

INTERNATIONAL STANDARD

NORME INTERNATIONALE



INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE

COMITÉ INTERNATIONAL SPÉCIAL DES PERTURBATIONS RADIOÉLECTRIQUES

Electromagnetic compatibility of multimedia equipment – Emission requirements

Compatibilité électromagnétique des équipements multimédia – Exigences d'émission



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Electromagnetic compatibility of multimedia equipment – Emission requirements

Compatibilité électromagnétique des équipements multimédia – Exigences d'émission

INTERNATIONAL
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTROMAGNETIC COMPATIBILITY
OF MULTIMEDIA EQUIPMENT –****Emission requirements****FOREWORD**

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International Standard CISPR 32 has been prepared by CISPR subcommittee 1: Electromagnetic compatibility of information technology equipment, multimedia equipment and receivers.

This second edition cancels and replaces the first edition published in 2012. This edition constitutes a technical revision.

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

- a) additional requirements using FAR,
- b) additional requirements for outdoor unit of home satellite receiving systems,
- c) addition of new informative annexes covering GTEM and RVC,
- d) numerous maintenance items are addressed to improve the testing of MME.



The text of this publication is based on the following documents:

FDIS	Report on voting
CIS/II/498/FDIS	CIS/II/501/RVD

Full information on the voting for the approval of this publication 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 the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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The contents of the corrigendum of June 2016 have been included in this copy.

ELECTROMAGNETIC COMPATIBILITY OF MULTIMEDIA EQUIPMENT –

Emission requirements

1 Scope

NOTE **Blue** coloured text within this document indicates text that will be aligned with the future MME immunity publication CISPR 35.

This International Standard applies to multimedia equipment (MME) as defined in 3.1.24 and having a rated r.m.s. AC or DC supply voltage not exceeding 600 V.

Equipment within the scope of CISPR 13 or CISPR 22 is within the scope of this publication.

MME intended primarily for professional use is within the scope of this publication.

The radiated emission requirements in this standard are not intended to be applicable to the intentional transmissions from a radio transmitter as defined by the ITU, nor to any spurious emissions related to these intentional transmissions.

Equipment, for which emission requirements in the frequency range covered by this publication are explicitly formulated in other CISPR publications (except CISPR 13 and CISPR 22), are excluded from the scope of this publication.

In-situ testing is outside the scope of this publication.

This publication covers two classes of MME (Class A and Class B). The MME classes are specified in Clause 4.

The objectives of this publication are:

- 1) to establish requirements which provide an adequate level of protection of the radio spectrum, allowing radio services to operate as intended in the frequency range 9 kHz to 400 GHz;
- 2) to specify procedures to ensure the reproducibility of measurement and the repeatability of results.

2 Normative references

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

CISPR 16-1-1:2010, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus*

CISPR 16-1-1:2010/AMD1:2010

CISPR 16-1-1:2010/AMD2:2014

CISPR 16-1-2:2003¹, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-2: Radio disturbance and immunity measuring apparatus – Ancillary equipment – Conducted disturbances*

CISPR 16-1-2:2003/AMD 1:2004

CISPR 16-1-2:2003/AMD 2:2006

CISPR 16-1-4:2010, *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 16-1-4:2010/AMD1:2012

CISPR 16-2-1:2008², *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-1: Methods of measurement of disturbances and immunity – Conducted disturbance measurements*

CISPR 16-2-1:2008/ AMD 1:2010

CISPR 16-2-1:2008/ AMD 2:2013

CISPR 16-2-3:2010, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-3: Methods of measurement of disturbances and immunity – Radiated disturbance measurements*

CISPR 16-2-3:2010/AMD1:2010

CISPR 16-2-3:2010/AMD2:2014

CISPR 16-4-2:2011, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modelling – Measurement instrumentation uncertainty*

IEC 61000-4-6:2008³, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

ISO IEC 17025:2005, *General requirements for the competence of testing and calibration laboratories*

ANSI C63.5-2006, *American National Standard (for) Electromagnetic Compatibility – Radiated Emission Measurements in Electromagnetic Interference (EMI) Control – Calibration of Antennas (9 kHz to 40 GHz)*

IEEE Std 802.3, *IEEE Standard for Information technology – Specific requirements – Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

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

¹ First edition (2003). This first edition has been replaced in 2014 by a second edition CISPR 16-1-2:2014, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-2: Radio disturbance and immunity measuring apparatus – Coupling devices for conducted disturbance measurements*.

² First edition (2008). This first edition has been replaced in 2014 by a second edition CISPR 16-2-1:2014, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-1: Methods of measurement of disturbances and immunity – Conducted disturbance measurements*.

³ Third edition (2008). This third edition has been replaced in 2013 by a fourth edition IEC 61000-4-6:2013, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*.

NOTE Terms and definitions related to EMC and to relevant phenomena are given in IEC 60050-161. A common set of definitions has been written for both CISPR 32 and the future CISPR 35. It is noted that some terms and definitions will only be used in one of these two publications but for purposes of consistency they are intentionally included in both.

3.1.1

AC mains power port

port used to connect to the mains supply network

Note 1 to entry: Equipment with a DC power port which is powered by a dedicated AC/DC power converter is defined as AC mains powered equipment.

3.1.2

analogue/digital data port

signal/control port (3.1.30), antenna port (3.1.3), wired network port (3.1.32), broadcast receiver tuner port (3.1.8), or optical fibre port (3.1.25) with metallic shielding and/or metallic strain relief member(s)

3.1.3

antenna port

port, other than a broadcast receiver tuner port (3.1.8), for connection of an antenna used for intentional transmission and/or reception of radiated RF energy

3.1.4

arrangement

physical layout and orientation of all the parts of the EUT, AE and any associated cabling, located within the area

3.1.5

associated equipment

AE

equipment needed to exercise and/or monitor the operation of the EUT

Note 1 to entry: AE may be either local (within the measurement or test area) or remote.

3.1.6

audio equipment

equipment which has a primary function of either (or a combination of) generation, input, storage, play, retrieval, transmission, reception, amplification, processing, switching or control of audio signals

3.1.7

broadcast receiver equipment

equipment containing a tuner that is intended for the reception of broadcast services

Note 1 to entry: These broadcast services are typically television and radio services, including terrestrial broadcast, satellite broadcast and/or cable transmission.

3.1.8

broadcast receiver tuner port

port intended for the reception of a modulated RF signal carrying terrestrial, satellite and/or cable transmissions of audio and/or video broadcast and similar services

Note 1 to entry: This port may be connected to an antenna, a cable distribution system, a VCR or similar device.

3.1.9

common mode impedance

asymmetrical mode (see CISPR 16-2-1) impedance between a cable attached to a port and the Reference Ground Plane (RGP)

Note 1 to entry: The complete cable is seen as one wire of the circuit and the RGP is seen as the other wire of the circuit. The common mode current flowing around this circuit can lead to the emission of radiated energy of EUT.

3.1.10 configuration

operational conditions of the EUT and AE, consisting of the set of hardware elements selected to comprise the EUT and AE, mode of operation (3.1.23) used to exercise the EUT and arrangement (3.1.4) of the EUT and AE

3.1.11 converted common mode current

asymmetrical mode current converted from differential mode current by the unbalance of an attached cable and/or network

3.1.12 DC network power port

port, not powered by a dedicated AC/DC power converter and not supporting communication, that connects to a DC supply network

Note 1 to entry: Equipment with a DC power port which is powered by a dedicated AC/DC power converter is considered to be AC mains powered equipment.

Note 2 to entry: DC power ports supporting communications are considered to be wired networks ports, for example Ethernet ports which include Power Over Ethernet (POE).

3.1.13 enclosure port

physical boundary of the EUT through which electromagnetic fields may radiate

3.1.14 entertainment lighting control equipment

equipment generating or processing electrical signals for controlling the intensity, colour, nature or direction of the light from a luminaire, where the intention is to create artistic effects in theatrical, televisual or musical productions and visual presentations

3.1.15 Equipment Under Test EUT

multimedia equipment (MME) being evaluated for compliance with the requirements of this standard

3.1.16 formal measurement

measurement used to determine compliance

Note 1 to entry: This is often the final measurement performed. It may be carried out following a prescan measurement. It is the measurement recorded in the test report.

3.1.17 function

operation carried out by a MME

Note 1 to entry: Functions are related to basic technologies incorporated in the MME such as: displaying, recording, processing, controlling, reproducing, transmitting, or receiving single medium or multimedia content. The content may be data, audio or video, either individually or in combination.

3.1.18 highest internal frequency

F_x

highest fundamental frequency generated or used within the EUT or highest frequency at which it operates

Note 1 to entry: This includes frequencies which are solely used within an integrated circuit.

3.1.19

Information Technology Equipment

ITE

equipment having a primary function of either (or a combination of) entry, storage, display, retrieval, transmission, processing, switching, or control of data and/or telecommunication messages and which may be equipped with one or more ports typically for information transfer

Note 1 to entry: Examples include data processing equipment, office machines, electronic business equipment and telecommunication equipment.

3.1.20

LNB

low noise block convertor which amplifies and converts broadcast satellite frequencies to frequencies usable by a satellite receiver

3.1.21

local AE

AE located within the measurement or test area

3.1.22

launched common mode current

asymmetric mode current produced by internal circuitry and appearing at the wired network port of the EUT

Note 1 to entry: Measurement of the launched common mode current requires the EUT port to be loaded by a perfectly balanced termination.

3.1.23

mode of operation

set of operational states of all functions of an EUT during a test or measurement

3.1.24

MultiMedia Equipment

MME

equipment that is information technology equipment (3.1.19), audio equipment (3.1.6), video equipment (3.1.31), broadcast receiver equipment (3.1.7), entertainment lighting control equipment (3.1.14) or combinations of these

3.1.25

optical fibre port

port at which an optical fibre is connected to an equipment

3.1.26

outdoor unit of home satellite receiving systems

outdoor unit which typically consists of a reflecting surface (or antenna) and an LNB

Note 1 to entry: The unit excludes the intermediate frequency amplifier and the demodulator included in the indoor receiver.

3.1.27

port

physical interface through which electromagnetic energy enters or leaves the EUT

Note 1 to entry: See Figure 1.

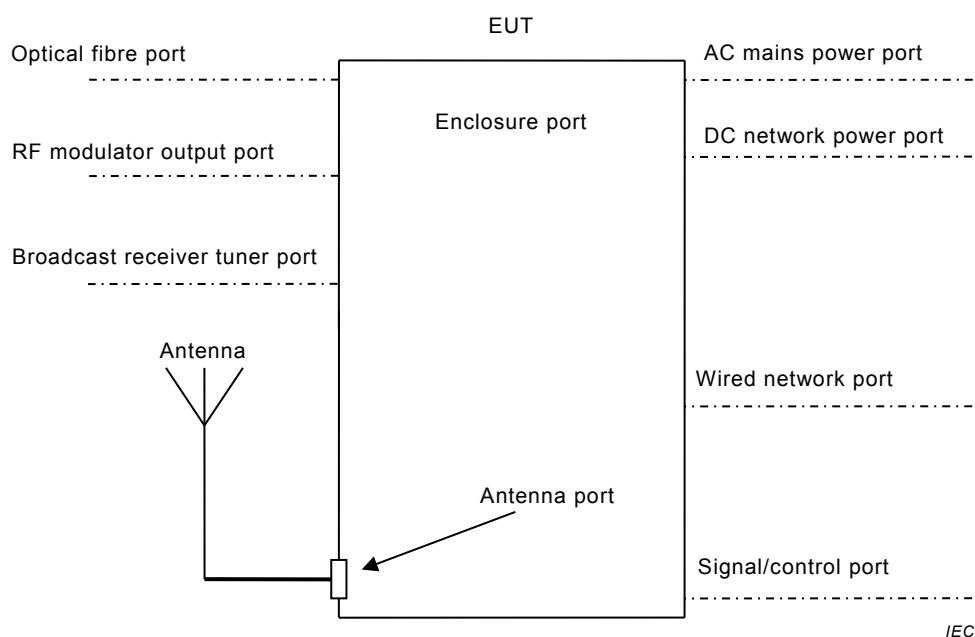


Figure 1 – Examples of ports

3.1.28

primary function

any function of an MME considered essential for the user or for the majority of users

Note 1 to entry: An MME may have more than one primary function. For example the primary functions of a basic television set include broadcast reception, audio reproduction and display.

3.1.29

RF modulator output port

port intended to be connected to a broadcast receiver tuner port in order to transmit a signal to the broadcast receiver

3.1.30

signal/control port

port intended for the interconnection of components of an EUT, or between an EUT and local 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 Standard 1394 ("Fire Wire").

3.1.31

video equipment

equipment which has a primary function of either (or a combination of) generation, input, storage, display, play, retrieval, transmission, reception, amplification, processing, switching, or control of video signals

3.1.32

wired network port

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

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

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

3.2 Abbreviations

For the purposes of this document, the following abbreviations apply.

AAN	Asymmetric Artificial Network
AC	Alternating Current
AC-3	ATSC standard: digital Audio Compression (AC-3)
AE	Associated Equipment, see 3.1.5
AM	Amplitude Modulation
AMN	Artificial Mains Network
ATSC	Advanced Television Systems Committee
AV	Audio Visual
BPSK	Binary Phase Shift Keying
CATV	Cable TV network
CISPR	International special committee on radio interference
CM	Common Mode
CMAD	Common Mode Absorbing Device
CVP	Capacitive Voltage Probe
DC	Direct Current
DMB-T	Digital Multimedia Broadcast – Terrestrial
DQPSK	Differential Quadrature Phase Shift Keying
DSL	Digital Subscriber Line
DVB	Digital Video Broadcast
DVB-C	Digital Video Broadcast – Cable
DVB-S	Digital Video Broadcast – Satellite
DVB-T	Digital Video Broadcast – Terrestrial
DVD	Digital Versatile Disc (an optical disc format also known as a Digital Video Disc)
EMC	ElectroMagnetic Compatibility
EUT	Equipment Under Test, see 3.1.15
FAR	Fully Anechoic Room
FM	Frequency Modulation
FSOATS	Free Space Open Area Test Site
F/UTP	Foil screened/Unscreened Twisted Pair
GTEM	Gigahertz Transverse ElectroMagnetic
HDMI	High-Definition Multimedia Interface
HID	Human Interface Device
IEC	International Electrotechnical Commission
IF	Intermediate Frequency
ISDB	Integrated Services Digital Broadcasting
ISDB-S	Integrated Services Digital Broadcasting – Satellite
ISDN	Integrated Services Digital Network
ISO	International Standardisation Organisation
ITE	Information Technology Equipment, see 3.1.19
ITU	International Telecommunication Union

ITU-R	International Telecommunication Union – Radio Communication Sector
ITU-T	International Telecommunication Union – Telecommunication Sector
LAN	Local Area Network
LCL	Longitudinal Conversion Loss
LO	Local Oscillator
LNB	Low-Noise Block converter
MME	Multimedia Equipment, see 3.1.24
MPEG	Moving Picture Experts Group
NSA	Normalized Site Attenuation
OATS	Open Area Test Site
OFDM	Orthogonal Frequency Division Multiplexing
PC	Personal Computer
POE	Power Over Ethernet
POS	Point Of Sale
PSTN	Public Switched Telephone Network
PSU	Power Supply Unit (including a AC/DC power converter)
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RGP	Reference Ground Plane
RVC	ReVerberation Chamber
SAC	Semi Anechoic Chamber
STP	Shielded Twisted Pair
TV	Television
TEM	Transverse ElectroMagnetic
UHF	Ultra High Frequency
USB	Universal Serial Bus
U/UTP	Unscreened/Unscreened Twisted Pair
VCR	Video Cassette Recorder
VHF	Very High Frequency
VSF	Vestigial Side Band
xBase-T	Where x is 10, 100 and 1 000 as defined in the IEEE 802.3 series of standards
xDSL	Generic term for all types of DSL technology

4 Classification of equipment

This standard defines Class A equipment and Class B equipment associated with two types of end-use environment.

Class A equipment is equipment which meets the requirements given in Table A.2, Table A.3, Table A.9, and Table A.11, using the limitations defined in Table A.1 and Table A.8.

Class B equipment is equipment which meets the requirements given in Table A.4, Table A.5, Table A.6, Table A.7, Table A.10, Table A.12 and Table A.13, using the limitations defined in Table A.1 and Table A.8.

The Class B requirements for equipment are intended to offer adequate protection to broadcast services within the residential environment.

Equipment intended primarily for use in a residential environment shall meet the Class B limits. All other equipment shall comply with the Class A limits.

Broadcast receiver equipment is class B equipment.

NOTE Equipment meeting Class A requirements may not offer adequate protection to broadcast services within a residential environment.

5 Requirements

The requirements for equipment covered within the scope of this publication are defined in Annex A.

6 Measurements

6.1 General

This clause defines the measurement facilities and instrumentation specific to the measurement of emissions from MME; it includes by reference the relevant basic requirements given in the CISPR 16 series and other standards shown in the normative references in this standard. It also defines how to configure and arrange the EUT, local AE and associated cabling, and provides the relevant measurement procedures.

The specification of the measurement facility, measurement equipment, procedures, and the arrangement of the measurement equipment to be used are given in the basic standards referred to in the tables in Annex A. Unless otherwise specified, the basic standards shall be used for all aspects of the measurement.

Where there are conflicts in the information presented in the CISPR 16 series and this publication, the content of this publication takes precedence.

The procedures to be used for measurement of emission levels depend upon several elements. These include but are not limited to:

- the type of EUT,
- the type of port,
- the types of cables used,
- the frequency range,
- the mode of operation.

If a single port satisfies the definition of more than one of the types of port defined in this standard, it is subject to the requirements for each of the port types that it satisfies. Where a port is specified by the manufacturer for use with both screened and unscreened cables, the port shall be evaluated with both cable types.

6.2 Host systems and modular EUT

This subclause describes how to configure EUTs that are a host system or modular in nature. Modular systems can comprise different types of module(s), for example the EUT can be:

- an external module, for example an infra-red remote control;
- an internal module, for example a computer hard disk;
- a plug-in module, for example a memory stick;

- a mounted module, for example a sound card or a video card.

Modules intended to be marketed and/or sold separately from a host shall be assessed with at least one representative host system. The modules may be internal, mounted, plug-in or external as illustrated in Figure 2. The port(s) of any module being assessed shall be terminated in accordance with Annex D. The functions of the host device that are specific to the module being assessed shall be exercised during the measurements. Modules shown to meet the requirements of this publication in any one representative host are deemed to meet the requirements of this publication when used in any host. The host and modules used during measurements shall be listed in the test report.

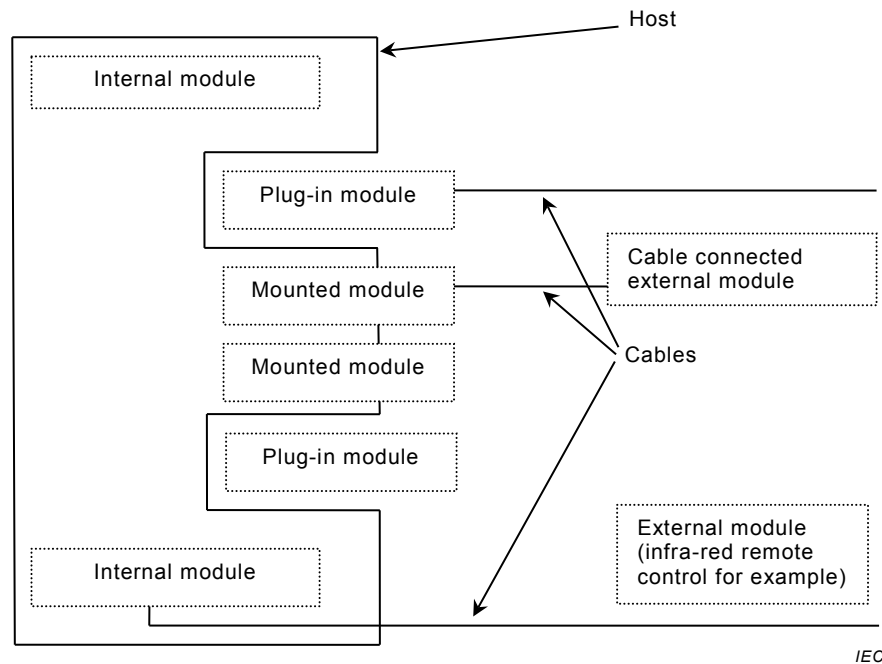


Figure 2 – Example of a host system with different types of modules

Modules whose functionality and connectivity allow them to be either, plug-in, internal, mounted and/or external shall be measured in each of the applicable configurations. However, where it can be shown that one particular configuration provides a worst case, measurement in the worst case configuration is sufficient to show compliance.

When the EUT is a host, it shall be configured with modules so that the resulting system is representative of typical use.

In the case where the EUT is a module, the host is considered as an AE.

In the case of plug-in, mounted, external or internal modules, the host shall be located in the measurement area.

6.3 Measurement procedure

Measurements shall be performed as follows:

- using the relevant measurement methods and procedures given in Table A.1, Table A.8 and Annex C, and the EUT exercised in accordance with Annex B;
- with the EUT, local AE and associated cabling configured and arranged, and with ports loaded as shown in 6.2 and Annex D;
- in accordance with supporting information and clarifications defined elsewhere within this publication.

In addition, during prescan measurements, the arrangement of the EUT, the arrangement of the local AE and the placement of cables shall be varied within the range of typical and normal placement to attempt to determine the cable arrangement giving the maximum emission level, as described in Annex D.

The arrangement for formal measurement shall be representative of a typical arrangement of the EUT, local AE and associated cabling.

The measurement is performed with the EUT and/or AE arranged either as floor-standing equipment, table-top equipment or combinations thereof as defined in D.1.1 and illustrated in Figure D.2 to Figure D.12.

For some products it is not always obvious how the EUT and/or AE should be arranged. This may be due to variations in the configurations of the EUT in practice, physical or practical limitations. Examples of these arrangements include:

- wall, ceiling or rack mounted,
- handheld,
- body worn.

For example, a video projector can be positioned in various ways with respect to walls, ceiling or the floor of a room. D.1.1 defines the additional information needed to configure the EUT to simulate these types of arrangements.

7 Equipment documentation

The user documentation and/or manual shall contain details of any special measures required to be taken by the purchaser or user to ensure EMC compliance of the EUT with the requirements of this publication. One example would be the need to use shielded or special cables, such as category 5 F/UTP or category 6 U/UTP cabling as defined in ISO IEC 11801.

Equipment compliant with the class A requirements of this publication should have a warning notice in the user manual stating that it could cause radio interference. For example

Warning: Operation of this equipment in a residential environment could cause radio interference.

8 Applicability

Measurements shall be performed on the relevant ports of the EUT according to the appropriate tables given in Annex A.

Where a manufacturer determines from the electrical characteristics and intended usage of the EUT that one or more measurements are unnecessary, the decision and justification not to perform these measurements shall be recorded in the test report.

The following table shows the highest frequency up to which radiated emission measurements shall be performed.

Based upon the value of F_x , Table 1 specifies the highest frequency applicable for the limits given in Table A.3 or Table A.5.

Table 1 – Required highest frequency for radiated measurement

Highest internal frequency (F_x)	Highest measured frequency
$F_x \leq 108$ MHz	1 GHz
$108 \text{ MHz} < F_x \leq 500$ MHz	2 GHz
$500 \text{ MHz} < F_x \leq 1$ GHz	5 GHz
$F_x > 1$ GHz	$5 \times F_x$ up to a maximum of 6 GHz
NOTE 1 For FM and TV broadcast receivers, F_x is determined from the highest frequency generated or used excluding the local oscillator and tuned frequencies.	
NOTE 2 F_x is defined in 3.1.18.	
NOTE 3 For outdoor units of home satellite receiving systems highest measured frequency shall be 18 GHz.	

Where F_x is unknown, the radiated emission measurements shall be performed up to 6 GHz.

9 Test report

General requirements for compiling a test report taken from 5.10 of ISO IEC 17025:2005, can be found in Annex F. Sufficient details shall be provided to facilitate reproducibility of the measurements. This shall include photographs of the measurement configuration for the formal measurements where this is appropriate.

The test report shall state the mode of operation of the EUT and how its ports were exercised (see Annex B). The test report shall clearly indicate whether the product is compliant with the Class A or Class B limits defined in Annex A.

For each relevant table clause in Annex A, the test report shall include the measurement results of at least the six highest emissions relative to the limit for each detector type,⁴ unless the emissions are:

- below the measurement system noise floor, or
- 10 dB or more below the limit.

The results shall include the following information for each of these emissions:

- the port assessed (including enough information to identify it);
- for AC power line measurements the line under test, for example line or neutral;
- frequency and amplitude of the emission;
- margin with respect to the specified limit;
- the limit at the frequency of the emission;
- the detector used.

The report shall indicate if fewer than six emissions within 10 dB of the limit are observed.

NOTE It can also be beneficial to record emissions 10 dB or more below the limit. In addition other aspects, such as antenna polarization or turntable azimuth, can be useful to record.

Additionally, the following shall be included in the test report:

⁴ It is sufficient to show compliance with all limits and detectors as shown in Figure C.3 to Figure C.5

- the frequency F_x of the highest internal frequency source within the EUT as defined in 3.1.18. This frequency need not be reported if radiated emissions are measured up to 6 GHz;
- the calculated measurement instrumentation uncertainty for each measurement type performed (see Table 1 of CISPR 16-4-2:2011). No reporting is required if U_{CISPR} is not defined for the relevant measurement type;
- the category of cable simulated by the AAN, where emissions from wired network ports are measured using an AAN. See Table C.2;
- the measurement distance for radiated emission measurements as defined in C.2.2.4 and Table A.2 to Table A.7. If another measurement distance is used, the report shall include a description of how the limits were calculated.

Further guidance is given in Annex F.

10 Compliance with this publication

Compliance with this publication requires that the EUT satisfies either the Class A or Class B requirements defined in Annex A, as appropriate. An EUT which fulfils the applicable requirements specified in Annex A is deemed to fulfil the requirements in the entire frequency range from 9 kHz to 400 GHz. No measurements need be performed at frequencies where no requirement is specified.

Where this publication gives options for measuring particular requirements with a choice of measurement methods, compliance can be shown against any of the specified limits using the appropriate measurement method. In any situation where it is necessary to re-measure the equipment to show compliance with this publication, the measurement method originally chosen shall be used in order to guarantee consistency of the results, unless it is agreed by the manufacturer to do otherwise. Requirements for radiated emission measurements are defined in Table A.2 to Table A.7 with the restrictions and limitations defined in Table A.1. Requirements for conducted emission measurements are defined in Table A.9 to Table A.13 with the restrictions defined in Table A.8.

The determination of compliance with this publication shall be based solely on contributions from the EUT. For example, where an AE is required to exercise or monitor the EUT, and emissions from the AE are known to contribute to the overall measured emission of the system being assessed (for example an AE which is a plug-in module for the EUT), the AE selected should, wherever possible, be compliant with relevant emission limits. If the AE is known to cause significant emissions, these emissions may be reduced by mitigation measures, as long as these measures do not reduce the emissions from the EUT. The preferred configuration is that the AE is removed from the measurement area, as allowed by D.1.

Compliance can be shown by measuring the EUT's emissions when operating its functions simultaneously, individually in turn, or any combination thereof.

11 Measurement uncertainty

The measurement instrumentation uncertainty shall be calculated in accordance with CISPR 16-4-2 and reported as described in Clause 9.

Measurement instrumentation uncertainty shall not be taken into account in the determination of compliance. Refer to CISPR TR 16-4-3 for guidance on the applicability of the limits to a series produced MME.

Annex A (normative)

Requirements

A.1 General

The requirements for an EUT covered by this publication are given on a port by port basis in Table A.1 to Table A.13, respectively.

Throughout this annex and unless otherwise stated:

The peak detector limits in Table A.3 and Table A.5 shall not be applied to emissions produced by arcs or sparks that are high voltage breakdown events. Such emissions arise when MME devices contain or control mechanical switches that control current in inductors, or when MME devices contain or control subsystems that create static electricity (such as paper handling devices). The average limits apply to emissions from arcs or sparks. Both peak and average limits apply to other emissions from such MME devices.

Other measurement methods and associated limits for RVCs and GTEM cells are presented in Annex H for information.

Where the limit value varies over a given frequency range, it changes linearly with respect to the logarithm of the frequency. For example, a graphical representation of the AC mains power port limits defined in Table A.10 is presented in Figure A.1.

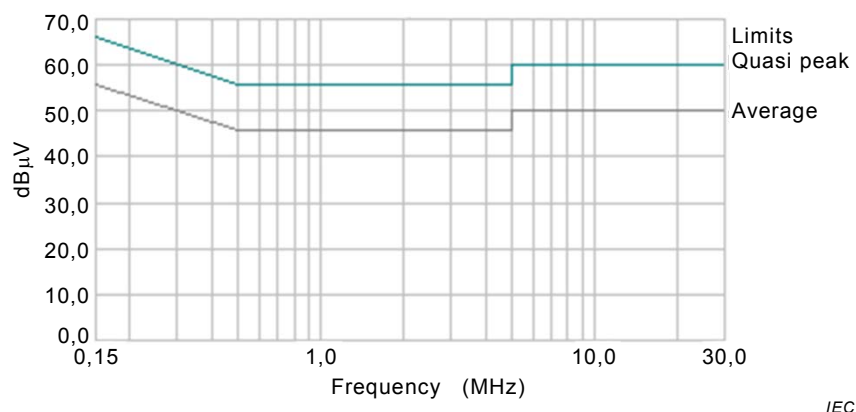


Figure A.1 – Graphical representation of the limits for the AC mains power port defined in Table A.10

- Where there is a step in the relevant limit, the lower value shall be applied at the transition frequency.
- The measurements shall be limited to:
 - a) the operating ranges of voltage and frequency as specified for the EUT, having regard to the supply voltage and frequency for the intended market of the EUT.
Measurement at two nominal voltages of 230 V (± 10 V) and 110 V (± 10 V), using a frequency of 50 Hz or 60 Hz, is normally sufficient for an EUT intended for worldwide use.
 - b) the environmental parameters (temperature, humidity and atmospheric pressure) specified for the EUT.

No additional environmental parameters are defined. It is not necessary to repeat measurements at more than one set of environmental parameters.

- If different detectors have been specified, the EUT shall be assessed using all relevant detectors against the appropriate limits. This procedure can be optimised by use of the decision trees in Figure C.3 to Figure C.5.
- For Ethernet interfaces, measurements are required at the highest data rate supported by the interface.
- The measurement facility validation shall be performed in accordance with the relevant basic standard and, for the purposes of this publication, may be limited to the frequency range where requirements are defined in Annex A.
- Equipment with a DC power port powered by a dedicated AC/DC power converter is considered to be AC mains powered equipment and shall be measured with a power converter. Where the power converter is provided by the manufacturer, the converter provided shall be used.

A.2 Requirements for radiated emissions

The EUT is deemed to comply fully with the radiated emission requirements in this publication when it has been shown to be compliant with the applicable limits as given in Table A.2 to Table A.7 using the specified requirements in the relevant table clause.⁵

Compliance may only be shown at measurement distances for which compliant measurement facility (or site) validation measurements exist for the measurement facility used.

Where limits in a frequency range are given for different types of measurement facility and/or distances, measurements only need to be performed using one combination of measurement facility and distance. The same combination shall be used for all frequencies in the range.

⁵ In this publication, table clauses are referenced using an x.y format, where x denotes the table and y denotes the referenced clause by row within the table. For example table clause A1.2 is Table A.1, clause (row) 2.

Table A.1 – Radiated emissions, basic standards and the limitation of the use of particular methods

Table clause	Measurement facility	Validation method	Measurement		Limitations and clarifications
			Procedure	Arrangement	
A1.1	SAC or OATS with weather protection cover	5.3 of CISPR 16-1-4:2010/AMD1:2012	7.3 of CISPR 16-2-3:2010	Annex D	The maximum width of the EUT, local AE and associated cabling shall be within the test volume as demonstrated during the NSA test site validation. The validated measurement volume does not need to encompass any local AE and associated cabling which are located below the RGP or turntable, or remotely located, as described in D.1. NSA verification figures for 5 m facilities are presented in Table C.3.
A1.2	OATS without weather protection cover	5.2 of CISPR 16-1-4:2010/AMD1:2012	7.3 of CISPR 16-2-3:2010	Annex D	NSA verification figures for 5 m facilities are presented in Table C.3.
A1.3	FSOATS	8.3 of CISPR 16-1-4:2010/AMD1:2012	7.6.6 of CISPR 16-2-3:2010	Annex D	A facility validated against the FSOATS requirements shall be used for measurements above 1 GHz. The EUT, local AE and associated cabling shall be within the measurement volume as demonstrated during the test site validation. An FSOATS may be a SAC/OATS with RF absorber on the RGP or a FAR.
A1.4	FAR	5.4.7 of CISPR 16-1-4:2010/AMD1:2012	Annex C and 7.4 of CISPR 16-2-3:2010	Annex D	This table clause applies to radiated emission measurement up to 1 GHz for an EUT set-up in the table top arrangement as shown Figure D.11 and Figure D.12. Where the same room is to be used for radiated emission testing above 1 GHz, apply table clause A.3 and use the room as a FSOATS. The maximum width and height of an EUT, local AE including cables connected to local AE shall be less than half of the measurement distance as demonstrated during the test site validation. Where relevant, the height of the EUT includes 0,8 m of vertically exposed cable. Where relevant, the width of the EUT includes 0,8 m of horizontally exposed cable.
NOTE As per Clause 2, the version of CISPR 16-1-4 is CISPR 16-1-4:2010 /AMD 1:2012. The version of CISPR 16-2-3 is CISPR 16-2-3:2010/ AMD 1:2010.					

Table A.2 – Requirements for radiated emissions at frequencies up to 1 GHz for class A equipment

Table clause	Frequency range MHz	Measurement			Class A limits dB(μV/m)
		Facility (see Table A.1)	Distance m	Detector type / bandwidth	
A2.1	30 to 230	OATS/SAC	10	Quasi Peak / 120 kHz	40
	230 to 1 000				47
A2.2	30 to 230	OATS/SAC	3		50
	230 to 1 000				57
A2.3	30 to 230	FAR	10	Quasi Peak / 120 kHz	42 to 35
	230 to 1 000				42
A2.4	30 to 230	FAR	3		52 to 45
	230 to 1 000				52
Apply only A2.1 or A2.2 or A2.3 or A2.4 across the entire frequency range.					

Table A.3 – Requirements for radiated emissions at frequencies above 1 GHz for class A equipment

Table clause	Frequency range MHz	Measurement			Class A limits dB(μV/m)
		Facility (see Table A.1)	Distance m	Detector type / bandwidth	
A3.1	1 000 to 3 000	FSOATS	3	Average / 1 MHz	56
	3 000 to 6 000				60
A3.2	1 000 to 3 000			Peak / 1 MHz	76
	3 000 to 6 000				80
Apply A3.1 and A3.2 across the frequency range from 1 000 MHz to the highest required frequency of measurement derived from Table 1.					

Table A.4 – Requirements for radiated emissions at frequencies up to 1 GHz for class B equipment

Table clause	Frequency range MHz	Measurement			Class B limits dB(μV/m)
		Facility (see Table A.1)	Distance m	Detector type / bandwidth	
A4.1	30 to 230	OATS/SAC	10	Quasi Peak / 120 kHz	30
	230 to 1 000				37
A4.2	30 to 230	OATS/SAC	3		40
	230 to 1 000				47
A4.3	30 to 230	FAR	10	Quasi Peak / 120 kHz	32 to 25
	230 to 1 000				32
A4.4	30 to 230	FAR	3		42 to 35
	230 to 1 000				42
Apply only table clause A4.1 or A4.2 or A4.3 or A4.4 across the entire frequency range.					
These requirements are not applicable to the local oscillator and harmonics frequencies of equipment covered by Table A.6.					

Table A.5 – Requirements for radiated emissions at frequencies above 1 GHz for class B equipment

Table clause	Frequency range MHz	Measurement			Class B limits dB(μV/m)
		Facility (see Table A.1)	Distance m	Detector type/ bandwidth	
A5.1	1 000 to 3 000	FSOATS	3	Average/ 1 MHz	50
	3 000 to 6 000				54
A5.2	1 000 to 3 000			Peak/ 1 MHz	70
	3 000 to 6 000				74

Apply A5.1 and A5.2 across the frequency range from 1 000 MHz to the highest required frequency of measurement derived from Table 1.

Table A.6 – Requirements for radiated emissions from FM receivers

Table Clause	Frequency Range MHz	Measurement			Class B Limit dB(μV/m)	
		Facility (see Table A.1)	Distance m	Detector type / Bandwidth	Fundamental	Harmonics
A6.1	30 to 230	OATS/SAC	10	Quasi Peak / 120 kHz	50	42
	230 to 300					42
	300 to 1 000					46
A6.2	30 to 230	OATS/SAC	3		60	52
	230 to 300					52
	300 to 1 000					56
A6.3	30 to 230	FAR	10	Quasi Peak / 120 kHz	52 to 45	44 to 37
	230 to 300				45	37
	300 to 1 000				45	41
A6.4	30 to 230	FAR	3		62 to 55	54 to 47
	230 to 300				55	47
	300 to 1 000				55	51

Apply only A6.1 or A6.2 or A6.3 or A6.4 across the entire frequency range.

These relaxed limits apply only to emissions at the fundamental and harmonic frequencies of the LO. Signals at all other frequencies shall be compliant with the limits given in Table A.4.

Table A.7 – Requirements for outdoor units of home satellite receiving systems

Table Clause	Frequency Range MHz	Measurement			Class B Limits	Applicable to
		Facility (see Table A.1)	Distance m	Detector type / Bandwidth		
A7.1	30 to 1 000	SAC / OATS / FAR	See Table A.4	Quasi Peak / 120 kHz	See Table A.4	
A7.2	1 000 to 2 500	FSOATS	3	Average / 1 MHz	50 dB(μV/m)	LO leakage and spurious radiated emissions from the EUT, in the region outside ±7° of the main beam axis. See Figure H.1
	64 dB(μV/m)					
A7.3	1 000 to 18 000	FSOATS	3	Average / 1 MHz	37 dB(μV/m)	LO leakage from the EUT, in the region within ±7° of the main beam axis. See Figure H.1
A7.4	1 000 to 18 000	Conducted (Clause H.4)	n/a	Average / 1 MHz	30 dBpW	
For details of the EUT configuration, see Annex H.						
For radiated emissions measurements at frequencies up to 1 GHz, the requirements defined in Table A.4 shall be satisfied.						
Apply the appropriate limits across the entire frequency range.						
Apply the limits defined in table Clause A7.1 and A7.2. Also apply the limits defined in either table Clause A7.3 or A7.4.						

A.3 Requirements for conducted emissions

The EUT is deemed to comply with the conducted emission requirements when it has been shown to be compliant with all applicable limits as given in Table A.9 to Table A.13. The required measurement methods are stated in Table A.8.

Table A.8 – Conducted emissions, basic standards and the limitation of the use of particular methods

Table clause	Coupling device	Basic standard	Validation method	Measurement arrangement	Measurement procedure and clarifications
A8.1	AMN	Clause 7 of CISPR 16-2-1:2008	Clause 4 of CISPR 16-1-2:2003	Annex D	Use the measurement procedures defined in C.3. The impedance and phase requirements of CISPR 16-1-2 in the range 0,15 MHz to 30 MHz apply.
A8.2	AAN	Clause 7 of CISPR 16-2-1:2008	Clause 7 of CISPR 16-1-2:2003 applying the requirements of Table C.2. of this standard	Annex D and C.4.1.1	Use the measurement procedures defined in Clause C.3 and C.4.1.1. Using the clarifications in Clause C.3.6.
A8.3	Current probe	Clause 7 of CISPR 16-2-1:2008	5.1 of CISPR 16-1-2:2003	Annex D and C.4.1.1	
A8.4	CVP	Clause 7 of CISPR 16-2-1:2008	5.2.2 of CISPR 16-1-2:2003	Annex D and C.4.1.1	
A8.5	Matching and combining networks for voltage measurement into 75 Ω	n/a	C.4.2	C.4.2	Use the measurement procedures defined in C.4.2 for the measurement of the unwanted emission voltages at a TV/FM broadcast receiver tuner port
A8.6	Matching network for voltage measurement into 75 Ω	n/a	C.4.3	C.4.3	Use the measurement procedures defined in C.4.3 for wanted signal and emission voltage at the RF modulator output port.
NOTE As per Clause 2, the version of CISPR 16-1-2 is CISPR 16-1-2:2003/ AMD 1:2004/ AMD 2:2006. The version of CISPR 16-2-1 is CISPR 16-2-1:2008/ AMD 1:2010 /AMD2:2013.					

Table A.9 – Requirements for conducted emissions from the AC mains power ports of Class A equipment

Applicable to				
1. AC mains power ports (3.1.1)				
Table clause	Frequency range MHz	Coupling device (see Table A.8)	Detector type / bandwidth	Class A limits dB(μV)
A9.1	0,15 to 0,5	AMN	Quasi Peak / 9 kHz	79
	0,5 to 30			73
A9.2	0,15 to 0,5	AMN	Average / 9 kHz	66
	0,5 to 30			60
Apply A9.1 and A9.2 across the entire frequency range.				

Table A.10 – Requirements for conducted emissions from the AC mains power ports of Class B equipment

Applicable to				
1. AC mains power ports (3.1.1)				
Table clause	Frequency range MHz	Coupling device (see Table A.8)	Detector type / bandwidth	Class B limits dB(μV)
A10.1	0,15 to 0,5	AMN	Quasi Peak / 9 kHz	66 to 56
	0,5 to 5			56
	5 to 30			60
A10.2	0,15 to 0,5	AMN	Average / 9 kHz	56 to 46
	0,5 to 5			46
	5 to 30			50
Apply A10.1 and A10.2 across the entire frequency range.				

Table A.11 – Requirements for asymmetric mode conducted emissions from Class A equipment

Applicable to					
1. wired network ports (3.1.32)					
2. optical fibre ports (3.1.25) with metallic shield or tension members					
3. antenna ports (3.1.3)					
Table clause	Frequency range MHz	Coupling device (see Table A.8)	Detector type / bandwidth	Class A voltage limits dB(μV)	Class A current limits dB(μA)
A11.1	0,15 to 0,5	AAN	Quasi Peak / 9 kHz	97 to 87	n/a
	0,5 to 30			87	
	0,15 to 0,5	AAN	Average / 9 kHz	84 to 74	
	0,5 to 30			74	
A11.2	0,15 to 0,5	CVP and current probe	Quasi Peak / 9 kHz	97 to 87	53 to 43
	0,5 to 30			87	43
	0,15 to 0,5	CVP and current probe	Average / 9 kHz	84 to 74	40 to 30
	0,5 to 30			74	30
A11.3	0,15 to 0,5	Current Probe	Quasi Peak / 9 kHz	n/a	53 to 43
	0,5 to 30				43
	0,15 to 0,5	Current Probe	Average / 9 kHz		40 to 30
	0,5 to 30				30
The choice of coupling device and measurement procedure is defined in Annex C.					
AC mains ports that also have the function of a wired network port shall meet the limits given in Table A.9.					
The measurement shall cover the entire frequency range.					
The application of the voltage and/or current limits is dependent on the measurement procedure used. Refer to Table C.1 for applicability.					
Testing is required at only one EUT supply voltage and frequency.					
Applicable to ports listed above and intended to connect to cables longer than 3 m.					

Table A.12 – Requirements for asymmetric mode conducted emissions from Class B equipment

Applicable to					
1. wired network ports (3.1.32) 2. optical fibre ports (3.1.25) with metallic shield or tension members 3. broadcast receiver tuner ports (3.1.8) 4. antenna ports (3.1.3)					
Table clause	Frequency range MHz	Coupling device (see Table A.8)	Detector type / bandwidth	Class B voltage limits dB(μV)	Class B current limits dB(μA)
A12.1	0,15 to 0,5	AAN	Quasi Peak / 9 kHz	84 to 74	n/a
	0,5 to 30			74	
	0,15 to 0,5	AAN	Average / 9 kHz	74 to 64	
	0,5 to 30			64	
A12.2	0,15 to 0,5	CVP and current probe	Quasi Peak / 9 kHz	84 to 74	40 to 30
	0,5 to 30			74	30
	0,15 to 0,5	CVP and current probe	Average / 9 kHz	74 to 64	30 to 20
	0,5 to 30			64	20
A12.3	0,15 to 0,5	Current Probe	Quasi Peak / 9 kHz	n/a	40 to 30
	0,5 to 30				30
	0,15 to 0,5	Current Probe	Average / 9 kHz		30 to 20
	0,5 to 30				20
The choice of coupling device and measurement procedure is defined in Annex C.					
Screened ports including TV broadcast receiver tuner ports are measured with a common-mode impedance of 150 Ω. This is typically accomplished with the screen terminated by 150 Ω to earth.					
AC mains ports that also have the function of a wired network port shall meet the limits given in Table A.10.					
The measurement shall cover the entire frequency range.					
The application of the voltage and/or current limits is dependent on the measurement procedure used. Refer to Table C.1 for applicability.					
Measurement is required at only one EUT supply voltage and frequency.					
Applicable to ports listed above and intended to connect to cables longer than 3 m.					

Table A.13 – Requirements for conducted differential voltage emissions from Class B equipment

Applicable to 1. TV broadcast receiver tuner ports (3.1.8) with an accessible connector 2. RF modulator output ports (3.1.29) 3. FM broadcast receiver tuner ports (3.1.8) with an accessible connector						
Table clause	Frequency range MHz	Detector type/ bandwidth	Class B limits dB(μV) 75 Ω			Applicability
			Other	Local Oscillator Fundamental	Local Oscillator Harmonics	
A13.1	30 to 950	For frequencies ≤1 GHz	46	46	46	See ^a
	950 to 2 150		46	54	54	
A13.2	950 to 2 150	Quasi Peak/ 120 kHz	46	54	54	See ^b
A13.3	30 to 300		46	54	50	See ^c
	300 to 1 000	52				
A13.4	30 to 300	For frequencies ≥1 GHz	46	66	59	See ^d
	300 to 1 000				52	
A13.5	30 to 950	Peak/ 1 MHz	46	76	46	See ^e
	950 to 2 150			n/a	54	

^a Television receivers (analogue or digital), video recorders and PC TV broadcast receiver tuner cards working in channels between 30 MHz and 1 GHz, and digital audio receivers.

^b Tuner units (not the LNB) for satellite signal reception.

^c Frequency modulation audio receivers and PC tuner cards.

^d Frequency modulation car radios.

^e Applicable to EUTs with RF modulator output ports (for example DVD equipment, video recorders, camcorders and decoders etc.) designed to connect to TV broadcast receiver tuner ports. Limits specified for the LO are for the RF modulator carrier signal and harmonics.

The term 'other' refers to all emissions other than the fundamental and the harmonics of the LO.

The measurement shall cover the entire frequency range.

The EUT shall be tuned in accordance with Table B.3 and clause C.4.2.1.

Annex B (normative)

Exercising the EUT during measurement and test signal specifications

B.1 General

This annex specifies the methods for exercising the EUT during the emission measurements.

MME typically have several different functions and numerous modes of operation associated with each function.

For each function, or group of functions selected to exercise the EUT, a number of representative modes of operation, including low power/standby mode, shall be considered for testing. The mode(s) that produce(s) the highest emissions shall be selected for the final measurements.

The EUT shall be operated in the selected mode(s) while the ports are exercised in accordance with this annex.

The emissions from the various ports (as required by this publication) shall be measured while appropriate test signals are applied as specified in this annex.

All ports, including loudspeakers and display devices, shall be exercised in a manner consistent with, and representative of, normal use. Exercising signals, audio levels and display parameters shall be chosen having regard to the intended function of the EUT and shall be such as to allow the correct operation of the EUT to be assessed.

Subsequent clauses give further clarification to aid reproducibility between laboratories. A description of the methods used to exercise the EUT and all relevant ports shall be recorded in the test report. Where a deviation in the application of one of the methods defined in this annex is used (for example using a different signal level or image), a justification shall be included in the test report.

B.2 Exercising of EUT ports

B.2.1 Audio signals

For EUTs that support audio signals, the signal used to exercise the EUT shall be a 1 kHz sinusoidal signal unless otherwise specified as more appropriate by the manufacturer.

B.2.2 Video signals

EUTs that display video images or EUTs with ports that are used to provide video signals shall be exercised in accordance with Table B.1 and configured, where possible, using the parameters given in Table B.2.

Video ports shall output signals, and images shall be displayed, corresponding to the highest complexity level listed in Table B.1 that the EUT is capable of generating. However, the manufacturer may choose to exercise the displays and video ports using the text image given in Table B.1 (Complexity level 2) where emission levels using this text image are not reduced in comparison to emission levels obtained using Complexity levels 3 or 4.

Table B.1 – Methods of exercising displays and video ports

Complexity Level	Display image	Description	Examples of equipment
4 (Most)	Colour bars with moving picture element	Standard colour bar image with a small moving element. See ^a .	Digital television set, set-top box, personal computer, DVD equipment, video game console, standalone monitor.
3	Colour bars	Standard colour bar image. See ^a .	Analogue television set, display on camera, display on photo printer.
2	Text image	Where possible a pattern consisting of all H characters shall be displayed. The character size and number of characters per line shall be set so that typically the greatest number of characters per screen is displayed. If text scrolling is supported on the display, the text shall scroll	POS terminal, computer terminal without graphic capability.
1 (Least)	Typical display	The most complex display that can be generated by the EUT.	An EUT with proprietary displays and/or not capable of displaying any of the above images, electronic music keyboard, telephone.

^a This display image is also valid for monochrome displays which will display grey scale bars.

When there is more than one display or video port, each display/port shall be exercised appropriately subject to the provisions of B.2.2.

The display images may be modified, when necessary to exercise primary functions of the EUT. Where possible, these modifications should be restricted to the bottom or top half of the display area so that the image defined in the table fills the majority of the display.

For analogue television sets, only colour bars should be displayed, defined in complexity 3.

Examples of colour bars required in complexity 3 and 4 are 100/0/100/0 or 100/0/75/0 bars as specified in ITU-R Recommendation BT.471-1.

Table B.2 – Display and video parameters

Function	Setting
Hardware acceleration	Maximum.
Screen settings	Highest effective resolution (including the settings for pixel and frame rate).
Colour quality	Highest colour bit depth.
Brightness, contrast, colour saturation	Use either the factory default settings or typical settings.
Other	Adjusted to obtain a typical picture using settings giving the highest performance.

B.2.3 Digital broadcast signals

Examples of digital broadcast signal specifications are shown in Table B.4.

B.2.4 Other signals

Other ports shall be exercised using the methods defined in Table B.3.

Table B.3 – Methods used to exercise ports

Port	Methods used to exercise port
Broadcast receiver tuner port	The modulation of the RF signal carrier shall be set according to the system for which the EUT is intended. Unless otherwise defined, the input signal level at the relevant ports shall be sufficient to provide a noise-free picture and/or audio In addition refer to B.2.1 and B.2.2 Examples of digital broadcast signal specifications for digital broadcast receiver ports are given in Table B.4. The radiated emissions and mains power port conducted emissions from an EUT with broadcast reception functionality shall be assessed when tuned to one channel in each reception mode, for example: analogue TV, DVB-T, DVB-C, analogue radio, digital radio etc. For guidance on how to determine channel/s for conducted measurements on the broadcast receiver tuner port see C.4.2.1.
Wired network port	A representative signal shall be defined by the manufacturer. For ports supporting Ethernet traffic (for example 100Base-T, 1000Base-T), that can operate at multiple rates, measurements may be limited to mode in which the EUT operates at its maximum rate. When assessing an EUT transmitting 10Base-T Ethernet traffic, apply the following: In order to make reliable emission measurements representative of high LAN utilization it is only necessary to create a condition of LAN utilization in excess of 10 % and sustain that level for a minimum of 250 ms. The content of the test traffic should consist of both periodic and pseudo-random messages in order to emulate realistic types of data transmission. (Examples of pseudo-random messages: files that are compressed or encrypted. Examples of periodic messages: uncompressed graphic files, memory dumps, screen updates, disk images.) If the LAN maintains transmission during idle periods, measurements shall also be made during idle periods.
All other ports not defined above	A representative signal shall be defined by the manufacturer.

Table B.4 – Examples of digital broadcast signal specifications

General	DVB	ISDB	ATSC	DMB-T
Standard	TR 101154	-	ATSC Standard A/65	System-A (DAB/Eureka-147)
Source coding	MPEG-2 video MPEG-2 audio	MPEG-2 video MPEG-2 audio	MPEG-2 video AC-3 audio	H.264/MPEG-4 AVC
Data coding	Optional	Optional	Optional	Optional
Video elementary stream	Colour bar, with small moving element	Colour bar, with small moving element	Colour bar, with small moving element	Colour bar, with small moving element
Video bit rate	6 MBit/s	6 MBit/s	6 MBit/s	(1 ~ 11) Mbit/s
Audio elementary stream for reference measurement	1 kHz/full range –6 dB	1 kHz/full range –6 dB	1 kHz/full range –6 dB	1 kHz/full range –6 dB
Audio elementary stream for noise measurement	1 kHz/silence	1 kHz/silence	1 kHz/silence	1 kHz/silence
Audio bit rate	192 kbit/s	192 kbit/s	192 kbit/s	192 kbit/s
Terrestrial TV	DVB-T	ISDB-T	ATSC	DMB-T
Standard	EN 300 744	ARIB STD-B21 ARIB STD-B31	ATSC 8VSB	System-A (DAB/Eureka-147)
Level	50 dB(μV)/75 Ω-VHF B III 54 dB(μV)/75 Ω-UHF B IV/V	34 dB(μV) to 89 dB(μV)/75 Ω	54 dB(μV) (using ATSC 64)	18 dB(μV) ~ 97 dB(μV)
Channel	6 to 69	-	2 to 69	-
Frequency	-	470 MHz to 770 MHz, 5,7 MHz bandwidth	-	174 MHz ~ 216 MHz
Modulation	OFDM	OFDM	8 VSB or 16 VSB	DQPSK, Transmission: OFDM
Mode	2 k or 8 k	8k, 4k, 2k	-	-
Modulation scheme	16 or 64 QAM or QPSK	QPSK, DQPSK, 16 QAM, 64 QAM	-	-
Guard interval	1/4, 1/8, 1/16, 1/32	1/4, 1/8, 1/16, 1/32	-	-
Code rate	1/2, 2/3, 3/4, 5/6, 7/8	1/2, 2/3, 3/4, 5/6, 7/8	2/3	-
Useful bit rate	Variable MBits	-	19,39 MBit/s	-
Information bit rate: max	31,668 MBit/s	23,234 MBit/s	-	-
Satellite TV	DVB-S	DVB-S (Communication satellite)	ISDB-S(Broadcasting satellite)	None
Specification	EN 300 421	ARIB STD-B1	ARIB STD-B20 ARIB STD-B21	-
Level	60 dB(μV)/75 Ω	48 dB(μV) to 81 dB(μV)/75 Ω	48 dB(μV) to 81 dB(μV)/75 Ω	-
Frequency	0,95 GHz to 2,15 GHz	12,2 GHz to 12,75 GHz	11,7 GHz to 12,2 GHz	-
Frequency 1 st IF	-	1 000 MHz to 1 550 MHz, 27 MHz bandwidth	1 032 MHz to 1 489 MHz, 34,5 MHz bandwidth	-
	-	12,5 GHz to 12,75 GHz	11,7 GHz to 12,2 GHz	-
Modulation	QPSK	QPSK	TC8PSK, QPSK, BPSK	-
Code Rate	3/4	1/2, 2/3, 3/4, 5/6, 7/8	2/3(TC8PSK), 1/2, 2/3, 3/4, 5/6, 7/8(QPSK,	-

General	DVB	ISDB	ATSC	DMB-T
			BPSK)	
Useful bit rate	38,015 MBit/s	29,2 MBit/s ($r = 3/4$)	-	-
Information bit rate	-	19,4 MBit/s to 34,0 MBit/s	-	-
Information bit rate: max	-	34,0 MBit/s	52,17 MBit/s	-
Cable TV	DVB-C	ISDB-C	ATSC	-
Specification	EN 300 429 ES 201 488 ES 202 488-1 EN 302 878 (DOCSIS)	JCTEA STD-002 JCTEA STD-007	ANSI/SCTE 07	-
Level	67 dB μ V at 75 Ω for 256 QAM 60 dB μ V at 75 Ω for 64 QAM	49 dB(μ V) to 81 dB(μ V)/75 Ω (64 QAM) TDB (256 QAM)	60 dB(μ V)/75 Ω	-
Frequency	110 MHz to 862 MHz	90 MHz to 770 MHz, 6 MHz bandwidth	88 MHz to 860 MHz	-
Modulation	16/32/64/128/256 QAM	64 QAM or 256 QAM	64 QAM or 256 QAM	-
Useful bit rate	38,44 MBit/s (64 QAM) and 51,25 MBit/s (256 QAM) at 6,952 Mbaud (8 MHz channel)	-	26,970 MBit/s (64 QAM), 38,810 MBit/s (256 QAM)	-
Transmission bit rate	41,71 MBit/s (64 QAM) 55,62 MBit/s (256 QAM) at 6,952 Mbaud (8 MHz channel)	31,644 MBit/s (64 QAM) 42,192 MBit/s (256 QAM)	-	-
Information bit rate	51,25 MBit/s (256 QAM) at 6,952 Mbaud (8 MHz channel)	29,162 MBit/s 38,883 MBit/s (256 QAM)	-	-
Return path	-	-	5 MHz to 40 MHz, QPSK	-

Annex C (normative)

Measurement procedures, instrumentation and supporting information

C.1 General

This annex provides additional information, measurement procedures and requirements to supplement the normative references defined in Table A.1 and Table A.8. Further supporting information is also provided in Annex G (informative).

This annex is divided into 3 main clauses:

- C.2 Instrumentation and supporting information;
- C.3 General measurement procedures;
- C.4 MME-related measurement procedures.

C.2 Instrumentation and supporting information

C.2.1 General

Each piece of measurement apparatus shall comply with the relevant requirements defined in the basic standards given in Table A.1 and Table A.8.

C.2.2 Using CISPR 16 series as the basic standard

C.2.2.1 General

The measuring receiver shall meet the relevant specifications of CISPR 16-1-1:2010, defined in Clause 2. Detectors and bandwidths shall be used as specified in relevant tables in Annex A. Where this publication specifies the use of an average detector, the linear average detector defined in Clause 6 of CISPR 16-1-1:2010 shall be used.

If the level of an isolated emission exceeds any relevant limit, it shall be ignored, provided that the following two conditions are met when measured over a two minute interval:

- 1) the emission does not exceed the limit for more than 1 s;
- 2) the emission does not exceed the limit more than once in any 15 s observation period.

Care shall be taken to avoid overloading the measurement system. See Annex E.

Measurement instruments provided with RF preselectors, which automatically follow the frequency being scanned, shall have a sufficiently long measurement time on each frequency to avoid errors in the measured amplitude values.

When using spectrum analysers during prescan (see C.3.2) measurements, the video bandwidth of the measurement instrument should be equal to, or greater than, the resolution bandwidth in order not to influence the measurement results. Other settings of resolution and video bandwidth may be used, but care should be taken to ensure the settings do not adversely influence the results.

C.2.2.2 Antennas for radiated emissions measurements

Any suitable broadband linearly polarised antenna or tuned dipole may be used during measurements. These shall be calibrated in free space conditions using the procedures in ANSI C63.5.

C.2.2.3 Ambient signals

If ambient signals are masking EUT emissions then the procedure defined in Annex A of CISPR 16-2-3:2010/AMD1:2010 shall be used to reduce the impact of each ambient. The frequencies and levels of the ambient signals masking EUT emissions shall be recorded in the test report.

C.2.2.4 Boundary of the EUT, local AE and associated cabling and measurement distance for radiated emissions measurements

The EUT and local AE shall be arranged in the most compact practical arrangement within the test volume, while respecting typical spacing and the requirements defined in Annex D. The central point of the arrangement shall be positioned at the centre of the turntable. The measurement distance is the shortest horizontal distance between an imaginary circular periphery just encompassing this arrangement and the calibration point of the antenna. See Figure C.1 and Figure C.2.

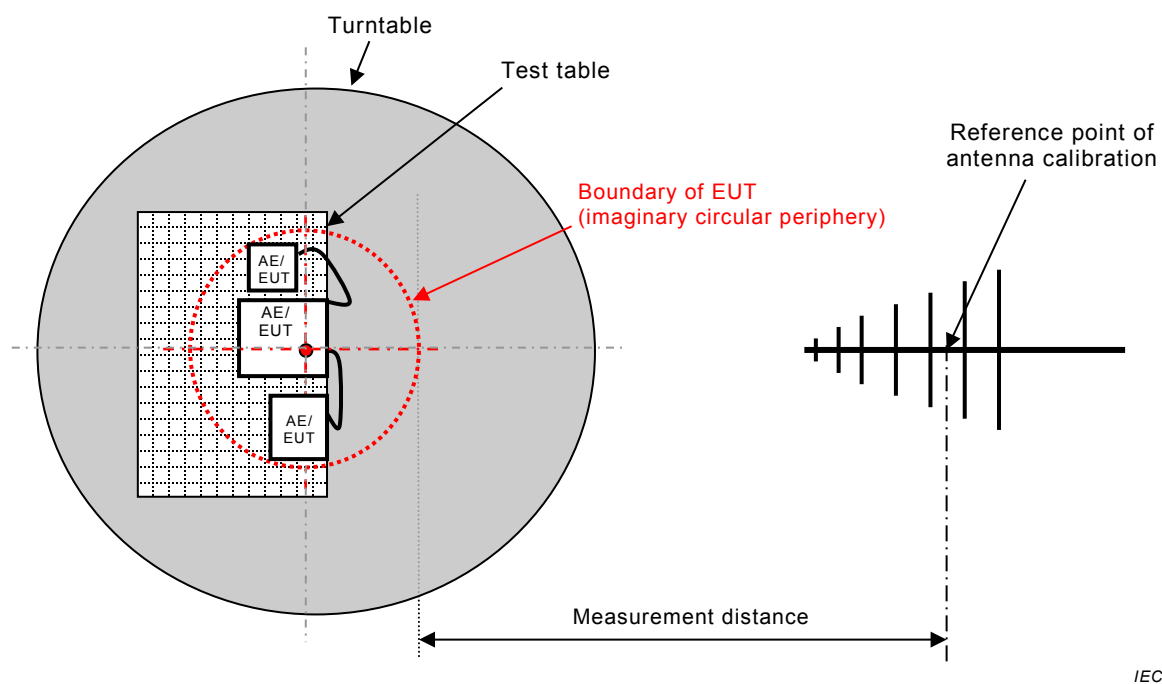


Figure C.1 – Measurement distance

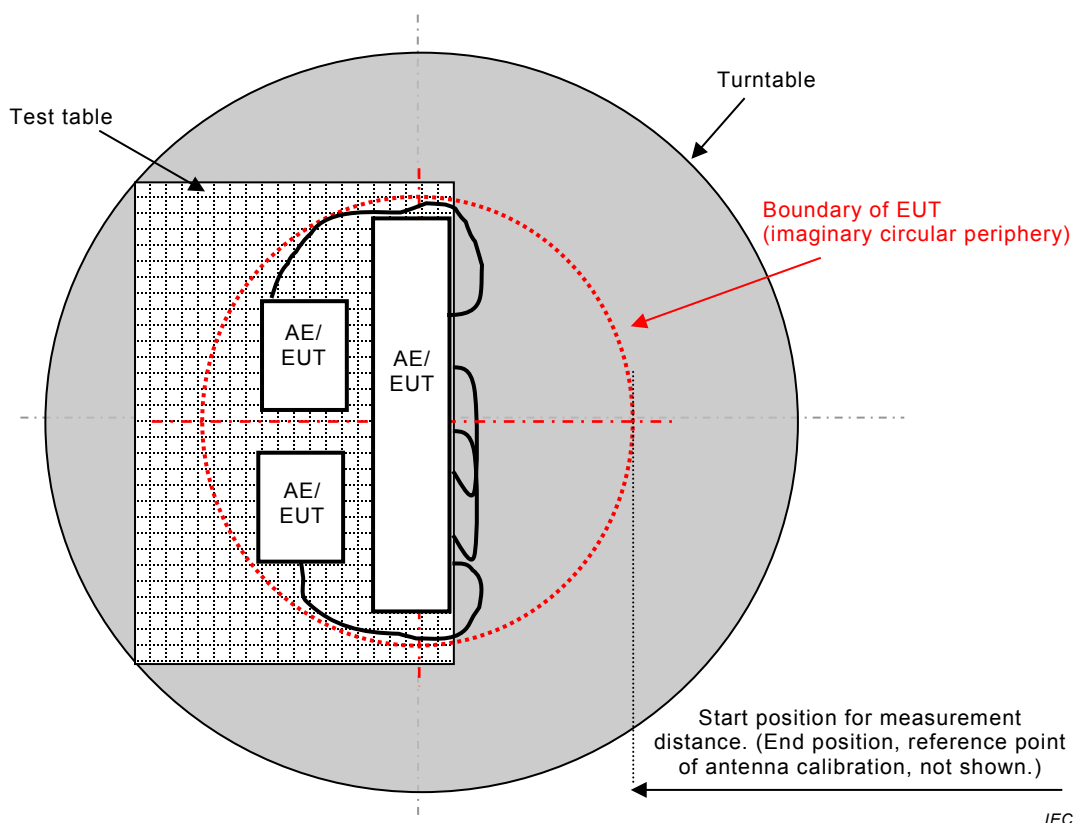


Figure C.2 – Boundary of EUT, Local AE and associated cabling

Where possible any HID should be placed in a typical arrangement. HID may be placed at the front edge of the table if the table is not deeper than 1 m. If a deeper table is used, the HID may only be placed at the front edge if this does not increase the size of the imaginary circular periphery, otherwise the HID may be placed at a distance of 1 m from the back edge of the table to the front of the HID.

Where AE is placed outside the measurement area (as described in D.1.1), this remotely located AE and its associated cabling shall not be considered to be within the circular periphery for the purposes of defining the measurement distance.

Where a test facility has been validated (in accordance with Tables 1 and 2 of CISPR 16-1-4:2010/AMD1:2012 or in C.4.4) for a different measurement distance not defined in Table A.2 to Table A.7, the measurement may be performed at that distance. In this case the limit L_2 , corresponding to the selected measurement distance d_2 , shall be calculated by applying the following formula:

$$L_2 = L_1 + 20 \log(d_1/d_2)$$

Where L_1 is the specified limit in dB μ V/m at the distance d_1 ; and, L_2 is the new limit for distance d_2 . The distances d_1 and d_2 use the same unit, such as m.

In addition, when using this formula, the test report shall show the limit L_2 and the actual measurement distance d_2 . To ensure consistency of calculation, wherever possible the limits for the 10 m measurement distance (up to 1 GHz) and the 3 m measurement distance (above 1 GHz) shall be used as the basis for calculations of limits at other measurement distances.

The minimum measurement distance for radiated emission measurement for frequencies below 1 GHz shall be 3 m and for frequencies above 1 GHz shall be 1 m.

When using a FAR and the position of the receiving antenna cannot be changed, then the limits shall be adjusted based on the above defined formula.

C.2.3 EUT cycle time and measurement dwell time

The cycle time is the period for the EUT to complete one entire operation. A dwell time longer than the cycle time shall normally be used during all formal measurements. The dwell time may be limited to 15 s.

C.3 General measurement procedures

C.3.1 Overview

The radiated and conducted emissions shall be assessed against the relevant requirements in Annex A, using the appropriate procedures defined in Table A.1 and Table A.8. The following subclauses provide a general overview taking into account the test facilities where the measurements are performed. Further information is also contained in C.4 and Annex G.

In order to speed-up the measurement procedure, peak detectors may be used in accordance with the decision trees defined in Figure C.3 to Figure C.5.

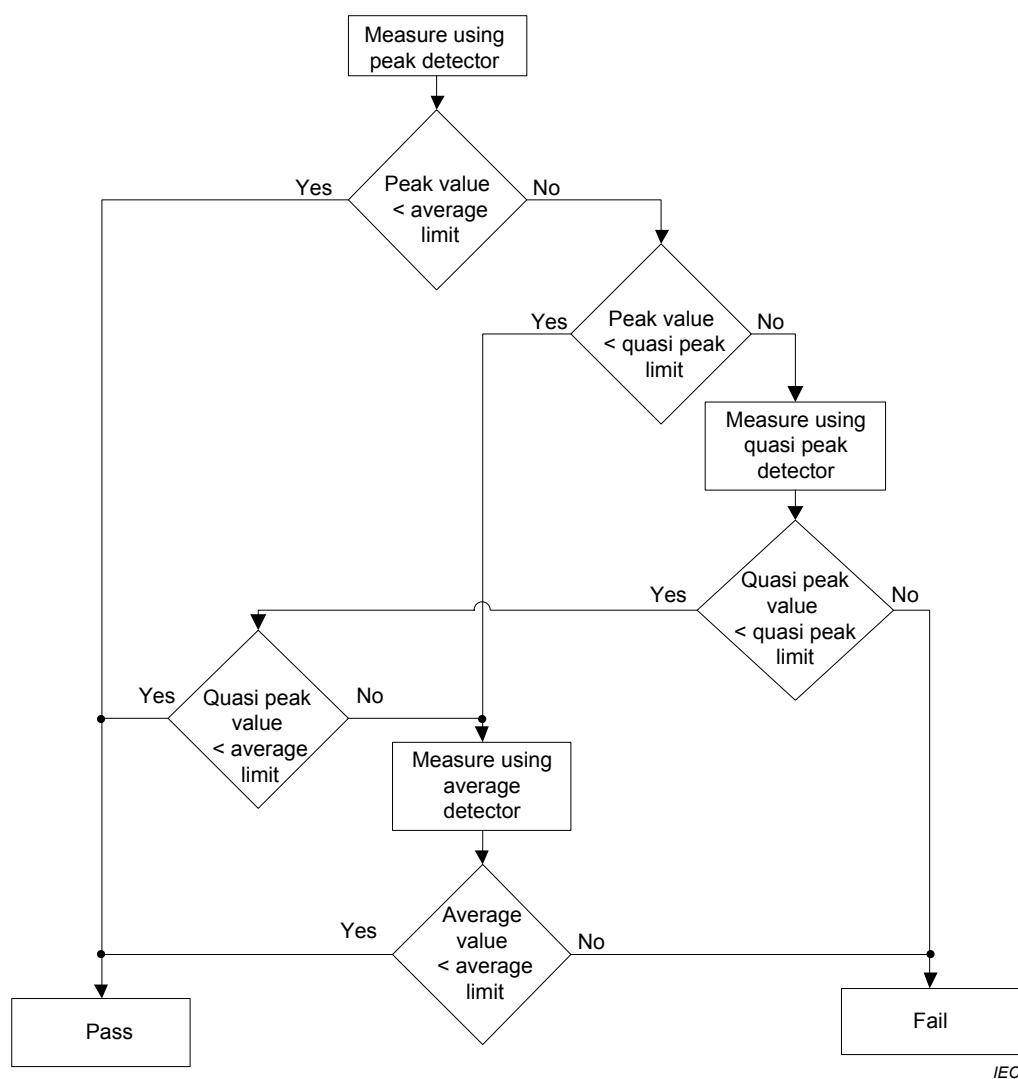


Figure C.3 – Decision tree for using different detectors with quasi peak and average limits

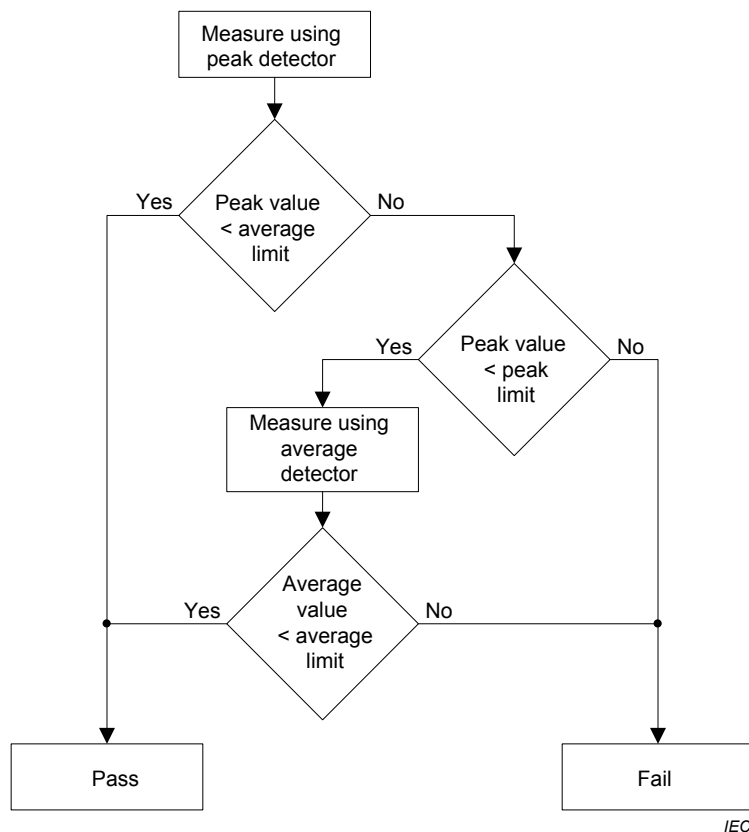


Figure C.4 – Decision tree for using different detectors with peak and average limits

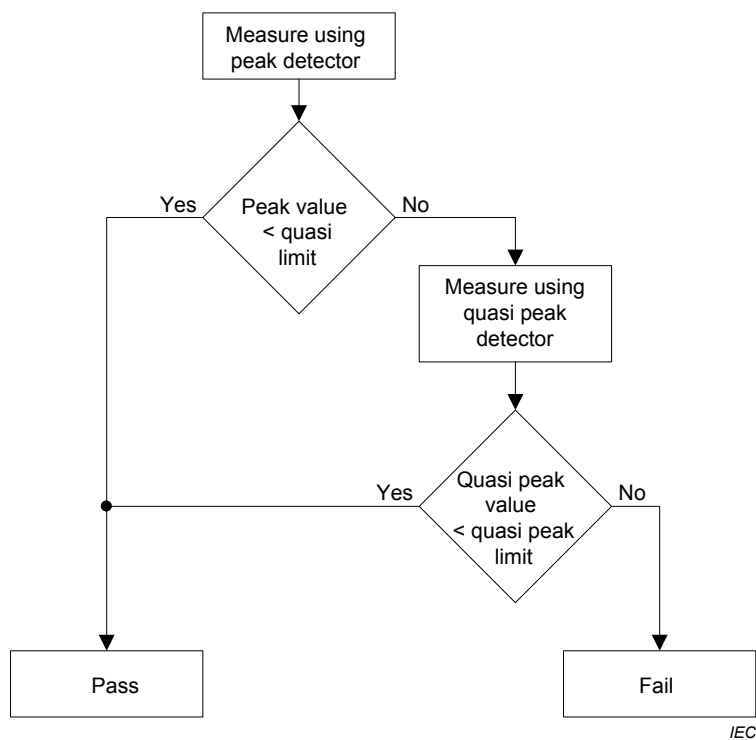


Figure C.5 – Decision tree for using different detectors with a quasi-peak limit

C.3.2 Prescan measurements

The purposes of a prescan measurement are to determine the frequencies at which the EUT produces the highest level of emissions and to help select the configuration(s) to be used in the formal measurements. For details on prescan measurements refer to Annex E.

C.3.3 Formal measurements

The configuration(s) found during the prescan measurement that produce(s) the highest amplitude emission relative to the limit shall be used for the formal measurement. Where prescan measurements have not been performed, the formal measurements shall be performed using the configuration(s) that are expected to produce the highest amplitude emissions relative to the limit; and, the reasons for the selection shall be given in the test report.

The formal measurements shall be performed using a compliant measurement facility as defined in Table A.1 and Table A.8. The measurements shall be performed in accordance with the basic standards and the requirements of this document.

Where measurements are performed using a FAR, the antenna together with the cable may be moved to achieve the specified measurement distance.

C.3.4 Specifics for radiated emission measurements

Formal emissions measurements shall determine the highest emission level at any frequency at which a limit is set, considering the following:

- antenna polarization (horizontal and vertical);
- full rotation of the EUT, local AE and associated cabling (through 360 degrees);
- antenna height.

Where measurements are made using an OATS/SAC, the antenna height scan shall be restricted to a range of 1 m to 4 m above the RGP.

Where measurements are made using a FSOATS, the antenna height scan shall encompass those heights defined in Figure 14, Figure 15 and Table 2 of CISPR 16-2-3:2010/AMD1:2010.

If no prescan has been performed, then the formal measurements shall be carried out across the entire frequency range.

C.3.5 Specifics for conducted emission measurements on the AC mains power ports

Testing shall include measurements on all live and neutral lines (or ports).

For guidance on elements of conducted measurements see 6.5.1 of CISPR 16-2-1:2008/ AMD 1:2010 /AMD2:2013.

C.3.6 Specifics for conducted emission measurements on analogue/digital data ports

MME may have different types of analogue/digital data ports to which different requirements apply as stated in Annex A. As a minimum, one port of each type shall be exercised and assessed against the requirements. The measurement procedures shall be selected using the information given in Table C.1 and elsewhere in this clause.

When an EUT has multiple analogue/digital data ports of the same type, at least one port of each type shall be assessed. Where it has been shown by pre-scanning or some other

technique that the ports are similar in their emission performance, only a single port need be assessed.

For guidance on elements of conducted measurements see 6.5.1 of CISPR 16-2-1:2008/ AMD 1:2010 /AMD2:2013.

C.3.7 Specifics for conducted emission measurements on broadcast receiver tuner ports

One of each port type (digital, analogue, satellite etc.) shall be assessed using the measurement procedures defined in C.4.2.

For guidance on elements of conducted measurements see 6.5.1 of CISPR 16-2-1:2008/ AMD 1:2010 /AMD2:2013.

C.3.8 Specifics for conducted emission measurements on RF modulator output ports

One of each port type shall be assessed using the measurement procedure defined in C.4.3.

For guidance on conducted measurements see 6.5.1 of CISPR 16-2-1:2008/ AMD 1:2010 /AMD2:2013.

C.4 MME-related measurement procedures

C.4.1 Measurement of conducted emissions at analogue/digital data ports

C.4.1.1 Measurement procedure selection

The purpose of these tests is to measure the common mode emission at analogue/digital data ports of an EUT. Appropriate measurement procedures are defined in Table C.1.

Table C.1 – Analogue/digital data port emission procedure selection

	Cable type	Number of pairs	Example of relevant figures	Measurement type	Procedures
1	Balanced Unscreened	1 (2 wire) 2 (4 wire) 3 (6 wire) 4 (8 wire)	Figure G.1 to Figure G.3 Figure G.2 to Figure G.5 Figure G.3 Figure G.3 or Figure G.6 or Figure G.7	Voltage	C.4.1.6.2.
2	Balanced Unscreened	Ports connected to cables with more than 4 balanced pairs or where the port is unable to function correctly when connected through an AAN.	n/a	Voltage and Current	C.4.1.6.4.
3	Screened or Coaxial	n/a	Figure G.8 Figure G.9 Figure G.10 or Figure G.11	Voltage	C.4.1.6.2.
4	Screened or Coaxial	n/a	n/a	Voltage or Current	C.4.1.6.3
5	Unbalanced cables	n/a	n/a	Voltage and Current	C.4.1.6.4
6	AC Mains	n/a	AMN CISPR 16-1-2:2003/ AMD 1:2004/ AMD 2:2006, Figure 5 and Figure 6	Voltage	Apply the requirements of Table A.9 or Table A.10, as appropriate. The AMN shall be used as a voltage probe.
Where used, an AAN shall satisfy all the requirements defined in C.4.1.2. Where used, the current probe shall satisfy the requirements defined in C.4.1.4 and the CVP shall satisfy the requirements defined in C.4.1.5. The mains voltage shall be supplied to the EUT via the AMN used when measuring the mains terminal emission voltages according to Table A.9 or Table A.10. Where used the AAN shall be selected in accordance with C.4.1.3. Care shall be taken when measuring common mode current with an AAN in the circuit to ensure that the measurement method accurately measures both the launched and converted components of the common mode current. The procedure defined in C.4.1.6.2 gives results with lower measurement uncertainty than the procedures in C.4.1.6.3 and C.4.1.6.4					

C.4.1.2 Characteristics of AAN

Measurement of common mode (asymmetric mode) current or voltage emissions at wired network ports for attachment of unscreened balanced pairs shall be performed with the wired network port connected by a cable to an AAN. The AAN shall define the common mode termination impedance seen by the wired network port during the emission measurements.

The combination of the AAN and all appropriate adapters required to connect to the EUT and AE shall have the following properties:

- The common mode termination impedance of the EUT port, in the frequency range 0,15 MHz to 30 MHz, shall be $150 \Omega \pm 20 \Omega$, phase angle $0 \pm 20^\circ$.
- The AAN shall provide sufficient isolation against emissions from an AE or load connected to the wired network port being assessed. The attenuation of the AAN, for common mode emissions originating from the AE, shall be such that the measured level of these

emissions at the measuring receiver input is at least 10 dB below the relevant emission limit.

The preferred minimum isolation is:

- 35 dB to 55 dB, increasing linearly with the logarithm of the frequency across the range 0,15 MHz to 1,5 MHz ;
- 55 dB across the range 1,5 MHz to 30 MHz

NOTE Isolation is the ratio of the common mode emission originating in an AE to that consequentially appearing at the EUT port of the AAN.

- c) The AAN shall meet the longitudinal conversion loss (LCL) requirements stated in Table C.2 from 0,15 MHz to 30 MHz. Actual LCL values to simulate different cables are defined in Table C.2.

Table C.2 – LCL values

Cable category	LCL dB	Tolerance
3 (or better)	$L_{LCL}(dB) = 55 - 10 \lg \left[1 + \left(\frac{f}{5} \right)^2 \right]$	±3 dB
5 (or better)	$L_{LCL}(dB) = 65 - 10 \lg \left[1 + \left(\frac{f}{5} \right)^2 \right]$	±3 dB for $f < 2$ MHz -3 dB/+4,5 dB for f between 2 MHz and 30 MHz
6 (or better)	$L_{LCL}(dB) = 75 - 10 \lg \left[1 + \left(\frac{f}{5} \right)^2 \right]$	±3 dB for $f < 2$ MHz -3 dB/+6 dB for f between 2 MHz and 30 MHz
Coaxial	n/a	n/a

NOTE 1 f has the units of MHz in the above formulas.

NOTE 2 These LCL values are approximations of the LCL values of typical unscreened balanced cables in representative environments. The specification for category 3 is considered representative of the LCL values of typical telecommunication copper access networks.

- d) The insertion loss or other deterioration of the signal quality in the wanted signal frequency band caused by the presence of the AAN shall not significantly affect the normal operation of the EUT.
- e) The AAN voltage division factor (V_{vdf}) shall be within ±1 dB of the nominal value across the frequency range 0,15 MHz to 30 MHz. The AAN voltage division factor is calculated as follows:

$$V_{vdf} = 20 \lg \left| \frac{V_{cm}}{V_{mp}} \right| \text{ dB}$$

where

V_{cm} is the common mode voltage appearing across the common mode impedance presented to the EUT by the AAN; and,

V_{mp} is the resulting receiver voltage measured directly at the voltage measurement port of the AAN.

The voltage division factor shall be added to the measured voltage measured by the receiver directly at the voltage measurement port of the AAN and the result compared with the voltage limits in Table A.11 or Table A.12 as applicable.

C.4.1.3 Selection of AAN for unscreened balanced multi-pair cables

The type of AAN is selected according to the number of pairs physically in the cable excluding any pairs which do not have a galvanic connection to any part of the EUT, including ground.

The AAN described in Figure G.4 to Figure G.7 are only appropriate for use where there are no unconnected pairs in the cable. The AANs shown in Figure G.1 to Figure G.3 are suited to any situation, including those where the use of some of the pairs is unknown, or some pairs are known to be unconnected.

C.4.1.4 Current probe characteristics

The current probe shall have a uniform frequency response without resonances within the frequency range of interest. It shall be capable of operating without saturation effects caused by the operating currents in the primary winding.

The insertion impedance of the current probe shall not exceed 1 Ω . See 5.1 of CISPR 16-1-2:2003/ AMD 1:2004/ AMD 2:2006.

C.4.1.5 Characteristics of the CVP

The CVP defined in 5.2.2 of CISPR 16-1-2:2003/ AMD 1:2004/ AMD 2:2006 shall be used.

C.4.1.6 Measurements at wired network ports, antenna ports and optical fibre cables having metallic screens or strength members

C.4.1.6.1 Choice of measurement procedure

This clause describes the various measurement procedures that can be used to measure the common mode conducted emission of analogue/digital data ports. Depending on the cable type, different procedures may be used, each with its advantages and disadvantages. See G.2 and Table G.1.

C.4.1.6.2 Measurement procedure using an AAN

Measurement is made at wired network ports using AANs with longitudinal conversion losses as defined in Table C.2. The AAN for the cable category specified by the equipment documentation provided to the user shall be used. The level of emissions from the EUT shall not exceed the applicable limits of Annex A.

When emission voltage measurements are performed, the AAN shall provide a voltage measurement port suitable for connection to a measuring receiver while simultaneously satisfying the analogue/digital data port common mode termination impedance requirements.

For unscreened cables containing balanced pairs, an AAN conforming to C.4.1.2 shall be used. The LCL values of the AAN shall be within the tolerance given in Table C.2 for an AAN appropriate to the cable category connected to the EUT.

The procedure shall be as follows:

- arrange the EUT, local AE and associated cabling (examples are given Annex D);
- measure the voltage at the measurement port of the AAN;
- correct the measured voltage by adding the AAN voltage division factor (V_{vdf}) defined in C.4.1.2 e);
- compare the corrected voltage with the limit.

C.4.1.6.3 Measurement procedure using a 150 Ω load connected to the outside surface of the cable screen

This procedure can be used for all types of coaxial cables, screened multi-pair cables or optical fibre cables having metallic screens or strength members.

The procedure shall be follows:

- Arrange the EUT, local AE and associated cabling, generally as shown in Figure D.4 or Figure D.5, replacing the CVP in Figure D.4 by a 150 Ω adaptor. The current probe to EUT horizontal distance may be increased to 0,8 m. Alternatively in Figure D.5, the AAN shall be replaced by the 150 Ω adaptor/current probe combination.
- Break the external protective insulation (exposing the shield) and connect a 150 Ω resistor with a physical connection between the cable screen and the RGP. The 150 Ω resistor shall be $\leq 0,3$ m from the outside surface of the screen to ground. For further information refer to G.2.5.
- Insert a ferrite tube or clamp between the 150 Ω connection and the AE.
- Measure the current with a current probe and compare to the current limit. Use the procedure given in C.4.1.7 to measure the asymmetric common mode impedance from the 150 Ω resistor towards the AE, which should be much greater than 150 Ω so as not to affect the measurement at frequencies emitted by the EUT.
- The separation distance between the AE and the ground plane is not critical if the impedance of the ferrite is higher than that given in G.2.5. If this cannot be achieved, then the AE shall be placed at 0,4 m from a vertical or horizontal RGP, as defined for the EUT in Table D.2.

The voltage measurement may also be performed in parallel with the 150 Ω resistor with a high impedance probe. Alternatively, the measurement may be performed using a "150 Ω to 50 Ω adaptor" described in IEC 61000-4-6:2008 as the 150 Ω load and applying the appropriate correction factor (9,5 dB in case of the "150 Ω to 50 Ω adaptor").

C.4.1.6.4 Measurement procedure using a combination of current probe and CVP

As an AAN is not used in this procedure, the common mode impedance is not stabilized. The emissions from the EUT shall be measured using both the voltage and current probes and the measured levels compared with the voltage and the current limits respectively.

The procedure shall be as follows:

Arrange the EUT, local AE and associated cabling as defined in Annex D, either as shown in Figure D.4 or as shown in Figure D.5, replacing the AAN with the current probe/CVP combination.

A CMAD or similar device may be used between the AE and the current probe/CVP combination.

The AE shall be placed 0,4 m from a vertical or horizontal RGP, as defined for the EUT in Table D.2. Where appropriate, the EUT shall be powered using an AMN placed on the RGP. The AMN shall be placed $>0,10$ m from the nearest edge of the RGP. The EUT power cord shall be routed away from the cable used for the measurements to minimize coupling or crosstalk effects.

The current shall be measured with the current probe and the results compared with the current limits.

The voltage shall be measured with the CVP specified in C.4.1.5.