

INTERNATIONAL STANDARD

NORME INTERNATIONALE



INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE
COMITÉ INTERNATIONAL SPÉCIAL DES PERTURBATIONS RADIOÉLECTRIQUES

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

Appareils industriels, scientifiques et médicaux – Caractéristiques de perturbations radioélectriques – Limites et méthodes de mesure

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CONTENTS

FOREWORD.....	5
INTRODUCTION.....	8
1 Scope.....	9
2 Normative references.....	9
3 Terms and definitions.....	10
4 Frequencies designated for ISM use.....	11
5 Classification of ISM equipment.....	12
5.1 Information for the user.....	12
5.2 Separation into groups.....	12
5.3 Division into classes.....	12
6 Limits of electromagnetic disturbances.....	13
6.1 General.....	13
6.2 Group 1 equipment measured on a test site.....	13
6.2.1 Limits of terminal disturbance voltage.....	13
6.2.2 Limits of electromagnetic radiation disturbance.....	14
6.3 Group 2 equipment measured on a test site.....	17
6.3.1 Limits of terminal disturbance voltage.....	17
6.3.2 Limits of electromagnetic radiation disturbance.....	19
6.4 Group 1 and group 2 class A equipment measured <i>in situ</i>	27
6.4.1 Limits of terminal disturbance voltage.....	27
6.4.2 Limits of electromagnetic radiation disturbance.....	27
7 Measurement requirements.....	29
7.1 General.....	29
7.2 Ambient noise.....	29
7.3 Measuring equipment.....	29
7.3.1 Measuring instruments.....	29
7.3.2 Artificial mains network.....	30
7.3.3 Voltage probe.....	30
7.3.4 Antennas.....	30
7.3.5 Artificial hand.....	31
7.4 Frequency measurement.....	31
7.5 Configuration of equipment under test.....	31
7.5.1 General.....	31
7.5.2 Interconnecting cables.....	31
7.5.3 Connection to the electricity supply network on a test site.....	32
7.6 Load conditions of equipment under test.....	33
7.6.1 General.....	33
7.6.2 Medical equipment.....	33
7.6.3 Industrial equipment.....	34
7.6.4 Scientific, laboratory and measuring equipment.....	35
7.6.5 Microwave cooking appliances.....	35
7.6.6 Other equipment in the frequency range 1 GHz to 18 GHz.....	35
7.6.7 Single and multiple-zone induction cooking appliances.....	36
7.6.8 Electric welding equipment.....	36
7.7 Recording of test-site measurement results.....	37
7.7.1 General.....	37

7.7.2	Conducted emissions.....	37
7.7.3	Radiated emissions.....	37
8	Special provisions for test site measurements (9 kHz to 1 GHz)	37
8.1	Ground planes.....	37
8.2	Measurement of mains terminal disturbance voltage	37
8.2.1	General	37
8.2.2	Handheld equipment which are normally operated without an earth connection.....	38
8.3	Radiation test site for 9 kHz to 1 GHz.....	38
8.3.1	General	38
8.3.2	Validation of the radiation test site (9 kHz to 1 GHz).....	39
8.3.3	Disposition of equipment under test (9 kHz to 1 GHz).....	39
8.3.4	Radiation measurements (9 kHz to 1 GHz).....	39
8.4	Alternative radiation test sites for the frequency range 30 MHz to 1 GHz	39
9	Radiation measurements: 1 GHz to 18 GHz	40
9.1	Test arrangement	40
9.2	Receiving antenna	40
9.3	Validation and calibration of test site.....	40
9.4	Measuring procedure	40
10	Measurement <i>in situ</i>	40
11	Safety precautions	41
12	Assessment of conformity of equipment	41
12.1	General	41
12.2	Statistical assessment of compliance of series produced equipment.....	41
12.3	Equipment in small-scale production	42
12.4	Equipment produced on an individual basis.....	42
12.5	Measurement uncertainty.....	42
13	Figures and flowcharts	42
Annex A (informative)	Examples of equipment classification	46
Annex B (informative)	Precautions to be taken in the use of a spectrum analyzer (see 7.3.1)	48
Annex C (normative)	Measurement of electromagnetic radiation disturbance in the presence of signals from radio transmitters	49
Annex D (informative)	Propagation of interference from industrial radio-frequency equipment at frequencies between 30 MHz and 300 MHz.....	50
Annex E (informative)	Recommendations of CISPR for protection of certain radio services in particular areas.....	51
Annex F (informative)	Frequency bands allocated for safety-related radio services	52
Annex G (informative)	Frequency bands allocated for sensitive radio services	53
Bibliography	54
Figure 1	– Test site	42
Figure 2	– Minimum size of metal ground plane	43
Figure 3	– Disposition of medical (capacitive type) and dummy load (see 7.6.2.1).....	43
Figure 4	– Circuit for disturbance voltage measurements on mains supply (see 7.3.3).....	44

Figure 5 – 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 44

Figure 6 – Artificial hand, RC element (see 7.3.5) 45

Table 1 – Frequencies in the radio-frequency (RF) range designated by ITU for use as fundamental ISM frequencies 12

Table 2 – Mains terminal disturbance voltage limits for class A group 1 equipment measured on a test site 14

Table 3 – Mains terminal disturbance voltage limits for class B group 1 equipment measured on a test site 14

Table 4 – Electromagnetic radiation disturbance limits for class A group 1 equipment measured on a test site 15

Table 5 – Electromagnetic radiation disturbance limits for class B group 1 equipment measured on a test site 16

Table 6 – Mains terminal disturbance voltage limits for class A group 2 equipment measured on a test site 18

Table 7 – Mains terminal disturbance voltage limits for class B group 2 equipment measured on a test site 18

Table 8 – Mains terminal disturbance voltage limits for induction cooking appliances 19

Table 9 – Electromagnetic radiation disturbance limits for class A group 2 equipment measured on a test site 21

Table 10 – Electromagnetic radiation disturbance limits for class A EDM and arc welding equipment measured on a test site 22

Table 11 – Electromagnetic radiation disturbance limits for class B group 2 equipment measured on a test site 23

Table 12 – Limits of the magnetic field strength for induction cooking appliances intended for commercial use 24

Table 13 – Limits of the magnetic field induced current in a 2 m loop antenna for induction cooking appliances for domestic use 25

Table 14 – Electromagnetic radiation disturbance peak limits for group 2 equipment producing CW type disturbances and operating at frequencies above 400 MHz 26

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 26

Table 16 – Electromagnetic radiation disturbance weighted limits for class B group 2 equipment producing fluctuating disturbances other than CW and operating at frequencies above 400 MHz 27

Table 17 – Electromagnetic radiation disturbance limits for class A group 1 equipment measured *in situ* 27

Table 18 – Electromagnetic radiation disturbance limits for class A group 2 equipment measured *in situ* 28

Table 19 – The non-central *t*-distribution factor *k* as a function of the sample size *n* 41

Table E.1 – Limits for electromagnetic radiation disturbances for *in situ* measurements to protect specific safety-related radio services in particular areas 51

INTERNATIONAL ELECTROTECHNICAL COMMISSION
INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE

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

FOREWORD

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This consolidated version of CISPR 11 consists of the fifth edition (2009) [documents CISPR/B/478/FDIS and CISPR/B/482/RVD] and its amendment 1 (2010) [documents CISPR/B/492/FDIS and CISPR/B/496/RVD]. It bears the edition number 5.1.

The technical content is therefore identical to the base edition and its amendment and has been prepared for user convenience. A vertical line in the margin shows where the base publication has been modified by amendment 1. Additions and deletions are displayed in red, with deletions being struck through.

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 fifth edition of CISPR 11 got a more transparent structure, introduces another set of particular limits for conducted and radiated disturbances of "heavy duty" general purpose equipment of class A group 1 with a rated input power in excess of 20 kVA, in accordance with the needs of the industries and refers to the full approach in respect of the measurement instrumentation uncertainty specified in CISPR-~~16-4-4~~ 16-4-2. Furthermore, any kind of "legal statements" were removed from the normative main body of this International Standard.

It 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* (2009).

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

The committee has decided that the contents of the base publication and its amendments will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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 publication using a colour printer.

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.

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CISPR 11:2009

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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 3.1 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. 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 6.2 and 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 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 outside 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.

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 3.1), this standard covers emission requirements related to radio-frequency disturbances in the frequency range of 9 kHz to 18 GHz.

Requirements for ISM RF lighting apparatus 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.

NOTE Induction cooking appliances are in the process of being transferred from CISPR 11 to CISPR 14-1. Until the removal of induction cooking appliances from the scope of CISPR 11, users of the standards may choose either CISPR 11 or CISPR 14-1 for testing.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

CISPR 16-1-1:2006, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus*

Amendment 1 (2006)

Amendment 2 (2007)

CISPR 16-1-2:2003, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-2: Radio disturbance and immunity measuring apparatus – Ancillary equipment – Conducted disturbances*

Amendment 1 (2004)

Amendment 2 (2006)

CISPR 16-1-4:2007, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-4: Radio disturbance and immunity measuring apparatus – Ancillary equipment – Radiated disturbances*

Amendment 1 (2007)

Amendment 2 (2008)

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

CISPR 16-4-2:2003, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements*

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

IEC 60601-1-2:2007, *Medical electrical equipment – Part 1-2: General requirements for basic safety and essential performance – Collateral standard: Electromagnetic compatibility – 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, *Arc welding equipment – Part 10: Electromagnetic compatibility (EMC) requirements*

IEC 61307:2006, *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), *Radio regulations, Volume 3 – Resolutions and recommendations, resolution no. 63*

3 Terms and definitions

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

3.1

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: 2004 – Articles, Definition 1.15]

NOTE 1 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.

NOTE 2 The abbreviation ISM RF is used throughout this standard for such equipment or appliances.

3.2

ISM 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

3.3

(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 By extension, the term "electromagnetic radiation" sometimes also covers induction phenomena.

[IEV 161-01-10:1990]

3.4

boundary of the equipment under test

imaginary straight line periphery describing a simple geometric configuration encompassing the equipment under test. All interconnecting cables are included within this boundary

3.5

electro-discharge machining (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

3.6

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

3.7

arc welding equipment

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

3.8

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

3.9

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.

[IEV 601-01-26:1985]

3.10

small equipment

equipment, either positioned on a table top or standing on the floor which, including its cables fits in a cylindrical test volume of 1,2 m in diameter and 1,5 m above the ground plane

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 3.1). These frequencies are listed in Table 1.

NOTE In individual countries, different or additional frequencies may be designated for use by ISM equipment.

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.

5 Classification of ISM equipment

5.1 Information 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.

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

5.2 Separation into groups

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, in the form of electromagnetic radiation, inductive and/or capacitive coupling, for the treatment of material or inspection/analysis purposes.

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

5.3 Division into classes

Class A equipment is equipment suitable for use in all establishments other than domestic 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.

Warning: Class A equipment is intended for use in an industrial environment. In the documentation for the user, a statement shall be included drawing attention to the fact that there may be potential difficulties in ensuring electromagnetic compatibility in other environments, due to conducted as well as radiated disturbances.

Class B equipment is equipment suitable for use in domestic establishments 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.

6 Limits of electromagnetic disturbances

6.1 General

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 be required.

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

6.2.1.1 General

The equipment under test shall meet either:

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

6.2.1.2 Frequency range 9 kHz to 150 kHz

For group 1 equipment, no limits apply in this frequency range.

6.2.1.3 Frequency range 150 kHz to 30 MHz

Limits for mains terminal disturbance voltages in the frequency range 150 kHz to 30 MHz for equipment measured on a test site using the 50 Ω /50 μ H CISPR network or the CISPR voltage probe (see 7.3.3 and Figure 4) are given in Tables 2 and 3.