

Vehicles, boats and internal combustion engines — Radio disturbance characteristics — Limits and methods of measurement for the protection of off-board receivers

ICS 27.020; 33.100.10

National foreword

This British Standard is the UK implementation of EN 55012:2007+A1:2009. It is identical to CISPR 12:2007, incorporating amendment 1:2009. It supersedes BS EN 55012:2002 which will be withdrawn 1 September 2010 and BS EN 55012:2007 which will be withdrawn 1 July 2012.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to IEC text carry the number of the IEC amendment. For example, text altered by IEC amendment 1 is indicated by **A1** **A1**.

The UK participation in its preparation was entrusted by Technical Committee GEL/210, EMC — Policy committee, to Subcommittee GEL/210/11, EMC product standards.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

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**Vehicles, boats and internal combustion engines -
Radio disturbance characteristics -
Limits and methods of measurement
for the protection of off-board receivers
(CISPR 12:2007)**

Véhicules, bateaux et
moteurs à combustion interne -
Caractéristiques
de perturbation radioélectrique -
Limites et méthodes de mesure
pour la protection
des récepteurs extérieurs
(CISPR 12:2007)

Fahrzeuge, Boote und
von Verbrennungsmotoren
angetriebene Geräte -
Funkstöreigenschaften -
Grenzwerte und Messverfahren
zum Schutz von außerhalb
befindlichen Empfängern
(CISPR 12:2007)

This European Standard was approved by CENELEC on 2007-09-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of document CISPR/D/322/CDV, future edition 6 of CISPR 12, prepared by CISPR SC D, Electromagnetic disturbances related to electric/electronic equipment on vehicles and internal combustion engine powered devices, was submitted to the IEC-CENELEC parallel Unique Acceptance Procedure and was approved by CENELEC as EN 55012 on 2007-09-01.

This European Standard supersedes EN 55012:2002 + A1:2005.

The following changes were made with respect to EN 55012:2002 + A1:2005:

- deletion of narrowband / broadband determination;
- general improvement of wording.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
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- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2010-09-01

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and covers essential requirements of EC Directive EMC (2004/108/EC). See Annex ZZ.

Annexes ZA and ZZ have been added by CENELEC.

Endorsement notice

The text of the International Standard CISPR 12:2007 was approved by CENELEC as a European Standard without any modification.

Foreword to amendment A1

The text of document CISPR/D/354/CDV, future amendment 1 to CISPR 12:2007, prepared by CISPR SC D, Electromagnetic disturbances related to electric/electronic equipment on vehicles and internal combustion engine powered devices, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A1 to EN 55012:2007 on 2009-07-01.

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implemented at national level by publication of
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- latest date by which the national standards conflicting
with the amendment have to be withdrawn (dow) 2012-07-01

Endorsement notice

The text of amendment 1:2009 to the International Standard CISPR 12:2007 was approved by CENELEC as an amendment to the European Standard without any modification.

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INTRODUCTION

There is a specific need for standards to define acceptable radio frequency performance of all electrical/electronic products. CISPR 12 has been developed to serve the road vehicle and related industries with test methods and limits that provide satisfactory protection for radio reception.

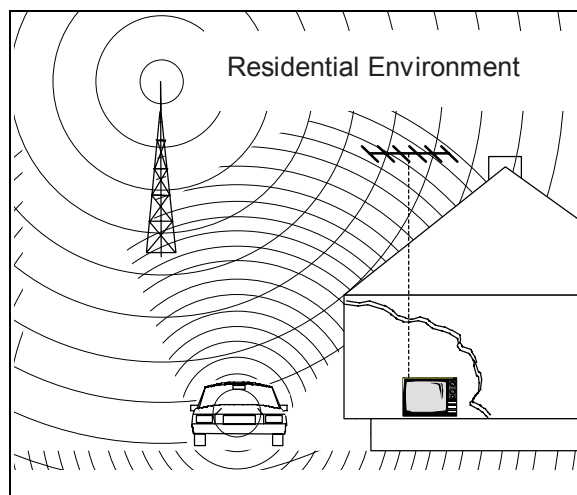
CISPR 12 has been used for many years as a regulatory requirement in numerous countries, to provide protection for radio receivers in the residential environment. It has been extremely effective in protecting the radio environment outside the vehicle.

VEHICLES, BOATS AND INTERNAL COMBUSTION ENGINES – 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 for broadcast receivers in the frequency range of 30 MHz to 1 000 MHz when used in the residential environment. Compliance with this standard may not provide adequate protection for new types of radio transmissions or 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 standard may 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 standard applies to the emission of electromagnetic energy which may cause interference to radio reception and which is emitted from

- a) vehicles propelled by an internal combustion engine, electrical means or both (see 3.1);
- b) boats propelled by an internal combustion engine, electrical means or both (see 3.2). Boats are to be tested in the same manner as vehicles except where they have unique characteristics as explicitly stated in this standard;
- A1** c) devices equipped with internal combustion engines or traction batteries (see 3.3). **A1**

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

- A1** This standard does not apply to aircrafts, household appliances, traction systems (railway, tramway and electric trolley bus), or to incomplete vehicles. In the case of a dual-mode trolley bus (e.g. propelled by power from either a.c./d.c. mains or an internal combustion engine), the internal combustion propulsion system shall be included, but the a.c./d.c. mains portion of the vehicle propulsion system shall be excluded from this standard. **A1**

NOTE 2 Protection of receivers used on board the same vehicle as the disturbance source(s) are covered by CISPR 25.

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

Annex H lists work being considered for future revisions.

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.

IEC 60050-161, *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electro-magnetic compatibility*

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*

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

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 25, *Radio disturbance characteristics for the protection of receivers used on board vehicles, boats, and on devices – Limits and methods of measurement*

3 Terms and definitions

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

3.1

vehicle

machine operating on land which is intended to carry persons or goods

NOTE Vehicles include, but are not limited to, cars, trucks, buses, mopeds, agricultural machinery, earth-moving machinery, material-handling equipment, mining equipment, floor treatment machines and snowmobiles. 

3.2

boat

vessel intended to be used on the surface of water, its length being no greater than 15 m

3.3

device

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

NOTE Devices include, but are not limited to, chainsaws, irrigation pumps, snow blowers, air compressors, walk-behind floor treatment machines and landscaping equipment. 

3.4

impulsive ignition noise

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

3.5**ignition noise suppressor**

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

3.6**outdoor test site (OTS)**

measurement site similar to an open area test site as specified in CISPR 16, however a ground plane is not required and there are dimensional changes

NOTE Specific requirements are defined in this document.

3.7**resistive distributor brush**

resistive pick-up brush in an ignition distributor cap

3.8**frequency sub-band**

segment of the frequency spectrum (30 MHz to 1 000 MHz) defined to enable statistical evaluation of the test data acquired by swept frequency testing

3.9**representative frequency**

assigned frequency of a frequency sub-band to be used for comparison of the data to the limit

3.10**characteristic level**

controlling (or dominant) emission level experienced in each frequency sub-band. The characteristic level is the maximum measurement obtained for both antenna polarizations and for all the specified measurement positions of the vehicle, boat or device. Known ambient signals are not considered part of the characteristic level.

3.11**tracking generator**

test signal oscillator (continuous wave, cw) that is frequency locked to the receive frequency of a measuring instrument

3.12**RF disturbance power**

RF power measured with a current transformer of an absorbing clamp and an RF measuring instrument. It may be measured – as the RF disturbance voltage – in a peak or quasi-peak mode

3.13**spark discharge**

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

3.14**resistive high-voltage (HV) ignition cable**

ignition cable whose conductor has a high resistance (attenuation)

3.15**residential environment**

environment having a 10 m protection distance between the source and the point of radio reception and where the source uses the public low voltage power system or battery power

NOTE Examples of a residential environment include rooming houses, private dwellings, entertainment halls, theatres, schools, public streets, etc.

A1 3.16**traction batteries**

high power batteries used for electric vehicle traction applications **A1**

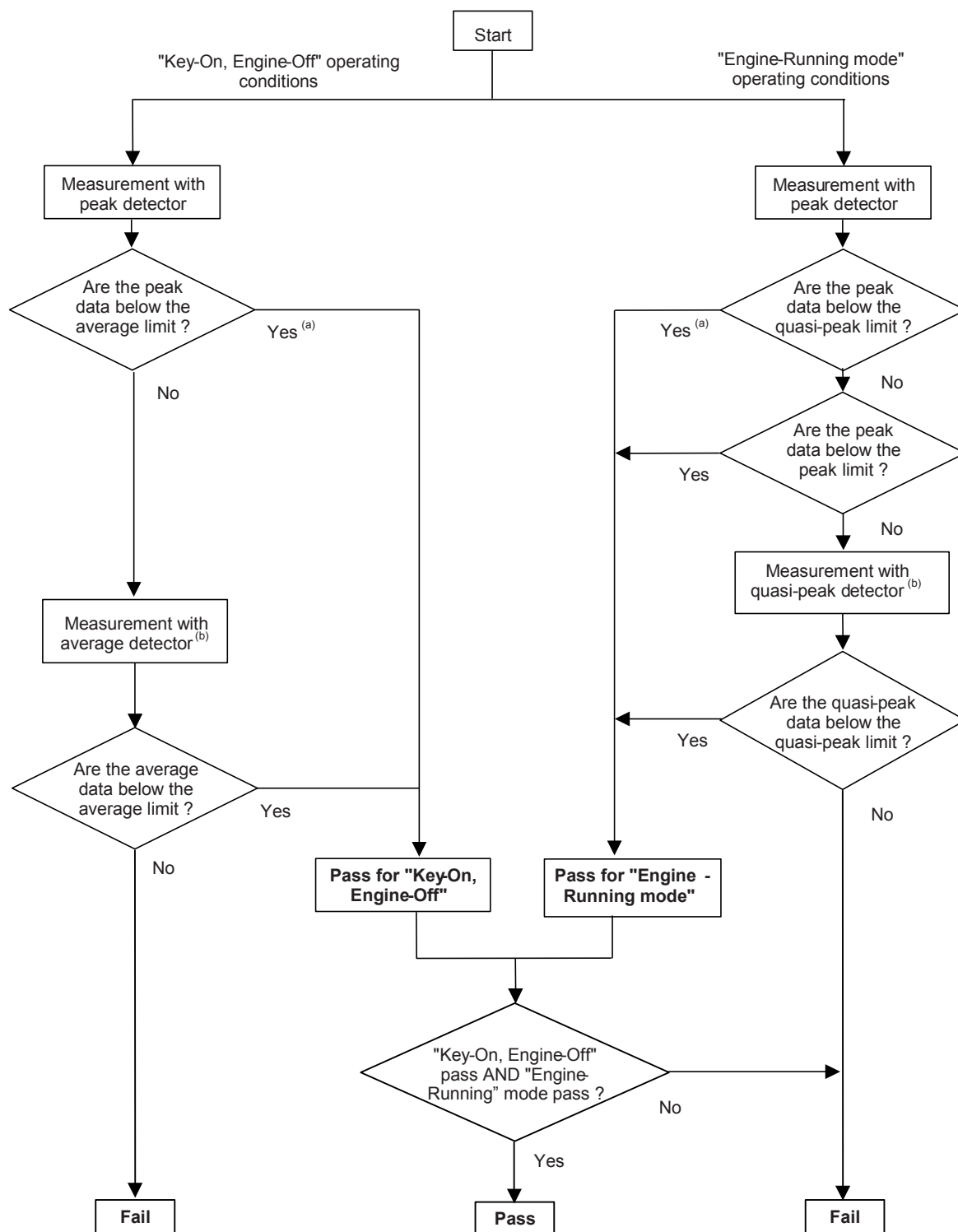
4 Limits of disturbance**4.1 Determination of conformance of vehicle/boat/device with limits**

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

- average limits when the vehicle/boat/device is in “Key-On, Engine-Off” mode (see 5.3.2.1), and
- peak or quasi-peak limits when the vehicle/boat/device is in “Engine-Running” mode (see 5.3.2.2)

The limits given in this standard take into account uncertainties.

Figure 1 defines the method for determination of conformance.



IEC 706/07

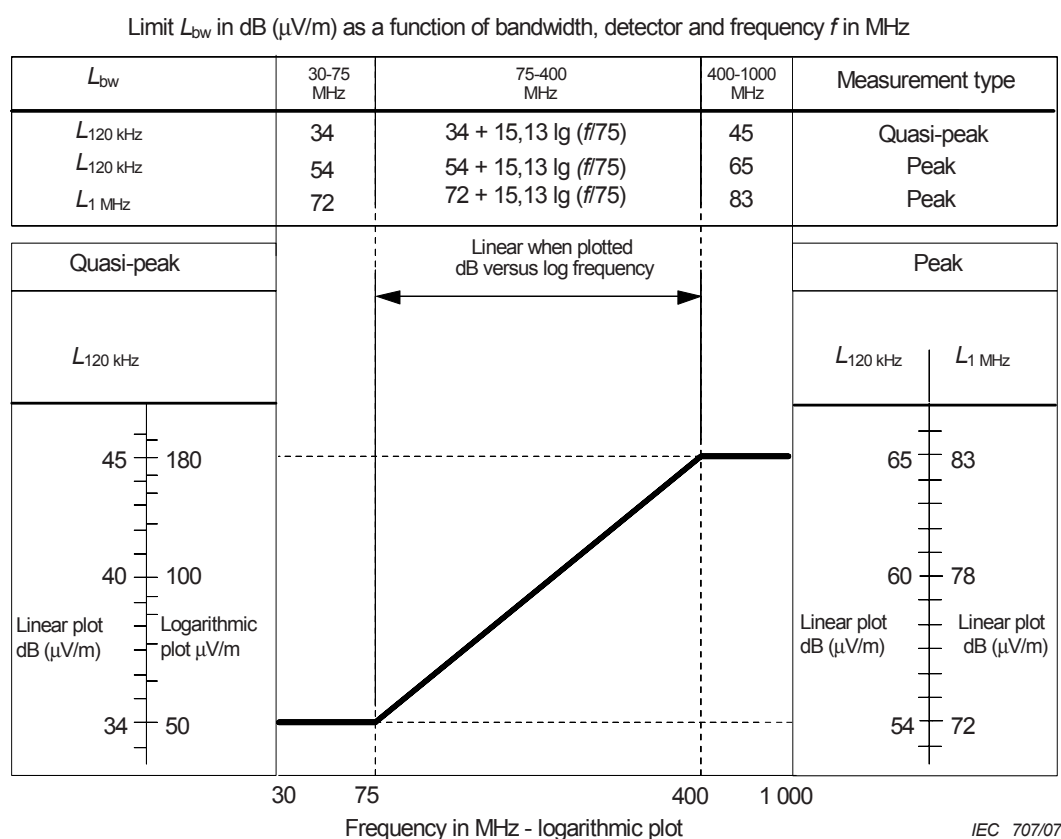
a Because measurement with peak detector is always higher than or equal to measurement with quasi-peak detector (and average detector respectively) and applicable peak limit is always higher than or equal to applicable quasi-peak limit (and average limit respectively), this single detector measurement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

b This flow-chart is applicable for each individual frequency, e.g only frequencies that are above the applicable limit need to be remeasured with quasi-peak detector (and average detector respectively).

Figure 1 – Method of determination of conformance

4.2 Peak and quasi-peak detector limits

The limit for emissions measured with peak or quasi-peak detector at 10 m antenna distance is given in the table of Figure 2 and is shown graphically in Figure 2. Only one of the bandwidths listed needs to be chosen for testing. For more accurate determination, the equations given in Figure 2 shall be used. For measurements at 3 m antenna distance, 10 dB shall be added to the limit.



NOTE 1 For vehicles equipped with electric propulsion motors, see 5.3.2.

NOTE 2 For peak measurements, see 5.5.

NOTE 3 The correlation factor between quasi-peak and peak measurements is +20 dB at 120 kHz bandwidth, based on experimental data accumulated in many countries.

**Figure 2 – Limit of disturbance (peak and quasi-peak detector)
at 10 m antenna distance**

4.3 Average detector limit

The limit for emissions measured with the average detector at 10 m antenna distance is shown in Figure 3. Vehicles/boats/devices not including electronic oscillators with an operating frequency greater than 9 kHz shall be deemed to be in compliance with the average requirements of this clause without performing tests for emissions with average detector. Vehicles/boats/devices which meet the average emissions requirements of CISPR 25, Clause 5 shall also be deemed to be in compliance with the average requirements of this subclause and no further testing is necessary.

For measurements at 3 m antenna distance, 10 dB shall be added to the limit.

Annex D of CISPR 16-2-3 explains the differences between the CISPR AV detector and an AV detector (complying with CISPR 16-1:1999). For the purpose of this standard either detector may be used, since the pulse repetition rate for internal combustion engines is above 10 Hz.

NOTE For type-approval testing per 6.4, use of an alternative test method based upon other regulatory standards is permitted as detailed herein. This alternate type-approval test applies to those vehicles/boats/devices for which on-board receivers can be installed. If, when measured in accordance with the vehicle test methodology of CISPR 25 for emissions using an average detector, the signal strength at the vehicle/boat/device broadcast radio antenna is less than 20 dB (μV) (10 μV) over the frequency range 76 MHz to 108 MHz, then the vehicle/boat/device can be deemed to comply with the limits for average emissions and no further testing must be required.

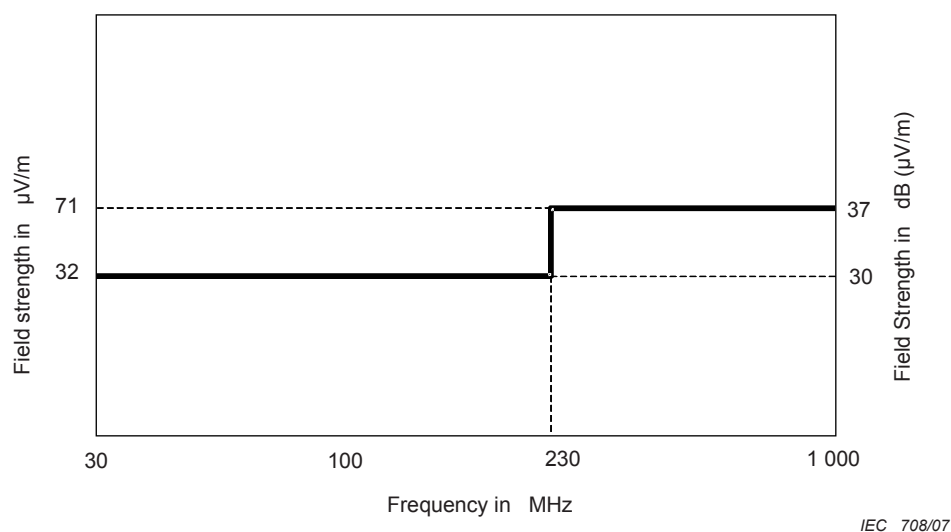


Figure 3 – Limits of disturbance (average detector) at 10 m antenna distance

5 Methods of measurement

5.1 Measuring instrument

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

NOTE Spectrum analysers and scanning receivers are particularly useful for disturbance measurements. The peak detection mode of spectrum analysers and scanning receivers provides a display indication which is never less than the quasi-peak indication for the same bandwidth. It may be convenient to measure emissions using peak detection because of the faster scan possible than with quasi-peak detection.

When quasi-peak limits are being used, and a peak detector is used for time efficiency, any peak measurements with results at or above the test limit shall be re-measured using the quasi-peak detector.

5.1.1 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.

The bandwidth of the spectrum analyser shall be chosen such that the noise floor is at least 6 dB lower than the limit curve.

NOTE A preamplifier may be used between the antenna and the spectrum analyser in order to achieve the 6 dB noise floor requirement.

The recommended scan time and bandwidth are listed in Table 1:

Table 1 – Spectrum analyser parameters

Frequency range MHz	Peak detector		Quasi-peak detector		Average detector	
	RBW ^{a)}	Scan time	BW ^{b)}	Scan time	RBW ^{a)}	Scan time
30 to 1 000	100 kHz / 120 kHz	100 ms / MHz	120 kHz	20 s / MHz	100 kHz / 120 kHz	100 ms / MHz
a) RBW is defined at –3 dB.						
b) BW is defined at –6 dB.						

If a spectrum analyser is used for peak measurements, the video bandwidth shall be at least three times the resolution bandwidth (RBW).

5.1.2 Scanning receiver parameters

The dwell time of the scanning receiver shall be adjusted for the CISPR frequency band and detection mode used. The minimum dwell time shall comply with the requirements of CISPR 16-2-3.

The bandwidth of the scanning receiver shall be chosen such that the noise floor is at least 6 dB lower than the limit curve.

NOTE A preamplifier may be used between the antenna and the scanning receiver in order to achieve the 6 dB noise floor requirement.

The recommended dwell time, maximum step size and bandwidth are listed in Table 2:

Table 2 – Scanning receiver parameters

Frequency range MHz	Peak detector			Quasi-peak detector			Average detector		
	Band-width	Step size ^a	Dwell time	Band-width	Step size ^a	Dwell time	Band-width	Step size ^a	Dwell time
30 to 1 000	120 kHz	50 kHz	5 ms	120 kHz	50 kHz	1 s	120 kHz	50 kHz	5 ms
^a For purely broadband disturbances, the maximum frequency step size may be increased up to a value not greater than the bandwidth value.									

5.1.3 Antenna types

5.1.3.1 Reference antenna

The antenna shall be a balanced dipole (see CISPR 16-1-4). Free-space antenna factors are to be used. For frequencies of 80 MHz or above, the antenna shall be resonant in length, and for frequencies below 80 MHz it shall be the length equal to the 80 MHz resonant length. It shall be matched to the feeder by a suitable symmetric-asymmetric transformer device.

5.1.3.2 Broadband antennas

Any linearly polarized receiving antenna is permitted, provided that it can be normalized to the reference antenna.

A broadband antenna shall be used when making measurements with an automated receiving system using a scanning measuring instrument. Such a broadband antenna is usable for measuring emission levels (over the frequency spectrum covered by this standard), provided that its output can be normalized to the output of the reference antenna in the actual test environment at the actual test site.

When broadband antennas are used, they shall meet the requirements for complex antennas given in CISPR 16-1-4. Examples of factors to be considered include:

- a) the effective aperture area of the antenna, including its polar response (horizontal and vertical planes).
- b) the effect of a phase centre which moves with frequency.
- c) the effect of ground reflection characteristics (including multiple ray reflections which may arise at specific frequencies at about 500 MHz vertical polarization and 900 MHz horizontal polarization).

See Annex C for alternate antenna characterization.

5.1.4 Accuracy

The measurement system consisting of the antenna, transmission line and the measuring instrument, but excluding the source and the measuring site, shall measure electric field strength over the frequency range of 30 MHz to 1 000 MHz with an accuracy of ± 3 dB. See Clause 4 of CISPR 16-1-4. The frequency accuracy shall be better than ± 1 %.

NOTE 1 To ensure that the measurements defined in this standard are within the stated tolerances, consideration should be given to all pertinent characteristics of measuring equipment (for example, frequency and amplitude stability, image rejection, cross-modulation, overload levels, selectivity, time constants, and signal/noise ratio), as well as those affecting the antenna and transmission line.

NOTE 2 It is reasonable to expect additional variations in measurements made of an electric field (see C.13) within the range of 30 MHz to 1 000 MHz. These are caused by variations in ground conductivity and other factors influencing repeatability.

5.2 Measuring location requirements

5.2.1 Outdoor test site (OTS) requirements

5.2.1.1 OTS for vehicles and devices

The test site shall be a clear area, free from electromagnetic reflecting surfaces within a circle of minimum radius 30 m measured from a point midway between the vehicle or device and the antenna. As an exception, the measuring equipment, and test hut or vehicle in which the measuring equipment is located (when used) may be within the test site, but only in the permitted region indicated by the crosshatched area of Figure 4.

NOTE The site requirements defined in 5.2.1.1 and Figure 4 are the application of CISPR 16-1-4 to large automotive objects.

Vehicles and devices smaller than 2 m in length and width may be tested on an OTS with dimensions corresponding to CISPR 16-1-4, Figures 2 or 3.

5.2.1.2 OTS for boats

The test site shall be a clear area free from electromagnetic reflecting surfaces within a circle of minimum radius 30 m measured from a point midway between the engine under test and the antenna. Exceptions for the measuring equipment are specified in 5.2.1.2.1 and also in 5.2.1.2.2. As an exception, the measuring equipment may be within the test site, but only in the permitted region indicated by the crosshatched area of Figure 5. The test hut or vehicle or non-metallic boat of test fixture in/on which the measuring equipment is located may be within the test site.

Boats or engines/motors for boats tested separately shall be tested in salt or fresh water at a measuring site as shown in Figure 5.

5.2.1.2.1 Land-based measuring equipment

When the measuring equipment is on land, the test hut or vehicle in which the measuring equipment is located may be within the test site, but only in the permitted region indicated by the cross-hatched area of Figure 5.

5.2.1.2.2 Water-based measuring equipment

The measuring equipment shall be installed in a non-metallic boat or non-metallic test fixture which may be within the test site, but only within the permitted region indicated by the cross-hatched area of Figure 5.