

**Industrial, scientific and medical (ISM)
radio-frequency equipment –
Electromagnetic disturbance characteristics –
Limits and methods of measurement**

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INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE

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INTERNATIONAL ELECTROTECHNICAL COMMISSION
INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE

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

FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The 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 the 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 National Committees.
- 3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
- 4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
- 5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
- 6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

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 fourth edition of CISPR 11 cancels and replaces the third edition published in 1997, amendment 1 (1999) and amendment 2 (2002). It has the status of a Product Family EMC standard in accordance with IEC Guide 107.

The document CISPR/B/295/FDIS, circulated to the National Committees as amendment 3, led to the publication of the new edition.

The text of this standard is based on the third edition, amendment 1, amendment 2 and the following documents:

FDIS	Report on voting
CISPR/B/295/FDIS	CISPR/B/301/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 2004. At this date, the publication will be

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

Withdrawn

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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

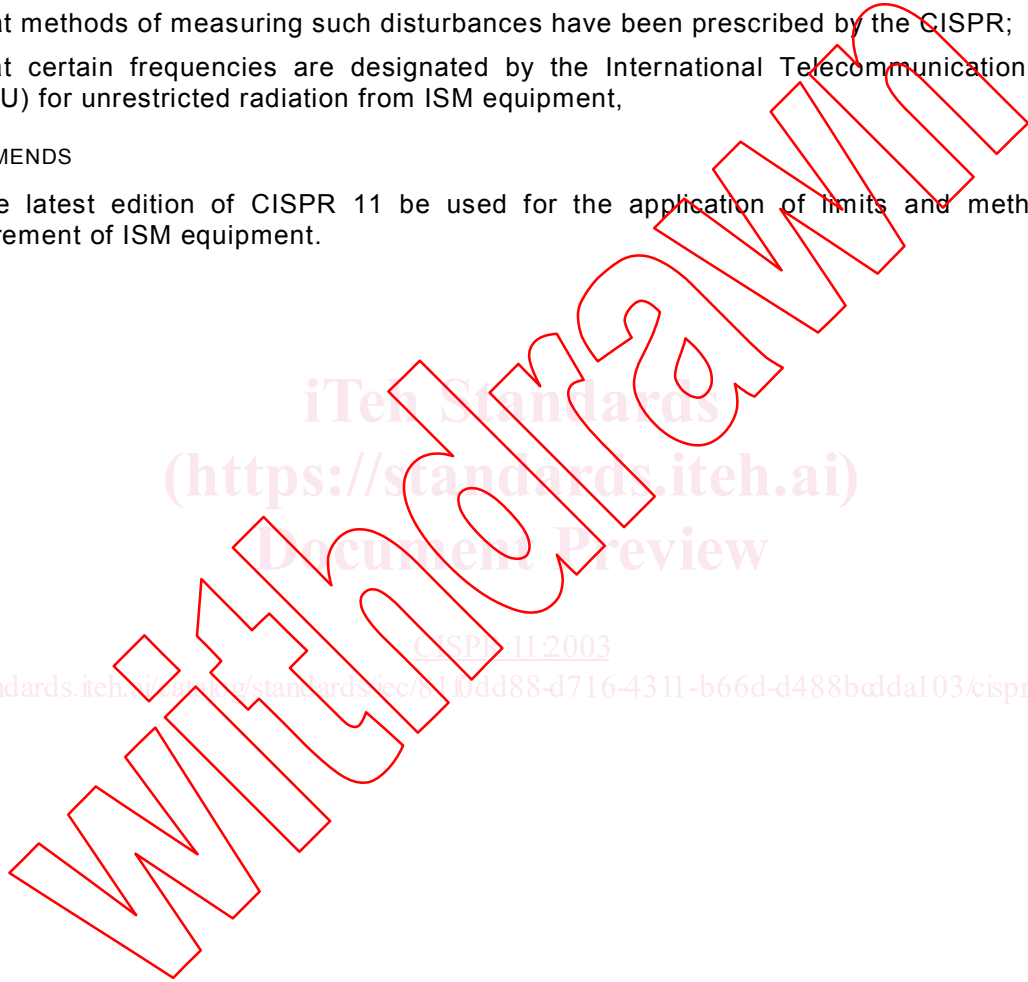
The CISPR

CONSIDERING

- a) that ISM r.f. 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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INDUSTRIAL, SCIENTIFIC AND MEDICAL (ISM) RADIO-FREQUENCY EQUIPMENT – ELECTROMAGNETIC DISTURBANCE CHARACTERISTICS – LIMITS AND METHODS OF MEASUREMENT

1 General

1.1 Scope and object

The limits and methods of measurement laid down in this International Standard apply to industrial, scientific and medical (ISM) equipment as defined in Clause 2, and to electro-discharge machining (EDM) and arc welding equipment.

NOTE 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.

Procedures are given for the measurement of radio-frequency disturbances and limits are laid down within the frequency range 9 kHz to 400 GHz.

Requirements for ISM lighting apparatus operating in the ISM frequency bands of 915 MHz (only allowed in region 2 as defined by the ITU Radio Regulations), 2,45 GHz and 5,8 GHz are contained in this standard.

Requirements for other types of lighting apparatus are covered in CISPR 15.

1.2 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 15, *Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment*

CISPR 16-1:1999, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1: Radio disturbance and immunity measuring apparatus*

CISPR 16-2:1996, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2: Methods of measurement of disturbances and immunity*

CISPR 19, *Guidance on the use of the substitution method for measurements of radiation from microwave ovens for frequencies above 1 GHz*

IEC 60050(161), *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electromagnetic compatibility*

IEC 60083, *Plugs and sockets outlets for domestic and similar general use standardized in member countries of IEC*

IEC 60705:1999, *Household microwave ovens – Methods for measuring performance*

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

IEC 61689, *Ultrasonics – Physiotherapy systems – Performance requirements and methods of measurement in the frequency range 0,5 MHz to 5 MHz*

2 Definitions

For the purpose of this document, the definitions of IEC 60050(161) and the following definitions apply.

2.1

ISM equipment

ISM appliance

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

2.2

electromagnetic radiation

1. The 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]

2.3

boundary of the equipment under test

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

2.4

click

disturbance which exceeds the limit of continuous disturbance no longer than 200 ms and which is separated from a subsequent disturbance by at least 200 ms. Both intervals are related to the level of the limit of continuous disturbance.

A click may contain a number of impulses, in which case the relevant time is that from the beginning of the first to the end of the last impulse.

2.5

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

2.6

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

2.7**arc welding equipment**

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

2.8**arc welding**

fusion welding in which the heat for welding is obtained from an electric arc or arcs

3 Frequencies designated for ISM use

Certain frequencies are designated by the International Telecommunication Union (ITU) for use as fundamental frequencies for ISM equipment. 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 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	S5.138
13,560	13,553 – 13,567	Unrestricted	S5.150
27,120	26,957 – 27,283	Unrestricted	S5.150
40,680	40,66 – 40,70	Unrestricted	S5.150
433,920	433,05 – 434,79	Under consideration	S5.138 in Region 1, except countries mentioned in S5.280
915,000	902 – 928	Unrestricted	S5.150 in Region 2 only
2 450	2 400 – 2 500	Unrestricted	S5.150
5 800	5 725 – 5 875	Unrestricted	S5.150
24 125	24 000 – 24 250	Unrestricted	S5.150
61 250	61 000 – 61 500	Under consideration	S5.138
122 500	122 000 – 123 000	Under consideration	S5.138
245 000	244 000 – 246 000	Under consideration	S5.138

^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.

4 Classification of ISM equipment

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.

NOTE See Annex A for examples of the classification of ISM equipment.

4.1 Separation into groups

Group 1 ISM equipment: group 1 contains all ISM equipment in which there is intentionally generated and/or used conductively coupled radio-frequency energy which is necessary for the internal functioning of the equipment itself.

Group 2 ISM equipment: group 2 contains all ISM equipment in which radio-frequency energy is intentionally generated and/or used in the form of electromagnetic radiation for the treatment of material, and EDM and arc welding equipment.

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

4.2 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.

NOTE 1 Operation of equipment which does not meet the class A limits but does not result in unacceptable degradation of radio services may be sanctioned on a case-by-case basis by the competent national authority.

NOTE 2 Although class A limits have been derived for industrial and commercial establishments, administrations may allow, with whatever additional measures are necessary, the installation and use of class A ISM equipment in a domestic establishment or in an establishment connected directly to domestic electricity power supplies.

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.

5 Limits of electromagnetic disturbances

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

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

Class B ISM equipment shall be measured on a test site.

Limits are under consideration for:

- arc stud welding equipment and arc striking and stabilizing devices for arc welding;
- radiology equipment;
- radio-frequency surgical diathermy equipment.

The limits given in Tables 2 to 9 are applicable to all electromagnetic disturbances at all frequencies not exempted according to Table 1.

The lower limit shall apply at all transition frequencies.

For ISM lighting devices operating in the ISM frequency bands 2,45 GHz and 5,8 GHz (and 915 MHz for Region 2 as defined by the ITU Radio Regulations), the limits to be applied are those for class B, group 2 ISM equipment.

5.1 Limits of terminal disturbance voltage

The equipment under test shall meet either:

- a) both the average limit specified for measurements with an average detector receiver and the quasi-peak limit specified for measurements with a quasi-peak detector (see 6.2); or
- b) the average limit when using a quasi-peak detector receiver (see 6.2).

Limits for signal line disturbance voltage are under consideration.

5.1.1 Frequency band 9 kHz to 150 kHz

Limits for mains terminal disturbance voltages in the frequency band 9 kHz to 150 kHz are under consideration, except for induction cooking appliances.

For class A, group 2 ISM equipment *in situ*, no limits apply unless otherwise specified in this standard.

5.1.2 Frequency band 150 kHz to 30 MHz

5.1.2.1 Continuous disturbance

Limits for mains terminal disturbance voltages in the frequency band 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 6.2.3 and Figure 4) are given in Tables 2a and 2b, except for the ITU designated frequency bands listed in Table 1 for which the mains terminal disturbance voltage limits are under consideration.

For class A, group 2 ISM equipment *in situ*, no limits apply unless otherwise specified in this standard.

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

Frequency band MHz	Class A equipment limits dB(μ V)					
	Group 1		Group 2		Group 2 ^a	
	Quasi-peak	Average	Quasi-peak	Average	Quasi-peak	Average
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 70	80 60	115	105
NOTE Care should be taken to comply with leakage current requirements.						
a Mains supply currents in excess of 100 A per phase when using the CISPR voltage probe or a suitable V-network (LISN or AMN).						

For class A EDM and arc welding equipment measured on a test site, the mains terminal disturbance voltage limits of Table 2a apply.

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.

**Table 2b – Mains terminal disturbance voltage limits
for class B equipment measured on a test site**

Frequency band MHz	Class B equipment limits dB(μ V)	
	Groups 1 and 2	
	Quasi-peak	Average
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
NOTE Care should be taken to comply with leakage current requirements.		

For class B arc welding equipment measured on a test site, the mains terminal disturbance voltage limits of Table 2b apply.