



**Industrial, scientific and medical
equipment—Radio-frequency
disturbance characteristics—Limits and
methods of measurement
(CISPR 11:2015+AMD1:2016 (ED.6.1)
MOD)**



This Australian Standard® was prepared by Committee TE-003, Electromagnetic Interference. It was approved on behalf of the Council of Standards Australia on 6 August 2017.

This Standard was published on 15 September 2017.

The following are represented on Committee TE-003:

- Australian Communications and Media Authority
 - Australian Industry Group
 - Australian Information Industry Association
 - Consumer Electronics Suppliers Association
 - Department of Defence (Australian Government)
 - Electrical Compliance Testing Association
 - EMC Society of Australia
 - Energy Networks Australia
 - Engineers Australia
 - Free TV Australia
 - Lighting Council Australia
 - National Measurement Institute
 - Wireless Institute Australia
-

This Standard was issued in draft form for comment as DR AS CISPR 11:2017.

Standards Australia wishes to acknowledge the participation of the expert individuals that contributed to the development of this Standard through their representation on the Committee and through the public comment period.

Keeping Standards up-to-date

Australian Standards® are living documents that reflect progress in science, technology and systems. To maintain their currency, all Standards are periodically reviewed, and new editions are published. Between editions, amendments may be issued.

Standards may also be withdrawn. It is important that readers assure themselves they are using a current Standard, which should include any amendments that may have been published since the Standard was published.

Detailed information about Australian Standards, drafts, amendments and new projects can be found by visiting **www.standards.org.au**

Standards Australia welcomes suggestions for improvements, and encourages readers to notify us immediately of any apparent inaccuracies or ambiguities. Contact us via email at **mail@standards.org.au**, or write to Standards Australia, GPO Box 476, Sydney, NSW 2001.

Australian Standard[®]

**Industrial, scientific and medical
equipment—Radio-frequency
disturbance characteristics—Limits and
methods of measurement
(CISPR 11:2015+AMD1:2016 (ED.6.1)
MOD)**

Originated as AS 2064—1977.
Previous edition AS/NZS CISPR 11:2011.
Third edition designated as AS CISPR 11:2017.
Reissued incorporating Amendment No. 1 (October 2020).

COPYRIGHT

© Standards Australia Limited

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher, unless otherwise permitted under the Copyright Act 1968.

ISBN 978 1 76035 873 0

PREFACE

This Standard was prepared by the Australian members of Joint Standards Australia/Standards New Zealand Committee TE-003, Electromagnetic Interference, to supersede AS/NZS CISPR 11:2011.

This Standard incorporates Amendment No. 1 (October 2020). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian Standard rather than an Australian/New Zealand Standard.

The objective of this Standard is to identify limits and methods of measurement of electromagnetic disturbance characteristics in ISM radio frequency equipment.

This Standard is an adoption with national modifications and has been reproduced from CISPR 11:2015+AMD1:2016 CSV (ED.6.1), *Industrial, scientific and medical equipment—Radio-frequency disturbance characteristics—Limits and methods of measurement*, and has been varied as indicated to take account of Australian conditions. The modifications are specified in Appendix ZZ.

A1 | As indicated above, CISPR Amendment No. 1:2016 is incorporated into the source text. The Australian Amendment No. 1:2020 has been issued to add CISPR Amendment No. 2:2019 to this Standard. The Amendment is located after the Bibliography.

The variations are related to the 900 MHz ISM band. In Australia, this bandwidth is reduced to 915 MHz to 928 MHz (instead of 902 MHz to 928 MHz).

As this Standard is reproduced from an International Standard, the following applies:

- (a) In the source text ‘this International Standard’ should read ‘this Australian Standard’.
- (b) A full point substitutes for a comma when referring to a decimal marker.

Australian or Australian/New Zealand Standards that are identical adoptions of international normative references may be used interchangeably. Refer to the online catalogue for information on specific Standards.

The terms ‘normative’ and ‘informative’ are used to define the application of the annex or appendix to which they apply. A normative annex or appendix is an integral part of a standard, whereas an informative annex or appendix is only for information and guidance.

NOTES

CONTENTS

FOREWORD.....	7
INTRODUCTION.....	10
Introduction to Amendment 1	11
1 Scope.....	12
2 Normative references.....	12
3 Terms and definitions	13
4 Frequencies designated for ISM use	16
5 Classification of equipment	17
5.1 Separation into groups	17
5.2 Division into classes.....	17
5.3 Documentation for the user	18
6 Limits of electromagnetic disturbances.....	18
6.1 General.....	18
6.2 Group 1 equipment measured on a test site	19
6.2.1 Limits for conducted disturbances	19
6.2.2 Limits of electromagnetic radiation disturbance.....	22
6.3 Group 2 equipment measured on a test site	23
6.3.1 Limits for conducted disturbances	23
6.3.2 Limits of electromagnetic radiation disturbance.....	25
6.4 Group 1 and group 2 class A equipment measured in situ	30
6.4.1 Limits for conducted disturbances	30
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 network (AN)	34
7.3.3 Voltage probe	35
7.3.4 Antennas	35
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	44
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 Electric welding equipment.....	45
7.6.8 ISM RF lighting equipment	45

7.6.9	Medium voltage (MV) and high voltage (HV) switchgear	45
7.6.10	Grid connected power converters	45
7.7	Recording of test-site measurement results	46
7.7.1	General	46
7.7.2	Conducted emissions	46
7.7.3	Radiated emissions	46
8	Special provisions for test site measurements (9 kHz to 1 GHz)	47
8.1	Ground planes	47
8.2	Measurement of conducted disturbances	47
8.2.1	General	47
8.2.2	Measurements on grid connected power converters	48
8.2.3	Handheld equipment which are normally operated without an earth connection	52
8.3	OATS and SAC for measurements in the range 9 kHz to 1 GHz	52
8.3.1	General	52
8.3.2	Validation of the radiation test site (9 kHz to 1 GHz)	53
8.3.3	Disposition of equipment under test (9 kHz to 1 GHz)	53
8.3.4	Radiation measurements (9 kHz to 1 GHz)	54
8.4	Alternative radiation test sites for the frequency range 30 MHz to 1 GHz	54
8.5	FAR for measurements in the range 30 MHz to 1 GHz	54
9	Radiation measurements: 1 GHz to 18 GHz	55
9.1	Test arrangement	55
9.2	Receiving antenna	55
9.3	Validation and calibration of test site	55
9.4	Measuring procedure	55
9.4.1	General	55
9.4.2	Operating conditions of the EUT	56
9.4.3	Preliminary measurement	56
9.4.4	Final measurement	57
10	Measurement <i>in situ</i>	58
11	Safety precautions for emission measurements on ISM RF equipment	59
12	Measurement uncertainty	59
	Annex A (informative) Examples of equipment classification	60
	Annex B (informative) Precautions to be taken in the use of a spectrum analyzer (see 7.3.1)	62
	Annex C (normative) Measurement of electromagnetic radiation disturbance in the presence of signals from radio transmitters	63
	Annex D (informative) Propagation of interference from industrial radio-frequency equipment at frequencies between 30 MHz and 300 MHz	64
	Annex E (informative) Recommendations of CISPR for protection of certain radio services in particular areas	65
	E.1 General	65
	E.2 Recommendations for protection of safety-related radio services	65
	E.3 Recommendations for protection of specific sensitive radio services	65
	Annex F (informative) Frequency bands allocated for safety-related radio services	66
	Annex G (informative) Frequency bands allocated for sensitive radio services	67
	Annex H (informative) Statistical assessment of series produced equipment against the requirements of CISPR standards	69

H.1	Significance of a CISPR limit	69
H.2	Type tests	69
H.3	Statistical assessment of series produced equipment	69
H.3.1	Assessment based on a general margin to the limit	69
H.3.2	Assessment based on the non-central t -distribution	70
H.3.3	Assessment based on the binomial distribution	72
H.3.4	Equipment produced on an individual basis	73
Annex I (normative)	Artificial Network (AN) for the assessment of disturbance voltages at d.c. power ports of semiconductor power converters	74
I.1	General information and purpose	74
I.2	Structures for a DC-AN	74
I.2.1	AN suitable for measurement of unsymmetrical mode (UM) disturbances	74
I.2.2	AN suitable for measurement of common mode (CM) and differential mode (DM) disturbances	74
I.2.3	AN suitable for measurement of UM, CM and DM disturbances	75
I.3	Employment of DC-ANs for compliance measurements	75
I.3.1	General	75
I.3.2	Pseudo V-AN	75
I.3.3	Delta-AN	75
I.4	Normative technical requirements for the DC-AN	76
I.4.1	Parameters and associated tolerances in the range 150 kHz to 30 MHz	76
I.4.2	Parameters and associated tolerances in the range 9 kHz to 150 kHz	77
I.5	Examples of practical implementations of DC-ANs	77
Annex J (informative)	Measurements on Grid Connected Power Converters (GCPC) – Setups for an effective test site configuration	80
J.1	General information and purpose	80
J.2	Setup of the test site	80
J.2.1	Block diagram of test site	80
J.2.2	DC power supply	81
J.2.3	AC power source	81
J.2.4	Other components	82
J.3	Other test setups	82
J.3.1	Configuration comprising laboratory AC power source and resistive load	82
J.3.2	Configuration in case of reverse power flow to the AC mains	83
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	85
K.1	General information and purpose	85
K.2	Recommendations for avoidance of saturation effects in the range 9 kHz to 150 kHz	86
K.3	Detailed advice	86
K.3.1	General	86
K.3.2	Insert of series inductors (or common mode chokes) in the laboratory's d.c. power supply chain	87
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	88
K.4	Background information	89
Bibliography	91

Figure 1 – Circuit for disturbance voltage measurements on mains supply	35
Figure 2 – Artificial hand, RC element	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 5 – Disposition of medical (capacitive type) and dummy load	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	49
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	50
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	51
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	51
Figure 10 – Test site	53
Figure 11 – Minimum size of metal ground plane	53
Figure 12 – Decision tree for the measurement of emissions from 1 GHz to 18 GHz of group 2 equipment operating at frequencies above 400 MHz	56
Figure H.1 – An example of possible difficulties	72
Figure I.1 – Practical implementation of a 150 Ω DC-AN suitable for measurement of UM disturbances (Example)	77
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)	78
Figure I.3 – Practical implementation of a 150 Ω DC-AN suitable for measurement of UM, or CM and DM disturbances (Example 1)	78
Figure I.4 – Practical implementation of a 150 Ω DC-AN suitable for measurement of UM, or CM and DM disturbances (Example 2)	79
Figure I.5 – Practical implementation of a 150 Ω DC-AN suitable for measurement of UM, or CM and DM disturbances (Example 3)	79
Figure J.1 – Setup of the test site (Case 1) – 2D diagram	80
Figure J.2 – Setup of the test site (Case 1) – 3D diagram	81
Figure J.3 – Setup of the test site (Case 2) – 2D diagram	82
Figure J.4 – Setup of the test site (Case 2) – 3D diagram	83
Figure J.5 – Setup of the test site (Case 3) – 2D diagram	84
Figure J.6 – Setup of the test site (Case 3) – 3D diagram	84
Figure K.1 – Flow of the common mode RF current at test site configuration level	87
Figure K.2 – Blocking of flow of common mode RF current by insert of series inductors	88
Figure K.3 – Blocking of flow of common mode RF current by employment of additional CM decoupling capacitors	88
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	89
Figure K.5 – Prevention of saturation of mitigation filters by use of additional decoupling capacitors	90
Figure K.6 – Change in the resonant frequency caused by the increase and decrease in the decoupling capacitor's capacitance	90

Figure K.7 – DC-AN circuit example where capacitance of blocking capacitors of the LC decoupling circuit can be increased or decreased.....	90
---	----

Table 1 – Frequencies in the radio-frequency (RF) range designated by ITU for use as fundamental ISM frequencies	17
Table 2 – Disturbance voltage limits for class A group 1 equipment measured on a test site (a.c. mains power port).....	20
Table 3 – Limits for conducted disturbances of class A group 1 equipment measured on a test site (d.c. power port).....	21
Table 4 – Disturbance voltage limits for class B group 1 equipment measured on a test site (a.c. mains power port).....	21
Table 5 – Disturbance voltage limits for class B group 1 equipment measured on a test site (d.c. power port).....	21
Table 6 – Electromagnetic radiation disturbance limits for class A group 1 equipment measured on a test site.....	22
Table 7 – Electromagnetic radiation disturbance limits for class B group 1 equipment measured on a test site.....	23
Table 8 – Disturbance voltage limits for class A group 2 equipment measured on a test site (a.c. mains power port).....	24
Table 9 – Disturbance voltage limits for class B group 2 equipment measured on a test site (a.c. mains power port).....	25
Table 10 – Electromagnetic radiation disturbance limits for class A group 2 equipment measured on a test site.....	27
Table 11 – Electromagnetic radiation disturbance limits for class A EDM and arc welding equipment measured on a test site	28
Table 12 – Electromagnetic radiation disturbance limits for class B group 2 equipment measured on a test site.....	28
Table 13 – Electromagnetic radiation disturbance peak limits for group 2 equipment operating at frequencies above 400 MHz	29
Table 14 – Electromagnetic radiation disturbance weighted limits for group 2 equipment operating at frequencies above 400 MHz	30
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 16 – Electromagnetic radiation disturbance limits for class A group 1 equipment measured <i>in situ</i>	31
Table 17 – Electromagnetic radiation disturbance limits for class A group 2 equipment measured <i>in situ</i>	32
Table 18 – Frequency sub-ranges to be used for weighted measurements	58
Table E.1 – Limits for electromagnetic radiation disturbances for <i>in situ</i> measurements to protect specific safety-related radio services in particular areas	65
Table H.1 – General margin to the limit for statistical evaluation	70
Table H.2 – The non-central <i>t</i> -distribution factor <i>k</i> as a function of the sample size <i>n</i>	71
Table H.3 – Application of the binomial distribution.....	73
Table I.1 – Parameters and associated tolerances in the range 150 kHz to 30 MHz.....	76
Table I.2 – Parameters and associated tolerances in the range 9 kHz to 150 kHz.....	77

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.

DISCLAIMER

This Consolidated version is not an official IEC Standard and has been prepared for user convenience. Only the current versions of the standard and its amendment(s) are to be considered the official documents.

This Consolidated version of CISPR 11 bears the edition number 6.1. It consists of the sixth edition (2015-06) [documents CISPR/B/628/FDIS and CISPR/B/631/RVD] and its amendment 1 (2016-06) [documents CISPR/B/627/CDV and CISPR/B/639A/RVC]. The technical content is identical to the base edition and its amendment.

This Final version does not show where the technical content is modified by amendment 1. A separate Redline version with all changes highlighted is available in this publication.