



DPC: 21 / 30440512 DC

BSI Group Headquarters

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000

Fax: +44 (0)20 8996 7400

www.bsigroup.com

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Responsible committee: GEL/210/11 EMC - Standards Committee

Interested committees:

Title: Draft BS EN 55012 Vehicles, boats and devices with internal combustion engines or traction batteries – Radio disturbance characteristics – Limits and methods of measurement for the protection of offboard receivers

Please notify the secretary if you are aware of any keywords that might assist in classifying or identifying the standard or if the content of this standard

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- iii) requires additional national guidance or information

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Responsible Committee Secretary: **Mrs Geraldine D Salt (BSI)**
Direct tel: **020 8996 7273**
E-mail: geraldine.salt@bsigroup.com

Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

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- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



CIS/D/474/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER:

CISPR 12 ED7

DATE OF CIRCULATION:

2021-07-02

CLOSING DATE FOR COMMENTS:

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SUPERSEDES DOCUMENTS:

CIS/D/467/CD, CIS/D/468A/CC

IEC CIS/D : ELECTROMAGNETIC DISTURBANCES RELATED TO ELECTRIC/ELECTRONIC EQUIPMENT ON VEHICLES AND INTERNAL COMBUSTION ENGINE POWERED DEVICES

SECRETARIAT:

Germany

SECRETARY:

Mr Holger Hirsch

OF INTEREST TO THE FOLLOWING COMMITTEES:

SC 61J, TC 69, TC 125, CIS/B, CIS/F

PROPOSED HORIZONTAL STANDARD:



Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.

FUNCTIONS CONCERNED:

☒ EMC

☐ ENVIRONMENT

☐ QUALITY ASSURANCE

☐ SAFETY

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

TITLE:

Vehicles, boats and devices with internal combustion engines or traction batteries – Radio disturbance characteristics – Limits and methods of measurement for the protection of off-board receivers

NOTE FROM TC/SC OFFICERS:

This draft includes the following major changes:

- 1) Clarification in the scope and related Annex D
- 2) Modification of the PK limits for the charging mode.

Currently, a task force is working on simplifying the test arrangements for the charging mode. The outcome of this work will likely be incorporated in the next stage of the project.

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CONTENTS

1		
2	FOREWORD	6
3	INTRODUCTION	8
4	1 Scope	9
5	2 Normative references	10
6	3 Terms and definitions	11
7	4 Limits of radiated disturbance	17
8	4.1 Determination of conformance of vehicle/boat/device with limits	17
9	4.2 Peak and quasi-peak detector limits	19
10	4.3 Average detector limit	20
11	5 Methods of measurement	21
12	5.1 Measuring instruments	21
13	5.1.1 Measuring receiver	21
14	5.1.2 Antenna types	22
15	5.2 Measurement instrumentation uncertainty	22
16	5.3 Measuring site requirements	23
17	5.3.1 General	23
18	5.3.2 Outdoor test site (OTS) requirements	23
19	5.3.3 Alternative test site requirements	26
20	5.4 Test setup for measurement	26
21	5.4.1 Antenna requirements	26
22	5.4.2 Test setup for vehicle in charging mode	31
23	5.5 Test object conditions	39
24	5.5.1 General	39
25	5.5.2 Vehicles and boats	39
26	5.5.3 Devices	42
27	5.6 Data collection	42
28	6 Methods of checking for compliance with CISPR requirements	42
29	6.1 General	42
30	6.2 Application of limit curves	42
31	6.2.1 Measurements under dry conditions	42
32	6.2.2 Measurements under wet conditions	42
33	6.3 Evaluation (general)	42
34	Annex A (normative) Procedure to determine an alternative emission limit for	
35	measurements	43
36	Annex B (informative) Measurement of the insertion loss of ignition noise suppressors	44
37	B.1 Overview	44
38	B.1.1 General	44
39	B.1.2 CISPR box method (50/75 Ω laboratory method)	44
40	B.1.3 Field comparison method	44
41	B.2 Comparison of test methods	44
42	B.2.1 CISPR box method	44
43	B.2.2 Field comparison method	44
44	B.3 CISPR box method (50/75 Ω laboratory method of measurement of insertion	
45	loss of ignition noise suppressors)	45
46	B.3.1 General conditions and limitations of measurement	45
47	B.3.2 Test procedure	45

48	B.3.3	Test box construction	45
49	B.3.4	Results	45
50	Annex C (informative)	Methods of measurement to determine the attenuation	
51		characteristics of ignition noise suppressors for high voltage ignition systems	49
52	C.1	General.....	49
53	C.2	Recommended requirements for ignition noise suppressors	49
54	C.3	Test set-up	49
55	C.4	Test procedure.....	50
56	C.5	Measuring spark-plugs without suppression elements	54
57	C.6	Test setup examples	54
58	C.6.1	General	54
59	C.6.2	Connection of a right-angle spark-plug ignition noise suppressor	54
60	C.6.3	Connection of a distributor rotor	55
61	C.6.4	Connection of distributor caps with integrated ignition noise	
62		suppressors	56
63	C.6.5	Connection of resistive ignition cables	56
64	Annex D (informative)	Applicability of CISPR 12	58
65	D.1	Flow chart.....	58
66	D.2	Example products that are in the scope of CISPR 12	59
67	D.2.1	General	59
68	D.2.2	Vehicles	59
69	D.2.3	Boats and boat engines/motors	60
70	D.2.4	Devices	60
71	Annex E (normative)	Direct current charging artificial networks (DC-charging-AN),	
72		artificial mains networks (AMN) and asymmetric artificial networks (AAN).....	61
73	E.1	General.....	61
74	E.2	Direct current charging artificial networks (DC-charging-AN).....	61
75	E.3	Artificial mains networks (AMN)	63
76	E.4	Asymmetric artificial network (AAN)	63
77	E.4.1	General	63
78	E.4.2	Signal/control port with symmetric lines	64
79	E.4.3	Signal/control port with PLC (technology) on control pilot line	64
80	E.4.4	Signal/control port with control pilot line	65
81	Annex F (informative)	Measurement instrumentation uncertainty	67
82	F.1	General.....	67
83	F.2	Uncertainty sources	67
84	F.3	Measurand.....	69
85	F.4	Input quantities to be considered	69
86	Annex G (informative)	Uncertainty budgets for radiated disturbance measurements of	
87		electric field strength	72
88	G.1	General.....	72
89	G.2	Typical CISPR 12 uncertainty budgets	72
90	G.3	Receiver's frequency step.....	76
91	Annex H (informative)	Items under consideration	77
92	H.1	General.....	77
93	H.2	Frequency range.....	77
94	H.3	Correlation between OTS, ALSE and OATS Measurements	77
95	H.4	Calibration of antennas	77
96	H.5	Charging mode for boats.....	

97	H.6 Necessity for the use of artificial networks in the test setups.....	77
98	Bibliography	78
99		
100	Figure 1 – Method of determination of conformance.....	18
101	Figure 2 – Limits of disturbance (peak and quasi-peak detector) at 10 m antenna	
102	distance – engine running mode	19
103	Figure 3 – Limits of disturbance (peak and quasi-peak detector) at 10 m antenna	
104	distance – charging mode	20
105	Figure 4 – Limits of disturbance (average detector) at 10 m antenna distance	21
106	Figure 5 – Measuring site (OTS) for vehicles, boats and devices	24
107	Figure 6 – Measuring site (OTS) for boats	25
108	Figure 7 – Antenna height to measure emissions – Elevation view (vertical polarization	
109	shown).....	27
110	Figure 8 – Antenna distance to measure emissions – Plan view (horizontal polarization	
111	shown).....	28
112	Figure 9 – Antenna position for $N = 1$ (one antenna position to be used) – Horizontal	
113	polarization shown	30
114	Figure 10 – Example antenna positions for $N = 2$ (multiple antenna positions to be	
115	used) – Horizontal polarization shown.....	30
116	Figure 11 – Example of test setup for vehicle with socket located on vehicle side	
117	(charging mode 1 or 2, AC powered, without communication)	32
118	Figure 12 – Example of test setup for vehicle with socket located front/rear of	
119	vehicle (charging mode 1 or 2, AC powered, without communication)	33
120	Figure 13 – Example of test setup for vehicle with socket located on vehicle side	
121	(charging mode 3 or mode 4, with communication)	36
122	Figure 14 – Example of test setup for vehicle with socket located front/rear of vehicle	
123	(charging mode 3 or mode 4, with communication)	37
124	Figure 15 – Example of test setup for vehicle in charging mode through wireless power	
125	transfer	39
126	Figure A.1 – Calculation of the resulting gain reduction X_{dB}	43
127	Figure B.1 – Test Circuit	46
128	Figure B.2 – General arrangement of the test box.....	46
129	Figure B.3 – Details of the test box lid	47
130	Figure B.4 – Details of the test box	47
131	Figure B.5 – Straight spark-plug ignition noise suppressor (screened or unscreened).....	47
132	Figure B.6 – Right-angle spark-plug ignition noise suppressor (screened or	
133	unscreened).....	47
134	Figure B.7 – Noise suppression spark-plug	48
135	Figure B.8 – Resistive distributor brush	48
136	Figure B.9 – Noise suppressor in distributor cap	48
137	Figure B.10 – Noise suppression distributor rotor.....	48
138	Figure B.11 – Noise suppression ignition cable (resistive or reactive)	48
139	Figure C.1 – Test set-up, side view	51
140	Figure C.2 – Test set-up, top view	52
141	Figure C.3 – Pressure chamber with ventilation	53
142	Figure C.4 – Top view of the set-up of a right-angle ignition noise suppressor for	
143	distributors.....	54

144	Figure C.5 – Location of high voltage ignition components.....	55
145	Figure C.6 – Top view of the test set-up for distributor rotors	56
146	Figure C.7 – Side view of the test set-up for ready-to-use resistive ignition cables.....	57
147	Figure E.1 – Example of 5 μ H / 50 Ω DC-charging-AN schematic.....	62
148	Figure E.2 – Characteristics of the DC-charging-AN impedance.....	62
149	Figure E.3 – Example of AAN circuit for signal/control port with PLC (technology) on	
150	control pilot.....	65
151	Figure E.4 – Example of AAN circuit for pilot line	66
152	Figure F.1 – Sources of measurement instrumentation uncertainty	68
153	Figure G.1 – Example of measurement for frequency step uncertainty evaluation for	
154	120 kHz bandwidth	76
155		
156	Table 1 – Spectrum analyser parameters.....	21
157	Table 2 – Scanning receiver parameters	22
158	Table 3 – Internal combustion engine operating speeds.....	41
159	Table C.1 – Limits.....	49
160	Table E.1 – Magnitude of the DC-charging-AN impedance Z_{PB}	63
161	Table F.1 – Input quantities to be considered for radiated disturbance measurements	69
162	Table G.1 – Typical uncertainty budget – 3 m/10 m distance – Biconical antenna	72
163	Table G.2 – Typical uncertainty budget – 3 m/10 m distance – Log-periodic antenna	74
164		
165		

INTERNATIONAL ELECTROTECHNICAL COMMISSION

INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE

**VEHICLES, BOATS AND DEVICES WITH INTERNAL COMBUSTION
ENGINES OR TRACTION BATTERIES – RADIO DISTURBANCE
CHARACTERISTICS – LIMITS AND METHODS OF MEASUREMENT
FOR THE PROTECTION OF OFF-BOARD RECEIVERS**

FOREWORD

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International Standard CISPR 12 has been prepared by CISPR subcommittee D: Electromagnetic disturbances related to electric/electronic equipment on vehicles, boats and internal combustion powered devices.

This seventh edition cancels and replaces the sixth edition published in 2007 and its Amendment 1 (2009). This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) test setups for electric vehicles and plug-in hybrid electric vehicles in charging mode were added,
- b) antenna positions relative to the vehicle were defined,
- c) some statements dealing with series surveillance and type approval were deleted.

- d) annexes for measurement instrumentation uncertainty were added,
e) an annex describing networks to be used for the charging mode was added and
f) general improvements were made.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
CISPR/XX/FDIS	CISPR/XX/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

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

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

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

236

INTRODUCTION

237 There is a specific need for standards to define acceptable radio frequency performance of all
238 electrical/electronic products. CISPR 12 has been developed to serve the road vehicles, boats,
239 internal combustion engines and related industries with test methods and limits that provide
240 satisfactory protection for radio reception.

241 CISPR 12 has been used for many years as a regulatory requirement in numerous countries,
242 to provide protection for radio receivers in the residential environment. It has been effective in
243 protecting the radio environment outside the vehicle.

244

245

VEHICLES, BOATS AND DEVICES WITH INTERNAL COMBUSTION ENGINES OR TRACTION BATTERIES – RADIO DISTURBANCE CHARACTERISTICS – LIMITS AND METHODS OF MEASUREMENT FOR THE PROTECTION OF OFF-BOARD RECEIVERS

1 Scope

The limits in this International Standard are designed to provide protection in the frequency range of 30 MHz to 1 000 MHz for off-board receivers when used in the residential environment. Compliance with this document might not provide adequate protection for receivers used in the residential environment nearer than 10 m to the vehicle, boat or device.

NOTE 1 Experience has shown that compliance with this document can provide satisfactory protection for receivers of other types of transmissions when used in the residential environment, including radio transmissions in frequency ranges other than that specified.

This document applies to the emission of electromagnetic energy that can cause interference to radio reception and which is emitted from:

- a) vehicles propelled by an internal combustion engine, electrical means or both (see 3.33);
- g) boats propelled by an internal combustion engine (inboard or outboard), electrical means or both (see 3.4). Boats are to be tested in the same manner as vehicles except where they have unique characteristics as explicitly stated in this document;
- h) devices equipped with internal combustion engines (see 3.8). In the case of hybrid devices (e.g. equipped with both internal combustion engine and traction batteries), only the internal combustion mode is included in this document;
- i) inboard and outboard boat engines or motors (i.e. equipped with internal combustion engine, electrical motor, or both), when marketed independently

See Annex D for a flow chart to help determine the applicability of CISPR 12.

This document does not apply to aircraft, household appliances, medical devices, traction systems (railway, tramway and electric trolley bus), vehicle / boat / device off-board chargers or to incomplete vehicles. In the case of a dual-mode trolley bus (e.g. propelled by power from either AC/DC mains or an internal combustion engine), the internal combustion propulsion system is included, but the AC/DC mains portion of the vehicle propulsion system is excluded from this document. In addition, domestic helper robots, such as household cleaning robots, hotel service robots and personal safety robots as similar as a mobile web camera are also excluded from the scope of this document as they are covered by other standards.

NOTE 2 Appliances without combustion engine for typical housekeeping and service functions in the household and similar environment are covered by the requirements of CISPR 14-1.

NOTE 3 Protection of receivers used on board the same vehicle as the disturbance source(s) are covered by CISPR 25.

The measurement of conducted electromagnetic disturbances while the vehicle/boat is connected to power mains is not covered in this document. The user is referred to appropriate IEC and CISPR standards, which define measurement techniques and limits for this condition.

NOTE 4 See IEC 61851-21-1

The emission requirements in this document are not intended to be applicable to the intentional transmissions from a radio transmitter as defined by the ITU including their spurious emissions.

NOTE 5 This exclusion is limited to those intended transmitter emissions, which leave the EUT as radiated emissions and are coupled onto the wire line in the measurement setup. For conducted transmissions on frequencies intentionally produced by the radio part of an EUT this exclusion does not apply.

Equipment that is covered by other CISPR product and product family emission standards are excluded from the scope of this standard, except where they include internal combustion engine(s). In the latter case, the equipment shall comply with this standard in all modes of operation where the internal combustion engine(s) is(are) active.

NOTE 6 The other CISPR product or product family emission standard might also apply to the equipment for those modes of operation where the internal combustion engine(s) is (are) not active. In case the internal combustion engine(s) is (are) always in operation, the other CISPR product or product family emission standard might still apply, for verifying the emissions from the other components and circuitry of the equipment.

Annex B and Annex C contain methods to evaluate the disturbance characteristics of high voltage ignition systems.

Annex H lists work being considered for future revisions.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

IEC 61851-1:2017, *Electric vehicle conductive charging system – Part 1: General requirements*

IEC 61980-1:2015, *Electric vehicle wireless power transfer (WPT) systems - Part 1: General requirements*
IEC 61980-1:2015/COR1:2017

CISPR 16-1-1:2019, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus*

CISPR 16-1-2:2014, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-2: Radio disturbance and immunity measurement apparatus – Coupling devices for conducted disturbance measurements*
CISPR 16-1-2:2014/AMD1:2017

CISPR 16-1-3:2004, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-3 Radio disturbance and immunity measuring apparatus – Ancillary equipment – Disturbance power*
CISPR 16-1-3:2004/AMD1:2016
CISPR 16-1-3:2004/AMD2:2020

CISPR 16-1-4:2019, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-4: Radio disturbance and immunity measuring apparatus – Antennas and test sites for radiated disturbance measurements*
CISPR 16-1-4:2019/AMD1:2020

CISPR 16-1-6:2014, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-6: Radio disturbance and immunity measuring apparatus – EMC antenna calibration*
CISPR 16-1-6:2014/AMD1:2017

CISPR 16-2-3:2016, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-3: Methods of measurement of disturbances and immunity – Radiated disturbance measurements*
CISPR 16-2-3:2016/AMD1:2019

CISPR 16-4-2:2011 *Specification for radio disturbance and immunity measuring apparatus and networks – Part 4-2: Uncertainties, statistics and limit modelling – Measurement instrumentation uncertainty*
CISPR 16-4-2:2011/AMD1:2014
CISPR 16-4-2:2011/AMD2:2018

CISPR 32:2015, *Electromagnetic compatibility of multimedia equipment – Emission requirements*
CISPR 32:2015/AMD1:2019

ANSI C63.5:2017, *American National Standard for Electromagnetic Compatibility – Radiated Emission Measurements in Electromagnetic Interference (EMI) Control - Calibration and Qualification of Antennas (9 kHz to 40 GHz)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1

absorber lined shielded enclosure

ALSE

shielded enclosure/screened room with radio frequency-absorbing material on its internal ceiling and walls

3.2

artificial mains network

AMN

provides a defined impedance to the EUT at radio frequencies and decouples the test circuit from the supply mains

Note 1 to entry: This note applies to the French language only.

3.3

asymmetric artificial network

AAN

provides a defined asymmetric impedance to the EUT at radio frequencies

Note 1 to entry: This network is inserted in the communication/signal lines of the vehicle in charging mode to provide a specific load impedance and/or a decoupling (e.g. between communication/signal lines and power mains). AAN is also used in this document for symmetric lines.

Note 2 to entry: This note applies to the French language only.

3.4**boat**

vessel intended to be used on the surface of water, its length being no greater than 15 m, intended to carry persons or goods and equipped with either an inboard or outboard engine

3.5**bonded**, verb

grounding connection with a DC resistance not exceeding 2,5 mΩ and that provides the lowest possible impedance (resistance and inductance) between two metallic parts (see 5.3 of CISPR 16-2-1: 2014).

Note 1 to entry: A low current (≤ 100 mA) 4-wire milliohm meter is recommended for these measurements.

3.6**charging mode**

mode of operation intended for charging the traction battery, of one of the four categories listed below:

3.6.1**charging mode 1**

charging mode as defined in 6.2.1 of IEC 61851-1:2017.

Note 1 to entry: In some countries, mode 1 charging can be prohibited or requires special precautions.

3.6.2**charging mode 2**

charging mode as defined in 6.2.2 of IEC 61851-1:2017, where the vehicle is connected to AC mains using a charging cable, which has an Electric Vehicle Supply Equipment (EVSE) box in-line (e.g. In-Cable Control Box / In-Cable Control and Protection Device), providing control pilot signalling between the vehicle and the EVSE box and personal protection against electric shock

Note 1 to entry: In some countries, special restrictions have to be applied for mode 2 charging.

Note 2 to entry: There is no communication between the vehicle and the AC supply network (mains).

3.6.3**charging mode 3**

charging mode as defined in 6.2.3 of IEC 61851-1:2017, where the vehicle is connected to a fixed installation (EVSE, e.g. AC charging station, AC wallbox) providing AC power to the vehicle, with communication between the vehicle and the EVSE (through signal/control lines and/or through wired network lines)

3.6.4**charging mode 4**

charging mode as defined in 6.2.4 of IEC 61851-1:2017, where the vehicle is connected to a fixed installation (EVSE, e.g. DC charging station), providing DC power to the vehicle (with an off-board charger), with communication between the vehicle and the EVSE (through signal/control lines and/or through wired network lines)

3.7**controller area network****CAN**

network documented in ISO 11898-1 that connects devices, sensors and actuators in systems

Note 1 to entry: This note applies to the French language only.

3.8**device**

machine, powered by an internal combustion engine, which is not primarily intended to carry persons or goods

425 Note 1 to entry: Devices include, but are not limited to: chainsaws, irrigation pumps, snow blowers, air compressors,
426 landscaping equipment and power generators.

427 **3.8.1**

428 **small device**

429 device that is handheld or has a footprint that fits within a circle not larger than 1,5 m in
430 diameter, regardless of orientation, without considering passive elements

431 Note 1 to entry: Examples include chainsaws, irrigation pumps, push-type snow blowers, air compressors, grass
432 trimmer (regardless of the length of its handle).

433 **3.8.2**

434 **large device**

435 device that is not a small device

436 Note 1 to entry: Examples include power generators and large landscaping equipment.

437 **3.9**

438 **direct current charging artificial network**

439 **DC-charging-AN**

440 network inserted in the high-voltage DC lead of vehicle in charging mode, which provides, in a
441 given frequency range, a specified load impedance and which can isolate the vehicle from the
442 HV DC charging station in that frequency range

443 Note 1 to entry: This note applies to the French language only.

444 **3.10**

445 **electric vehicle**

446 vehicle propelled exclusively by electric motor(s) powered by onboard traction battery or
447 batteries

448 Note 1 to entry: Vehicles equipped with an additional power source (e.g. auxiliary combustion engine, fuel cell)
449 used to provide electric power to the electric motor/traction battery only, without contributing to the mechanical
450 propulsion of the vehicle, are considered as an electric vehicle

451 **3.11**

452 **EV supply equipment**

453 **EVSE**

454 The conductors, including the phase, neutral and protective earth conductors, the EV couplers,
455 attachment plugs, and all other accessories, devices, power outlets or apparatuses installed
456 specifically for the purpose of delivering energy from the premises wiring to the EV and allowing
457 communication between them if required.

458 **3.12**

459 **hybrid electric vehicle**

460 vehicle propelled by electric motor(s) and internal combustion engine

461 Note 1 to entry: The two propulsion systems can operate individually or in a combined mode depending on the
462 hybrid system.

463 **3.13**

464 **ignition noise suppressor**

465 portion of a high-voltage ignition circuit intended to limit the emission of impulsive ignition noise

466 **3.14**

467 **impulsive ignition noise**

468 unwanted emission of electromagnetic energy, predominantly impulsive in content, arising from
469 the ignition system within a vehicle, boat or device

3.15**inboard engine (motor)**

boat propulsion system that is installed (usually factory-installed) inside the hull of the boat and connected to the propeller by means of a drive shaft that runs through the bottom of the hull (or to an impeller, in case of jet drives)

Note 1 to entry: All types of inboard boat engines (motors) that are marketed independently are under the scope of CISPR 12: equipped with internal combustion engine, with electrical motor, or hybrid.

3.16**mobile machine**

self-propelled machine, operating on land, which is designed and constructed specifically to perform work and that, due to its construction characteristics, is not suitable for carrying passengers or for transporting goods

EXAMPLES: Agricultural machinery, earth-moving machinery, material-handling equipment, mining equipment, floor treatment machines, ice resurfacing machines.

Note 1 to entry: Machinery mounted on a motor vehicle chassis is not considered as mobile machinery.

[SOURCE: European Union Directive 2007/46/EC of 5-09-2007, Article 3, definition 16, modified – second sentence moved to Note 1; added examples]

3.17**Open-area test site****OATS**

Facility for measurements and calibrations in which the ground reflection is made reproducible by a large flat electrically conducting ground plane

Note 1 to entry: An OATS is an uncovered outdoor site, and is far enough away from buildings, electric lines, fences, trees, underground cables, pipelines, and other potentially reflective objects, so that the effects due to such objects are negligible. See CISPR 16-1-4 for guidance on the construction of an OATS.

3.18**Outboard engine (motor)**

self-contained boat propulsion/steering system, including the engine, gearbox, and propeller or jet drive, all in one unit, which is installed to the outside of the transom (the rear part of the boat hull) serving for both propulsion and steering of the boat

Note 1 to entry: All types of outboard boat engines (motors) that are marketed independently are under the scope of CISPR 12: equipped with internal combustion engine, with electrical motor, or hybrid.

3.19**outdoor test site****OTS**

measurement site similar to an open area test site, but without any type of metallic ground plane and with different dimensions

Note 1 to entry: Specific requirements are defined in this document.

Note 2 to entry: This note applies to the French language only.

3.20**parallel hybrid propulsion**

propulsion of a hybrid electric vehicle where both the electric motor and the internal combustion engine work together for the propulsion of the vehicle

Note 1 to entry: The internal combustion engine (ICE) and the electric motor are both connected to the transmission. A controller in the transmission determines when to operate the electric motor and when to switch to the ICE.

3.21**plug-in hybrid vehicle**

vehicle propelled by electric motor(s) and internal combustion engine with traction battery which has vehicle inlet for charging

3.22**powerline communications technology****PLC**

communication technology based on error-tolerant modulation schemes, which is able to transmit information superimposed to low-frequency signals on lines or in cables

3.23**residential environment**

environment having a 10 m protection distance between the source and the point of radio reception

Note 1 to entry: Examples of a residential environment include rooming houses, private dwellings, entertainment halls, theatres, schools, public streets, shopping centres / malls, etc..."

3.24**resistive distributor brush**

pick-up brush in an ignition distributor cap where the brush is made of a conductor with high electrical resistance

3.25**resistive ignition cable**

ignition cable whose conductor has a high electrical resistance (attenuation)

3.26**RF disturbance power**

RF power measured with a current transformer of an absorbing clamp and an RF measuring receiver

Note 1 to entry: It can be measured – as the RF disturbance voltage – in a peak or quasi-peak mode.

3.27**self-propelled**

equipped with a propulsion engine or motor

Note 1 to entry: This term is not meant to imply that the machine is necessarily autonomous (robotic).

3.28**series hybrid propulsion**

propulsion of a hybrid electric vehicle where the electric motor is solely responsible for the propulsion of the vehicle

Note 1 to entry: The electric motor is energized by the battery pack or by the generator, which is powered by the internal combustion engine. The ICE in a series hybrid is not coupled to the wheels and does not directly propel the vehicle. A controller in the transmission determines how much power is needed to propel the vehicle and whether to use power from the battery or the generator.

3.29**signal/control port**

port intended for the interconnection of components of an equipment under test (EUT), or between an EUT and local associated equipment (AE) and used in accordance with relevant functional specifications (for example for the maximum length of cable connected to it)

Note 1 to entry: Examples include RS-232, Universal Serial Bus (USB), High-Definition Multimedia Interface (HDMI), IEEE Std 1394 ("FireWire").

561 Note 2 to entry: For vehicles in charging mode, for the purpose of this document, signal/control ports contain control
562 / pilot signals, PLC signals used on control / pilot signal lines and CAN-signals.

563 **3.30**

564 **spark discharge**

565 discharge of energy stored in the ignition coil, in an arc across the electrodes of a measuring
566 spark-plug

567 Note 1 to entry: See C.5

568 **3.31**

569 **traction batteries**

570 high voltage (HV) batteries used for the propulsion of electric or hybrid electric vehicles

571 **3.32**

572 **unladen, adj**

573 not carrying any additional weight in the vehicle or boat (passengers or cargo)

574 **3.33**

575 **vehicle**

576 mobile machine or self-propelled machine, operating on land, which is intended to carry persons
577 or goods or that is operated by a person

578 Note 1 to entry: Vehicles include, but are not limited to cars: trucks, buses, mopeds, agricultural machinery, earth-
579 moving machinery, trailers, material-handling equipment, mining equipment, floor treatment machines, walk-behind
580 floor treatment machines (only if self-propelled) and snowmobiles.

581 Note 2 to entry: Goods, in this definition, include shipping boxes and containers (such as carried by a lorry, truck,
582 van, or forklift), construction or mining materials (such as carried by a paver, dump truck, cement truck), liquid
583 substances (such as carried by a street sweeper, milk tanker truck, or gas tanker truck / lorry), etc.

584 Note 3 to entry: In case the vehicle is operated by a person (i.e., non-autonomous vehicles), that person can be
585 inside the vehicle (e.g., car, truck, excavator), near the vehicle (e.g., walk-behind floor treatment machine), or
586 operating the vehicle through remote control.

587 **3.34**

588 **vehicle inlet**

589 **electric vehicle inlet**

590 part of a vehicle coupler incorporated in, or fixed to, the electric vehicle or hybrid vehicle (if
591 equipped)

592 [SOURCE: IEC 62196-1:2014, 3.3.2]

593 **3.35**

594 **wired network port**

595 port for the connection of voice, data and signaling transfers intended to interconnect widely
596 dispersed systems by direct connection to a single-user or multi-user communication network

597 Note 1 to entry: Examples of these include CATV, PSTN, ISDN, xDSL, LAN and similar networks.

598 Note 2 to entry: Wired network ports may support screened or unshielded cables and may also carry AC or DC
599 power where this is an integral part of the telecommunication specification.

600 **3.36**

601 **wireless Power Transfer**

602 **WPT**

603 transfer of electrical energy from a power source to an electrical load via electric and/or
604 magnetic fields or electromagnetic waves

605

4 Limits of radiated disturbance

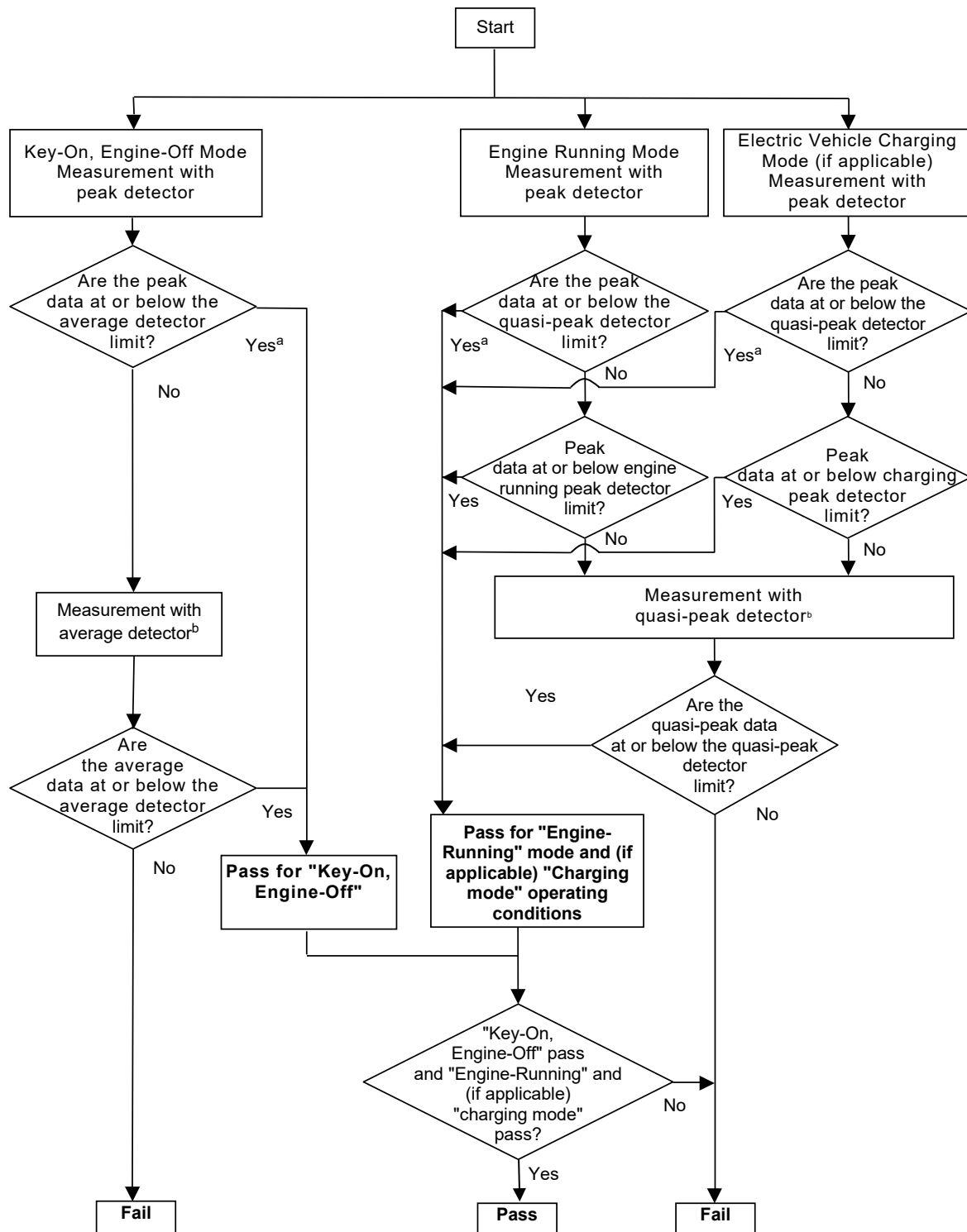
4.1 Determination of conformance of vehicle/boat/device with limits

In the 30 MHz – 1 GHz frequency range, the vehicle/boat/device shall comply with:

- average detector limits when the vehicle/boat/device is in “Key-On, Engine-Off” mode (see 5.5.2.2 and 5.5.3), and
- peak or quasi-peak detector limits when the vehicle/boat/device is in “Engine-Running” mode (see 5.5.2.3 and 5.5.3), and
- if applicable, peak or quasi-peak detector limits when the vehicle is in “Charging mode connected to the power grid” or “wireless power transfer (WPT)” charging mode (see 5.5.2.4).

The limits given in this document take into account uncertainties.

Figure 1 defines the method for determination of conformance.



618

619 a Because the measurement result with peak detector is always higher than or equal to the measurement result
 620 with quasi-peak detector (and average detector respectively) and applicable peak detector limit is always higher
 621 than or equal to applicable quasi-peak detector limit (and average detector limit respectively), this single detector
 622 measurement can lead to a simplified and quicker conformance process.

623 b This flow-chart is applicable for each individual frequency, i.e. only the emissions that are above the applicable
 624 limit (average or peak) when measured with peak detector need to be remeasured with average or quasi-peak
 625 detector, as applicable.

626

Figure 1 – Method of determination of conformance

627

4.2 Peak and quasi-peak detector limits

The limits for emissions measured with peak and quasi-peak detectors at 10 m antenna distance are presented in Figure 2 and Figure 3.

For a vehicle in an engine running mode the limits in the table of Figure 2 apply and are additionally graphically shown in Figure 2.

For an electric vehicle in a charging mode the limits in the table of Figure 3 apply and are additionally graphically shown in Figure 3.

For more accurate determination, the equations given in Figure 2 and Figure 3 shall be used. For measurements at 3 m antenna distance, 10 dB shall be added to the limit.

When quasi-peak limits are being used, and a peak detector is used for time efficiency, any peak field-strength levels above the quasi-peak limit shall be re-measured using the quasi-peak detector.

The peak and quasi-peak detectors are defined in CISPR 16-1-1.

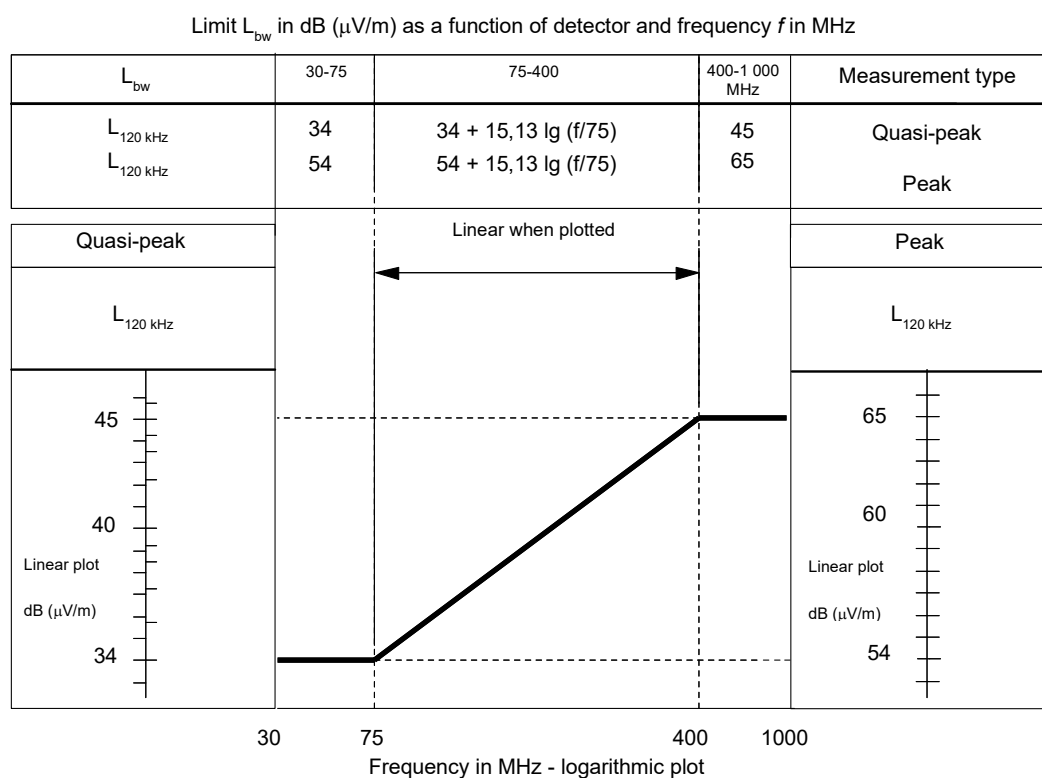


**Figure 2 – Limits of disturbance (peak and quasi-peak detector)
at 10 m antenna distance – engine running mode**

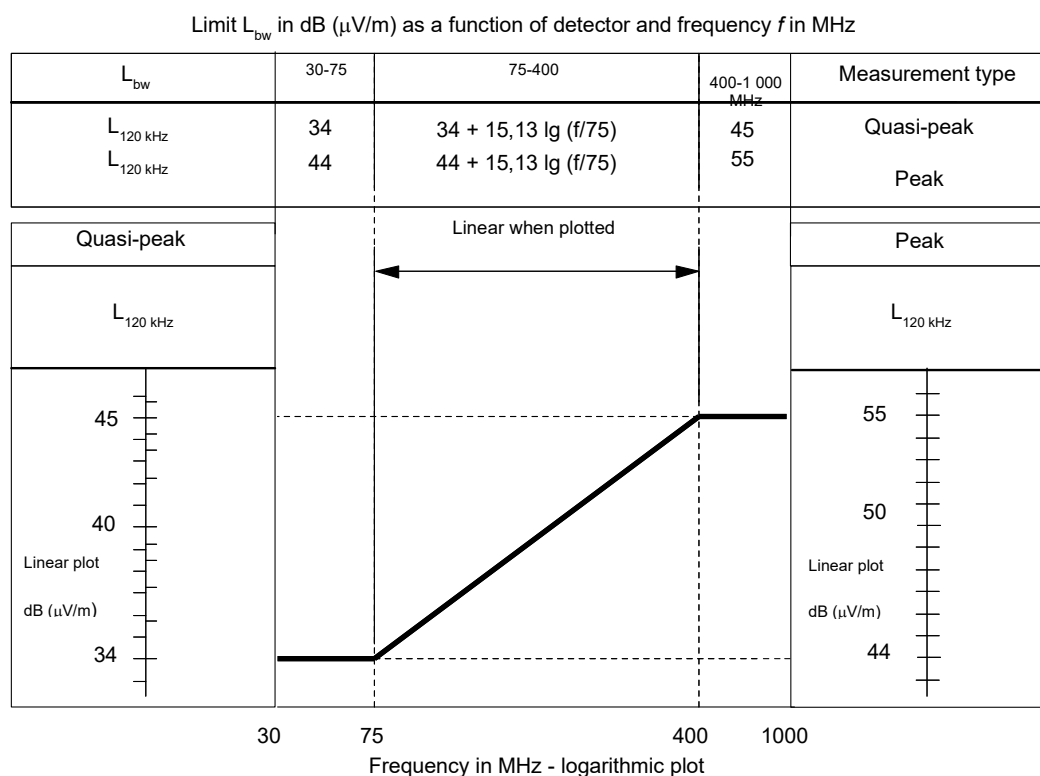


**Figure 3 – Limits of disturbance (peak and quasi-peak detector)
at 10 m antenna distance – charging mode**

4.3 Average detector limit

The limit for emissions measured with the average detector at 10 m antenna distance is shown in Figure 4. Vehicles/boats/devices not including electronic oscillators with an operating frequency greater than 9 kHz shall be deemed to be in compliance with the requirements of this clause without performing tests for emissions with average detector. For measurements at 3 m antenna distance, 10 dB shall be added to the limit.

The average detector is defined in CISPR 16-1-1.

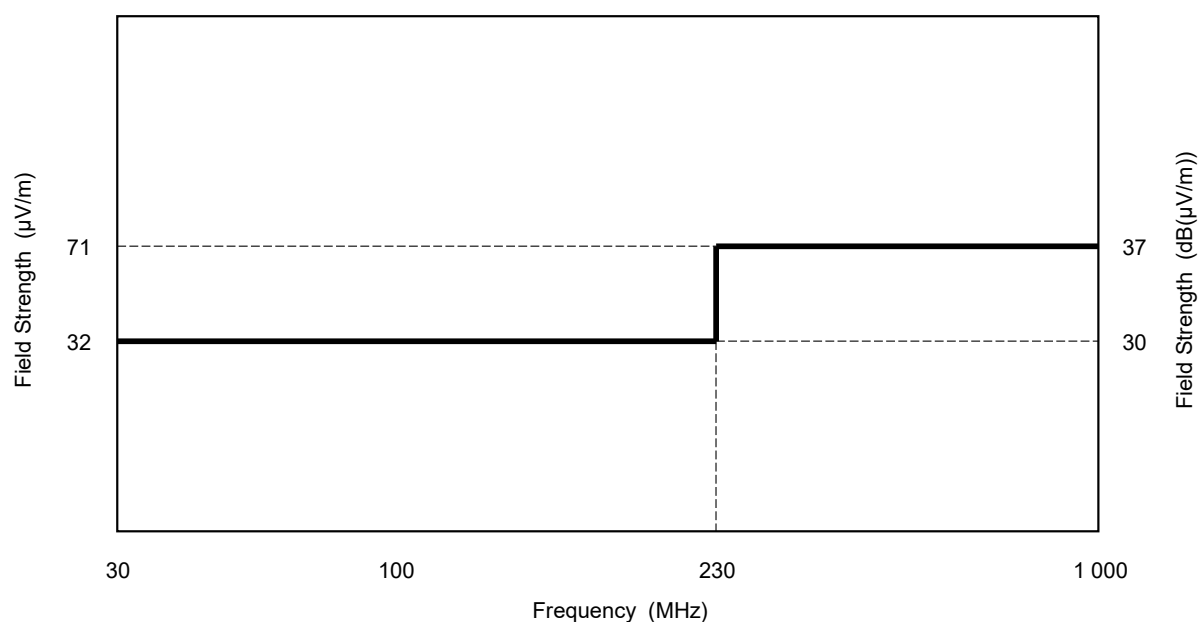


Figure 4 – Limits of disturbance (average detector) at 10 m antenna distance

5 Methods of measurement

5.1 Measuring instruments

5.1.1 Measuring receiver

5.1.1.1 General

The measuring receiver shall comply with the requirements of CISPR 16-1-1. Either manual or automatic frequency scanning may be used.

NOTE A preamplifier can be used between the antenna and measuring receiver in order to achieve the 6 dB noise floor requirements. If a preamplifier is used to achieve the 6 dB noise floor requirement (see 5.3.2.3), the laboratory should establish a procedure to avoid overloading of the preamplifier, such as using a step attenuator. The laboratory should also ensure the receiver is not overloaded in all measurement scenarios, with or without an external preamplifier.

5.1.1.2 Spectrum analyser parameters

The scan rate of the spectrum analyser shall be adjusted for the CISPR frequency band and detection mode used. The maximum scan rate shall comply with the requirements of CISPR 16-2-3.

Spectrum analysers may be used for performing compliance measurements to this document providing the precautions cited in CISPR 16-1-1 on the use of spectrum analysers are adhered to and that the broadband emissions from the product being tested have a repetition frequency greater than 20 Hz.

The minimum scan time and resolution bandwidth (RBW) are listed in Table 1.

Table 1 – Spectrum analyser parameters

Frequency range MHz	Peak detector		Quasi-peak detector		Average detector	
	RBW at –3 dB	Scan time	RBW at –6 dB	Scan time	RBW at –3 dB	Scan time
30 to 1 000	100 kHz or 120 kHz	100 ms / MHz	120 kHz	20 s / MHz	100 kHz or 120 kHz	100 ms / MHz

When a spectrum analyser is used for measurements, the video bandwidth shall be at least three times the RBW.

5.1.1.3 Scanning receiver parameters

The dwell time of the scanning receiver shall be adjusted for the CISPR frequency band and detection mode used. The bandwidth (BW), minimum dwell time and maximum step size are listed in Table 2.

Table 2 – Scanning receiver parameters

Frequency range MHz	Peak detector			Quasi-peak detector			Average detector		
	BW at –6 dB	Step size	Dwell time	BW at –6 dB	Step size	Dwell time	BW at –6 dB	Step size	Dwell time
30 to 1 000	120 kHz	60 kHz	5 ms	120 kHz	60 kHz	1 s	120 kHz	60 kHz	5 ms

5.1.2 Antenna types

5.1.2.1 Preferred antenna

The antenna shall be

- tuned dipole antennas, whose element pairs are either straight rods or conical in shape;
- dipole arrays such as the log-periodic dipole array (LPDA) antennas, comprising a series of staggered sets of straight rod elements;
- hybrid antennas.

Free-space antenna factors are to be used. If a tuned dipole is used the antenna shall be resonant in length for frequencies of 80 MHz or above, and for frequencies below 80 MHz it shall be the length equal to the 80 MHz resonant length. It shall be matched to the characteristic impedance of the antenna cable by a suitable symmetric-asymmetric transformer device.

5.1.2.2 Alternative antennas

Any linearly polarized broadband antenna may be used for measurements. The antenna factor shall be determined with one of the following methods for the intended measurement distance, i.e. 10 m or 3 m and for the reference point as defined in 5.4.1.3:

- ANSI C63.5 reference antenna method;
- ANSI C63.5 standard site method;
- CISPR 16-1-6 using the standard antenna method (SAM) with a tuned or calculable dipole as the standard antenna and performed at a metal ground plane site;
- CISPR 16-1-6 using the standard site method (SSM) performed at a metal ground plane site.

When broadband antennas are used, they shall meet the requirements for complex antennas given in CISPR 16-1-4.

5.2 Measurement instrumentation uncertainty

The measurement instrumentation uncertainty shall be calculated as described in Annex F. Measurement instrumentation uncertainty shall not be taken into account in the determination of compliance.