF disturbances caused by ISM RF applications in the meaning of the definition of the International Telecommunication Union (ITU), see also Definition 3.13 in this International Standard. CISPR and ITU share their responsibility for the protection of radio services in respect of the use of ISM RF applications.

The CISPR is concerned with the control of RF disturbances from ISM RF applications by means of an assessment of these disturbances either at a standardised test site or, for an individual ISM RF application which cannot be tested at such a site, at its place of operation. Consequently, this CISPR Publication covers requirements for conformity assessment of both, equipment assessed by means of type tests at standardised test sites or of individual equipment under in situ conditions.

The ITU is concerned with the control of RF disturbances from ISM RF applications during normal operation and use of the respective equipment at its place of operation (see Definition 1.15 in the ITU Radio Regulations). There, use of radio-frequency energy decoupled from the ISM RF application by radiation, induction or capacitive coupling is restricted to the location of that individual application.

This CISPR publication contains, in 6.3, the essential emission requirements for an assessment of RF disturbances from ISM RF applications at standardised test sites. These requirements allow for type testing of ISM RF applications operated at frequencies up to 18 GHz. It further contains, in 6.4, the essential emission requirements for an in situ assessment of RF disturbances from individual ISM RF applications in the frequency range up to ~~18~~ 1 GHz. All requirements were established in close collaboration with the ITU and enjoy approval of the ITU.

However, for operation and use of several types of ISM RF applications the manufacturer, installer and/or customer should be aware of additional national provisions regarding possible licensing and particular protection needs of local radio services and applications. Depending on the country concerned, such additional provisions may apply to individual ISM RF applications operated at frequencies outsides designated ISM bands (see Table 1). They also may apply to ISM RF applications operated at frequencies above 18 GHz. For the latter type of applications, local protection of radio services and appliances requires an accomplishment of the conformity assessment by application of the relevant national provisions in the frequency range above 18 GHz in accordance with vested interests of the ITU and national administrations. These additional national provisions may apply to spurious emissions, emissions appearing at harmonics of the operation frequency, and to wanted emissions at the operation frequency allocated outside a designated ISM band in the frequency range above 18 GHz.

Recommendations of CISPR for the protection of radio services in particular areas are found in Annex E of this International Standard.

Definition 1.15 of the ITU Radio Regulations reads as follows:

**1.15** *industrial, scientific and medical (ISM) applications (of radio frequency energy)*: Operation of equipment or appliances designed to generate and use locally radio frequency energy for industrial, scientific, medical, domestic or similar purposes, excluding applications in the field of telecommunications.

[ITU Radio Regulations Volume 1: 2012 – Chapter I, Definition 1.15]

Documents
Document Sharing Hub

Full document details: CISPR 11 2015 RLV

# INDUSTRIAL, SCIENTIFIC AND MEDICAL EQUIPMENT – RADIO-FREQUENCY DISTURBANCE CHARACTERISTICS – LIMITS AND METHODS OF MEASUREMENT

## 1 Scope

This International Standard applies to industrial, scientific and medical electrical equipment operating in the frequency range 0 Hz to 400 GHz and to domestic and similar appliances designed to generate and/or use locally radio-frequency energy.

This standard covers emission requirements related to radio-frequency (RF) disturbances in the frequency range of 9 kHz to 400 GHz. Measurements need only be performed in frequency ranges where limits are specified in Clause 6.

For ISM RF applications in the meaning of the definition found in the ITU Radio Regulations (see Definition 3.13), this standard covers emission requirements related to radio-frequency disturbances in the frequency range of 9 kHz to 18 GHz.

NOTE Emission requirements for induction cooking appliances are specified in CISPR 14-1 [1][1].

Requirements for ISM RF lighting ~~apparatus~~ equipment and UV irradiators operating at frequencies within the ISM frequency bands defined by the ITU Radio Regulations are contained in this standard.

Equipment covered by other CISPR product and product family emission standards are excluded from the scope of this standard.

## 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.

CISPR 16-1-1:~~2006~~ 2010, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus*
CISPR 16-1-1:2010/AMD 1:~~2006~~ 2010
CISPR 16-1-1:2010/AMD 2:~~2007~~ 2014

CISPR 16-1-2:~~2003~~ 2014, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-2: Radio disturbance and immunity measuring apparatus – ~~Ancillary equipment – Conducted disturbances~~ Coupling devices for conducted disturbance measurements*
~~Amendment 1 (2004)~~
~~Amendment 2 (2006)~~

CISPR 16-1-4:~~2007~~ 2010, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-4: Radio disturbance and immunity measuring apparatus –*

[1] Figures in square brackets refer to the Bibliography.

Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

~~*Ancillary equipment – Radiated disturbances*~~ *Antennas and test sites for radiated disturbance measurements*
CISPR 16-1-4:2010/AMD 1:~~2007~~ 2012
~~Amendment 2 (2008)~~

CISPR 16-2-1:2014, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-1: Methods of measurement of disturbances and immunity – Conducted disturbance measurements*

CISPR 16-2-3:~~2006~~ 2010, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-3: Methods of measurement of disturbances and immunity – Radiated disturbance measurements*
CISPR 16-2-3:2010/AMD 1:2010
CISPR 16-2-3:2010/AMD 2:2014

CISPR 16-4-2:~~2003~~ 2011, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modelling –* ~~*Uncertainty in EMC measurements*~~ *Measuring instrumentation uncertainty*
CISPR 16-4-2:2011/AMD 1:2014

IEC 60050-161:1990, *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electromagnetic compatibility*
~~Amendment 1 (1990)~~
~~Amendment 2 (1998)~~

IEC 60601-1-2:~~2007~~ 2014, *Medical electrical equipment – Part 1-2: General requirements for basic safety and essential performance – Collateral standard: Electromagnetic* ~~*compatibility*~~ *disturbances – Requirements and tests*

IEC 60601-2-2:2009, *Medical electrical equipment – Part 2-2: Particular requirements for the basic safety and essential performance of high frequency surgical equipment and high frequency surgical accessories*

IEC 60974-10:~~2007~~ 2014, *Arc welding equipment – Part 10: Electromagnetic compatibility (EMC) requirements*

IEC 61307:~~2006~~ 2011, *Industrial microwave heating installations – Test methods for the determination of power output*

IEC 62135-2:2007, *Resistance welding equipment – Part 2: Electromagnetic compatibility (EMC) requirements*

ITU Radio Regulations (~~2008~~ 2012), *Radio regulations, Volume 3 – Resolutions and recommendations, Resolution no. 63* (available at http://www.itu.int/pub/R-REG-RR-2012)

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-161, as well as the following, apply.

**3.1**
**a.c. mains power port**
port used to connect to a public low voltage a.c. mains power distribution network or other low voltage a.c. mains installation

Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

**3.2**
**arc welding equipment**
equipment for applying current and voltage and having the required characteristics suitable for arc welding and allied processes

**3.3**
**artificial mains network**
**AMN**
network that provides a defined impedance to the EUT at radio frequencies, couples the disturbance voltage to the measuring receiver and decouples the test circuit from the supply mains

Note 1 to entry: There are two basic types of AMN, the V-network (V-AMN) which couples the unsymmetrical voltages, and the Delta-network which couples the symmetric and the asymmetric voltages separately.

Note 2 to entry: The terms line impedance stabilization network (LISN) and V-AMN are used interchangeably.

**3.4**
**boundary of the equipment under test**
imaginary straight line periphery describing a simple geometric configuration encompassing the equipment under test

NOTE 1 to entry: All interconnecting cables are included within this boundary.

**3.5**
**component**
product which serves a specific function or functions and which is intended for use in a higher order assembled equipment or system

**3.6**
**d.c. artificial network**
**artificial d.c. network**
**DC-AN**
artificial network that provides defined termination to the EUT's d.c. power port under test while also providing the necessary decoupling from conducted disturbances originating from the laboratory d.c. power source or from the load

**3.7**
**d.c. power port**
port used to connect to a low voltage d.c. power generating system or energy storage, or to another source/load

Note 1 to entry: Such a system may be for example a photovoltaic or a fuel cell power generating system, or also a battery.

**3.8**
**electro-discharge machining (EDM) equipment**
**EDM equipment**
all the necessary units for the spark erosion process including the machine tool, the generator, control circuits, the working fluid container and integral devices

**3.9**
**~~(~~electromagnetic~~)~~ radiation**
1) phenomenon by which energy in the form of electromagnetic waves emanates from a source into space

2) energy transferred through space in the form of electromagnetic waves

Note 1 to entry: By extension, the term "electromagnetic radiation" sometimes also covers induction phenomena.

AVA Documents
Document Sharing Hub

Full document details: CISPR 11 2015 RLV

[SOURCE: IEC 60050-161:1990, 161-01-10]

**3.10**
**equipment for resistance welding and allied processes**
all equipment associated with carrying out the processes of resistance welding or allied processes consisting of e.g. power source, electrodes, tooling and associated control equipment, which may be a separate unit or part of a complex machine

**3.11**
**grid connected power converter**
**GCPC**
power converter connected to an a.c. mains power distribution network or other a.c. mains installation and used in a power generating system

**3.12**
**high power electronic system and equipment**
one or more semiconductor power converters with a combined rated power greater than 75 kVA, or an equipment containing such converters

Note 1 to entry: Examples of such high power electronic equipment are semiconductor power converters for application in UPS (Uninterruptible Power Systems) and PDS (Power Drive Systems).

**3.13**
**industrial, scientific and medical (ISM) applications (of radio frequency energy)**
**ISM applications (of radio frequency energy)**
operation of equipment or appliances designed to generate and use locally radio frequency energy for industrial, scientific, medical, domestic or similar purposes, excluding applications in the field of telecommunications

Note 1 to entry: Typical applications are the production of physical, biological, or chemical effects such as heating, ionisation of gases, mechanical vibrations, hair removal, acceleration of charged particles. A non-exhaustive list of examples is given in Annex A.

[SOURCE: ITU Radio Regulations Volume 1:~~2004~~ 2012 – ~~Articles~~ Chapter I, Definition 1.15]

**3.14**
**ISM RF equipment and appliances**
equipment or appliances designed to generate and/or use locally radio-frequency energy for industrial, scientific, medical, domestic or similar purposes, excluding applications in the field of telecommunications and information technology and other applications covered by other CISPR publications

Note 1 to entry: The abbreviation “ISM RF” is used throughout this standard for such equipment or appliances only.

**3.15**
**low voltage**
**LV**
a set of voltage levels used for the distribution of electricity and whose upper limit is generally accepted to be 1 000 V a.c or 1 500 V d.c..

[SOURCE: IEC 60050-601:1985, 601-01-26, modified – addition of the words "or 1 500 V d.c."]

**3.16**
**photovoltaic power generating system**
electric power generating system which uses the photovoltaic effect to convert solar power into electricity

Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

**3.17**
**small size equipment**
equipment, either positioned on a table top or standing on the floor which, including its cables fits in an imaginary cylindrical test volume of 1,2 m in diameter and 1,5 m height (to ground plane)

**3.18**
**spark erosion**
removal of material in a dielectric working fluid by electro-discharges, which are separated in time and randomly distributed in space, between two electrically conductive electrodes (the tool electrode and the work piece electrode), and where the energy in the discharge is controlled

**3.19**
**type test**
test of one or more devices made to a certain design to show that the design meets certain specifications

Note 1 to entry: Recognition of a type test as type approval may depend on national or regional regulation, see H.2 in Annex H.

## 4 Frequencies designated for ISM use

Certain frequencies are designated by the International Telecommunication Union (ITU) for use as fundamental frequencies for ISM RF applications (see also Definition 3.13). These frequencies are listed in Table 1.

NOTE In individual countries different or additional frequencies ~~may~~ can be designated for use by ISM ~~equipment~~ RF applications.

**Table 1 – Frequencies in the radio-frequency (RF) range designated by ITU for use as fundamental ISM frequencies**

| **Centre frequency** MHz | **Frequency range** MHz | **Maximum radiation limit** [b] | **Number of appropriate footnote to the table of frequency allocation of the ITU Radio Regulations** [a] |
|---|---|---|---|
| 6,780 | 6,765 – 6,795 | Under consideration | 5.138 |
| 13,560 | 13,553 – 13,567 | Unrestricted | 5.150 |
| 27,120 | 26,957 – 27,283 | Unrestricted | 5.150 |
| 40,680 | 40,66 – 40,70 | Unrestricted | 5.150 |
| 433,920 | 433,05 – 434,79 | Under consideration | 5.138 in Region 1, except countries mentioned in 5.280 |
| 915,000 | 902 – 928 | Unrestricted | 5.150 in Region 2 only |
| 2 450 | 2 400 – 2 500 | Unrestricted | 5.150 |
| 5 800 | 5 725 – 5 875 | Unrestricted | 5.150 |
| 24 125 | 24 000 – 24 250 | Unrestricted | 5.150 |
| 61 250 | 61 000 – 61 500 | Under consideration | 5.138 |
| 122 500 | 122 000 – 123 000 | Under consideration | 5.138 |
| 245 000 | 244 000 – 246 000 | Under consideration | 5.138 |

[a] Resolution No. 63 of the ITU Radio Regulations applies.

[b] The term “unrestricted” applies to the fundamental and all other frequency components falling within the designated band. Outside of ITU designated ISM bands the limits for the disturbance voltage and radiation disturbance in this standard apply.

Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

## 5 Classification of ~~ISM~~ equipment

### 5.1 Separation into groups

In order to simplify identification of the relevant limits, equipment in the scope of this standard is categorized into two groups, i.e. into group 1 and group 2.

*Group 1 equipment:* group 1 contains all equipment in the scope of this standard which is not classified as group 2 equipment.

*Group 2 equipment:* group 2 contains all ISM RF equipment in which radio-frequency energy in the frequency range 9 kHz to 400 GHz is intentionally generated and used or only used locally, in the form of electromagnetic radiation, inductive and/or capacitive coupling, for the treatment of material, for inspection/analysis purposes, or for transfer of electromagnetic energy.

NOTE See Annex A for examples of the separation of equipment into group 1 or 2.

### 5.2 Division into classes

In accordance with the intended use of equipment in the electromagnetic environment, this standard defines two classes of equipment, namely class A and class B.

*Class A equipment* is equipment suitable for use in all ~~establishments~~ locations other than ~~domestic~~ those allocated in residential environments and those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

Class A equipment shall meet class A limits.

~~In the case of~~ Arc welding equipment which contains arc striking or stabilizing devices ~~or in the case of~~ and stand-alone arc striking or stabilizing devices for arc welding~~, the manufacturer shall inform the user that such equipment is~~ shall be classified as class A equipment.

*Class B equipment* is equipment suitable for use in ~~domestic establishments~~ locations in residential environments and in establishments directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

Class B equipment shall meet class B limits.

### 5.3 ~~Information~~ Documentation for the user

The manufacturer and/or supplier of ~~ISM~~ equipment shall ensure that the user is informed about the class and group of the equipment, either by labelling or by the accompanying documentation. In both cases the manufacturer/supplier shall explain the meaning of both the class and the group in the documentation accompanying the equipment.

The documentation accompanying the equipment shall contain details of any precautions to be observed by the purchaser or user to ensure that regular operation and use of the equipment in the field does not cause harmful radio frequency interference (RFI). In the framework of this standard, these details concern information about:

- the possibility of radio frequency interference originating from operation of class A equipment in certain environments,
- special precautions to be observed when connecting class A equipment to a low voltage power supply network, see Footnote a and b in Table 2, Footnote b in Table 3 and Footnote a in Table 6, respectively,
- measures which can be taken at installation level to reduce emissions from installed class A equipment, see Footnote b in Table 2 and Footnote a in Table 8.

AVA Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

For class A equipment, the instructions for use accompanying the product shall contain the following text:

**Caution:** This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

## 6 Limits of electromagnetic disturbances

### 6.1 General

For measurements at standardized test sites, the requirements specified hereafter constitute the requirements for type tests.

Class A equipment may be measured either on a test site or in situ as preferred by the manufacturer.

NOTE 1 Due to size, complexity or operating conditions some equipment may have to be measured in situ in order to show compliance with the radiation disturbance limits specified herein.

Class B equipment shall be measured on a test site.

NOTE 2 The limits have been determined on a probabilistic basis taking into account the likelihood of interference. In cases of interference, additional provisions may have to ~~be required~~ be applied.

The lower limit shall apply at all transition frequencies.

~~Excluded from the testing requirements and limits of this standard are components and subassemblies not intended to perform any stand-alone ISM function.~~

Measuring apparatus and methods of measurement are specified in Clauses 7, 8 and 9.

### 6.2 Group 1 equipment measured on a test site

#### 6.2.1 Limits ~~of terminal disturbance voltage~~ for conducted disturbances

##### 6.2.1.1 General

The equipment under test shall meet either:

a) both the average limit specified for measurements with an average detector and the quasi-peak limit specified for measurements with a quasi-peak detector (see 7.3); or

b) the average limit when using a quasi-peak detector (see 7.3).

The limits for the LV d.c. power port specified hereafter apply only to grid connected power convertors (GCPCs) intended for assembly into photovoltaic power generating systems.

##### 6.2.1.2 Frequency range 9 kHz to 150 kHz

~~For group 1 equipment, no limits apply in this frequency range.~~ In the frequency range 9 kHz to 150 kHz limits are not specified.

##### 6.2.1.3 Frequency range 150 kHz to 30 MHz

Limits for ~~mains terminal~~ the disturbance voltage at low voltage a.c. mains power ports in the frequency range 150 kHz to 30 MHz for equipment measured on a test site using the 50 Ω/50 μH CISPR artificial mains network (V-AMN) or the CISPR voltage probe (see 7.3.3 and Figure 1) are given in Tables 2 and 4.

Limits for conducted disturbances at low voltage d.c. power ports in the frequency range 150 kHz to 30 MHz for equipment measured on a test site using the 150 Ω CISPR network

Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

(DC-AN) (see 7.3.2.3 and Annex I) or the current probe (see CISPR 16-1-2) are given in Table 3 and 5.

**Table 2 – ~~Mains terminal~~ Disturbance voltage limits for class A group 1 equipment measured on a test site (a.c. mains power port)**

| Frequency range MHz | Rated ~~input~~ power of ≤ 20 kVA [c] | | Rated ~~input~~ power of > 20 kVA and ≤ 75 kVA [a, c] | | High power electronic systems and equipment, Rated power of > 75 kVA [b, c] | |
|---|---|---|---|---|---|---|
| | Quasi-peak dB(μV) | Average dB(μV) | Quasi-peak dB(μV) | Average dB(μV) | Quasi-peak dB(μV) | Average dB(μV) |
| 0,15 – 0,50 | 79 | 66 | 100 | 90 | 130 | 120 |
| 0,50 – 5 | 73 | 60 | 86 | 76 | 125 | 115 |
| 5 – 30 | 73 | 60 | 90 decreasing linearly with logarithm of frequency to 73 | 80 decreasing linearly with logarithm of frequency to 60 | 115 | 105 |

At the transition frequency, the more stringent limit shall apply.

~~NOTE 1 Limits only apply to low voltage a.c. mains input ports.~~

~~NOTE 2~~ For class A equipment intended to be connected solely to isolated neutral or high impedance earthed (IT) industrial power distribution networks (see IEC 60364-1) the limits for ~~group 2~~ equipment with a rated ~~input~~ power > 75 kVA ~~in Table 6 can~~ may be applied, regardless of its actual rated power.

NOTE A rated input or output power ~~consumption~~ of 20 kVA corresponds for example to a current of approximately 29 A per phase in case of 400 V three-phase power supply networks, and to a current of approximately 58 A per phase in case of 200 V three phase power supply networks.

a These limits apply to equipment with a rated ~~input~~ power > 20 kVA and intended to be ~~powered by~~ connected to a dedicated power transformer or generator, and which is not connected to low voltage (LV) overhead power lines. For equipment not intended to be ~~powered by~~ connected to a user specific power transformer the limits for ≤ 20 kVA apply. The manufacturer, and/or supplier shall provide information on installation measures that can be used to reduce emissions from the installed equipment. In particular it shall be indicated that this equipment is intended to be ~~powered by~~ connected to a dedicated power transformer or generator and not ~~by~~ to LV overhead power lines.

b These limits apply only to high power electronic systems and equipment with a rated power greater than 75 kVA when intended to be installed as follows:

- installation is supplied from a dedicated power transformer or generator, and which is not connected to Low Voltage (LV) overhead power lines,
- installation is physically separated from residential environments by distance greater than 30 m or by a structure which acts as a barrier to radiated phenomena,
- the manufacturer and/or supplier shall indicate that this equipment meets the disturbance voltage limits for high power electronic systems and equipment of rated input power > 75 kVA and provide information on installation measures to be applied by the installer. In particular, it shall be indicated that this equipment is intended to be used in an installation which is powered by a dedicated power transformer or generator and not by LV overhead power lines.

c Selection of the appropriate set of limits shall be based on the rated a.c. power stated by the manufacturer.

AVA Documents Document Sharing Hub

Full document details: CISPR 11 2015 RLV

**Table 3 – Limits for conducted disturbances of class A group 1 equipment measured on a test site (d.c. power port)**

| Frequency range MHz | Rated power of ≤ 20 kVA [a] | | Rated power of > 20 kVA to ≤ 75 kVA [a, b] | | | | Rated power of > 75 kVA [a, b] | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Voltage limits | | Voltage limits | | Current limits | | Voltage limits | | Current limits | |
| | QP | AV | QP | AV | QP | AV | QP | AV | QP | AV |
| | dB(μV) | dB(μV) | dB(μV) | dB(μV) | dB(μA) | dB(μA) | dB(μV) | dB(μV) | dB(μA) | dB(μA) |
| 0,15 | 97 | 84 | 116 | 106 | 72 | 62 | 132 | 122 | 88 | 78 |
| to | to | to | to | to | to | to | to | to | to | to |
| 5 | 89 | 76 | 106 | 96 | 62 | 52 | 122 | 112 | 78 | 68 |
| 5 | 89 | 76 | 106 | 96 | 62 | 52 | 122 | 112 | 78 | 68 |
| to | | | to | to | to | to | to | to | to | to |
| 30 | | | 89 | 76 | 45 | 32 | 105 | 92 | 61 | 48 |

In certain frequency ranges, the limits in this table decrease linearly with logarithm of frequency.

[a] Selection of the appropriate set of limits shall be based on the rated a.c. power stated by the manufacturer.

[b] These limits apply to equipment with a rated power > 20 kVA and intended to be installed in a large photovoltaic power generating system by a professional. In the manual accompanying the product, the manufacturer, and/or supplier shall provide information on mitigation measures that can be used to reduce emissions from the installed equipment, with the goal of preventing harmful interference to radio reception in a distance of 30 m from the installation. In particular it shall be indicated that this equipment can be equipped with additional filtering and that installation is physically separated from residential environments by distance greater than 30 m. The installer is invited to check the mitigated installation against CISPR 11 in-situ measurements as indicated in clause 6.4 of this standard.

**Table ~~3~~ 4 – ~~Mains terminal~~ Disturbance voltage limits for class B group 1 equipment measured on a test site (a.c. mains power port)**

| Frequency range MHz | Quasi-peak dB(μV) | Average dB(μV) |
|---|---|---|
| 0,15 – 0,50 | 66<br>Decreasing linearly with logarithm of frequency to<br>56 | 56<br>Decreasing linearly with logarithm of frequency to<br>46 |
| 0,50 – 5 | 56 | 46 |
| 5 – 30 | 60 | 50 |
| At the transition frequency, the more stringent limit shall apply. | | |

For diagnostic X-ray generators operating in intermittent mode the quasi-peak limits of Table 2 or Table 4 can be relaxed by 20 dB.

**Table 5 – Disturbance voltage limits for class B group 1 equipment measured on a test site (d.c. power port)**

| Frequency range | Quasi-peak | Average |
|---|---|---|
| MHz | dB(μV) | dB(μV) |
| 0,15 – 0,50 | 84 | 74 |
| | Decreasing linearly with logarithm of frequency to | Decreasing linearly with logarithm of frequency to |
| | 74 | 64 |
| 0,50 – 30 | 74 | 64 |

AVA Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

### 6.2.2 Limits of electromagnetic radiation disturbance

#### 6.2.2.1 General

The equipment under test shall meet the quasi-peak limits when using a quasi-peak detector.

#### 6.2.2.2 Frequency range 9 kHz to 150 kHz

~~For group 1 equipment, no limits apply~~ In the frequency range 9 kHz to 150 kHz, limits are not specified.

#### 6.2.2.3 Frequency range 150 kHz to 1 GHz

~~For group 1 equipment, no limits apply~~ In the frequency range 150 kHz to 30 MHz, limits are not specified.

In the frequency range above 30 MHz the limits refer to the electric field strength component of the electromagnetic radiation disturbance.

The electromagnetic radiation disturbance limits for the frequency range 30 MHz to 1 GHz for group 1, classes A and B equipment are specified in Table 6 and 7, respectively. Recommendations for the protection of specific safety-related radio services are given in Annex E and Table E.1.

On a test site, class A equipment can be measured at a nominal distance of 3 m, 10 m or 30 m (see information in Table 6), and class B equipment at a nominal distance of 3 m, or 10 m (see information in Table 7). A measuring distance less than 10 m is allowed only for equipment which complies with the definition for *small size equipment* given in 3.17.

**Table ~~4~~ 6 – Electromagnetic radiation disturbance limits for class A group 1 equipment measured on a test site**

| Frequency range MHz | 10 m measuring distance rated ~~input~~ power of | | 3 m measuring distance [b] rated power of | |
|---|---|---|---|---|
| | ≤ 20 kVA [c] | > 20 kVA [a, c] | ≤ 20 kVA [c] | > 20 kVA [a, c] |
| | Quasi-peak dB(μV/m) | Quasi-peak dB(μV/m) | Quasi-peak dB(μV/m) | Quasi-peak dB(μV/m) |
| 30 – 230 | 40 | 50 | 50 | 60 |
| 230 – 1 000 | 47 | 50 | 57 | 60 |

On a test site, class A equipment can be measured at a nominal distance of 3 m, 10 m or 30 m. In case of measurements at a separation distance of 30 m, an inverse proportionality factor of 20 dB per decade shall be used to normalize the measured data to the specified distance for determining compliance.

At the transition frequency, the more stringent limit shall apply.

[a] These limits apply to equipment with a rated ~~input~~ power of > 20 kVA and intended to be used at locations where there is a distance greater than 30 m between the equipment and third party sensitive radio communications. The manufacturer shall indicate in the technical documentation that this equipment is intended to be used at locations where the separation distance to third party sensitive radio services is > 30 m. ~~If the manufacturer does not include the particular conditions of use of the equipment in the technical documentation for the user, then the limits for equipment with a rated input power of ≤ 20 kVA shall apply.~~ If these conditions are not met, then the limits for ≤ 20 kVA apply.

[b] The 3 m separation distance applies only to small size equipment meeting the size criterion defined in 3.17.

[c] Selection of the appropriate set of limits shall be based on the rated a.c. power stated by the manufacturer.

AVA Documents Document Sharing Hub

Full document details: CISPR 11 2015 RLV

**Table ~~5~~ 7 – Electromagnetic radiation disturbance limits for class B group 1 equipment measured on a test site**

| Frequency range<br>MHz | 10 m measuring distance<br>Quasi-peak<br>dB(μV/m) | 3 m measuring distance [a]<br>Quasi-peak<br>dB(μV/m) |
|---|---|---|
| 30 – 230 | 30 | 40 |
| 230 – 1 000 | 37 | 47 |
| On a test site, class B equipment can be measured at a nominal distance of 3 m or 10 m. ~~An inverse proportionality factor of 20 dB per decade shall be used to normalize the measured data to the specified distance for determining compliance.~~<br>At the transition frequency, the more stringent limit shall apply. | | |
| [a] The 3 m separation distance applies only to *small size equipment* meeting the size criterion defined in 3.17. | | |

For medical electrical equipment intended to be permanently installed in shielded locations, further provisions with regard to the measurement arrangement and load conditions are found in IEC 60601-1-2.

#### 6.2.2.4 Frequency range 1 GHz to 18 GHz

~~For group 1 equipment, no limits apply~~ In the frequency range 1 GHz to 18 GHz, limits are not specified.

#### 6.2.2.5 Frequency range 18 GHz to 400 GHz

~~For group 1 equipment, no limits apply~~ In the frequency range 18 GHz to 400 GHz, limits are not specified.

## 6.3 Group 2 equipment measured on a test site

### 6.3.1 Limits ~~of terminal disturbance voltage~~ for conducted disturbances

#### 6.3.1.1 General

The equipment under test shall meet either:

a) both the average limit specified for measurements with an average detector and the quasi-peak limit specified for measurements with a quasi-peak detector (see 7.3); or

b) the average limit when using a quasi-peak detector (see 7.3).

#### 6.3.1.2 Frequency range 9 kHz to 150 kHz

In the frequency range 9 kHz to 150 kHz limits ~~for mains terminal disturbance voltages apply to induction cooking appliances only, see Table 8~~ are not specified.

#### 6.3.1.3 Frequency range 150 kHz to 30 MHz

Limits for ~~mains terminal~~ the disturbance voltage at low voltage a.c. mains power ports in the frequency range 150 kHz to 30 MHz for equipment measured on a test site using the 50 Ω/50 μH CISPR artificial mains network (V-AMN) or the CISPR voltage probe (see 7.3.3 and Figure 1) are given in Tables 8 and 9, except for the ITU designated frequency bands listed in Table 1 where no limits apply.

For electric welding equipment the limits of Table 8 or 9 apply in active mode of operation. In stand-by (or idle) mode, the limits of Table 2 or 4 apply.

AVA Documents Document Sharing Hub

Full document details: CISPR 11 2015 RLV

For ISM RF lighting devices operating in dedicated ISM frequency bands (defined by the ITU in Table 1) the limits of Table 9 apply.

~~For induction cooking appliances for domestic or for commercial use, the limits of Table 8 apply.~~

**Table ~~6~~ 8 – ~~Mains terminal~~ Disturbance voltage limits for class A group 2 equipment measured on a test site (a.c. mains power port)**

| Frequency range MHz | Rated ~~input~~ power of ≤ 75 kVA [b] | | Rated ~~input~~ power of > 75 kVA [a, b] | |
|---|---|---|---|---|
| | Quasi-peak dB(μV) | Average dB(μV) | Quasi-peak dB(μV) | Average dB(μV) |
| 0,15 – 0,50 | 100 | 90 | 130 | 120 |
| 0,50 – 5 | 86 | 76 | 125 | 115 |
| 5 – 30 | 90 decreasing linearly with logarithm of frequency to 73 | 80 decreasing linearly with logarithm of frequency to 60 | 115 | 105 |
| At the transition frequency, the more stringent limit shall apply.<br>~~NOTE 1 Limits only apply to Low Voltage (LV) a.c. mains input ports.~~<br>~~NOTE 2~~ For class A equipment with a rated power ≤ 75 kVA intended to be connected solely to isolated neutral or high impedance earthed (IT) industrial power distribution networks (see IEC 60364-1) the limits defined for group 2 equipment with a rated ~~input~~ power > 75 kVA ~~can~~ may be applied. | | | | |
| [a] The manufacturer and/or supplier shall provide information on installation measures that can be used to reduce emissions from the installed equipment.<br>[b] Selection of the appropriate set of limits shall be based on the rated a.c. power stated by the manufacturer. | | | | |

NOTE A rated input or output power ~~consumption~~ of 75 kVA corresponds for example to a current of approximately 108 A per phase in case of 400 V three phase power supply networks and to a current of approximately 216 A per phase in case of 200 V three phase power supply networks.

High-frequency (HF) surgical equipment shall meet the limits of Table 2 or 4 specified for group 1 equipment, in stand-by mode of operation. For high-frequency (HF) surgical equipment operating at frequencies outside designated ISM bands (see Table 1), these limits also apply at the operating frequency and inside the designated frequency bands. The related measurements shall be performed in a test arrangement in accordance with IEC 60601-2-2.

**Table ~~7~~ 9 – ~~Mains terminal~~ Disturbance voltage limits for class B group 2 equipment measured on a test site (a.c. mains power port)**

| Frequency range MHz | Quasi-peak dB(μV) | Average dB(μV) |
|---|---|---|
| 0,15 – 0,50 | 66 Decreasing linearly with logarithm of frequency to 56 | 56 Decreasing linearly with logarithm of frequency to 46 |
| 0,50 – 5 | 56 | 46 |
| 5 – 30 | 60 | 50 |
| At the transition frequency, the more stringent limit shall apply. | | |

AVA Documents Document Sharing Hub

Full document details: CISPR 11 2015 RLV

~~**Table 8 – Mains terminal disturbance voltage limits for induction cooking appliances**~~

| ~~Frequency range~~ ~~MHz~~ | ~~Induction cooking appliance limits~~ | | | |
|---|---|---|---|---|
| | ~~All appliances except 100 V rated appliances without an earth connection~~ | | ~~100 V rated appliances without an earth connection~~ | |
| | ~~Quasi-peak~~ ~~dB(μV)~~ | ~~Average~~ ~~dB(μV)~~ | ~~Quasi-peak~~ ~~dB(μV)~~ | ~~Average~~ ~~dB(μV)~~ |
| ~~0,009 – 0,050~~ | ~~110~~ | ~~–~~ | ~~122~~ | ~~–~~ |
| ~~0,050 – 0,148 5~~ | ~~90~~ ~~Decreasing linearly with logarithm of frequency to~~ ~~80~~ | ~~–~~ | ~~102~~ ~~Decreasing linearly with logarithm of frequency to~~ ~~92~~ | ~~–~~ |
| ~~0,148 5 – 0,5~~ | ~~66~~ ~~Decreasing linearly with logarithm of frequency to~~ ~~56~~ | ~~56~~ ~~Decreasing linearly with logarithm of frequency to~~ ~~46~~ | ~~72~~ ~~Decreasing linearly with logarithm of frequency to~~ ~~62~~ | ~~62~~ ~~Decreasing linearly with logarithm of frequency to~~ ~~52~~ |
| ~~0,5 – 5~~ | ~~56~~ | ~~46~~ | ~~56~~ | ~~46~~ |
| ~~5 – 30~~ | ~~60~~ | ~~50~~ | ~~60~~ | ~~50~~ |
| ~~At the transition frequency, the more stringent limit shall apply.~~ | | | | |

### 6.3.2 Limits of electromagnetic radiation disturbance

#### 6.3.2.1 General

The equipment under test shall meet the limits when using a measuring instrument with a peak, quasi-peak or average detector as indicated in the appropriate table.

Up to 30 MHz the limits refer to the magnetic component of the electromagnetic radiation disturbance. Above 30 MHz the limits refer to the electric field strength component of the electromagnetic radiation disturbance.

#### 6.3.2.2 Frequency range 9 kHz to 150 kHz

In the frequency range 9 kHz to 150 kHz limits ~~apply to induction cooking appliances only, see Tables 12 and 13~~ are not specified.

#### 6.3.2.3 Frequency range 150 kHz to 1 GHz

Except for the designated frequency range listed in Table 1, the electromagnetic radiation disturbance limits for the frequency range 150 kHz to 1 GHz for group 2 class A equipment are specified in Table 10; and for group 2 class B equipment in Table 12.

The limits in Tables 10 and 12 apply to all electromagnetic disturbances at all frequencies not exempted according to Table 1 Footnote b).

For class A resistance welding equipment the limits of Table 10 apply in the frequency range 30 MHz to 1 GHz in active mode of operation. In stand-by (or idle) mode, the limits of Table 6 apply. For class B resistance welding equipment the limits of Table 12 apply in active mode of operation. In stand-by (or idle) mode, the limits of Table 7 apply.

For class A arc welding equipment the limits of Table 11 apply in active mode of operation. In stand-by (or idle) mode, the limits of Table 6 apply. For class B arc welding equipment the limits of Table 7 apply in active mode of operation and in stand-by (or idle) mode.

Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

For class A EDM equipment, the limits of Table 11 apply.

For ISM RF lighting devices operating in dedicated ISM frequency bands (defined by the ITU in Table 1) the limits of Table 12 apply.

~~For induction cooking appliances, limits in the frequency range up to 30 MHz are specified in Table 12 (commercial use) and 13 (domestic use), respectively, and in Table 11 for the frequency range above 30 MHz.~~

For high-frequency (HF) surgical equipment, the limits of Table 6 or 7 apply. High-frequency (HF) surgical equipment shall meet the respective limits when tested in stand-by mode of operation.

Recommendations for the protection of specific safety services are given in Annex E and Table E.1.

On a test site, class A equipment can be measured at a nominal distance of 3 m, 10 m or 30 m, and class B equipment at a nominal distance of 3 m or 10 m (see Tables 10 and 12).

In the frequency range 30 MHz to 1 GHz, a measuring distance less than 10 m is allowed only for equipment which complies with the definition given in 3.17.

Documents
Document Sharing Hub

Full document details: CISPR 11 2015 RLV

**Table ~~9~~ 10 – Electromagnetic radiation disturbance limits for class A group 2 equipment measured on a test site**

| Frequency range MHz | Limits for a measuring distance $D$ in m | | | | | |
|---|---|---|---|---|---|---|
| | On a test site $D$ = 30 m from the equipment | | On a test site $D$ = 10 m from the equipment | | On a test site $D$ = 3 m from the equipment [a] | |
| | Electric field | Magnetic field | Electric field | Magnetic field | Electric field | Magnetic field |
| | Quasi-peak | Quasi-peak | Quasi-peak | Quasi-peak | Quasi-peak | Quasi-peak |
| | dB(μV/m) | dB(μA/m) | dB(μV/m) | dB(μA/m) | dB(μV/m) | dB(μA/m) |
| 0,15 – 0,49 | – | 33,5 | – | 57,5 | – | 82 |
| 0,49 – 1,705 | – | 23,5 | – | 47,5 | – | 72 |
| 1,705 – 2,194 | – | 28,5 | – | 52,5 | – | 77 |
| 2,194 – 3,95 | – | 23,5 | – | 43,5 | – | 68 |
| 3,95 – 11 | – | 8,5 | – | 18,5 | – | 43,5 decreasing linearly with logarithm of frequency to 28,5 |
| 11 – 20 | – | 8,5 | – | 18,5 | – | 28,5 |
| 20 – 30 | – | -1,5 | – | 8,5 | – | 18,5 |
| 30 – 47 | 58 | – | 68 | – | 78 | – |
| 47 – 53,91 | 40 | – | 50 | – | 60 | – |
| 53,91 – 54,56 | 40 | – | 50 | – | 60 | – |
| 54,56 – 68 | 40 | – | 50 | – | 60 | – |
| 68 – 80,872 | 53 | – | 63 | – | 73 | – |
| 80,872 – 81,848 | 68 | – | 78 | – | 88 | – |
| 81,848 – 87 | 53 | – | 63 | – | 73 | – |
| 87 – 134,786 | 50 | – | 60 | – | 70 | – |
| 134,786 – 136,414 | 60 | – | 70 | – | 80 | – |
| 136,414 – 156 | 50 | – | 60 | – | 70 | – |
| 156 – 174 | 64 | – | 74 | – | 84 | – |
| 174 – 188,7 | 40 | – | 50 | – | 60 | – |
| 188,7 – 190,979 | 50 | – | 60 | – | 70 | – |
| 190,979 – 230 | 40 | – | 50 | – | 60 | – |
| 230 – 400 | 50 | – | 60 | – | 70 | – |
| 400 – 470 | 53 | – | 63 | – | 73 | – |
| 470 – 1 000 | 50 | – | 60 | – | 70 | – |

~~NOTE~~ On a test site, class A equipment can be measured at a nominal distance of 3 m, 10 m or 30 m.
A measuring distance less than 10 m is allowed only for equipment which complies with the definition given in 3.17.

At the transition frequency, the more stringent limit shall apply.

[a] In the frequency range 30 MHz to 1 GHz, the 3 m separation distance applies only to *small size equipment* meeting the size criterion defined in 3.17.

Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

**Table ~~10~~ 11 – Electromagnetic radiation disturbance limits for class A EDM and arc welding equipment measured on a test site**

| Frequency range MHz | Limits for a measuring distance ~~of 10~~ *D* in m ~~Quasi-peak~~ ~~dB(μV/m)~~ | |
|---|---|---|
| | *D* = 10 m | *D* = 3 m [a] |
| 30 – 230 | Quasi-peak dB(μV/m) | Quasi-peak dB(μV/m) |
| | 80 Decreasing linearly with logarithm of frequency to 60 | 90 Decreasing linearly with logarithm of frequency to 70 |
| 230 – 1 000 | 60 | 70 |
| On a test site, class A equipment can be measured at a nominal distance of 3 m, 10 m or 30 m. In case of measurements at a separation distance of 30 m, an inverse proportionality factor of 20 dB per decade shall be used to normalize the measured data to the specified distance for determining compliance. | | |
| [a] The 3 m separation distance applies only to *small size equipment* meeting the size criterion defined in 3.17. | | |

**Table ~~11~~ 12 – Electromagnetic radiation disturbance limits for class B group 2 equipment measured on a test site**

| Frequency range MHz | Limits for a measuring distance *D* in m | | | | |
|---|---|---|---|---|---|
| | Electric field | | | | Magnetic field |
| | *D* = 10 m | | *D* = 3 m [b] | | *D* = 3 m |
| | Quasi-peak | Average [a] | Quasi-peak | Average [a] | Quasi-peak |
| | dB(μV/m) | | dB(μV/m) | | dB(μA/m) |
| 0,15 – 30 | – | – | – | – | 39 Decreasing linearly with the logarithm of frequency to 3 |
| 30 – 80,872 | 30 | 25 | 40 | 35 | – |
| 80,872 – 81,848 | 50 | 45 | 60 | 55 | – |
| 81,848 – 134,786 | 30 | 25 | 40 | 35 | – |
| 134,786 – 136,414 | 50 | 45 | 60 | 55 | – |
| 136,414 – 230 | 30 | 25 | 40 | 35 | – |
| 230 – 1 000 | 37 | 32 | 47 | 42 | – |
| On a test site, class B equipment can be measured at a nominal distance of 3 m or 10 m. ~~In the frequency range above 30 MHz, an inverse proportionality factor of 20 dB per decade shall be used to normalize the measured data to the specified distance for determining compliance.~~ In the frequency range 30 MHz to 1 GHz, a measuring distance less than 10 m is allowed only for equipment which complies with the definition given in 3.17. At the transition frequency, the more stringent limit ~~shall~~ should apply. | | | | | |
| [a] The average limits apply to magnetron driven equipment and microwave ovens only. If magnetron driven equipment or microwave ovens exceed the quasi-peak limit at certain frequencies, then the measurement shall be repeated at these frequencies with the average detector and the average limits specified in this table apply. [b] In the frequency range 30 MHz to 1 GHz, the 3 m separation distance applies only to *small size equipment* meeting the size criterion defined in 3.17. | | | | | |

AVA Documents Document Sharing Hub

Full document details: CISPR 11 2015 RLV

~~**Table 12 – Limits of the magnetic field strength for induction cooking appliances intended for commercial use**~~

| ~~**Frequency range**~~ ~~MHz~~ | ~~**Limits at 3 m distance**~~ ~~**Quasi-peak**~~ ~~dB(μA/m)~~ |
|---|---|
| ~~0,009 – 0,070~~ | ~~69~~ |
| ~~0,070 – 0,148 5~~ | ~~69~~ ~~Decreasing linearly with logarithm of frequency to~~ ~~39~~ |
| ~~0,148 5 – 4,0~~ | ~~39~~ ~~Decreasing linearly with logarithm of frequency to~~ ~~3~~ |
| ~~4,0 – 30~~ | ~~3~~ |
| ~~The limits of this table apply to induction cooking appliances intended for commercial use and those for domestic use with a diagonal diameter of more than 1,6 m.~~<br><br>~~The measurements are performed at 3 m distance with a 0,6 m loop antenna as described in 4.2.1 of CISPR 16-1-4.~~<br><br>~~The antenna shall be vertically installed, with the lower edge of the loop at 1 m height above the floor.~~ | |

~~**Table 13 – Limits of the magnetic field induced current in a 2 m loop antenna for induction cooking appliances for domestic use**~~

| ~~**Frequency range**~~ ~~MHz~~ | ~~**Quasi-peak**~~ ~~dB(μA)~~ | |
|---|---|---|
| | ~~**Horizontal component**~~ | ~~**Vertical component**~~ |
| ~~0,009 – 0,070~~ | ~~88~~ | ~~106~~ |
| ~~0,070 – 0,148 5~~ | ~~88~~ ~~Decreasing linearly with logarithm of frequency to~~ ~~58~~ | ~~106~~ ~~Decreasing linearly with logarithm of frequency to~~ ~~76~~ |
| ~~0,148 5 – 30~~ | ~~58~~ ~~Decreasing linearly with logarithm of frequency to~~ ~~22~~ | ~~76~~ ~~Decreasing linearly with logarithm of frequency to~~ ~~40~~ |
| ~~The limits of this table apply to induction cooking appliances for domestic use which have a diagonal dimension of less than 1,6 m.~~<br><br>~~The measurement is performed using the loop antenna system (LAS) as described in 7.6 of CISPR 16-2-3.~~ | | |

#### 6.3.2.4 Frequency range 1 GHz to 18 GHz

The limits in the frequency range 1 GHz to 18 GHz apply only to group 2 equipment operating at frequencies above 400 MHz. The limits specified in the Tables 13 to 15 apply only to RF disturbances appearing outside designated ISM bands as listed in Table 1.

The electromagnetic radiation disturbance limits for the frequency range 1 GHz to 18 GHz are specified in Tables 13 to 15. The equipment shall meet either the limits of Table 13, or at least the limits of Table 14 or Table 15 ~~and 16~~ (see decision tree in 9.4.1, Figure 12).

ISM RF lighting devices operating in dedicated ISM frequency bands (defined by the ITU in Table 1) shall either meet the class B limits of Table 13 or at least the limits of ~~both Tables 15 and 16~~ Table 14.

For microwave-powered UV irradiators, the limits specified in Table 13 apply.

Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

Recommendations for the protection of specific safety services are given in Annex E and Table E.1.

**Table ~~14~~ 13 – Electromagnetic radiation disturbance peak limits for group 2 equipment ~~producing CW type disturbances and~~ operating at frequencies above 400 MHz**

| **Frequency range** GHz | **Limits for a measurement distance of 3 m** **Peak** dB(μV/m) | |
|---|---|---|
| 1 – 18 | **Class A** | **Class B** |
| Within harmonic frequency bands | 82 [a] | 70 |
| Outside harmonic frequency bands | 70 | 70 |
| 11,7 – 12,7 | 73 [b] | 73 [b] |
| Peak measurements with a resolution bandwidth of 1 MHz and a video signal bandwidth (VBW) higher than or equal to 1 MHz. The recommended VBW is 3 MHz.<br>NOTE In this table, "harmonic frequency bands" means the frequency bands which are multiples of the ISM bands allocated above 1 GHz. | | |
| [a] At the upper and lower edge frequency of harmonic frequency bands, the more stringent limit of 70 dB(μV/m) applies.<br>[b] In the satellite radio broadcasting band, the measured disturbance values shall not exceed 73 dB(μV/m). | | |

**~~Table 15 – Electromagnetic radiation disturbance peak limits for class B group 2 equipment producing fluctuating disturbances other than CW and operating at frequencies above 400 MHz~~**

| ~~**Frequency range**~~ ~~GHz~~ | | | ~~**Limits for a measuring distance of 3 m**~~ ~~**Peak**~~ ~~dB(μV/m)~~ |
|---|---|---|---|
| ~~1~~ | ~~–~~ | ~~2,3~~ | ~~92~~ |
| ~~2,3~~ | ~~–~~ | ~~2,4~~ | ~~110~~ |
| ~~2,5~~ | ~~–~~ | ~~5,725~~ | ~~92~~ |
| ~~5,875~~ | ~~–~~ | ~~11,7~~ | ~~92~~ |
| ~~11,7~~ | ~~–~~ | ~~12,7~~ | ~~73~~ |
| ~~12,7~~ | ~~–~~ | ~~18~~ | ~~92~~ |
| ~~Peak measurements with a resolution bandwidth of 1 MHz and a video signal bandwidth higher or equal to 1 MHz.~~<br>~~At the transition frequency, the more stringent limit shall apply.~~<br>~~NOTE Limits in this table were derived considering fluctuating sources such as magnetron-driven microwave ovens.~~ | | | |

Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

**Table ~~16~~ 14 – Electromagnetic radiation disturbance weighted limits for ~~class B~~ group 2 equipment ~~producing fluctuating disturbances other than CW and~~ operating at frequencies above 400 MHz**

| Frequency range<br>GHz | Limits for a measuring distance of 3 m<br>Peak<br>dB(μV/m) |
|---|---|
| 1 – 2,4 | 60 |
| 2,5 – 5,725 | 60 |
| 5,875 – 18 | 60 |

Weighted measurements shall be performed with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz.

~~NOTE To check the limits of this table, measurements need only be performed around two centre frequencies: the highest emission in the 1 005 MHz – 2 395 MHz range and the highest peak emission in the 2 505 MHz to 17 995 MHz range (outside the band 5 720 MHz – 5 880 MHz). At these two centre frequencies, measurements are performed with a span of 10 MHz on the spectrum analyser.~~

To check conformance with the limits of this table, weighted measurements shall be performed in all of the following frequency ranges, in which the limit of Table 13 was exceeded during the peak measurement:

a) 1 005 MHz – 2 395 MHz (1 000 MHz – 2 400 MHz)*;

b) 2 505 MHz – 6 125 MHz (outside the band 5 720 MHz – 5 880 MHz)*;

c) 6 125 MHz – 8 575 MHz;

d) 8 575 MHz – 11 025 MHz;

e) 11 025 MHz – 13 475 MHz;

f) 13 475 MHz – 15 925 MHz;

g) 15 925 MHz – 17 995 MHz*.

At sub-ranges where the limit of Table 13 was exceeded, a weighted measurement shall be performed with a span of 10 MHz around the centre frequency adjusted to the frequency of the highest disturbance level in the respective sub-range.

* In cases where the frequency of highest emission during peak measurement is found closer than 5 MHz from the frequency edges 1 GHz, 2,4 GHz, 2,5 GHz, 5,72 GHz, 5,88 GHz or 18 GHz, the span for weighted measurements shall remain 10 MHz but in such case the centre frequency shall be adjusted so that the frequency edges are not exceeded.

NOTE See annex B for further guidance on the use of the spectrum analyser.

**Table 15 – Electromagnetic radiation disturbance APD level corresponding to $10^{-1}$ limits for class B group 2 equipment operating at frequencies above 400 MHz**

| Frequency range<br>GHz | Limits for a measurement distance of 3 m<br>APD level corresponding to $10^{-1}$<br>dB(μV/m) |
|---|---|
| 1 – 2,4 | 70 |
| 2,5 – 5,725 | 70 |
| 5,875 – 18 | 70 |

APD measurements with a resolution bandwidth of 1 MHz and a video signal bandwidth higher than or equal to 1 MHz.

NOTE An APD level corresponding to $10^{-1}$ means that the amplitude of the disturbance exceeds the specified level during the observation time with a probability of 10 %.

Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

## 6.4 Group 1 and group 2 class A equipment measured in situ

### 6.4.1 Limits ~~of terminal disturbance voltage~~ for conducted disturbances

Under *in situ* conditions, an assessment of conducted disturbances is not required.

### 6.4.2 Limits of electromagnetic radiation disturbance

The limits given in Table 16 apply to class A group 1 equipment and the limits given in Table 17 apply to class A group 2 equipment.

**Table ~~17~~ 16 – Electromagnetic radiation disturbance limits for class A group 1 equipment measured *in situ***

| Frequency range<br>MHz | Limits with measuring distance 30 m from the outer face of the exterior wall of the building in which the equipment is situated | |
|---|---|---|
| | Electric field<br>Quasi-peak<br>dB(μV/m) | Magnetic field<br>Quasi-peak [a]<br>dB(μA/m) |
| 0,15 – 0,49 | – | 13,5 |
| 0,49 – 3,95 | – | 3,5 |
| 3,95 – 20 | – | –11,5 |
| 20 – 30 | – | –21,5 |
| 30 – 230 | 30 | – |
| 230 – 1 000 | 37 | – |
| At the transition frequency, the more stringent limit shall apply.<br>If local conditions do not allow for measurements at 30 m, then a larger distance can be used. In this case, an inverse proportionality factor of 20 dB per decade shall be used to normalize the measured data to the specified distance for determining compliance. | | |

[a] These limits apply in addition to the limits in the frequency range 30 MHz to 1 GHz to radiated disturbances originating from the operation frequency and its harmonics appearing in the frequency range 150 kHz to 30 MHz, caused by the installed class A group 1 equipment with a rated ~~input~~ power exceeding 20 kVA. In the event that the ambient noise level exceeds the above limits, the emissions of the EUT shall not increase this noise floor by more than 3 dB.

Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

**Table ~~18~~ 17 – Electromagnetic radiation disturbance limits for class A group 2 equipment measured *in situ***

| Frequency range<br>MHz | Limits for a measuring distance of $D$ in m from the exterior wall of the building | |
|---|---|---|
| | **Electric field**<br>**Quasi-peak**<br>dB(μV/m) | **Magnetic field**<br>**Quasi-peak**<br>dB(μA/m) |
| 0,15 – 0,49 | – | 23,5 |
| 0,49 – 1,705 | – | 13,5 |
| 1,705 – 2,194 | – | 18,5 |
| 2,194 – 3,95 | – | 13,5 |
| 3,95 – 20 | – | –1,5 |
| 20 – 30 | – | –11,5 |
| 30 – 47 | 48 | – |
| 47 – 53,91 | 30 | – |
| 53,91 – 54,56 | 30 | – |
| 54,56 – 68 | 30 | – |
| 68 – 80,872 | 43 | – |
| 80,872 – 81,848 | 58 | – |
| 81,848 – 87 | 43 | – |
| 87 – 134,786 | 40 | – |
| 134,786-136,414 | 50 | – |
| 136,414 – 156 | 40 | – |
| 156 – 174 | 54 | – |
| 174 – 188,7 | 30 | – |
| 188,7 – 190,979 | 40 | – |
| 190,979 – 230 | 30 | – |
| 230 – 400 | 40 | – |
| 400 – 470 | 43 | – |
| 470 – 1000 | 40 | – |
| At the transition frequency, the more stringent limit shall apply. | | |

For group 2 equipment measured *in situ*, the measuring distance $D$ from the exterior wall of the building in which the equipment is situated equals $(30 + x/a)$ m or 100 m whichever is smaller, provided that the measuring distance $D$ is within the boundary of the premises. In the case where the calculated distance $D$ is beyond the boundary of the premises, the measuring distance $D$ equals $x$ or 30 m, whichever is longer.

For the calculation of the above values:

$x$ is the nearest distance between the ~~outside~~ exterior wall of the building in which the equipment is situated and the boundary of the user's premises in each measuring direction;

$a$ = 2,5 for frequencies lower than 1 MHz;

$a$ = 4,5 for frequencies equal to or higher than 1 MHz.

Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

# 7 Measurement requirements

## 7.1 General

The requirements specified in this clause, together with the limits specified in Clause 6, constitute the essential EMC requirements of this standard. For measurements at test sites (see Clause 8), verification of compliance of a given type of equipment with these essential EMC requirements qualifies as *type test*.

Requirements which relate to measurements at such test sites are type test requirements. A type test may be recognized as type approval if the conditions for the statistical assessment of measurement results according to Annex H are observed.

Class A equipment may be measured either on a test site or *in situ* as determined by the manufacturer. Class B equipment shall be measured on a test site.

Specific requirements for making measurements on a test site are given in Clauses 8 and 9, for making measurements *in situ* in Clause 10.

The requirements of the present clause are to be met for both, test site and/or *in situ* measurements.

Measurements need only be performed in frequency ranges where limits are specified in Clause 6.

~~Excluded from the testing requirements and limits of this standard are components and subassemblies not intended to perform any stand-alone ISM function.~~

Components or subassemblies for higher order equipment or systems which are intended to be assembled at their respective place of operation only can also be tested according to the requirements of this standard. For testing purposes in the framework of this standard, such components or subassemblies shall be regarded as stand-alone equipment. Components or subassemblies for which compliance with the relevant requirements cannot be shown when measured at a test site can also be assessed *in situ* when being installed into the higher order system, in which case the provisions of 6.4 shall apply.

NOTE 1 The environments encompassed in this standard are residential, commercial or industrial environments as described in IEC 61000-2-5 [11][2]. Adherence of equipment to the requirements of this standard will allow for its operation and use in these environments without resulting in an increased risk of RFI. There may also exist other IEC product standards which allow for compliance testing of components or subassemblies of higher order systems but which encompass other environments than those specified in IEC 61000-2-5 [11]. Choice of this standard or the other appropriate IEC product standard for compliance testing of components or subassemblies is up to the manufacturer.

NOTE 2 Examples for such components include, but are not limited to power converters used for distributed generation and supply of electric energy into LV a.c. mains networks or installations or, by means of their own dedicated transformer, into MV power distribution networks, but also power electric subassemblies intended for supply of higher order systems with power from LV a.c. mains networks.

## 7.2 Ambient noise

A test site for type testing shall allow emissions from the equipment under test to be distinguished from ambient noise. The suitability in this respect can be determined by measuring the ambient noise levels with the equipment under test inoperative and ensuring that the ambient noise levels are at least 6 dB below the limits specified in 6.2 or 6.3, as appropriate for the measurement being carried out. Further information on compliance testing in the presence of ambient noise is found in CISPR 16-2-1:2014, 6.2.2 and CISPR 16-2-3:2010, 6.2.2.

---

2 Figures in square brackets refer to the Bibliography.

Documents
Document Sharing Hub

Full document details: CISPR 11 2015 RLV

It is not necessary to reduce the ambient noise level to 6 dB below the specified limit where the combination of the ambient noise plus the emission from the equipment under test does not exceed the specified limit. Under these conditions~~,~~ the equipment under test is considered to satisfy the specified limit.

When carrying out measurements~~ on mains terminal disturbance voltage~~ of conducted RF disturbances, local radio transmissions may increase the ambient noise level at some frequencies. A suitable radio-frequency filter may be inserted between the artificial~~ mains~~ network (V-AMN and/or DC-AN) and the respective laboratory a.c. mains supply or d.c. power source, or measurements may be performed in a shielded enclosure. The components forming the radio-frequency filter should be enclosed in a metallic screen directly connected to the reference~~ earth~~ ground of the measuring system. The requirements for the impedance of the artificial~~ mains~~ network shall be satisfied at the frequency of measurement when the radio-frequency filter is connected.

If, when measuring~~ the electromagnetic radiation disturbance~~ radiated RF disturbances, the 6 dB ambient noise conditions cannot be met, then the antenna may be located at a distance closer to the equipment under test than specified in Clause 6 (see 8.3.4). Further advice on measurement conditions in presence of high level ambient noise is found in Annex C.

## 7.3 Measuring equipment

### 7.3.1 Measuring instruments

Receivers with quasi-peak detectors shall be in accordance with CISPR 16-1-1. Receivers with average detectors shall be in accordance with CISPR 16-1-1.

NOTE 1 Both detectors~~ may~~ can be incorporated in a single receiver and measurements carried out by alternately using the quasi-peak detector and the average detector.

NOTE 2 The average detector in CISPR 16-1-1 is commonly referred to as “CISPR-Average”. This is to emphasize that the average detector used in a CISPR receiver obtains a measurement result that is equivalent to the peak reading of a meter with a time constant as defined in CISPR 16-1-1.

The measuring receiver used shall be operated in such a way that a variation in frequency of the disturbance being measured does not affect the results.

NOTE 3 Measuring instruments having other detector characteristics~~ may~~ can be used provided the measurement of the disturbance values can be proved to be the same. Attention is drawn to the convenience of using a panoramic receiver or a spectrum analyzer, particularly if the working frequency of the equipment under test changes appreciably during the work cycle.

To avoid the possibility of the measuring instrument incorrectly indicating non-compliance with the limits, the measuring receiver shall not be tuned closer to the edge of one of the bands designated for ISM use than the frequency at which its 6 dB bandwidth point aligns with the edge of the designated band.

~~NOTE 3~~ When making measurements on high power equipment, care should be taken to ensure that screening and the spurious response rejection characteristics of the measuring receiver are adequate.

For measurements at frequencies above 1 GHz, a spectrum analyser with characteristics as defined in CISPR 16-1-1 shall be used.

~~NOTE 4~~ Precautions which~~ should~~ can be taken in the use of a spectrum analyzer are given in Annex B.

Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

### 7.3.2 Artificial ~~mains~~ network (AN)

#### 7.3.2.1 General

The artificial network (AN) is required to provide a defined termination impedance for the EUT's a.c. mains power port or d.c. power port under test at radio frequencies ~~across the mains supply~~ at the point of measurement. The AN will also provide isolation of the equipment under test from ambient noise on the respective a.c. or d.c power lines.

#### 7.3.2.2 Artificial mains network (AMN)

Measurement of the ~~mains terminal~~ disturbance voltage at low voltage a.c. mains power ports shall be made using an artificial mains network (V-AMN) as specified in CISPR 16-1-2.

#### 7.3.2.3 Artificial d.c. network (DC-AN)

Measurement of the disturbance voltage at low voltage d.c. power ports shall be made either using the 150 Ω artificial mains Delta-network specified in 4.7 of CISPR 16-1-2:2014 (see also CISPR 16-1-2:2014, Figure A.2) or the 150 Ω artificial d.c. network specified in Annex I of this standard. For simplified wording, any of these networks intended for use with measurements at low voltage d.c. power ports is further on denoted as DC-AN.

### 7.3.3 Voltage probe

The voltage probe shown in Figure 1 shall be used when the artificial mains network (V-AMN) cannot be used. The probe is connected sequentially between each line and the reference earth chosen (metal plate, metal tube). The probe consists mainly of a ~~blocking~~ decoupling capacitor and a resistor such that the total resistance between the line and earth is at least 1 500 Ω. The effect on the accuracy of measurement of the capacitor or any other device which may be used to protect the measuring receiver against dangerous currents shall be either less than 1 dB or allowed for in calibration. The voltage probe shall meet the requirements specified in CISPR 16-1-2:2014, Clause 5.

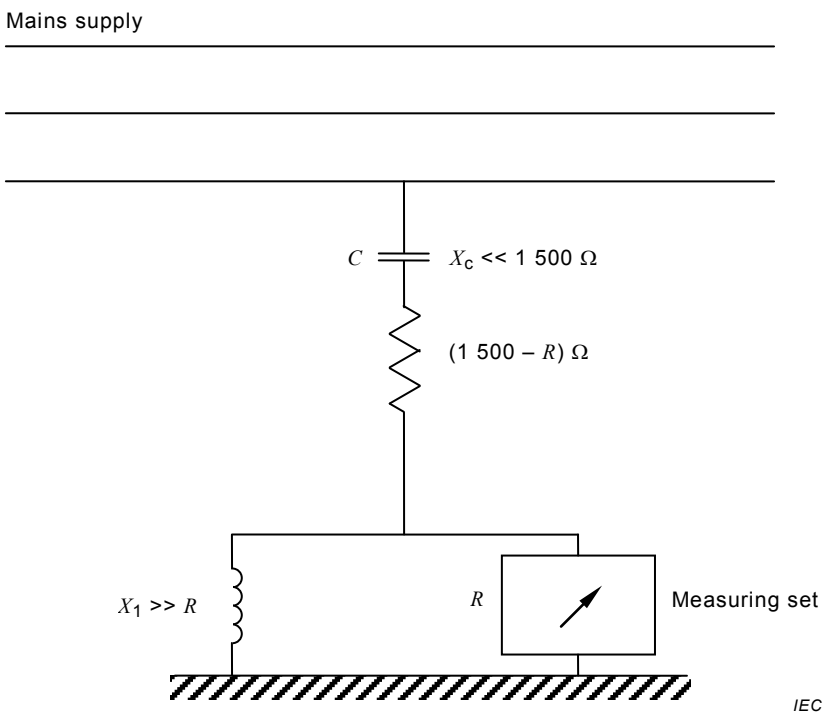



**Figure ~~4~~ 1 – Circuit for disturbance voltage measurements on mains supply ~~(see 7.3.3)~~**

Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

### 7.3.4 Antennas

#### 7.3.4.1 Frequency range below 30 MHz

In the frequency range below 30 MHz the antenna shall be a loop as specified in CISPR 16-1-4. The antenna shall be supported in the vertical plane and be rotatable about a vertical axis. The lowest point of the loop shall be 1 m above ground level.

#### 7.3.4.2 Frequency range from 30 MHz to 1 GHz

In the frequency range from 30 MHz to 1 GHz the antenna used shall be as specified in CISPR 16-1-4. Measurements shall be made for both horizontal and vertical polarization. The nearest point of the antenna to the ground shall be not less than 0,2 m.

For measurements on a test site the centre of the antenna shall be varied between 1 m and 4 m height for maximum indication at each test frequency.

For measurements *in situ* the centre of the antenna shall be fixed at (2,0 ±0,2) m height above the ground.

NOTE Other antennas ~~may~~ can be used provided the results can be shown to be within ±2 dB of the results which would have been obtained using a balanced dipole antenna.

#### 7.3.4.3 Frequency range above 1 GHz

For measurements at frequencies above 1 GHz, the antenna used shall be as specified in CISPR 16-1-4.

### 7.3.5 Artificial hand

In order to simulate the influence of the user's hand, application of the artificial hand is required for hand-held equipment during the mains disturbance voltage measurement.

The artificial hand consists of metal foil which is connected to one terminal (terminal M) of an RC element consisting of a capacitor of 220 pF ± 20 % in series with a resistance of 510 Ω ± 10 % (see Figure 2); the other terminal of the RC element shall be connected to the reference ground of the measuring system (see CISPR 16-1-2). The RC element of the artificial hand may be incorporated in the housing of the artificial mains network.

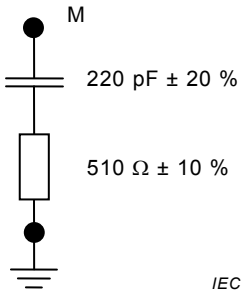



**Figure ~~6~~ 2 – Artificial hand, RC element ~~(see 7.3.5)~~**

## 7.4 Frequency measurement

For equipment which is intended to operate with a fundamental frequency in one of the designated bands listed in Table 1, the frequency shall be checked with measuring equipment having an inherent error of measurement not greater than 1/10 of the permissible tolerance for the mid-band frequency of the designated band. The frequency shall be measured over all the load range from the lowest power normally used up to the maximum.

Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

## 7.5 Configuration of equipment under test

### 7.5.1 General

Consistent with typical applications of the equipment under test, the level of the disturbance shall be maximized by varying the configuration of the equipment. An example of a typical setup for measurements of radiated disturbances from a table-top EUT is provided in Figure 3. The measurement arrangement shall be typical of normal installation practice and centred to the turntable's vertical axis.

NOTE 1 The extent to which this subclause is applicable to the measurement of an installation *in situ* will depend on the flexibility inherent in each particular installation. The provisions of this subclause apply to *in situ* measurements in so far as a particular installation allows for the position of cables to be varied and different units within the installation to be operated independently, the extent to which the position of the installation can be moved within the premises, etc.

For measurement of radiated disturbances with a separation distance of 3 m the assessment of the radiation from the cabling of the EUT shall be restricted to those fractions of interconnecting cables (see 7.5.2) and mains cables (see 7.5.3) which are within the test volume of 1,2 m diameter times 1,5 m height above ground. Peripheral equipment not fitting into the test volume shall be excluded from the measurements or decoupled from the test environment.

NOTE 2 Restriction of radiation assessment to the cable fractions inside the test volume can be achieved for example by application of CMADs at the cables at the position where they leave the test volume. CISPR 16-2-3 gives further guidance on the application of CMADs.

Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

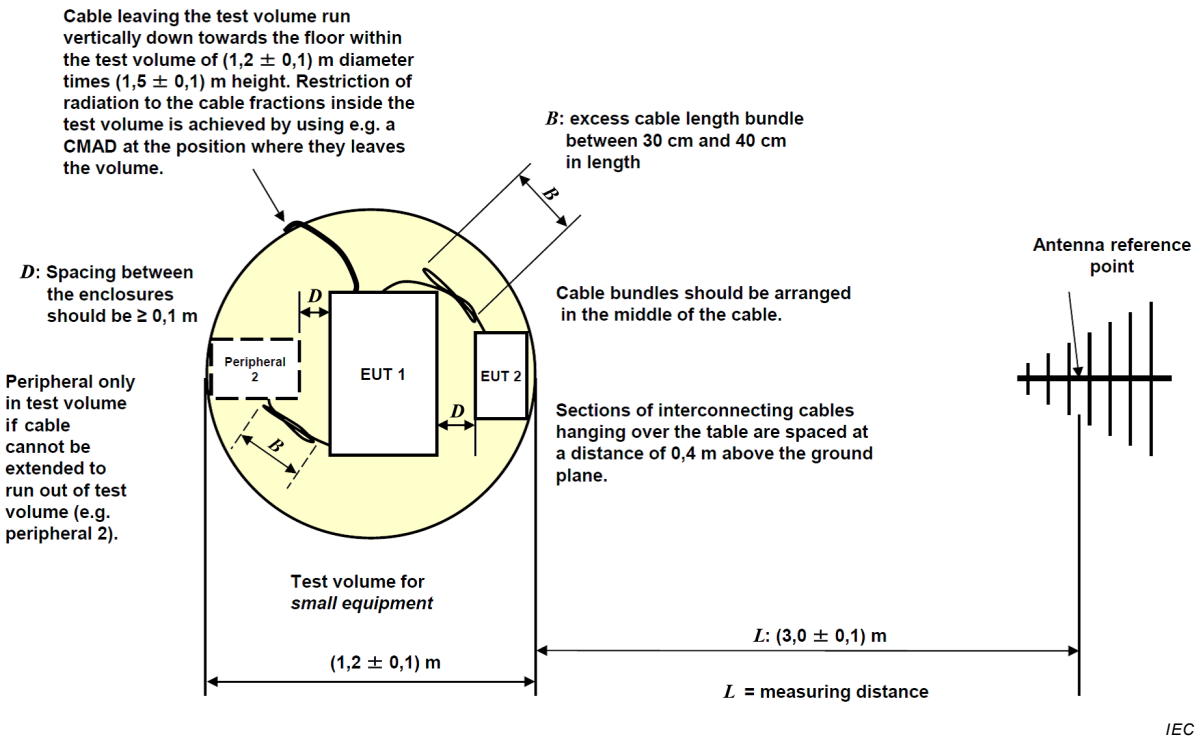



**Figure 3a – Top view**

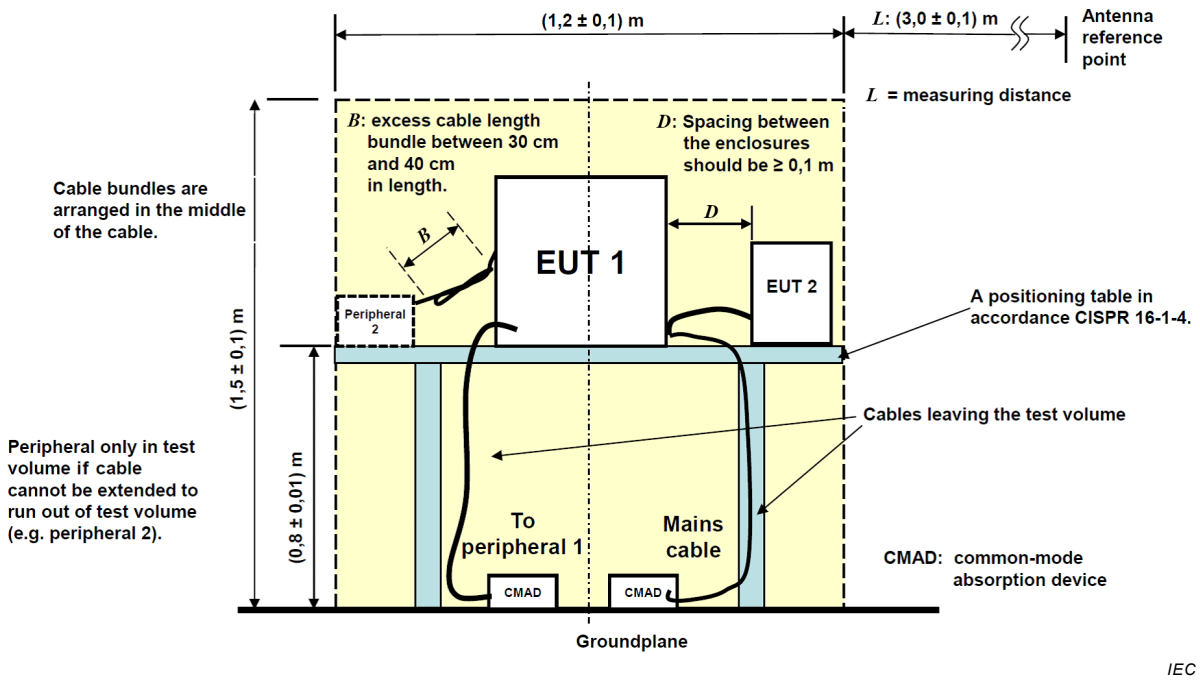



**Figure 3b – Side view**

**Figure 3 – Example for a typical cable arrangement for measurements of radiated disturbances in 3 m separation distance, Table-top EUT**

An example of a typical unified test set up for floor standing equipment suitable for measurement of conducted as well as radiated disturbances is shown in Figure 4. Further examples of typical arrangements of the EUT and associated peripherals are given in CISPR 16-2-3 and CISPR 16-2-1.

AVA Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

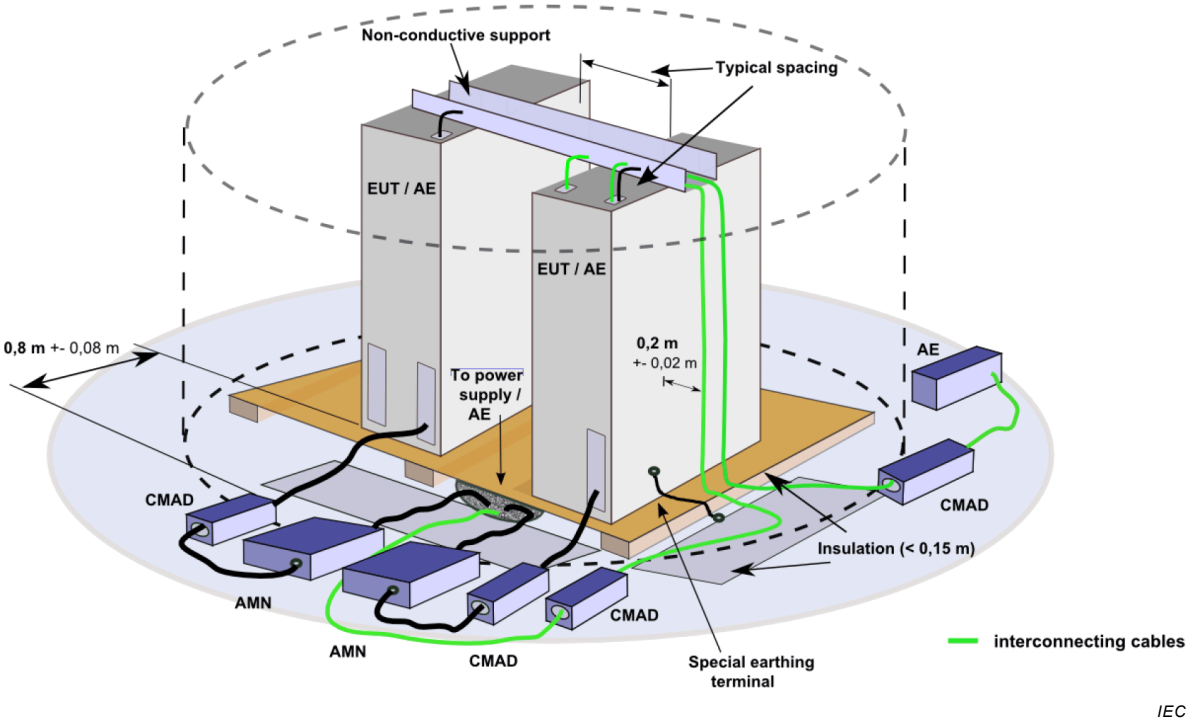



**Figure 4 – Example for a typical test set up for measurement of conducted and/or radiated disturbances from a floor standing EUT, 3D view**

The configuration of the equipment under test shall be precisely ~~noted~~ documented in the test report.

### 7.5.2 Interconnecting cables

This subclause applies to equipment in which there are interconnecting cables between various parts of the equipment, or systems where a number of ~~equipments~~ components are interconnected.

NOTE 1 The observation of all provisions in this subclause permits the application of the results of an evaluation to a number of system configurations using the same types of equipment and cables as tested, but no other, each system configuration being in effect a subsystem of the one evaluated.

Interconnecting cables shall be of the type and length specified in the individual equipment requirements. If the length can be varied, the length shall be selected to produce maximum emission when performing field strength measurements.

If shielded or special cables are used during the tests then the use of such cables shall be specified in the instruction manual.

The connection of signal leads, except for the leads supplied by the manufacturer, is not required during radio-frequency emission measurements for portable test and measurement apparatus, group 1, or those intended for use in laboratories and operated by competent persons. Examples are signal generators, network and logic analysers, and spectrum analysers.

~~When performing terminal voltage measurements,~~ Excess lengths of cables shall be bundled at the approximate centre of the cable with bundles of 30 cm to 40 cm in length. If it is impracticable to do so the disposition of the excess cable shall be noted precisely in the test report.

Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

Where there are multiple interface ports all of the same type, connecting a cable to just one of that type of port is sufficient provided that it can be shown that the additional cables would not significantly affect the results.

Any set of results shall be accompanied by a complete description of the cable and equipment orientation so that results can be repeated. If there are conditions of use, those conditions shall be specified, documented and included in the instructions for use.

If a given type of equipment can perform separately any one of a number of functions then the equipment shall be tested while performing each of these functions. For systems which may include a number of different ~~equipments~~ components, one of each type of ~~equipment~~ component which is included in the system configuration shall be included in the evaluation.

A system which contains a number of identical ~~equipments~~ components, but has been evaluated using only one of those ~~equipments~~ components, does not require further evaluation if the initial evaluation was satisfactory.

NOTE 2 This is ~~permissible~~ possible because it has been found that in practice emissions from identical modules are not additive.

When equipment is being evaluated which interacts with other equipment to form a system then the evaluation may be carried out using either additional equipment to represent the total system or with the use of simulators. In either method care shall be taken to ensure that the equipment under test is evaluated with the effects of the rest of the system or simulators satisfying the ambient noise conditions specified in 7.2. Any simulator used in lieu of actual equipment shall properly represent the electrical and in some cases the mechanical characteristics of the interface, especially with respect to radio-frequency signals and impedances, as well as cable configuration and types.

NOTE 3 This procedure is required to ~~permit~~ facilitate the evaluation of equipment which will be combined with other equipment from different manufacturers to form a system.

### 7.5.3 Connection to the electricity supply network on a test site

#### 7.5.3.1 Connection to the laboratory a.c. mains network

##### 7.5.3.1.1 General

Where necessary the mains power from the laboratory's electricity power supply network shall be provided through the artificial mains network (AMN) specified in 7.3.2.2.

For connection to the AMN or to the test site's electricity supply network, appropriate lengths of mains cables shall be used. If the manufacturer's installation instructions specify a particular type of mains cable for use with the EUT, connection to the AMN or to the test site's electricity supply network shall be made with that cable type.

Mains power at the nominal voltage shall be supplied.

##### 7.5.3.1.2 Connection to the laboratory a.c. mains network for measurement of conducted disturbances and for radiated disturbances in the range up to 30 MHz

When performing measurements on a test site, the ~~V-network~~ artificial mains network (V-AMN) specified in 7.3.2.2 is to be used whenever possible. The enclosure of the ~~V-network~~ V-AMN shall be located so that its closest surface is no less than 0,8 m from the nearest boundary of the equipment under test.

Where a flexible mains cord is provided by the manufacturer this shall be 1 m long or, if in excess of 1 m, the excess cable shall be folded to and forth to form a bundle not exceeding 0,4 m in length.

AVA Documents Document Sharing Hub

Full document details: CISPR 11 2015 RLV

~~Mains power at the nominal voltage shall be supplied.~~

Where a mains cable is specified in the manufacturer's installation instructions a 1 m length of the type specified shall be connected between the test unit and the ~~V-network~~ AMN.

Earth connections, where required for safety purposes, shall be connected to the reference "earth" point of the ~~V-network~~ AMN and where not otherwise provided or specified by the manufacturer shall be 1 m long and run parallel to the mains connection at a distance of not more than 0,1 m.

Other earth connections (e.g. for EMC purposes) either specified or supplied by the manufacturer for connection to the same terminal as the safety earth connection shall also be connected to the reference earth of the ~~V-network~~ AMN.

Ancillary low voltage a.c. mains ports shall be connected to the laboratory a.c. mains network via one or more separate artificial mains networks (V-AMN) as specified in 7.3.2.2.

Where the equipment under test is a system comprising more than one unit, each unit having its own power cord, the point of connection for the ~~V-network~~ AMN is determined from the following rules:

a) each mains cable which is terminated in a mains supply plug of a standard design (e.g., IEC 60083) shall be tested separately;

b) mains cables or terminals which are not specified by the manufacturer to be connected to another unit in the system for the purposes of supplying mains power shall be tested separately;

c) mains cables or terminals which are specified by the manufacturer to be connected to another unit in the system for the purposes of supplying mains power shall be connected to that unit, and the mains cables or terminals of that unit are connected to the ~~V-network~~ AMN;

d) where a special connection is specified, the necessary hardware to effect the connection shall be used during the evaluation of the equipment under test.

#### 7.5.3.1.3 Connection to the laboratory a.c. mains network for measurement of radiated disturbances in the range 30 MHz to 18 GHz

Connection to the laboratory's electricity supply network may be provided with or without the use of an AMN allocated inside the test environment, see Figure 4. For measurement arrangements not including an AMN, grounding and earthing of the EUT shall be guaranteed by adherence to the principles set out in 7.5.3.1.2 as far as possible.

If the measurement arrangement does not include an AMN, then excessive lengths of mains cables do not need to be bundled and allocated inside the test volume. They may be accommodated someplace outside the test volume or test environment. For decoupling of radiation from these excessive cable lengths it is however recommended to carefully terminate these mains cables at the location where they leave the test volume. For this decoupling use of CMADs is recommended. For measurements with a separation distance of 3 m this decoupling is mandatory, see 7.5.1.

### 7.5.3.2 Connection to the laboratory d.c. power supply or other d.c. power source

When performing measurements on a test site, the 150 Ω artificial d.c. network (DC-AN) specified in 7.3.2.3 is to be used whenever possible. The enclosure of the DC-AN shall be located so that its closest surface is 0,8 m from the nearest boundary of the equipment under test.

Where the DC-AN is used as voltage probe, the EUT's d.c. power port under test shall be decoupled from the d.c. power source by means of suitable common mode decoupling

AVA Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

devices such as ferrite tubes, CMADs or a CDN as specified in 6.2.4 of IEC 61000-4-6:2013 which are to be clamped at or to be inserted in the d.c. power cable connecting the d.c. power source with the measurement arrangement for the EUT, see also Figure 7, 8 and 9 in 8.2.2.2.3. If a CDN according to IEC 61000-4-6 is used for decoupling purposes, its RF power input port shall not be terminated with a 50 Ω resistive load.

Connection is to be made to a suitable d.c. power source. The d.c. output voltage of this power source shall be adjustable to provide a voltage level within the rated operation range for the respective type of EUT.

NOTE 1 For supply of the EUT's d.c. power port under test, a dedicated laboratory d.c. power source, appropriate (sets of) batteries or also other d.c. energy sources such as e. g. fuel cell modules can be used, provided that they allow for continuous and stable voltage, current, etc. necessary for power converters under rated output operating conditions, throughout the measurement.

Care should be taken when selecting the laboratory d.c. power source and installing it in the measurement arrangement. It is recommended to select and install only such a d.c. power source which provides for a good galvanic insulation and also sufficient RF decoupling of both d.c. power terminals from the laboratory reference ground plane. Internal decoupling capacitors at the d.c. power source's terminals used for internal suppression of asymmetrical disturbances may provide an unwanted bypass for the common mode 150 Ω termination impedance of the DC-AN used for the measurements. This may cause saturation effects in the mitigation filter of the power converter under test, in particular at the operation frequency (i.e. the switching frequency) of the power converter and its harmonics, which are usually allocated in the range from 2 kHz to some 20 kHz. Saturated mitigation filters do however lead to incorrect and invalid measurement results, since the power converter is not operated as intended, during the measurements. For guidance on prevention of saturation effects caused by the configuration of the test site, see information in Annex K.

Where a particular type of d.c. power cable is specified in the manufacturer's installation instructions, this shall be used during testing.

For testing, a cable length as short as possible shall be connected between the equipment under test and the DC-AN respecting the proximity of the boundary conditions defined above.

Where the equipment under test has more than one d.c. power port of the same type, the number of d.c. power ports needed to operate the equipment at its rated power shall be connected to the DC-AN for the measurements. All other d.c. power ports shall be terminated with a suitable 150 Ω common mode termination impedance. Multiple ports galvanically connected in parallel (such as bus bars or strips for connection to multiple cables) are considered to represent one single port only.

NOTE 2 For these other terminations, any suitable device can be used. This includes e.g. use of further 150 Ω networks according to CISPR 16-1-2, further DC-ANs as specified in 7.3.2.3, or also use of 150 Ω coupling/decoupling devices (CDN) as defined in IEC 61000-4-6.

Ancillary d.c. power ports shall be connected to an appropriate separate laboratory d.c. power source or battery, via a suitable 150 Ω common mode termination impedance.

NOTE 3 If a separate mains-connected laboratory d.c. power source is used, then it can be appropriate to also insert another EMI filter in the connection to that power source. Diagrams showing suitable setups for the test site are found in Annex J.

## 7.6 Load conditions of equipment under test

### 7.6.1 General

Load conditions of the equipment under test are specified in this subclause. Equipment not covered by this subclause are to be operated so as to maximize the ~~interference~~ disturbance generated while still conforming with normal operating procedures as provided in the operating manual of the equipment.

Documents
Document Sharing Hub

Full document details: CISPR 11 2015 RLV

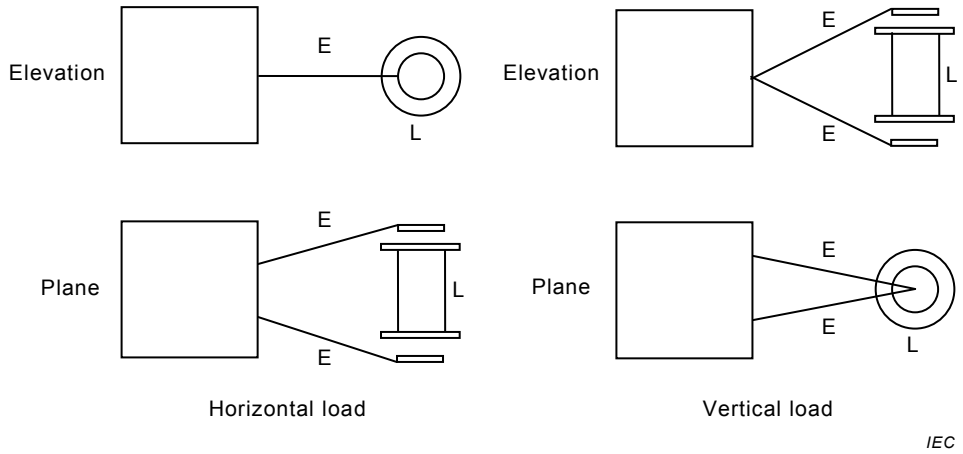
### 7.6.2 Medical equipment

#### 7.6.2.1 Therapeutic equipment using frequencies from 0,15 MHz to ~~300~~ 400 MHz

All measurements shall be made under operating conditions as provided for in the operating manual of the equipment. The output circuit to be used to load the equipment depends on the nature of the electrodes with which it is to be used.

*For equipment of the capacitive type*, a dummy load shall be used for the measurements. The general arrangement is shown in Figure 5. The dummy load shall be substantially resistive and capable of absorbing the rated maximum output power of the equipment.

The two terminals of the dummy load shall be at opposite ends of the load and each terminal shall be joined directly to a circular flat metal plate having a diameter of 170 mm ±10 mm. Measurements shall be made with each of the output cables and capacitive electrodes supplied with the equipment. The capacitive electrodes are to be disposed parallel to the circular metal plates at the ends of the dummy load, the spacing between them being adjusted to produce the appropriate power dissipation in the dummy load.




E = electrode arms and cables

L = dummy load

**Figure ~~3~~ 5 – Disposition of medical (capacitive type) and dummy load ~~(see 7.6.2.1)~~**

Measurements shall be made with the dummy load both horizontal and vertical (see Figure 5). In each case, the equipment, together with the output cables, capacitive electrodes and dummy load, shall be rotated around its vertical axis during measurements of electromagnetic radiation disturbance in order that the maximum value can be measured.

NOTE The following arrangement of lamps has been found suitable for testing many types of equipment in the power range tested:

a) nominal output power 100 W to 300 W:

four lamps 110 V/60 W in parallel, or five lamps 125 V/60 W in parallel;

b) nominal output power 300 W to 500 W:

four lamps 125 V/100 W in parallel, or five lamps 150 V/100 W in parallel.

*For equipment of the inductive type*, measurements shall be made using the cables and coils supplied with the equipment for the treatment of the patient. The test load shall consist of a vertical tubular container of insulating material, having a diameter of 10 cm, filled to a height of 50 cm with a solution consisting of 9 g of sodium chloride to 1 litre of distilled water.

Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

The container shall be placed within the coil with the axis of the container coincident with the axis of the coil. The centres of the coil and the liquid load shall also coincide.

Measurements shall be made at both maximum and half-maximum power and, where the output circuit can be tuned, it shall be tuned to resonance with the fundamental frequency of the ~~apparatus~~ equipment.

All measurements shall be made under all operating conditions as provided in the operating manual of the equipment.

#### 7.6.2.2 UHF and microwave therapeutic equipment using frequencies above ~~300~~ 400 MHz

Measurements shall be made ~~initially~~ with the output circuit of the equipment connected to a non-radiating resistive load ~~resistor~~ having the same value as the characteristic impedance of the cable used to supply the equipment load.

~~Secondly, having regard to the specifications in the operating manual of the equipment, measurements shall be made with each of the applicators supplied with the equipment in each possible position and direction and with no absorbing medium.~~

~~The highest of the levels measured using the two arrangements shall be used to determine compliance with the limits.~~

~~NOTE 1 Where necessary, the maximum power output of the equipment should be measured with the first arrangement. In order to determine the matching of the terminating resistor to the output-circuit of the equipment, the standing wave ratio should be measured on the line between the generator and the terminating resistor. The voltage standing wave ratio VSWR should not exceed the value of 1,5.~~

~~NOTE 2 Methods of loading other medical equipment are under consideration.~~

#### 7.6.2.3 Ultrasonic therapy equipment

Measurements shall be made with the transducer connected to the generator. The transducer shall be dipped in a non-metallic container having a diameter of about 10 cm and filled with distilled water.

Measurement shall be made at both maximum and half-maximum power and, where the output circuit can be tuned, it shall be tuned to resonance and then detuned. The specifications in the operating manual of the equipment are to be considered.

~~NOTE The measurement of~~ It is recommended to measure the maximum output of the equipment ~~should be made~~ in accordance with the method published in IEC 61689 or using a derived arrangement, if necessary.

### 7.6.3 Industrial equipment

The load used when industrial equipment is tested may be either the load used in service or an equivalent device.

Where means for connecting auxiliary services such as water, gas, air, etc. are provided, connection of these services to the equipment under test shall be made by insulating tubing not less than 3 m long. When testing with the load used in service, the electrodes and cables shall be disposed in the manner of their normal use. Measurements shall be made at both maximum output power and at half-maximum output power. Equipment which will normally operate at zero or very low output power shall also be tested in these conditions.

Industrial induction heating and dielectric heating equipment should be tested in a configuration and with a load that is equivalent to actual or intended use. Where the equipment may be configured for a variety of loads or the load is not available, the load as

Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

specified in IEC 61922 for induction heating and IEC 61308 for dielectric heating equipment may be used. Industrial resistance heating equipment shall be tested with or without the charge, as specified by the manufacturer.

NOTE A circulating water load has been found suitable for many types of dielectric heating equipment.

Industrial microwave heating equipment shall conform to the limits of radiation in Clause 6 when loaded according to IEC 61307 or with a load used in practice. The load shall be varied as required to produce maximum power transfer, frequency variation or harmonic variation depending on the characteristics under examination.

### 7.6.4 Scientific, laboratory and measuring equipment

Scientific equipment shall be tested under normal operating conditions. Laboratory and measuring equipment shall be operated as intended. Any RF output ports shall be terminated in a matching non-radiating load.

### 7.6.5 Microwave cooking appliances

Microwave cooking appliances shall ~~conform to the limits of radiation in Clause 6, when tested~~ be operated with all normal components such as shelves in place, and with a load of 1 l of tap water initially at 20 °C ± 5 °C placed at the centre of the load-carrying surface provided by the manufacturer.

The water container shall be a cylindrical container of borosilicate glass of an external diameter of 190 mm ± 5 mm and a height of 90 mm ± 5 mm, see also IEC 60705.

~~Before the measurement, preliminary operation of the microwave oven under test shall be performed until the magnetron oscillating frequency is stabilized. More than 5 min preheating time is required.~~

~~NOTE During the measurement, the water load should be exchanged to cold water before it starts to boil.~~

~~For peak measurements above 1 GHz (Table 14 or Table 15), measurements shall be made with the azimuth of the EUT varying every 30° (starting position perpendicular to the front door). At each of these 12 positions, a maximum hold shall be made for a period of 20 s. Then, at the position where the maximum occurred, a maximum hold for a period of 2 min shall be made, and the result compared to the relevant limit (see Table 14 or Table 15).~~

~~Weighted measurements above 1 GHz (see Table 16) shall be performed at the position where the maximum occurred during the peak measurements and shall be the result of a maximum hold during at least five sweeps.~~

~~In all cases, the starting phase of the oven (a few seconds) is to be ignored.~~

Detailed information on the measurement procedure to be used in the frequency range above 1 GHz is found in 9.4.

### 7.6.6 Other equipment in the frequency range 1 GHz to 18 GHz

Other equipment shall conform to the limits of radiation in Clause 6 when tested with a dummy load consisting of a quantity of tap water in a non-conductive container. The size and shape of the container, its position in the equipment and the quantity of water contained therein shall be varied as required to produce maximum power transfer, frequency variation or harmonic radiation depending on the characteristics under examination.

Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

~~**7.6.7 Single and multiple-zone induction cooking appliances**~~

~~Each cooking zone is operated with an enamelled steel vessel filled with tap water up to 80 % of its maximum capacity.~~

~~The position of the vessel shall match the hob marking on the plate.~~

~~Cooking zones shall be operated separately in sequence.~~

~~A cooking zone with more than one induction coil shall be measured with two load conditions. The first measurement shall be performed with the smallest coil of the zone activated. The second measurement shall be performed with all coils of the zone activated. In each case, the smallest usable standard vessel shall be used (or the smallest vessel according to the manufacturer's instructions, which take precedence), which just activates the smallest coil, or all coils of the zone, respectively.~~

~~Energy controller settings shall be selected to give the maximum input power.~~

~~The vessel bottom shall be concave and shall not deviate from flatness by more than 0,6 % of its diameter at the ambient temperature 20 °C ±5 °C.~~

~~The smallest usable standard vessel shall be placed in the centre of each cooking zone. For the dimension of the vessels, the manufacturer's instructions take precedence.~~

~~Cooking zones which are not intended for use with even vessels (e.g. wok-zones) shall be measured with the vessel provided together with the hob, or with the vessel recommended by the manufacturer.~~

~~Standard cooking vessels (dimension of the contact surface) are:~~

- ~~110 mm~~
- ~~145 mm~~
- ~~180 mm~~
- ~~210 mm~~
- ~~300 mm~~

~~Material of the vessel: the induction cooking method has been developed for ferromagnetic utensils. For this reason, measurements shall be made with enamelled steel vessels.~~

~~NOTE Some vessels on the market are manufactured from alloys with a ferromagnetic portion. However, these utensils might influence the sensing circuit for vessel displacement.~~

### 7.6.7 Electric welding equipment

For arc welding equipment, the welding operation during the test is simulated by loading the equipment with a conventional load. Arc striking and stabilising devices shall be switched ~~off~~ on during the emission measurements. The load conditions and the test configuration for arc welding equipment are specified in IEC 60974-10.

For resistance welding equipment, the welding operation during the test is simulated by short-circuiting the welding circuit. The load conditions and the test configuration for resistance welding equipment are specified in IEC 62135-2.

The start of the measurements according to this standard shall be delayed by up to 5 s after the welding equipment under test has been taken into operation.

Documents
Document Sharing Hub

Full document details: CISPR 11 2015 RLV

### 7.6.8 ISM RF lighting equipment

ISM RF lighting equipment shall conform to the limits in 6.3 when tested as delivered by the manufacturer under normal operating conditions. In case of ISM RF lighting equipment, the EUT shall be operated until the magnetron oscillating frequency is stabilized. The start of any measurement according to this standard shall hence be delayed by at least 15 min.

### 7.6.9 Medium voltage (MV) and high voltage (HV) switchgear

For equipment used in medium or high voltage switchgear, the start of any measurements according to this standard shall be delayed until switching actions related to the main or primary circuit are finished (e.g. switching actions of breakers or disconnectors).

### 7.6.10 Grid connected power converters

#### 7.6.10.1 Connection to the laboratory a.c. mains or similar load

The power converter under test shall be connected to the laboratory a.c. mains network via the artificial mains network (V-AMN) specified in 7.3.2.2, whenever possible. If such connection is not possible or not intended, then the power converter under test can be connected to an appropriate resistive load and the laboratory a.c. mains network in parallel, via the artificial mains network (V-AMN) specified in 7.3.2.2.

Connection to an appropriate resistive load is also recommended for power converters solely intended for use in island low voltage a.c. mains installations which are not connected to an other public low voltage a.c. mains power distribution network. For advice, consult the installation instructions of the manufacturer.

Alternatively the a.c. supply power for the laboratory d.c. power source can be taken from the a.c. output lines of the GCPC via the V-AMN without connecting the resistive load. The output a.c. power of the GCPC will be used to contribute to the required d.c. input power for that GCPC, thus the resistive load is not necessary in this case, see Figure J.1 in Annex J.

For suitable test site configurations, see Annex J.

#### 7.6.10.2 Connection to another appropriate load

For power converters intended to be supplied from a.c. power sources, the d.c. power port under test shall be connected to a suitable resistive load or other adequate energy storage via an 150 Ω artificial network (DC-AN) as specified in 7.3.2.3. The EUT shall be connected to an appropriate load within the rated operational range for the respective type of EUT.

NOTE An example of a type of GCPC intended to be supplied from an a.c. power source is a power converter intended for assembly into an off-board charging station for electric vehicles (EV).

## 7.7 Recording of test-site measurement results

### 7.7.1 General

Any results obtained from measurements of conducted and/or radiated radio-frequency disturbances shall be recorded in the test report. If the results are not recorded in a continuous way and/or in graphical form over the frequency range observed, then the minimum requirements to the recordings set out in 7.7.2 and 7.7.3 shall apply.

The test report shall contain a statement underlining that the measurement instrumentation uncertainty (MIU) ~~as specified in~~ was determined according to CISPR 16-4-2 and was also considered when determining compliance with the limits for the tested individual equipment or the number of items in the sample of series-produced equipment.

Documents
Document Sharing Hub
Full document details: CISPR 11 2015 RLV

The test report may include the numerical values of the MIU which the test laboratory has determined for each test performed. If the uncertainty budgets specified in CISPR 16-4-2 are exceeded, then the test report shall include the numerical values of the MIU of the test instrumentation actually used.

### 7.7.2 Conducted emissions

Of those conducted emissions above ($L$ – 20 dB), where $L$ is the limit level in logarithmic units, the record shall include at least the disturbance levels and the frequencies of the six highest disturbances in each observed frequency range from each mains port belonging to the EUT. The record shall also include an indication upon which conductor of the mains port carried the observed disturbance(s).

### 7.7.3 Radiated emissions

Of those radiated emissions above ($L$ – 10 dB), where $L$ is the limit level in logarithmic units, the record shall include at least the disturbance levels and the frequencies of the six highest disturbances in each observed frequency range. The record shall include the antenna polarization, antenna height and turntable rotation position if applicable for each reported disturbance. In case of test site measurements, the measurement distance actually selected and used (see 6.2.2~~ or~~ and 6.3.2~~, respectively~~) shall also be recorded in the test report.

## 8 Special provisions for test site measurements (9 kHz to 1 GHz)

### 8.1 Ground planes

A ground plane shall be used when making measurements on a test site. The relationship of the equipment under test to the ground plane shall be equivalent to that occurring in use~~, i.e., floor -standing equipment resting on the ground plane or isolated from it by a thin insulating covering, portable and other non-floor-standing equipment placed on a non-metallic table 0,8 m above the ground plane~~. Except at the manufacturer's intended grounding locations, a floor standing EUT shall be insulated from the ground plane by a dielectric material with thickness of up to 15 cm. Direct connection to earth (i.e. to the ground plane) shall be done

a) either according to the manufacturer's instructions,

b) or, if the equipment under test is fitted with a special earthing terminal, then this terminal shall be connected to earth (i.e. be bonded to the ground plane) with a lead as short as possible, see also Figure 4.

A ground plane shall be used for radiation measurement and the measurement of~~ terminal~~ disturbance voltages. The requirements for the radiation test site are given in 8.3 and, for the ground plane for the measurement of~~ terminal~~ conducted disturbances~~ voltage~~, in 8.2.

~~NOTE – For the larger commercial microwave ovens, it is necessary to ensure that the measurement results are not affected by near field effects. CISPR 16-2-3 should be consulted for guidance.~~

### 8.2 Measurement of~~ mains terminal disturbance voltage~~ conducted disturbances

#### 8.2.1 General

For the EUT's earthing and grounding conditions as well as connection to the laboratory's electricity supply network see 7.5.3.

The measurement of~~ the mains terminal disturbance voltage~~ conducted disturbances~~ may~~ shall be carried out using one of the following three options:

a) on the radiation test site with the equipment under test having the same configuration as used during the radiation measurement;

b) above a metal ground plane which shall extend at least 0,5 m beyond the boundary of the equipment under test and have a minimum size of 2 m × 2 m; or

AVA Documents Document Sharing Hub