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INTERNATIONAL STANDARD

colour inside

INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE

Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment

CISPR 15:2018-05+AMD1:2024-07 CSV(en)

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Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 33.100.10

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

CISPR 15
Edition 9.0 2018-05

LIMITS AND METHODS OF MEASUREMENT OF RADIO DISTURBANCE CHARACTERISTICS OF ELECTRICAL LIGHTING AND SIMILAR EQUIPMENT

INTERPRETATION SHEET 1

This interpretation sheet has been prepared by subcommittee CISPR F: Interference relating to household appliances tools, lighting equipment and similar apparatus, of IEC technical committee CISPR: International special committee on radio interference.

The text of this interpretation sheet is based on the following documents:

DISH	Report on voting
CIS/F/777/DISH	CIS/F/790/RVDISH

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

CISPR 15 interpretation sheet on the worst-case mode of operation

Introduction

Subclause 7.5 specifies the operating modes of lighting equipment that must be considered during an emission test. A few examples are given to support the explanation of what 'different operating modes' means. The list of examples is of course not exhaustive. Apparently, the example of 'colour shifting' is not clear enough and it is sometimes interpreted as if any possible colour and/or correlated colour temperature (CCT) setting that lighting equipment may produce shall be assessed during measurements. Many types of LED lighting may be set in many different colours and CCTs. Compared to other operational-mode related influence quantities such as light level regulation, flashing or radio communication, the risk of not capturing the maximum level of electromagnetic (EM) disturbances due to different colour or CCT settings is very small, provided that all channels of a LED driver used to change colour or CCT are operative. The 'colour shifting'-example was meant for example for a mode where the light output continuously switches from one colour to another with a certain repetition frequency (e.g. applied for entertainment, events etc.), instead of emitting a single stable colour and/or CCT.

ICS 33.100.10

CISPR 15:2018-05/ISH1:2019-11(en)

Question

What is the meaning of example ‘colour shifting’ as mode of operation to be considered during testing? What colour and/or colour temperature should be selected in case lighting equipment can be set in a wide range of colours and/or CCTs?

Interpretation

The example ‘colour shifting’ in the first paragraph of 7.5 of CISPR 15:2018 must not be interpreted as if any possible colour and/or CCT setting that lighting equipment may produce shall be assessed during measurements.

Generally, according to 7.5 the worst case shall be found by prescanning every mode of operation over at least one repetition interval of the specific mode.

Alternatively, measurements can be performed using the setting(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.

A reason could be that highest level of electromagnetic (EM) disturbances will be captured if all channels of a LED driver used to create different colours and/or CCTs are operative. The number of channels applied depends on the LED-driver/LED-light-source architecture. Often, maximum EM disturbances can be achieved by selecting a white colour and/or a CCT setting in the middle of the specified CCT range.

EXAMPLE Colour variation and CCT variation may be achieved using a 5-channel LED driver powering three LED strings for colour (RGB) setting and two cool white and warm white LED strings for CCT setting. Hence, in case the lighting equipment under test is capable to operate at different colours and/or CCTs, a white colour and/or a single CCT in the middle of the specified CCT range may be selected[1].

1 7.4 of CISPR 15:2018, also still applies.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE

LIMITS AND METHODS OF MEASUREMENT OF RADIO DISTURBANCE CHARACTERISTICS OF ELECTRICAL LIGHTING AND SIMILAR EQUIPMENT

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This consolidated version of the official IEC Standard and its amendment has been prepared for user convenience.

CISPR 15 edition 9.1 contains the ninth edition (2018-05) [documents CIS/F/733/FDIS and CIS/F/736/RVD], its interpretation sheet (2019-11), and its amendment 1 (2024-07) [documents CIS/F/851/FDIS and CIS/F/854/RVD].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions are in green text, deletions are in strikethrough

red text. A separate Final version with all changes accepted is available in this publication.

International Standard CISPR 15 has been prepared by subcommittee CIS/F: Interference relating to household appliances tools, lighting equipment and similar apparatus, of IEC technical committee CISPR: International special committee on radio interference.

This ninth edition cancels and replaces the eighth edition published in 2013 and its Amendment 1:2015. This edition constitutes a technical revision.

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

a) full editorial revision and restructuring;
b) the restriction to mains and battery operation is deleted in the scope;
c) radiated disturbance limits in the frequency range 300 MHz to 1 GHz have been introduced;
d) the load terminals limits and the CDNE (alternative to radiated emissions) limits have changed;
e) deletion of the insertion-loss requirements and the associated Annex A;
f) introduction of three basic ports: wired network ports, local wired ports and the enclosure port;
g) introduction of a more technology-independent approach;
h) replacement of Annex B (CDNE) by appropriate references to CISPR 16-series of standards;
i) modified requirements for the metal holes of the conical housing;
j) new conducted disturbance measurement method for GU10 self-ballasted lamp;
k) addition of current probe measurement method and limits for various types of ports (in addition to voltage limits and measurement methods);
l) introduction of the term 'module' (instead of independent auxiliary) and requirements for measurement of modules using a host (reference) system;
m) modified specifications for stabilization times of EUTs;
n) for large EUT (> 1,6 m), addition of the magnetic field measurement method using a 60 cm loop antenna at 3 m distance (method from CISPR 14-1) as an alternative to the 3 m and 4 m LAS.

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

FDIS	Report on voting
CIS/F/733/FDIS	CIS/F/736/RVD

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

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

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

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

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INTRODUCTION to Amendment 1

This Amendment includes the following significant technical changes with respect to CISPR 15:2018.

a) The voltage probe method for the conducted disturbance measurement of local wired port other than the electrical power supply interface of ELV lamps has been deleted.

b) Limits and measurement methods have been introduced for radiated disturbance of the enclosure port in the frequency range 1 GHz to 6 GHz.

c) The test set-up for the conical metal housing for single capped lamps has been rotated.

d) The arrangement of cables connected to interfaces of wired network ports has been modified. Cable length has been extended to 1,0 m.

e) Measuring arrangements for conducted disturbances for very large EUTs have been clarified.

f) Annex E regarding statistical methods has been deleted.

LIMITS AND METHODS OF MEASUREMENT OF RADIO DISTURBANCE CHARACTERISTICS OF ELECTRICAL LIGHTING AND SIMILAR EQUIPMENT

1 Scope

This document ~~applies to~~ sets out requirements for controlling the emission (radiated and conducted) of radiofrequency disturbances from:

– lighting equipment (3.3.16) and modules, except for the types excluded in the second paragraph;

– the lighting part of multi-function equipment where this lighting part is a primary function;

NOTE 1 Examples are lighting equipment with visible-light communication~~, entertainment lighting~~.

– UV and IR radiation equipment for residential and non-industrial applications;

– simple advertising signs (see 3.3.1);

~~NOTE 2 Examples are neon tube advertising signs.~~

– decorative and entertainment lighting (see 3.3.6);

– emergency signs.

Excluded from the scope of this document are:

– components or modules intended to be built into lighting equipment and which are not user-replaceable;

~~NOTE 3 See CISPR 30 (all parts) for built-in controlgear.~~

~~– lighting equipment operating in the ISM frequency bands (as defined in Resolution 63 (1979) of the ITU Radio Regulation);~~

~~– lighting equipment for aircraft and airfield facilities (runways, service facilities, platforms);~~

~~– video signs;~~

– lighting equipment intended exclusively for aircraft or airfield facilities (runways, service facilities, platforms). However, general-purpose lighting that can be installed in many locations, including installations not related to aircraft or airfield, is not excluded from the scope of this document;

– installations;

– equipment for which the electromagnetic compatibility requirements in the radio-frequency range are explicitly formulated in other ~~CISPR~~ IEC standards, even if they incorporate a built-in lighting function.

NOTE 42 Examples of exclusions are:

– equipment with built-in lighting devices for display back lighting, scale illumination and signalling;

~~– SSL-displays;~~

– video signs and dynamic displays (in scope of CISPR 32);

– range hoods, refrigerators, freezers (in scope of CISPR 14);

– photocopiers, projectors (in scope of CISPR 32);

– lighting equipment for road vehicles (in scope of CISPR 12);

– maritime equipment (in scope of IEC TC 18 and TC 80);

– lighting equipment operating in the ISM frequency bands (in scope of CISPR 11).

The frequency range covered is 9 kHz to 400 GHz. No measurements need to be performed at frequencies where no limits are specified in this document.

Multi-function equipment which is subjected simultaneously to different clauses of this document and/or other standards need to meet the provisions of each clause/standard with the relevant functions in operation.

For equipment outside the scope of this document and which includes lighting as a secondary function, there is no need to separately assess the lighting function against this document, provided that the lighting function was operative during the assessment in accordance with the applicable standard.

NOTE 5 Examples of equipment with a secondary lighting function can be range hoods, fans, refrigerators, freezers, ovens and TV with ambient lighting.

The ~~radiated~~ emission requirements in this document 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~~ including their spurious emissions.

Within the remainder of this document, wherever the term "lighting equipment" or "EUT" is used, it is meant to be the electrical lighting and similar equipment falling in the scope of this document as specified in this clause.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60038, *IEC standard voltages*

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

IEC 60050-845:1987, *International Electrotechnical Vocabulary – Chapter 845: Lighting*

IEC 60061-1, *Lamp caps and holders together with gauges for the control of interchangeability and safety – Part 1: Lamp caps*

IEC 60081, *Double-capped fluorescent lamps – Performance specifications*

IEC 60598-1:2014, *Luminaires – Part 1: General requirements and tests*
IEC 60598-1:2014/AMD1:2017

IEC 60921, *Ballasts for tubular fluorescent lamps – Performance requirements*

IEC 61000-4-20:2010: *Electromagnetic compatibility (EMC) – Part 4-20: Testing and measurement techniques – Emission and immunity testing in transverse electromagnetic (TEM) waveguides*

IEC 61195, *Double-capped fluorescent lamps – Safety specifications*

IEC 62504:2014, *General lighting – Light emitting diode (LED) products and related equipment – Terms and definitions*

CISPR 16-1-1:~~2015~~2019, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus*

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

CISPR 16-1-4:~~2010~~2019, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-4: Radio disturbance and immunity measuring apparatus – Antennas and test sites for radiated disturbance measurements*
CISPR 16-1-4:~~2010~~2019/AMD1:~~2012~~2020
CISPR 16-1-4:~~2010~~2019/AMD2:~~2017~~2023

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*
CISPR 16-2-1:2014/AMD1:2017

CISPR 16-2-3:2016, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-3: Methods of measurement of disturbances and immunity – Radiated disturbance measurements*
CISPR 16-2-3:2016/AMD1:2019
CISPR 16-2-3:2016/AMD2:2023

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*
CISPR 16-4-2:2011/AMD1:2014
CISPR 16-4-2:2011/AMD2:2018

CISPR TR 30-1:2012, *Test method on electromagnetic emissions – Part 1: Electronic control gear for single- and double-capped fluorescent lamps*

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

ISO/IEC 17025:2005[1], *General requirements for the competence of testing and calibration laboratories*

3 Terms, definitions and abbreviated terms

3.1 General

For the purposes of this document, the terms and definitions given in IEC 60050-161, IEC 62504, IEC 60050-845 and the following apply.

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

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

1 This edition was replaced by ISO/IEC 17025:2017 but the listed edition applies.

3.2 General terms and definitions

3.2.1
base of the luminaire
mounting surface of the luminaire in normal use, usually the side opposite of the optical window

3.2.2
clock frequency
fundamental frequency of any signal used in the EUT excluding those generated inside an integrated circuit (IC) and which are solely used inside the same IC without being accessible outside that IC, and excluding those used exclusively for radio transmission or radio receiving functions

Note 1 to entry: High frequencies are often generated inside integrated circuits (IC) by phase-locked-loop (PLL) circuits from lower clock oscillator frequencies outside the IC.

3.2.3
ELV
extra-low voltage
voltage which does not exceed 50 V AC or 120 V ripple free DC between conductors or between any conductor and earth (voltage band 1 of IEC 60449) applied to load interfaces supplying power to lighting equipment, excluding interfaces used for communication or data transfer

Note 1 to entry: Ripple free is conventionally defined for sinusoidal ripple voltage as ripple content of not more than 10 % RMS: the maximum peak value does not exceed 140 V for a nominal 120 V ripple-free DC system.

[SOURCE: IEC 61347-1:2015 + AMD1:2017, 3.27, modified – The definition has been rephrased.]

3.2.4
inductive power transfer
process of inductive transfer of electrical energy over time from a source to a separate load when these are placed in physical (but not electrical) contact or in close proximity with each other

EXAMPLE: Examples are rechargeable luminaires incorporating inductive power transfer or electrodeless lamps with inductive power transfer.

Note 1 to entry: If in addition a radio technology, as defined by the ITU, is used or superimposed to the power transfer function of inductive power transfer equipment for the purpose of data communication then the applicable standards for this radio technology apply.

Note 2 to entry: Any propagation of electromagnetic energy outside of the system of inductive power source and load is seen as electromagnetic disturbance and therefore subject to assessment by this standard.

3.2.5
optical window
side of the lighting equipment from which the light emanates

3.2.6
primary function
function of an equipment ~~which is defined as such by the manufacturer~~ as specified in the instructions for use

3.2.7
secondary function
any function of an equipment not being essential for fulfilling the primary function~~, defined by the manufacturer~~ as specified in the instructions for use

3.2.8
test arrangement
specific arrangement of the EUT, cabling and auxiliary equipment during the test

3.3 Terms and definitions related to equipment

3.3.1
simple advertising sign
unit which makes use of lighting for advertising, traffic signage, road signs or ~~alike~~ the like

EXAMPLE Neon tube advertising signs, emergency signs, inner-illuminated signs.

3.3.2
ancillary equipment
transducers (e.g. current ~~and voltage~~ probes and artificial networks) and other equipment (e.g. cables, preamplifiers, attenuators, filters, adapters) connected to a measuring receiver or ~~to~~ the EUT and used in the disturbance signal transfer between the EUT and the measuring receiver

~~Note 1 to entry: Within CISPR publications various different definitions are given for associated, auxiliary and ancillary equipment. The definitions given in this document are based on CISPR 16-2-3. See also 3.3.3 and 3.3.4.~~

~~Note 2 to entry: See also Figure 2.~~

~~[SOURCE: CISPR 16-2-3:2016, 3.1.2, modified – Examples in the definition and Notes to entry have been added.]~~

3.3.3
associated equipment
AE
apparatus, that is not part of the system under test, but needed to help exercise the EUT

EXAMPLE: Equipment to generate lighting control signals.

Note 1 to entry: See also Figure 2.

Note 2 to entry: The emission from the associated equipment should not influence the emission of the EUT.

[SOURCE: CISPR 16-2-3:2016, 3.1.5, modified – The example and Notes ~~1~~ to entry have been added.]

3.3.4
auxiliary equipment
AuxEq
peripheral equipment that is part of the system under test

EXAMPLE: In CISPR TR 30-1 or CISPR TR 30-2, the reference luminaire, in case a ballast or driver is tested.

Note 1 to entry: See also Figure 2.

[SOURCE: CISPR 16-2-3:2016; 3.1.6, modified – The example and the Note to entry have been added.]

3.3.5
controlgear
electrical device between the supply and one or more light source(s) which may serve to transform the supply voltage, limit the current of the light source(s) to the required value, provide starting voltage and preheating current, prevent cold starting, correct power factor, reduce radio interference, include means for dimming, and further control functions

Note 1 to entry: This definition deviates from IEC 60598-1.

[SOURCE: IEC 62504:2014; 3.6.1, modified – The abbreviation ‘LED’ in the term is removed and various modifications in the definition.]

3.3.6
decorative and entertainment lighting
equipment that emits light for atmospheric, artistic or ambiance purposes

Note 1 to entry: Examples of decorative lighting include LED strip lights, rope lights, and projectors for illuminating building walls or statues in coloured and/or patterned light. Usually, these types of lighting equipment are static, but they can shift through various colours or patterns.

Note 2 to entry: Examples of entertainment lighting include stage, theatre and sky beam lights. Usually, these types of lighting equipment also include some movement, such as dynamically changing the direction of the projected light.

3.3.7
double-capped lamp adapter
component designed to be installed into luminaires which are constructed for lamps of one tube diameter (according IEC 60081 and IEC 61195) and one specific tube length for the purpose of allowing them to receive lamps of another tube diameter or another tube length instead

Note 1 to entry: A lamp adapter may incorporate a switch or a fuse or an electronic lamp controlgear for HF lamp operation.

3.3.8
double-capped self-ballasted lamp
unit which cannot be dismantled without being permanently damaged, provided with one or more light sources and two lamp caps and any additional elements necessary for starting and stable operation of the light source

Note 1 to entry: See Notes 1 and 2 to entry given in 3.3.21.

3.3.9
double-capped semi-luminaire
unit similar to a self-ballasted lamp but designed to utilize a replaceable light source and/or starting device

Note 1 to entry: Semi-luminaires for compact fluorescent lamps and for incandescent lamps, sometimes called adapters, are devices equipped, on the one side, with an IEC 60061-1 standardized lamp cap to allow mounting in a standard lampholder and, on the other side, with a lampholder to allow the insertion of a replaceable light source.

Note 2 to entry: The light source component and/or starting device of a semi luminaire is readily replaceable.

Note 3 to entry: For gas-discharge technologies, the ballast component is not replaceable and is not disposed of each time a light source is replaced.

3.3.10
double-capped retrofit lamp
tubular lamp applying a technology alternative to fluorescent technology and which can be used as a replacement for double-capped fluorescent lamps without requiring any internal modification in the luminaire and which, after installation, maintains the same level of safety of the replaced lamp in the luminaire

Note 1 to entry: The replacement of a glow starter according to IEC 60155 with LED replacement starter having the same dimensions and fit, for the correct functioning of the double-capped LED lamp is not considered as a modification to the luminaire.

3.3.11
electrodeless lamp
gas discharge lamp in which the power required to generate light is transferred from outside the lamp envelope to the gas inside via an electric or magnetic field

3.3.12
equipment-under-test
EUT
equipment in the scope of this document subjected to EMC (emission) compliance (conformity assessment) tests

EXAMPLE: The EUT may be a luminaire including lamp(s), a self-ballasted lamp, a rope light or a module.

Note 1 to entry: See also Figure 2.

[SOURCE: CISPR 16-2-3:2016, 3.1.14, modified – Definition is modified and the example and Note 2 to entry have been added.]

3.3.13
lamp
unit containing one or more light sources and one or two standardised caps for interfacing

3.3.14
LED light source
device containing an LED or collection of LEDs used for the purpose of illumination

3.3.15
light source
device emitting light produced by a transformation of electrical energy

Note 1 to entry: Lighting equipment emits light in the range from visible wavelength 400 nm to 780 nm.

[SOURCE: IEC 60050-845:1987, 845-07-01, modified – The definition has been rephrased and the Note to entry has been added.]

3.3.16
lighting equipment
device ~~which~~ that can be used as an independent unit to illuminate a scene, objects or their surroundings so that they can be seen, and components and modules designed to be used in or with such a device or assembly of devices

Note 1 to entry: Examples of lighting equipment are luminaires, self-ballasted lamps, ELV-lamps and modules which are used for general purpose lighting, street/flood lighting intended for outdoor use, lighting installed in or on transport vehicles and which is not in the scope of CISPR 12.

[SOURCE: IEC 60050-845:1987, 845-09-01, modified – The definition has been rephrased.]

3.3.17
luminaire
lighting equipment which distributes, filters or transforms the light transmitted from one or more lamps or light sources and which includes all the parts necessary for supporting, fixing and protecting the lamps, but not usually the lamps themselves, and, where necessary, circuit auxiliaries, together with the means to connect them to the supply, the driver, control units, cabling, housing and mounting are included

Note 1 to entry: This definition comes from the definition given in the luminaire product standard IEC 60598-1. In the latter standard a luminaire does not include a lamp, unless the lamp is an integral part. For the purpose of emission testing in this document however, a luminaire always contains a lamp or a light source or resistive load.

[SOURCE: IEC 60598-1:2014, 1.2.1, modified – The definition has been rephrased.]

3.3.18
module
electronic or electrical part which serves a specific function or functions of a lighting application and may contain radio-frequency sources, which is intended for application in a

luminaire or in an installation by an end user and which is intended to be marketed and/or sold separately from a lighting apparatus or system

Note 1 to entry: Examples are: self-ballasted lamp, starter, controlgear, wall dimmer, control unit, LED module.

3.3.19
passive EUT
equipment which, by its inherent nature and physical characteristics such as absence of active and fast variation or switching of currents or voltages, is incapable of generating or contributing to electromagnetic emissions which exceed a level allowing radio reception to happen as intended

Note 1 to entry: A passive EUT is not likely to produce any electromagnetic disturbances. See 6.2.

Note 2 to entry: Mains rectifier diodes and an electronic starter that is only active during the starting phase is considered to be a passive component.

3.3.20
restricted ELV lamp
ELV lamp with specific restrictions on the type of power supply and/or the cable length that can be applied to it, as ~~provided or~~ specified ~~by~~ in the ~~manufacturer~~ instructions for use

Note 1 to entry: ELV lamps without detailed description of restrictions are non-restricted.

3.3.21
self-ballasted lamp
self-contained unit incorporating a light source and any additional elements that may be necessary for starting and ensuring a stable operation of the light source which cannot be dismantled without being permanently damaged and which is connected to a lamp holder or luminaire via one or two IEC 60061-1 standardized lamp caps

Note 1 to entry: The light source component of a self-ballasted lamp is not replaceable.

Note 2 to entry: For gas-discharge technologies, the ballast component is part of the self-ballasted lamp; it is not part of the luminaire.

Note 3 to entry: The term "self-ballasted lamp" is used as a general term for designating all lamps that can operate independent of other external accessories or auxiliary equipment, except for a lampholder. This includes gas-discharge technologies as well as LED and OLED technologies.

[SOURCE: IEC 60598-1:2014, 1.2.59, modified – The definition has been rephrased, Notes 2 and 3 to entry have been modified and Note 4 to entry has been deleted.]

3.3.22
semi luminaire
device (sometimes called adapter) equipped, on the one side, with any IEC-standardised lamp cap system to allow mounting in a standard lampholder and, on the other side, with a lampholder to allow the insertion of a replaceable light source with a cap

3.3.23
UV and IR radiation equipment
optical radiation equipment operating at a wavelength between 780 nm to 1 mm or 1 nm to 400 nm

EXAMPLE: Examples are appliances used for medical and cosmetic care, and for instant zone heating.

[SOURCE: IEC 60050-731:1991 + AMD1:2016, 731-01-05 and 731-01-06, modified – The definitions have been combined.]

3.3.24
user-replaceable
components or modules which can be replaced by the end-user

3.4 Terms and definitions related to interfaces and ports

3.4.1
AC electric power supply interface
connection point to an external AC electrical supply network

3.4.2
communication/data/network interface
point of connection for data and signalling transfers intended to interconnect widely dispersed systems via such means as direct connection to multi-user telecommunications networks (e.g. local area networks like Ethernet, token ring, etc.)

3.4.3
control interface
point at which a conductor or cable is attached to the lighting equipment for the purpose of controlling the function of the equipment

3.4.4
DC electric power supply interface
connection point to an external DC electrical supply network

3.4.5
electric power supply interface
connection point at which a conductor or cable carrying the primary electrical power needed for the operation (functioning) of the lighting equipment is connected, and through which also conducted electromagnetic disturbance may couple to the electromagnetic environment

Note 1 to entry: It is possible to connect cables to such an interface for transmission of electric power from DC and/or AC mains power distribution systems which has a topology such that an electromagnetic disturbance easily couples to the electromagnetic environment.

3.4.6
enclosure port
artificial non-intentional wireless interface of the lighting equipment through which electromagnetic disturbances can radiate into the environment

Note 1 to entry: Based on IEC 61000-6-3:2006/AMD1:2010, 3.1.2.

Note 2 to entry: The artificial interface can consist of for instance seams and apertures in the physical metallic enclosure, but also limited lengths of each of its wired interfaces. In the frequency range above 30 MHz typically one third of a wavelength of the length of the wired interfaces can contribute to radiated disturbances. Therefore, also included are wired interfaces to auxiliary equipment which are intended to be connected with cables of less than 3 m length.

3.4.7
electrical interface
connection point of equipment at which a conductor or cable is attached for various purposes such as powering, control or communication

EXAMPLES: See Figure 3.

3.4.8
functional earth
terminal of equipment intended for connection to an external grounding conductor for functional and/or electromagnetic compatibility purposes

3.4.9
load interface
connection point of the lighting equipment providing electrical energy to another item of lighting equipment

3.4.10
local wired port
interface of the lighting equipment which directly connects to cables that are not connected to a network and have a length greater than or equal to 3 m, or that are indirectly connected to a network via auxiliary equipment

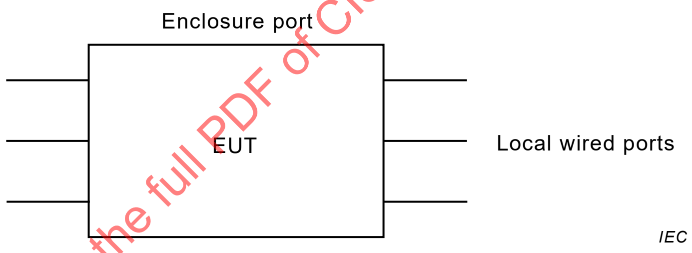
EXAMPLE: Examples are, the electrical power supply interface of ELV lamp, an interface of a driver for connecting a long (≥ 3 m) load cable with a light source, a control interface of a sensor for connecting a short (< 3 m) control cable with an AC mains-fed luminaire. See Annex D for examples.

Note 1 to entry: Such a port can emit electromagnetic disturbances.

3.4.11
network
electrical installation consisting of equipment and interconnecting cables or wiring for the transmission and distribution of electrical power, electrical signal for data transmission or communication or alike

3.4.12
port
particular category of an interface of an EUT which provides a coupling path for electromagnetic disturbances from the EUT into the electromagnetic environment specific for that category

Note 1 to entry: See Figure 1.



NOTE The enclosure port may include other wired interfaces, with lengths less than 3 m (see 3.4.6).

Figure 1 – EMC-ports of an EUT

3.4.13
protective earth
equipment terminal intended for connection to an external conductor for protection against electrical shock in case of a fault

3.4.14
wired network port
wired interface of the lighting equipment which connects to cables that are directly connected to a network and through which conducted electromagnetic disturbances may be coupled to that network

3.5 Abbreviated terms

AAN	~~artificial asymmetrical network~~ asymmetric artificial network
AC	alternating current
AE	associated equipment
AMN	artificial mains network
AuxEq	auxiliary equipment
CDNE	Coupling Decoupling Network Emission
CISPR	Comité International Spécial des Perturbations Radioélectriques

CM	common mode
CP	current probe
CVP	capacitive voltage probe
dB	decibel
DC	direct current
DALI	Digital Addressable Lighting Interface
DM	differential mode
E	earth terminal
ELV	extra-low voltage
EMC	electromagnetic compatibility
EUT	equipment under test
FAR	fully anechoic room
FE	functional earth
FSOATS	free space open area test site
Fx	clock frequency
GHz	gigahertz
GU10	glass U-shaped housing and cap of a multifaceted reflector (MR) light bulb
Hz	hertz
IEC	International Electrotechnical Commission
IEV	International Electrotechnical Vocabulary
IR	infrared
ISM	industrial, scientific and medical
~~ISN~~	~~impedance stabilization network~~
ITE	information technology equipment
ITU	International Telecommunication Union
kHz	kilohertz
L	line
LAN	local area network
LED	light emitting diode
LLAS	large loop antenna system
MHz	megahertz
μA	microampere
μF	microfarad
μV	microvolt
N	neutral
N.A.	not applicable
nF	nanofarad
OATS	open area test site
OLED	organic light emitting diode
PE	protective earth
PWM	pulse width modulation
RF	radio frequency
RGP	reference-ground plane

SAC	semi anechoic chamber
SSL	solid state lighting
TEM	transverse electromagnetic
TR	technical report
UV	ultraviolet
VBW	video bandwidth

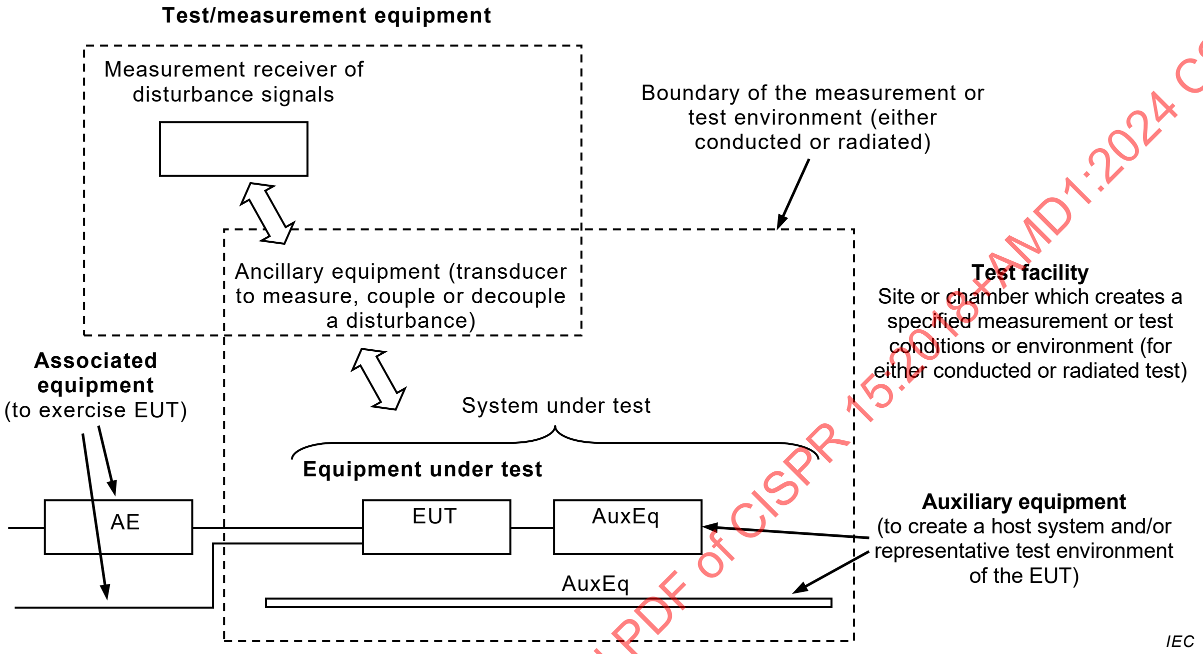


Figure 2 – Generic depiction of the definitions of test-, ancillary-, auxiliary- and associated equipment w.r.t. EUT and the test/measurement environment (definitions given in CISPR 16-2-3)

4 Limits

4.1 General

The requirements for an EUT are given in this clause on the basis of three possible EMC ports that can apply to each of the EUT interfaces: enclosure port, wired network port, and local wired port. The port classification and the application of limit for each possible interface of an EUT is specified in Clause 5 and in Clause 6.

Disturbance limits are specified for specific types of detectors, i.e. quasi-peak or average detectors (see the specification of the CISPR receiver in CISPR 16-1-1). If the applicable limits over a specific frequency range are specified for both quasi-peak and average detectors, provided the disturbance levels of the EUT are measured using the quasi-peak detector, and are found to meet the average limits, then, the EUT shall be deemed to meet both limits and the measurement with the average detector need not to be carried out for that frequency range.

In case different methods with associated limits can be applied, the test report shall state which method and corresponding limits were used.

NOTE The limits in this document have been determined on a probabilistic basis. In exceptional cases, additional provisions are required.

4.2 Frequency ranges

In 4.3, 4.4 and 4.5, limits and measurement methods for radio disturbance characteristics are given as a function of frequency range. No measurements need to be performed at frequencies where no limits are specified.

4.3 Limits and methods for the assessment of wired network ports

4.3.1 Electric power supply interface

The limits and measurement method for the assessment of conducted disturbance voltages at the AC or DC electric power supply interface terminals for the frequency range 9 kHz to 30 MHz are given in Table 1.

Table 1 – Disturbance voltage limits at the electric power supply interface

Frequency range	Limits [a] dB(µV)		Method
	Quasi-peak	Average	
9 kHz to 50 kHz	110	–	CIPR 16-2-1 and 8.3
50 kHz to 150 kHz	90 to 80[b]	–	
150 kHz to 0,5 MHz	66 to 56[b]	56 to 46[b]	
0,5 MHz to 5,0 MHz	56[c]	46[c]	
5 MHz to 30 MHz	60	50	

[a] At the transition frequency, the lower limit applies.

[b] The limit decreases linearly with the logarithm of the frequency in the ranges 50 kHz to 150 kHz and 150 kHz to 0,5 MHz.

[c] For lighting equipment incorporating exclusively electrodeless lamps, the limit in the frequency range of 2,2 MHz to 3,0 MHz is 73 dB(µV) quasi-peak and 63 dB(µV) average.

NOTE In the US, lighting devices are classified as either a non-consumer (Class A) or consumer (Class B) device. These classification limits are similar to the Class A and Class B equipment categories in CISPR 32:2015 and CISPR 32:2015/AMD1:2019.

4.3.2 Wired network interfaces other than power supply

The limits and measurement methods for the assessment of conducted disturbance voltages at wired network interfaces other than power supply for the frequency range 150 kHz to 30 MHz are given in Table 2 and Table 3.

Either of the methods and the associated limits from Table 2 or Table 3 can be applied to demonstrate compliance.

Table 2 – Disturbance voltage limits at wired network interfaces other than power supply

Frequency range (MHz)	Limits dB(µV)		Method
	Quasi-peak	Average	
0,15 to 0,50	84 to 74	74 to 64	CISPR 16-2-1 and 8.4
0,50 to 30	74	64	

NOTE 1 The limits decrease linearly with the logarithm of the frequency in the range 0,15 MHz to 0,5 MHz.

NOTE 2 The disturbance voltage limits are derived for use with an ~~artificial asymmetrical network~~ asymmetric artificial network (AAN) which presents a common mode (asymmetric mode) impedance of 150 Ω to the measured interface.

Table 3 – Disturbance current limits at wired network interfaces other than power supply

Frequency range (MHz)	Limits dB(μA)		Method
	Quasi-peak	Average	
0,15 to 0,50	40 to 30	30 to 20	CISPR 16-2-1 and 8.4
0,50 to 30	30	20	

NOTE 1 The limits decrease linearly with the logarithm of the frequency in the range 0,15 MHz to 0,5 MHz.

NOTE 2 The disturbance current limits are derived for use of a common mode (asymmetric mode) impedance of 150 Ω. Hence the conversion factor applied is 20 log(150) = 44 dBΩ.

4.4 Limits and methods for the assessment of local wired ports

This standard differentiates between two categories of “local wired port”. These are:

a) EUT interface that indirectly connects to a network, via auxiliary equipment (this includes the electrical power supply interface of ELV lamps);

b) EUT interface that does not connect to a network, directly or indirectly, and which can be connected to cables having a length equal to or greater than 3 m.

For these two sub-categories of “local wired port”, as listed above, limits for conducted disturbances are prescribed in this subclause.

Interfaces that are not connected to a network and having a length less than 3 m shall not be assessed for conducted disturbances.

~~The limits and measurement methods for the assessment of conducted disturbance voltages of local wired ports for the frequency range 9 kHz to 30 MHz are given in Table 1, Table 4, Table 5 and Table 6.~~

The limits and methods applicable to the electrical power supply interfaces of ELV lamps are given in Table 1 and Table 4, for restricted and non-restricted ELV lamps, respectively, with additional requirements for the test method in 6.4.7.

Table 4 – Disturbance voltage limits of local wired ports: electrical power supply interface of non-restricted ELV lamps

Frequency range	Limits [a c d] dB(μV)		Method
	Quasi-peak	Average	
9 kHz to 50 kHz	136	–	CISPR 16-2-1 and A.5.1
50 kHz to 150 kHz	116 to 106[b]	–	
150 kHz to 0,5 MHz	92 to 82[b]	82 to 72[b]	
0,5 MHz to 5,0 MHz	82	72	
5 MHz to 30 MHz	86	76	

[a] At the transition frequency, the lower limit applies.

[b] The limit decreases linearly with the logarithm of the frequency in the ranges 50 kHz to 150 kHz and 150 kHz to 0,5 MHz.

[c] The limits in this table apply if no 26 dB attenuator is applied (see Figure A.3).

[d] Disturbance voltage limits for restricted ELV lamps are given in Table 1 (see 6.4.7).

The limits and methods given in Table 5 or Table 6 shall be applied apply to local wired ports other than electrical power supply interfaces of ELV lamps.

Table 5 – Disturbance voltage limits at local wired ports: local wired ports other than electrical power supply interface of ELV lamp

Frequency range MHz	Limits dB(μV)[a]		Method
	Quasi-peak	Average	
0,15 to 0,50	80	70	CISPR 16-2-1 (voltage probe method) See 8.5.2.2
0,50 to 30	74	64	
[a] At the transition frequency, the lower limit applies.			

Table 6 – Disturbance current limits at local wired ports: local wired ports other than electrical power supply interface of ELV lamp

Frequency range MHz	Limits dB(μA)		Method
	Quasi-peak	Average	
0,15 to 0,50	40 to 30	30 to 20	CISPR 16-2-1 See 8.5.2.3
0,50 to 30	30	20	
NOTE 1 The limits decrease linearly with the logarithm of the frequency in the range 0,15 MHz to 0,5 MHz. NOTE 2 The current disturbance limits are derived for use of a common mode (asymmetric mode) impedance of 150 Ω, and the conversion factor applied is 20 log(150) = 44 dBΩ.			

4.5 Limits and methods for the assessment of the enclosure port

4.5.1 General

This subclause gives radiated disturbance limits for the enclosure port as a function of frequency range.

4.5.2 Frequency range 9 kHz to 30 MHz

Radiated-field disturbance limits in the frequency range of 9 kHz to 30 MHz are given in Table 8 and Table 9.

The limits in Table 8 are expressed in terms of a current measured in a large loop-antenna system (LLAS) as specified in CISPR 16-1-4. This current is a measure for the magnetic field level around the EUT. This limit, applicable for the quasi-peak detector of the CISPR receiver, is given for three different sizes of large loop antenna systems in the frequency range 9 kHz to 30 MHz.

The range of maximum dimensions of the EUT for each of the three loop-antenna diameters is given in Table 7.

For EUT dimensions larger than 1,6 m, the limits given in Table 9 associated with the magnetic field loop antenna measurement method specified in 9.3.3 can be applied.

The limits in Table 8 and Table 9 provide different options. In any situation where it is necessary to verify the original measurement results, the measuring method originally chosen shall be used in order to ensure consistency of the results. The test report shall state which method was used and which limits were applied.

Table 7 – Maximum EUT dimension that can be used for testing using LLAS with different diameters

Maximum dimension of the EUT, D m	Loop antenna diameter m
$D \leq 1{,}6$	2
$D \leq 2{,}6$	3
$D \leq 3{,}6$	4
No minimum EUT dimensions are given for the 3 m and 4 m LLAS. However, it is recommended to apply the smallest size of LLAS that is appropriate for the size of the EUT. If a small EUT is tested in a large LLAS (i.e. EUT smaller than 1,6 m tested in a 3 m or 4 m LLAS, or EUT smaller than 2,4 m tested in a 4 m LLAS), it shall be confirmed that the LLAS is able to detect EUT generated emissions with at least 10 dB of margin above the measuring instrument's noise floor.	

Table 8 – LLAS radiated disturbance limits in the frequency range 9 kHz to 30 MHz

Frequency range	Quasi-peak limits for three loop diameters dB(μA)			Method
	2 m	3 m	4 m	
9 kHz to 70 kHz	88	81	75	CISPR 16-2-3 and 9.3.2
70 kHz to 150 kHz	88 to 58[a]	81 to 51[a]	75 to 45[a]	
150 kHz to 3,0 MHz	58 to 22[a b]	51 to 15[a b]	45 to 9[a b]	
3,0 MHz to 30 MHz	22	15 to 16[c]	9 to 12[c]	

[a] Decreasing linearly with the logarithm of the frequency.

[b] For lighting equipment incorporating exclusively electrodeless lamps, the limit in the frequency range of 2,2 MHz to 3,0 MHz is 58 dB(μA) for 2 m, 51 dB(μA) for 3 m and 45 dB(μA) for 4 m loop diameter.

[c] Increasing linearly with the logarithm of the frequency.

4.5.3 Frequency range 30 MHz to 1 GHz

Radiated-field disturbance limits and measurement methods in the frequency range of 30 MHz to 1 GHz are given in Table 10 in terms of quasi-peak values of the electric field component.

Table 10 provides different options. In any situation where it is necessary to verify the original measurement results, the measuring method and measuring distance originally chosen shall be used in order to ensure consistency of the results. The test report shall state which method was used and which limits were applied.

Table 9 – Loop antenna radiated disturbance limits in the frequency range 9 kHz to 30 MHz for equipment with a dimension > 1,6 m

Frequency range MHz	**Limits at 3 m distance** **Quasi-peak** dB(µA/m)	**Method**
0,009 to 0,070	69	9.3.3
0,070 to 0,150	69 to 39 [b]	
0,150 to 4,0	39 to 3 [a] [b]	
4,0 to 30	3	

[a] For lighting equipment incorporating exclusively electrodeless lamps, the limit in the frequency range of 2,2 MHz to 3,0 MHz is 39 dB(µA/m).

[b] Decreasing linearly with logarithm of frequency.

Table 10 – Radiated disturbance limits and associated measurement methods in the frequency range 30 MHz to 1 GHz

Testing method [a]	**Reference** [g]	**Frequency range** MHz	**Quasi-peak limits** [d]
OATS or SAC at 10 m distance	CISPR 16-2-3	30 to 230 230 to 1 000	30 dB(µV/m) 37 dB(µV/m)
OATS or SAC at 3 m distance	CISPR 16-2-3	30 to 230 230 to 1 000	40 dB(µV/m) 47 dB(µV/m)
FAR at 3 m distance	CISPR 16-2-3	30 to 230 230 to 1 000	42 to 35 [e] dB(µV/m) 42 dB(µV/m)
TEM-waveguide [b]	IEC 61000-4-20	30 to 230 230 to 1 000	30 dB(µV/m) 37 dB(µV/m)
CDNE method [c, f]	CISPR 16-2-1	30 to 100 100 to 200 200 to 300	64 to 54 [e] dB(µV) 54 dB(µV) 54 to 51 [e] dB(µV)

[a] Any of the methods and the associated limits can be applied to demonstrate compliance.

[b] The TEM-waveguide is limited to EUTs without cables attached and with a maximum size according to 6.2 of IEC 61000-4-20:2010 (the largest dimension of the enclosure at 1 GHz measuring frequency is one wavelength, 300 mm at 1 GHz). The results taken in a TEM waveguide are converted to field strength for comparison with OATS-based limits at 10 m distance.

[c] The CDNE method and the associated limits up to 300 MHz can be only applied for EUTs with clock frequencies below or equal to 30 MHz. In such a case, the product is deemed to comply with the requirements between 300 MHz and 1 000 MHz. The CDNE-limits between 200 MHz and 300 MHz specified in Table 10 are more stringent than the limits given in CISPR 15:2013. An increasing margin (up to 10 dB at 300 MHz) has been applied between 200 MHz and 300 MHz. If the CDNE test fails, then any of the other methods and associated limits can still be applied [a].

[d] At the transition frequency, the lower limit applies.

[e] The limit decreases linearly with the logarithm of the frequency.

[f] The EUT size limitation of CISPR 16-2-1 does not apply. For the CDNE method, the largest dimensions of the EUT are 3 m x 1 m x 1 m (l x w x h). The CDNE restrictions apply to the EUT only, and not the wiring or the total dimension of the system under test, see Figure 2.

[g] See also 9.3.4.

NOTE In the US, lighting devices are classified as either a non-consumer (Class A) or consumer (Class B) device. These classification limits are similar to the Class A and Class B equipment categories in CISPR 32:2015 and CISPR 32:2015/AMD1:2019.

4.5.4 Frequency range 1 GHz to 6 GHz

Radiated disturbance measurements in this frequency range shall be performed up to the frequency determined in accordance with Table 13, based on the highest clock frequency of the EUT. However, if the clock frequencies of the EUT are not known, radiated disturbance measurements shall be performed up to 6 GHz.

Table 13 – Radiated measurement highest frequency

Highest clock frequency Fx	**Highest measurement frequency**
Fx ≤ 108 MHz	1 GHz
108 MHz < Fx ≤ 500 MHz	2 GHz
500 MHz < Fx ≤ 1 GHz	5 GHz
Fx > 1 GHz	5 × Fx up to a maximum of 6 GHz

Radiated disturbance limits and measurement methods in the frequency range of 1 GHz to 6 GHz are given in Table 14 in terms of peak and average values of the electric field component.

Table 14 – Radiated disturbance requirements at frequencies above 1 GHz

Frequency range MHz	**Testing method**	**Testing distance** m	**Detector type / bandwidth**	**Limits** dB(μV/m)
1 000 to 3 000	FSOATS	3	Average / 1 MHz	50
3 000 to 6 000				54
1 000 to 3 000			Peak / 1 MHz	70
3 000 to 6 000				74

Apply across the frequency range from 1 000 MHz to the highest required frequency of measurement derived from Table 13.

Allowed measurement distances: 1 m, 3 m, 5 m, or 10 m.

Where a different measurement distance is chosen, other than the reference testing distance defined (3 m), the limit is offset based upon the following formula:

$L_{new} = L_{def} - 20 \log (d_{meas}/d_{ref})$

where

L_{new} is the new limit at the reference distance in dB(μV/m);

L_{def} is the defined limit at the measurement distance in dB(μV/m);

d_{meas} is the measurement distance in metres;

d_{ref} is the reference distance in metres.

An FSOATS may be a SAC/OATS with RF absorber on the RGP or a FAR, see specific details in CISPR 16-2-3:2016, CISPR 16-2-3:2016/AMD1:2019 and CISPR 16-2-3:2016/AMD2:2023.

NOTE In the US, lighting devices are classified as either a non-consumer (Class A) or consumer (Class B) device. These classification limits are similar to the Class A and Class B equipment categories in CISPR 32:2015 and CISPR 32:2015/AMD1:2019.

5 Application of the limits

5.1 General

The applicability of limits for EUTs is given in Clause 5. Additional guidelines/requirements for the applicability of the limits to specific kinds of EUTs are given in Clause 6. See Figure 4.

The general operational conditions for the EUT are given in Clause 7. The measurement methods for conducted and radiated disturbances are specified in Clause 8 and Clause 9.

5.2 Identification of the interfaces subject to test

If the EUT does not fall in one of the categories specified in Clause 6, then the applicable test cases for the various EUT interfaces shall be derived as follows.

First, the EMC-relevant physical properties of the EUT and its wired interfaces are to be determined; see Figure 3 for guidance. For each wired interface in turn a decision is then made as to whether it is connected to a network in a direct way, indirect way or not at all. Once the types of interface and possible connections are known, each interface is allocated to one of the three possible standardised EMC ports as detailed below:

- enclosure port;
- wired network port;
- local wired port.

The applicable test method, associated test arrangement and limits shall then be selected for each interface in turn, depending upon its port classification and, as per the requirements in 5.3.

5.3 Application of limits to the interfaces

5.3.1 General

A flow chart depicting the decision process for the application of limits is given in Figure 4.

5.3.2 Conducted disturbance requirements for the wired network port

5.3.2.1 Conducted disturbance requirements for the electrical power supply interface

The disturbance voltage limits and measurement method of the electrical power supply interfaces in the frequency range 9 kHz to 30 MHz are given in Table 1.

These limits apply for electrical power supply interfaces that are directly connected to a power supply network (Figure 4).

5.3.2.2 Conducted disturbance requirements for wired network interfaces other than power supply

The limits specified in this subclause apply for wired network interfaces other than power supply that are directly connected to a network (Figure 4).

The disturbance voltage limits and measurement method of wired network interfaces other than power supply (e.g. for communication or data transfer) in the frequency range 150 kHz to 30 MHz are given in Table 2 for use with an ~~artificial asymmetrical network~~ asymmetric artificial network (AAN). If no coupling network is available for the interface in question, then the current limits given in Table 3 shall be applied using the current measurement method given in 8.4.

5.3.3 Conducted disturbance requirements for local wired ports

These limits apply for interfaces of the following type (Figure 4):

1) indirectly connected to a network via other equipment, including power supply interface of ELV lamp;
2) not connected to a network and with a length greater than or equal to 3 m.

For local wired ports other than power supply interface of ELV lamp, the disturbance ~~voltage or the disturbance~~ current limits given in ~~Table 5 or~~ Table 6 shall be applied using the measurement method~~s~~ given in ~~8.5.2.2 and~~ 8.5.2.3. The method of measurement and the applicable limits for the power supply interface of ELV lamp are described in 6.4.7.

NOTE Interfaces that are not connected to a network and with a length less than 3 m are assessed through the enclosure port test. Nonetheless, the electrical power supply interface of ELV lamp is always subject to conducted emissions test, as per 6.4.7.

5.3.4 Radiated disturbance requirements for the enclosure port

5.3.4.1 Frequency range 9 kHz to 30 MHz

Radiated-field disturbance limits in the frequency range of 9 kHz to 30 MHz (Table 8 or Table 9) apply to the enclosure port of the EUT. However, the EUT needs to be tested for radiated emissions within 9 kHz to 30 MHz only if the application, construction or technology of the EUT can cause large magnetic dipole moments. In case of doubt, or if no such information is available then the test is to be done. A large dipole moment is obtained if a substantial disturbance current is running in a loop that encompasses a large surface, such as (but not limited to) the following cases:

– the ~~manufacturer~~ instructions for use allow~~s~~ external wired interfaces connected to the EUT by single-conductor cables;
– the EUT applies internal single-conductor and separated interconnect wiring (or PCBs tracks) that cause loops and an associated magnetic dipole;
– EUTs that apply technologies with inductive power transfer.

EXAMPLES Luminaires that have separated supply lines; electrodeless lamps with inductive power transfer and rechargeable luminaires incorporating inductive power transfer are considered to be equipment with large magnetic dipole moments. DC-fed LED light sources and magnetic 50 Hz or 60 Hz wound ballasted luminaires are examples of lighting equipment that are considered to have very small dipole moments and therefore do not need to be tested.

If the EUT is incapable of generating a large magnetic dipole moment, then no test is required and the EUT is deemed to comply with the radiated-field disturbance limits in the frequency range of 9 kHz to 30 MHz.

5.3.4.2 Frequency range 30 MHz to 1 000 MHz

The EUT shall be evaluated for radiated emissions in the 30 MHz to 1 000 MHz range by testing in accordance with one of the methods in Table 10.

When the CDNE method is used and all clock frequencies of the EUT are below or equal to 30 MHz, then the product is deemed to comply with the requirements between 300 MHz and 1 000 MHz if the emissions comply with the limits in the 30 MHz to 300 MHz frequency range as specified in Table 10.

5.3.4.3 Frequency range 1 GHz to 6 GHz

The EUT shall be tested for radiated disturbance in the range 1 GHz to 6 GHz in accordance with Table 14.

5.3.5 Multiple interfaces of the same type

Where the EUT has more than one interface of the same type, they shall be selected for testing as follows:

- if there are multiple similar interfaces connected to the same card or module, then it is acceptable to assess one of those interfaces;
- where there are ports of the same type on different cards or modules, then it is acceptable to assess one typical port on each card or module types.

The above is applicable to conducted emissions measurements on network ports and local wired ports only.

The test report shall identify the ports assessed. All other interfaces and ports are deemed to comply with the applicable limits in CISPR 15 provided the above requirements were followed in selecting the ports for testing and provided all tested ports were demonstrated to be compliant with the applicable limits of CISPR 15.

5.3.6 Interfaces that can be categorised as multiple types of ports

If a single interface satisfies the definition of more than one type of port defined in this publication, it is subject to the requirements that apply for each of the port types it satisfies.

EXAMPLE A power-over-Ethernet can be identified as both a wired network port (Ethernet-connection) and a local-wired port (DC power supply). For the wired network port (Ethernet-connection), the limits in either Table 2 or Table 3 would apply. For the local-wired port (DC power supply) the limits in ~~either Table 5 or~~ Table 6 apply. In this case, the disturbance current limits of Table 3 and Table 6 are the same. ~~The disturbance voltage limits of Table 2 and Table 5 are different below 0,5 MHz because of the different methods.~~ In this example, the limits for either type of port are basically the same. Broadband over power and powerline communication are other examples where the interface in question can be categorized as different kinds of wired network ports (4.3).

6 Product specific limit application requirements

6.1 General

This clause includes limit application requirements for specific types of lighting equipment and shall be used in conjunction with the general requirements in Clause 5. Clause 5 applies for equipment not listed in Clause 6 (first decision box in Figure 4).

Product specific application notes referring to particular measurement set-ups or operating conditions are given in Annex A.

6.2 Passive EUT

A passive EUT is deemed to fulfil the requirements of this document without further testing. Examples of such equipment include: luminaires suitable for incandescent lamps or self-ballasted lamps, transformers for incandescent or self-ballasted lamps that do not regulate the voltage by means of active electronic components, luminaires fitted with only LEDs and passive components. Mains rectifier diodes are considered passive components.

NOTE Where in this document, the term "incandescent lamp" is used, all types of incandescent lamps including halogen lamps are meant.

EXAMPLE Incandescent lamps are generally also passive equipment. Although it should be noted that some types of incandescent lamps with very long filaments can generate excessive disturbances.

EUT with electromagnetic controlgear can be considered to contain only passive components. However due to the physical characteristic of discharge lamps, further assessment is required. Such equipment shall comply with the disturbance voltage limits at the electric power supply interface terminals given in Table 1. However, luminaires for discharge lamps containing only passive controlgear and fitted with a power factor correction capacitor or suppression capacitor (at least 47 nF) across the mains terminals are deemed to comply with the requirements of this document without measurement. Compliance can be achieved by inspection.

6.3 Rope lights

6.3.1 General

Rope lights e.g. Christmas lights, lighting chains, are used for different applications both indoor and outdoor in the areas of general and effect lighting. Depending upon the application and construction, different light source or lamp technologies can be applied, e.g. incandescent lamps or LED lamps. The controlgear for rope lights can be independent or integrated. Also rope lights without controlgear are feasible.

6.3.2 Requirements for rope lights

Rope lights with active switching electronic components shall comply with the disturbance voltage limits at mains terminals given in Table 1 and with the radiated disturbance limits given in Table 8 or Table 9 if applicable, and in Table 10 and Table 14 if applicable.

The setup and test arrangements are specified in Clause A.3.

6.4 Components and modules

6.4.1 General

This subclause specifies how to configure a system under test in case the EUT is a component or module that is intended to be marketed and/or sold separately from a lighting apparatus or system and thus to be applied by an end user in a lighting apparatus or system.

Different types of components or modules can be distinguished, for example the EUT can be (Figure 5):

- a replaceable component or module, for example a self-ballasted lamp, an ELV lamp or starter;
- an external component or module, for example an independent driver or igniter, a wall dimmer or a remote control;
- an internal component or module, for example a driver;
- a mounted component or module, for example a light source, an adapter or a network interface card.

Internal, mounted, replaceable or external components or modules shall be assessed with at least one representative host system as auxiliary equipment.

The port(s) of any component or module being assessed shall be terminated in accordance with 7.9. The functions of the host that are specific to the component or module being assessed shall be exercised during the measurements. Components or modules shown to meet the requirements of this document in one representative host are deemed to meet the requirements of this publication when used in any host. The host and components or modules used during measurements shall be listed in the test report.

~~The manufacturer of the module shall specify~~ The host or the type of luminaire and associated circuits ~~which are~~ shall be suitable and representative for use with the component or module as specified in the instructions for use. This shall be based on analysing various possible typical applications for the specific component or module such that the selected host is representative of typical use in terms of mitigation of disturbances from the component or module in question.

Disturbances from auxiliary equipment (including the host) itself shall be sufficiently below the applicable limit levels.

Requirements for specific types of component or modules are given in 6.4.3 through 6.4.10.

6.4.2 Modules having multiple applications

Modules whose functionality and connectivity allows them to be replaceable, internal, mounted and/or external shall be tested in each of those applicable configurations. Where it can be shown that one particular configuration provides a worst case, testing in this configuration is sufficient to show compliance.

6.4.3 Internal modules

For internal modules, the applicability of the limits is determined using the process given in 5.3. That process shall be applied to each of the interfaces of the host that may be affected by emissions (conducted or radiated) generated by the module under test. For those interfaces of the host that are not tested, the test report shall include a justification why they were deemed not to be affected by emissions generated by the module under test.

The host, that includes the module as EUT, is tested as a luminaire in accordance with Clause B.6 (Figure B.1b) and Clause C.4 (Figure C.4) or CDNE setup according CISPR 16-2-1:2014 and CISPR 16-2-1:2014/AMD1:2017. Examples of the host (reference luminaire) are given in CISPR TR 30-1:2012 and CISPR TR 30-2:2012.

NOTE The host or reference luminaire is considered as the EUT and therefore the limitation of the CDNE method to EUTs having not more than two cables (CISPR 16-2-1:2014, 9.1 c)) is applicable to the host and not to the internal module.

6.4.4 External modules

For external modules the applicability of the limits is determined using the process given in 5.3 for each of the interfaces of the module.

NOTE For external modules, the host that is applied is auxiliary equipment. The disturbance is measured at the terminals of the EUT (module under test). See for instance Clause D.3 (Case 2- application 2).

External modules as EUT are measured separately to make sure that the auxiliary equipment (host) does not alter the measurement result (no mutual interaction). Details on the arrangement of external modules are given in Clause B.6 (Figure B.2) and Clause C.4 (Figure C.5) or CDNE setup according CISPR 16-2-1.

6.4.5 Single capped self-ballasted lamps

Single capped self-ballasted lamps shall comply with the disturbance voltage limits at ~~mains terminals~~ electric power supply interface given in Table 1 ~~and~~ with the radiated disturbance limits given in Table 8 or Table 9 if applicable, and in Table 10 and Table 14 if applicable.

The setup and test arrangements for single capped self-ballasted lamps are specified in Clause A.1.

6.4.6 Double-capped self-ballasted lamps, double-capped lamp adapters, double-capped semi-luminaires and double-capped retrofit lamps used in fluorescent lamp luminaires

Double-capped self-ballasted lamps, double-capped lamp adapters, double-capped semi-luminaires and double-capped retrofit lamps used in fluorescent lamp luminaires shall comply with the electric power supply interface voltage limits given in Table 1 and with the radiated disturbance limits given in Table 8 or Table 9 if applicable, and in Table 10 and Table 14 if applicable.

The test methods are specified in Clause A.4.

6.4.7 ELV lamps

ELV lamps shall comply with one of the following requirements:

a) Non-restricted (see 3.3.20) extra-low voltage (ELV) lamps, intended for connection to symmetrical ELV networks, shall comply with the conducted disturbance voltages of local wired ports of Table 4 at the ELV interface, measured in accordance with the method specified A.5.1, and with the radiated disturbance limits of Table 8 or Table 9 if applicable, and in Table 10 and Table 14 if applicable, measured in accordance with the method specified in A.5.2.

   NOTE 1 The insertion loss of the applied controlgear is typically 26 dB based on measurements on real configurations.

   NOTE 2 Special care is taken that no overloading of the receiver occurs.

   NOTE 3 The 26 dB addition is not applied to the assessment of radiated disturbances.

b) Restricted ELV lamps (see 3.3.20) shall comply with the mains disturbance voltage limits of Table 1, measured in accordance with the method specified A.5.1, and with the radiated disturbance limits of Table 8 or Table 9 if applicable, and in Table 10 and Table 14 if applicable, measured in accordance with the method specified in A.5.2.

NOTE 4 ELV lamps with active electronic circuit are not intended for the connection to unsymmetrical ELV networks.

6.4.8 Single-capped semi-luminaires

Single-capped semi-luminaires shall comply with the requirements given in Clause 5, with a typical lamp satisfying the load requirements as specified in 7.4.

Single-capped semi-luminaires shall be arranged, setup and measured as a self-ballasted lamp. The test methods are specified in Clause A.1.

6.4.9 Independent igniters

Independent igniters for fluorescent and other discharge lamps shall comply with the mains disturbance voltage limits of Table 1, and they are tested in a circuit as described in Clause A.6.

6.4.10 Replaceable starters for fluorescent lamps

If the replaceable starter contains active switching electronic components, it shall comply with the mains disturbance voltage limits of Table 1, while it is applied and tested in a relevant host, i.e. a single lamp luminaire equipped with a lamp of the highest power rating for which the starter is designed. The ~~manufacturer~~ instructions for use shall specify ~~in the operating manual~~ the type of luminaire and associated circuit(s), which are suitable for use with the starter. The host that includes the replaceable starter as EUT is tested as a luminaire in accordance with Clause B.5.

If replaceable starters incorporate a capacitor having a value between 0,005 µF and 0,02 µF and which is connected parallel to the contact pins of the starter it is deemed to comply with the requirements of this document without testing.

7 Operating and test conditions of the EUT

7.1 General

When measurements of disturbances of the EUT are being made, the equipment shall be operated under the conditions specified in 7.2 to 7.9.

The EUT is to be tested as delivered by the manufacturer under normal operating conditions, for example, as given in IEC 60598-1 for luminaires.

The possible special conditions given in Clause 8 and Clause 9 for the different methods of measurement shall be applied additionally, as appropriate.

7.2 Switching

The disturbance caused by manual or automatic operation of a switch (external or included in equipment) to connect or disconnect the mains shall be disregarded. This includes manual on/off switches or, for example, switches activated by sensors or ripple control receivers. However, switches which might be operated more often than once in a 10 seconds period (e.g. such as those of advertising signs) are not included in this exemption (see 7.5).

7.3 Supply voltage and frequency

The supply voltage shall be within ± 2 % of the rated voltage. In the case of a voltage range, measurement shall be carried out within ± 2 % of each of the standard supply voltages of that range given in IEC 60038. The frequency of the mains supply shall be as rated for the equipment.

During the tests, the EUT shall be operated at the rated voltage specified for the equipment. The supply voltage shall be within ±2 % of the selected nominal test voltage.

For single-phase equipment with a rated voltage range of:

– 100 V to 127 V, testing shall be carried out at one nominal voltage within this range; the recommended test voltage is 120 V;
– 200 V to 240 V, testing shall be carried out at one nominal voltage within this range; the recommended test voltage is 230 V;
– 100 V to 240 V, testing shall be carried out at one nominal voltage within the range 100 V to 127 V (recommended value is 120 V), and at one nominal voltage within the range 200 V to 240 V (recommended value is 230 V). However, if the lighting equipment is intended for a specific region, it may be tested only at the corresponding nominal voltage in the applicable voltage range for that region. This decision shall be recorded in the test report.

Multi-phase equipment shall be tested applying the same principles set-out above.

For three-phase equipment with a rated voltage range of:

– 200 V to 240 V, testing shall be carried out at one nominal voltage within this range; the recommended test voltage is 220 V;
– 380 V to 450 V, testing shall be carried out at one nominal voltage within this range; the recommended test voltage is 400 V.

EUTs that can be operated from either an AC or DC supply shall be measured in both conditions.

If the rated frequency range includes 50 Hz and 60 Hz, a measurement at either 50 Hz or at 60 Hz shall be performed. The emissions at the other mains frequency are then covered by this measurement.

7.4 Rated lamp load and light regulation

If the EUT has a range of lamp loads it shall be measured with the maximum rated lamp load only.

If the EUT has the possibility to reduce the output power (dimming), the electromagnetic disturbance of the EUT shall be measured at the maximum and minimum light output.

Phase-cut dimmers are operated in the worst case setting as determined during a pre-test.

7.5 Operating modes

If the EUT is capable of being used in different operating modes – e.g. flashing, running illumination, communication by light modulation, colour shifting, emergency, charging, etc. – then measurements shall be performed in the worst-case mode of operation, i.e. the mode of operation with the highest emission relative to the limit.

NOTE 1 Multiple charge regimes can be used by some battery technologies during charging, i.e. fast, trickle, stand by, PWM, etc., for applications in torches, emergency lighting, etc.

The worst case shall be found either by pre-scanning every mode of operation over at least one repetition interval of the specific mode, or by using the setting(s) that are expected to produce the highest amplitude emissions relative to the limit.

NOTE 2 Maximum electromagnetic disturbances can often be captured by operating all channels of an LED driver that are needed to create different colours and/or correlated-colour-temperatures (CCT). The number of channels applied depends on the LED-driver/LED-light-source architecture.

NOTE 3 Maximum electromagnetic disturbances can often be captured by selecting a white colour and/or a CCT setting in the middle of the specified CCT range.

EXAMPLE Colour variation and CCT variation can be achieved using a five-channel LED driver powering three LED strings for colour (RGB) setting and two cool white and warm white LED strings for CCT setting. Hence, in case the lighting equipment under test is capable of operating at different colours and/or CCTs, a white colour and/or a single CCT in the middle of the specified CCT range can be selected.

The reasons for the selection shall be given in the test report.

7.6 Ambient conditions

Measurements shall be carried out in normal laboratory conditions. The ambient temperature shall be within the range from 15 °C to 30 °C or within the range specified by the ~~manufacturer in the operating manual~~ instructions for use if more restricted.

7.7 Lamps

7.7.1 Type of lamps used in lighting equipment

Disturbance measurements of lighting equipment shall be carried out with the lamp for which the lighting equipment is designed.

When the lighting equipment incorporates more than one lamp, all lamps shall be operated simultaneously.

7.7.2 Ageing times

The light source(s) or lamp(s) that is/are part of the EUT shall be stable units. Some light source technologies need a minimum time of ageing to reach a state where its performance characteristics are stable for the purpose of this test.

Unless otherwise stated in this document or specified ~~by the manufacturer~~ in the instructions for use, the following ageing times shall be applied:

– 2 h for incandescent technologies;

– 100 h for discharge technologies.

For LED and OLED technologies no ageing time is required from an EMC-testing point of view.

7.8 Stabilization times

Prior to a measurement, the EUT including the light source(s) or lamp(s) that is (are) part of the EUT shall be operated until stabilization has been reached. Unless otherwise stated in this document or specified by the manufacturer in the instructions for use, the following stabilization time shall be applied:

- ~~15 min for EUTs that do not include gas discharge technologies;~~
- 30 min for EUTs that include gas discharge technologies.
- 1 min for EUTs that do not include gas discharge technologies.

7.9 Operation and loading of wired interfaces

7.9.1 General

Interfaces or connections that are designated as wired ports shall be operated with typical wiring and loads or terminations in accordance with the manufacturer's specification. Any transmission protocol required shall be typical for normal use and as specified ~~by the manufacturer~~ in the instructions for use.

7.9.2 Interface intended for a continuous signal or data transmission

If the interface is intended for a continuous signal transmission (e.g. PWM), the signal transmission shall be in operation during the measurement of all ports of the EUT. A continuous signal or data transmission may be required to maintain the status (e.g. dimming level) of the EUT or of the equipment connected to the EUT.

7.9.3 Interface not intended for a continuous signal or data transmission

If the transmission is not continuous or a continuous data transmission is not necessary to maintain the status of the EUT (e.g. dimming command sent via a DALI protocol), continuous transmission during the tests shall not be applied.

7.9.4 Load

The load of an EUT shall be applied as follows:

- load interfaces which are suitable for both incandescent lamps and other types of lighting equipment (e.g. self-ballasted lamps) shall be tested with non-inductive resistive loads;

  NOTE Incandescent lamps are also considered as non-inductive resistive loads.

- load interfaces which are suitable only for lighting equipment other than incandescent lamps, shall be tested with the appropriate lighting equipment as specified ~~by the manufacturer~~ in the instructions for use.

The load level requirements are given in 7.4.

8 Methods of measurement of conducted disturbances

8.1 General

This clause specifies the measurement methods, EUT arrangements and procedures associated with the conducted disturbance measurements and include specific requirements that take precedence over those provided in the basic standards. Details on specific EUT-arrangements for conducted disturbance measurements are given in Annex B.

8.2 Measurement instrumentation and methods

Conducted disturbances at the different ports shall be measured by applying instrumentation, test sites, procedures and method as indicated in the references of Table 11.

Table 11 – Overview of standardized conducted disturbance measurement methods

Interface	Limits	Frequency range	Reference
Electric power supply interface	Table 1	9 kHz to 30 MHz	CISPR 16-1-1:2019 (receiver) CISPR 16-1-2:2014 and CISPR 16-1-2:2014/AMD1:2017 (~~ancillary equipment:~~ AMN) CISPR 16-2-1:2014 and CISPR 16-2-1:2014/AMD1:2017 (measurement method)
Wired network interfaces other than power supply interface (e.g. for communication or data transfer) [a]	Table 2	150 kHz to 30 MHz	CISPR 16-1-1:2019 (receiver) CISPR 16-1-2:2014 and CISPR 16-1-2:2014/AMD1:2017 (AAN, artificial network, CVP) CISPR 16-2-1:2014 and CISPR 16-2-1:2014/AMD1:2017 and 8.4 (measurement method)
	Table 3~~a~~	150 kHz to 30 MHz	CISPR 16-1-1:2019 (receiver) CISPR 16-1-2:2014 and CISPR 16-1-2:2014/AMD1:2017 (current probe) CISPR 16-2-1:2014 and CISPR 16-2-1:2014/AMD1:2017 and 8.4 (measurement method)
Local wired port – electrical power supply interface of ELV lamps	Table 1 or Table 4	9 kHz to 30 MHz	CISPR 16-1-1:2019 (receiver) CISPR 16-1-2:2014 and CISPR 16-1-2:2014/AMD1:2017 (~~ancillary equipment:~~ AMN) CISPR 16-2-1:2014 and CISPR 16-2-1:2014/AMD1:2017 and A.5.1 (measurement method)
Local wired port – other than the electrical power supply interface of ELV lamps	~~Table 5~~	~~150 kHz to 30 MHz~~	~~CISPR 16-1-1 (receiver)~~ ~~CISPR 16-1-2 (voltage probe)~~ ~~CISPR 16-2-1 and 8.5.2.2 (measurement method)~~
	Table 6	150 kHz to 30 MHz	CISPR 16-1-1:2019 (receiver) CISPR 16-1-2:2014 and CISPR 16-1-2:2014/AMD1:2017 (current probe) CISPR 16-2-1:2014 and CISPR 16-2-1:2014/AMD1:2017 and 8.5.2.3 (measurement method)

[a] Depending on the EUT port under test and on the selected test method, the applicable limit will be Table 2 or Table 3 or both.

In addition to the requirements given in the basic standards, the following requirements for the EUT arrangement and measurement procedure apply.

8.3 Electrical power supply interface disturbance measurement

The disturbance voltage measurement shall be performed as per the method of CISPR 16-2-1 at the electrical power supply interface of the EUT by means of the circuits and arrangement described in Annex B for the relevant type of equipment. An artificial mains V-network 50 Ω / 50 µH + 5 Ω that satisfies the requirements of CISPR 16-1-2 in both the 9 kHz to 150 kHz and 150 kHz to 30 MHz frequency ranges shall be used.

8.4 Disturbance measurement of wired network interfaces other than power supply

Voltage disturbance measurements at wired network interfaces other than power supply (e.g. for communication or data transfer) shall be carried out by means of an artificial asymmetrical network (AAN) as specified in CISPR 32. The AAN shall be bonded to reference-ground plane (see Annex B). The measurement method specified in CISPR 16-2-1 applies.

Current disturbance measurements at wired network interfaces other than power supply (e.g. for communication or data transfer) shall be carried out by means of the current probe (CP) method specified in CISPR 16-2-1. The current probe shall be in accordance with 5.1 of CISPR 16-1-2:2014.

Alternatively, combined voltage and current probe measurements can be applied using the limits of both Table 2 and Table 3 and the combined CVP/CP method described in C.4.1.6.4 of CISPR 32:2015.

NOTE Only the common mode disturbance generated is being measured, as in practice disturbances from the differential-mode control signals are negligible.

Conducted disturbance measurement from wired network interfaces other than power supply (e.g. for communication or data transfer) shall be measured using the applicable procedure as described in CISPR 16-2-1:2014 and CISPR 16-2-1:2014/AMD1:2017, depending on the type of the interface under test. Annex H of CISPR 16-2-1:2014 provides a description of each measurement procedure, as well as the applicability criteria of each procedure to the specific EUT interfaces.

In case of unscreened balanced interfaces measured using an AAN, if no cable longitudinal conversion loss (LCL) is specified in the instructions of use of the EUT, the requirements for the AAN corresponding to Cat. 3 LCL shall be applied.

Depending on the measurement procedure selected, the limits in Table 2, Table 3, or both Table 2 and Table 3 apply (see Annex H of CISPR 16-2-1:2014).

The AAN, artificial network, current probe, and CVP shall comply with the applicable requirements in CISPR 16-1-2:2014 and CISPR 16-1-2:2014/AMD1:2017. The AAN, artificial network and CVP, if used, shall be bonded to the reference ground plane (see Annex B).

8.5 Local wired port disturbance measurement

8.5.1 Electrical power supply of ELV lamps

The method for conducted disturbance measurements at the electrical power supply interface of ELV lamps is specified A.5.1.

8.5.2 Other than electrical power supply of ELV lamps

8.5.2.1 General

The methods for conducted disturbance measurements at local wired ports other than the ELV interface of an ELV lamp shall be as per CISPR 16-2-1 and the following subclauses.

8.5.2.2 Voltage probe measurement method

When a voltage probe is used for measuring voltage disturbances on local wired ports, the measuring circuit shown in Figure B.2 shall be applied. See also B.3.5.

The voltage is measured between each single lead of the cable of the local wired port and the ground.

The voltage probe shall be as defined in 5.2 of CISPR 16-1-2:2014.

~~The measuring results shall be corrected according to the voltage division between the probe and the measuring set. For this correction, only the resistive parts of the impedance shall be taken into account.~~

~~The length of the coaxial cable between the probe and the measuring receiver shall not exceed 2 m.~~

8.5.2.3 Current probe measurement method

When a current probe is used for measuring conducted disturbances on local wired ports, the measuring circuit shown in Figure B.2 shall be applied. See also B.3.5.

The current probe shall be in accordance with 5.1 of CISPR 16-1-2:2014.

9 Methods of measurement of radiated disturbances

9.1 General

This clause provides details on the measurement methods, EUT arrangements and procedures associated with the radiated disturbance measurements and include specific requirements that take precedence over those provided in the basic standards. Details on specific EUT arrangements for radiated disturbance measurements are given in Annex C.

9.2 Intentional wireless transmitters

If intentional wireless transmitters are part of the EUT, the emission from the wireless transmitters shall not be considered as part of the radiated disturbance (see Clause 1). This can be done either by switching off the wireless function of the EUT (if possible and if it does not compromise the typical non-intentional emissions) or by ignoring the intentional radiated emission in the corresponding frequency band.

NOTE For intentional wireless transmitters, applicability of country/region specific regulations is considered.

9.3 Measurement instrumentation and methods

9.3.1 General

Radiated disturbances at the different ports shall be measured by applying instrumentation, test sites, procedures and method as indicated in the references of Table 12.

Table 12 – Overview of standardized radiated disturbance measurement methods

Method	Limits	Frequency range	Reference
LLAS	Table 8	9 kHz to 30 MHz	CISPR 16-1-1 (receiver) CISPR 16-1-4 (instrumentation: antennas and test site) CISPR 16-2-3 (measurement method)
Loop antenna	Table 9	9 kHz to 30 MHz	CISPR 16-1-1 (receiver) CISPR 16-1-4 (instrumentation: antennas and test site) 9.3.3 (measurement method)
OATS/SAC	Table 10	30 MHz to 1 GHz	CISPR 16-1-1 (receiver) CISPR 16-1-4 (instrumentation: antennas and test site) CISPR 16-2-3 (radiated measurement method)
FAR	Table 10	30 MHz to 1 GHz	CISPR 16-1-1 (receiver) CISPR 16-1-4 (instrumentation: antennas and test site) CISPR 16-2-3 (measurement method)

Method	Limits	Frequency range	Reference
TEM	Table 10	30 MHz to 1 GHz	CISPR 16-1-1 (receiver) IEC 61000-4-20 (measurement method and instrumentation)
CDNE	Table 10	30 MHz to 300 MHz	CISPR 16-1-1 (receiver) CISPR 16-1-2 (instrumentation: coupling devices – CDNEs) CISPR 16-2-1 (CDNE measurement method)
FSOATS	Table 14	1 GHz to 6 GHz	CISPR 16-1-1 (receiver) CISPR 16-1-4 (instrumentation: antennas and test site) CISPR 16-2-3 (radiated measurement method)

In addition to the requirements given in the basic standards, the following requirements for the EUT arrangement and measurement procedure apply.

9.3.2 LLAS radiated disturbance measurement 9 kHz to 30 MHz

9.3.2.1 ~~Setup EUT~~ EUT setup

The magnetic component shall be measured by means of a large loop antenna system (LLAS) as described in CISPR 16-1-4. The EUT shall be placed in the centre of the LLAS as shown in Annex C of CISPR 16-1-4:2010. The requirements for routing the cables from the EUT and for the positioning of the EUT inside the LLAS given in CISPR 16-1-4 shall be applied.

If the ~~manufacturer~~ instructions for use allow~~s~~ external wired interfaces to be connected to the EUT by single-conductor cables (which can cause loops and associated magnetic dipoles; see 5.3.4.1), then the EUT shall be tested by configuring each of these external interfaces with a single-conductor wiring having a rectangular loop with an area of (1 ± 0,05) m^2. The support plate of Figure A.6 can be used to establish this 1 m^2 loop. The system under test, i.e. the EUT including its external interfaces arranged in one or more 1 m^2 loops, shall be arranged such that it fits within the smallest possible sphere while at the same time complying with the following requirements:

- distance between the EUT's enclosure and the plane of any of its interfaces arranged in 1 m^2 loops is equal to or greater than 10 cm;
- distance between the loop area of any two adjacent EUT interfaces arranged in 1 m^2 loops is equal to or greater than 10 cm.

~~This smallest possible sphere encompassing the EUT and its interfaces arranged in 1 m^2 loops shall be placed with its centre at the centre of the LLAS.~~

The EUT and its interfaces arranged in 1 m^2 loops shall be placed such that this imaginary sphere is concentric with the LLAS. Example LLAS test arrangements for EUTs that include a 1 m^2 loop are given in Annex C.

9.3.2.2 Measurements in three directions

The current induced in the LLAS is measured in accordance with 7.2 of CISPR 16-2-3:2016. By means of a coaxial switch, the three field directions of the EUT can be measured in sequence. The measurement results for each direction shall comply with the limits.

9.3.3 Loop antenna radiated disturbance measurement 9 kHz to 30 MHz

~~The measurements are performed at 3 m distance with a 60 cm loop antenna as specified in 4.3.2 of CISPR 16-1-4:2010.~~

The measurements shall be performed at a distance of 3 m with a small loop antenna compliant with 4.3 and 4.4 of CISPR 16-1-4:2019 and of CISPR 16-1-4:2019/AMD2:2023.

The following setup requirements and measurement method apply:

1) The measurement shall be performed on an OATS or SAC;

   NOTE Validation requirements for below 30 MHz measurements are under development by CISPR/A; see IEC PAS 62825 for some guidance.

2) The height of the centre of the small loop antenna shall be 1,3 m above the GRP of the OATS or SAC must be 1,3 m test site's ground plane;

3) The loop antenna shall be positioned in the two vertical positions with respect to the GRP, i.e. vertical coaxial and vertical coplanar;

4) The measurement distance is to be taken shall be between the projections onto the ground plane of the centre of the small loop antenna and the EUT boundary of the EUT;

5) The EUT shall be arranged in accordance with Clause C.4;

6) The EUT shall be rotated for each orientation of the loop antenna and the maximum value recorded for each loop antenna orientation shall comply with the limits given in Table 9.

9.3.4 Radiated disturbance measurement 30 MHz to 1 GHz

9.3.4.1 OATS or SAC method

The setup requirements and test method of CISPR 16-2-3 apply when tests are made using the radiated method on an OATS or SAR. Specifics on EUT-arrangements can be found in Annex C.

To improve the reproducibility, the mains supply cable of the EUT shall be terminated with a CDNE (as defined in CISPR 16-1-2) positioned on the reference-ground plane (if applicable) and the receiver port of the CDNE terminated with a 50 Ω impedance.

9.3.4.2 FAR method

The setup requirements and test method of CISPR 16-2-3 apply when tests are made using the radiated method in a FAR. Specifics on EUT-arrangements can be found in Annex C.

To improve the reproducibility, the mains supply cable of the EUT shall be terminated with a CDNE (as defined in CISPR 16-1-2) positioned on the reference-ground plane (if applicable) and the receiver port of the CDNE terminated with a 50 Ω impedance.

9.3.4.3 TEM method

The setup requirements and test method of IEC 61000-4-20 apply when tests are made using the radiated method in a TEM cell.

9.3.4.4 CDNE-method

The setup requirements and test method of CISPR 16-2-1 apply when tests are made using the CDNE.

9.3.5 Radiated disturbance measurement 1 GHz to 6 GHz

The setup requirements and test method of CISPR 16-2-3:2016, CISPR 16-2-3:2016/AMD1:2019 and CISPR 16-2-3:2016/AMD2:2023 apply when tests are made using the radiated method on an FSOATS. Specifics on EUT arrangements can be found in Annex C.

When using a spectrum analyser, the VBW shall be 1 MHz or higher. The recommended VBW is 3 MHz.

10 Compliance with this document

~~Where this document gives options for evaluating particular EMC characteristics 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 document, the measurement method originally chosen shall be used in order to ensure consistency of the results.~~

~~NOTE If individual items of equipment from a series are tested, it can be expected that a range of results will be obtained, irrespective of measurement uncertainty. Annex E contains information about methods for statistical evaluation of mass-produced equipment.~~

Where this document gives options for evaluating particular EMC characteristics with a choice of test methods and associated limits, any one of these options may be used.

The equipment complies with the requirements of this document with respect to the addressed EMC characteristics when one of the test methods returns a test result compliant with the applicable requirements.

NOTE In any situation involving the retesting of equipment, reproducibility of test results is best achieved if the original test method is used.

11 Measurement uncertainty

Where guidance for the calculation of the instrumentation uncertainty of a measurement is specified in CISPR 16-4-2, this shall be followed, and for these measurements the determination of compliance with the limits in this document shall take into consideration the measurement instrumentation uncertainty in accordance with CISPR 16-4-2. Calculations to determine the measurement result and any adjustment of the test result required when the test laboratory uncertainty is larger than the value for U_{CISPR} given in CISPR 16-4-2 shall be included in the test report.

12 Test report

General requirements of 5.10 of ISO/IEC 17025:2005 for compiling a test report apply. Sufficient details shall be provided to facilitate reproducibility of the measurements. This shall include photographs of the EUT and the measurement configuration where this is appropriate.

The test report shall include the following information:

- dimensions of the EUT;
- the below 30 MHz radiated-field disturbance method used and the associated limits that have been applied (4.5.2);
- the above 30 MHz radiated-field disturbance method used and the associated limits that have been applied (4.5.3);
- when using the CDNE method to show compliance to 1 GHz, a statement ~~(from the manufacturer)~~ that the clock frequency is below 30 MHz;
- the wired interfaces that have been assessed together with the assigned port, the method used and associated limits (5.3);
- in case of module measurements, description and arrangement of the host and modules used during measurements (6.4);
- the adjustment of the test result required when the test laboratory uncertainty is larger than the value for U_{CISPR} given in CISPR 16-4-2;
- deviations from cable length requirements, in case of conflicting lengths of cables with other requirements on cable lengths or dimensions in the test setup (B.2.1);

- tested operating mode(s) of the EUT and reason for selection;
- controller settings, in case the EUT is capable of operating at different manually adjustable settings for light colour and/or intensity;
- selected repetition frequency during testing, in case the EUT is capable of operating with automatic change of light colour and/or light intensity.

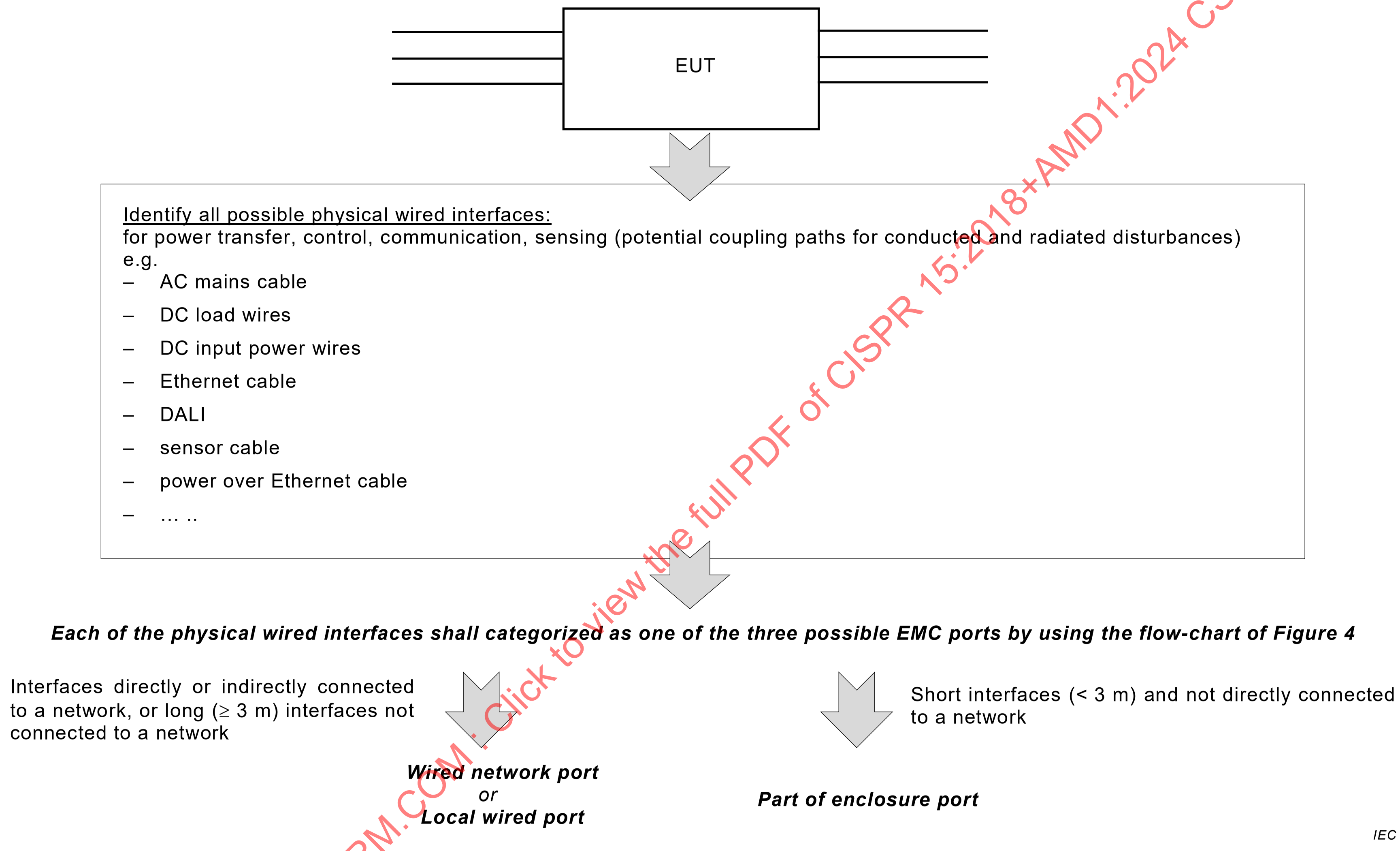
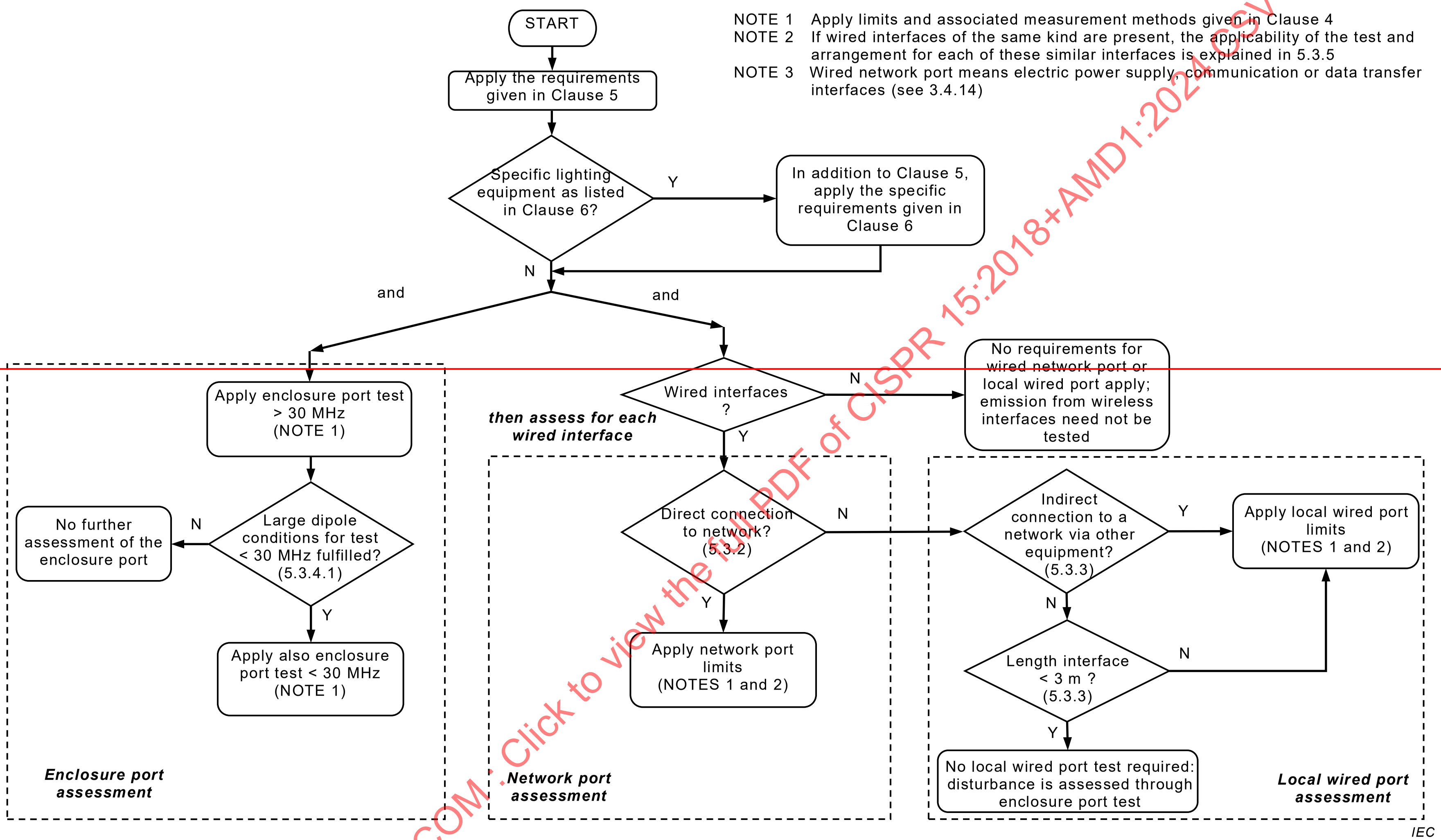


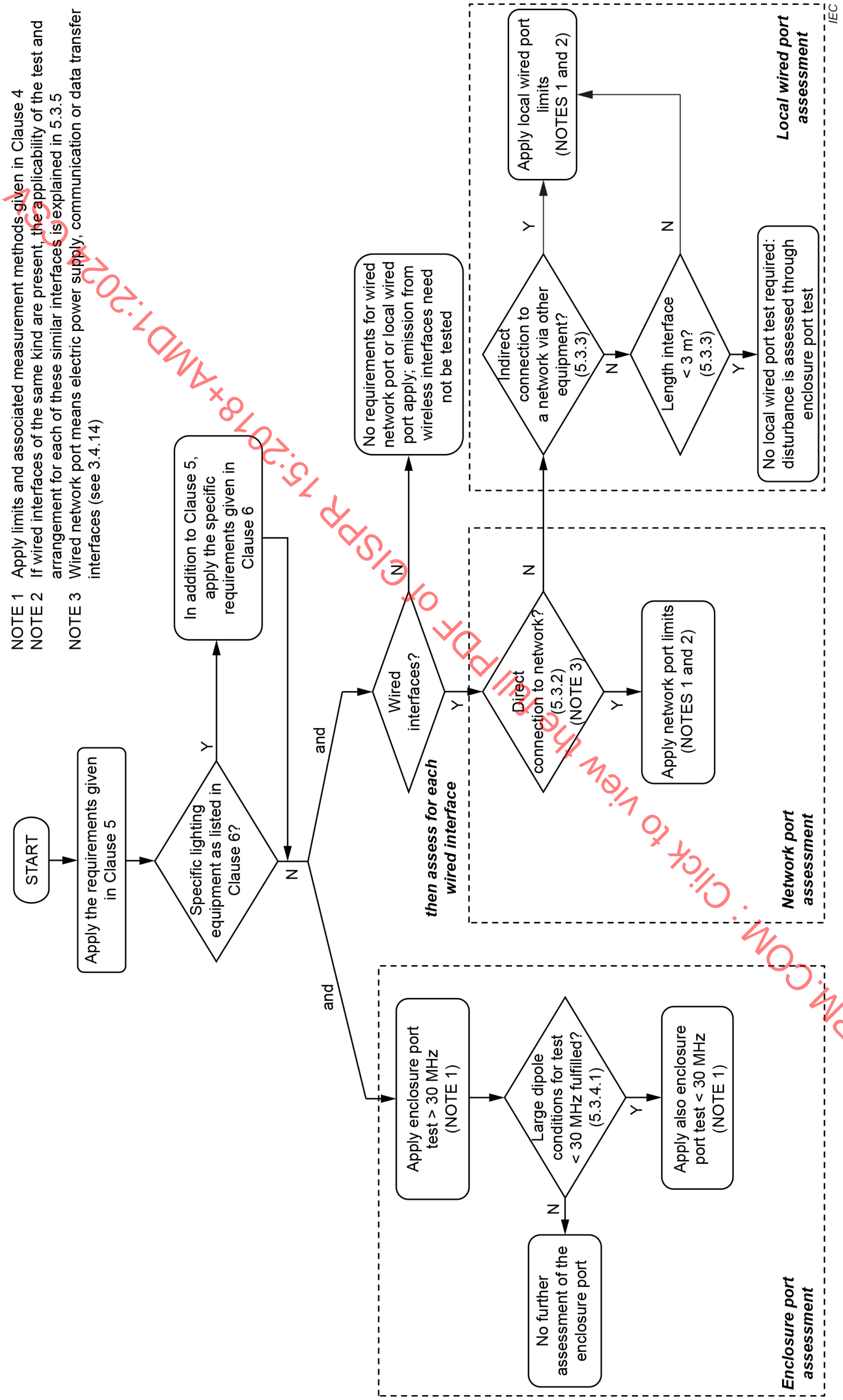
Figure 3 – EUT and its physical interfaces



NOTE 1 Apply limits and associated measurement methods given in Clause 4

NOTE 2 If wired interfaces of the same kind are present, the applicability of the test and arrangement for each of these similar interfaces is explained in 5.3.5

NOTE 3 Wired network port means electric power supply, communication or data transfer interfaces (see 3.4.14)



NOTE 1 Apply limits and associated measurement methods given in Clause 4

NOTE 2 If wired interfaces of the same kind are present, the applicability of the test and arrangement for each of these similar interfaces is explained in 5.3.5

NOTE 3 Wired network port means electric power supply, communication or data transfer interfaces (see 3.4.14)

Figure 4 – Decision process on the application of limits to the EUT

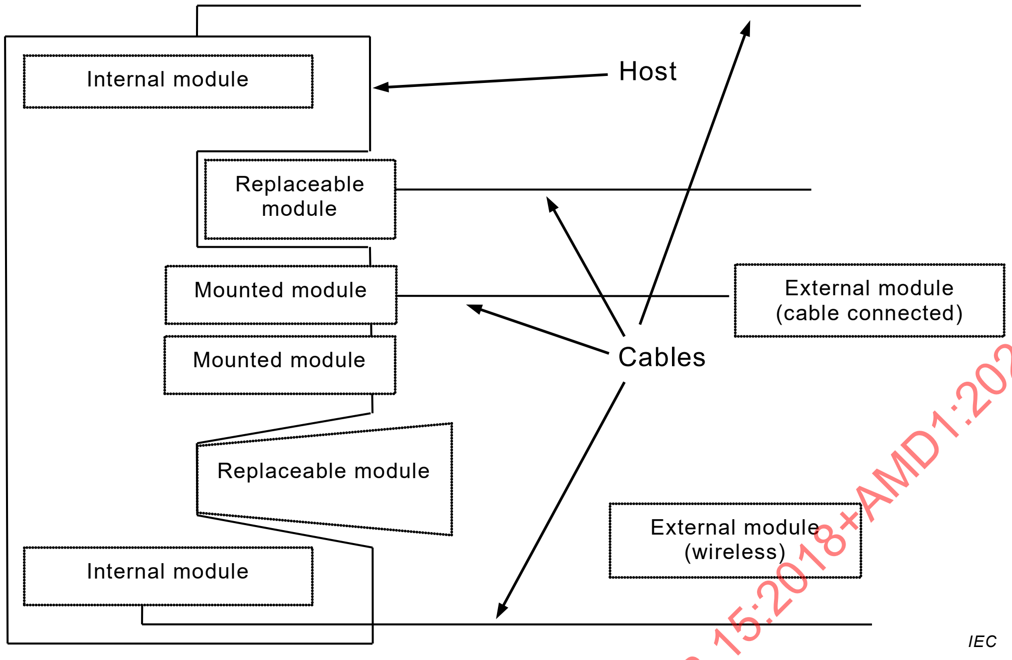


Figure 5 – Example of a host system with different types of modules

Annex A
(normative)

Product specific application notes referring to particular measurement set-ups or operating conditions

A.1 Single-capped self-ballasted lamps

A.1.1 Arrangement for conducted disturbance measurements

The circuit for the measurement of the disturbance voltage for a single capped lamp is shown in Figure B.1c.

The lamp ~~is~~ shall be fitted in an appropriate lampholder and mounted in a conical reference housing as specified in Figure A.2. The conical housing ~~is~~ shall be positioned on the table ~~with~~ such that the closest part of the cone is at 40 cm distance from the RGP (see ~~Figure B.1 and Figure A.3 and Figure A.4~~ Figure B.3). The horizontal RGP is fixed at 40 cm from the tube (T). The electric power supply interface (EPSI) is routed horizontally such that a fixed distance to the horizontal RGP is maintained. The vertical RGP (if present) is ≥ 80 cm away from the edge of the set-up. The lamp in the reference housing shall be measured similar to luminaires in which the optical window is positioned as given in Figure B.3. Self-ballasted lamps with a GU10 bayonet cap (IEC 60061-1) ~~are to~~ shall be fitted in an electrical conductive hose-clamp type of fixture which makes contact with the circumference of the housing (either conductive or non-conductive) of the GU10 lamp near the rim as indicated in Figure A.5. The hose-clamp shall have a width of (9 ± 1) mm. ~~The hose-clamp fixture is to be connected to the earth terminal of the AMN.~~ The conductive hose-clamp, together with an appropriate lamp holder, acts as a reference luminaire for GU10 lamps.

The power supply cable connecting the terminals of the conical housing or of the GU10's hose-clamp to the AMN shall be of ~~0,8~~ 1 m. The conical reference metal housing or the GU10's hose-clamp shall be connected to the earth terminal of the AMN.

Single-capped self-ballasted lamps having particular shapes that do not fit in the conical housing shall be measured using a reference housing (reference luminaire) that satisfies the requirements for a host system specified in 6.4.1.

A.1.2 Arrangement for radiated disturbance measurements

The single capped lamp shall be measured when inserted in a relevant lampholder.

A.2 Semi-luminaires

Semi-luminaires shall be measured with a suitable lamp having the maximum power allowed for it. The combination of the semi-luminaire (EUT) and the lamp (AuxEq) is the system under test and the combination shall be tested as a single capped lamp in accordance with Clause A.1.

A.3 Rope lights

A.3.1 Preparation of the EUT

The rope lights (not the mains cord, if applicable) shall be folded on the insulating support plate as depicted in Figure A.6. The support plate consists of a square insulating plate with dimensions (1 250 x 1 250) mm and two rows of 24 circular insulating sticks positioned as shown in Figure A.6. The starting point (mains connection) of the rope is in the middle between the two rows on the left side of the plate. If the length of the rope light (excluding the mains cord) is less than 1,2 m, then no meandering on the support plate is needed and the rope light shall be treated as a luminaire.

A.3.2 Arrangement for conducted disturbance measurements

The insulating support (AuxEq) with the rope lights (EUT) shall be considered a luminaire and shall be arranged as specified in Clause B.5.

A.3.3 Arrangement for radiated disturbance measurements

The insulating support (AuxEq) with the rope lights (EUT) shall be considered a luminaire and shall be arranged as specified in C.4.2.

A.4 Double-capped lamp adapters, double-capped self-ballasted lamps, double-capped semi-luminaires and double-capped retrofit lamps used in fluorescent lamp luminaires

A.4.1 For application in linear luminaires with electromagnetic controlgear

Double-capped lamp adapter, double-capped self-ballasted lamp, double-capped semi-luminaire and double-capped retrofit lamp shall be measured with the auxiliary equipment specified in Figure A.1. The EUT is inserted into a linear reference luminaire as specified in Figure A.1. The existing magnetic lamp controlgear is short-circuited if specified ~~by the manufacturer in the operating manual~~ in the instructions for use. The height of the lamp holders shall be such that the distance between the exterior of the lamp and the metal plate is (9 ± 1) mm for lamps having a nominal tube diameter lower or equal to 25 mm and (20 ± 1) mm for lamps having a nominal tube diameter greater than 25 mm.

The units under test (EUT) shall be measured as manufactured. For double-capped lamp adapter and double-capped semi-luminaire, suitable lamps having the maximum power allowed for it shall be used.

If the use of a magnetic controlgear is required ~~by the manufacturer in the operating manual~~ in the instructions for use, the magnetic controlgear shall fulfil IEC 60921 and the parasitic capacity between line and earth shall be less than 2 nF, as measured at or below 1 kHz. The magnetic lamp controlgear in the measurement set-up of Figure A.1 shall be short-circuited if the use of the magnetic controlgear is not required ~~by the manufacturer~~ in the instructions for use. For conducted emissions, the cable connecting the terminals at the reference luminaire to the AMN shall comply with the requirements given in B.2.1 and the ground terminal of the reference luminaire shall be connected to the earth terminal of the AMN.

A.4.2 For application in linear luminaires with electronic controlgear

For application of double-capped lamp adapters, double-capped self-ballasted lamps, double-capped semi-luminaires and double-capped retrofit lamps in luminaires with electronic controlgear in operation, the requirements are to be verified using a typical host luminaire or a CISPR TR 30-1 reference luminaire compliant with this document.

A.4.3 For application in other than linear luminaires

Double-capped self-ballasted lamps having particular shapes (e.g. U-shaped) that do not fit in the reference luminaire of Figure A.1 shall be measured using a reference housing that satisfies the requirements for a host system specified in 6.4.1.

A.4.4 Measurement methods

EUT in the reference luminaire (AuxEq) is tested as a luminaire. The system under test, including the EUT, as shown in Figure A.1 shall be used for both the measurement of the disturbance voltages described in Clause 8 and for the measurement of the radiated electromagnetic disturbances described in Clause 9.

A.5 ELV lamps

A.5.1 Conducted disturbance test

ELV lamps shall be tested as follows:

a) Non-restricted ELV lamps: The extra-low voltage terminals of the ELV lamp shall be connected to the AMN. The mains input side of the AMN is connected to the output of a suitable magnetic transformer. See Figure A.3.

b) Restricted ELV lamps: The ELV lamp shall be connected to the power supply of the same model/type as specified ~~by the manufacturer in the operating manual~~ in the instructions for use. The combination shall be measured using the arrangement as shown in Figure A.4.

In both cases, the ELV lamp is mounted as described in A.1.1. In either case, the bonding strap of the AMN shall satisfy the requirements in 5.3 of CISPR 16-2-1:2014.

A.5.2 Radiated disturbance tests

Radiated disturbance measurements of an ELV lamp (as applicable; see 6.4.7) shall be performed in accordance with Clause 9. However, the lamp shall not be mounted in a conical metal housing.

For any assessment method of the radiated disturbances, the following applies:

- for non-restricted ELV lamps, only the lamp shall be assessed;
- for restricted ELV lamps, both the lamp and the specific power source shall be assessed.

A.6 Independent igniters

Independent igniters are measured in a relevant lamp-ballast circuit. The igniter shall be mounted together with the suitable lamp and ballast on a piece of insulating material, (12 ± 2) mm thick, which shall be placed on a metal plate of dimensions slightly larger than the piece of insulating material. The plate shall be connected to the reference earth of the AMN. If the device or ballast is provided with an earth terminal, it shall also be connected to that reference earth. The lamp is then started. After the stabilization time, the terminal voltage is measured.

Dimensions in millimetres

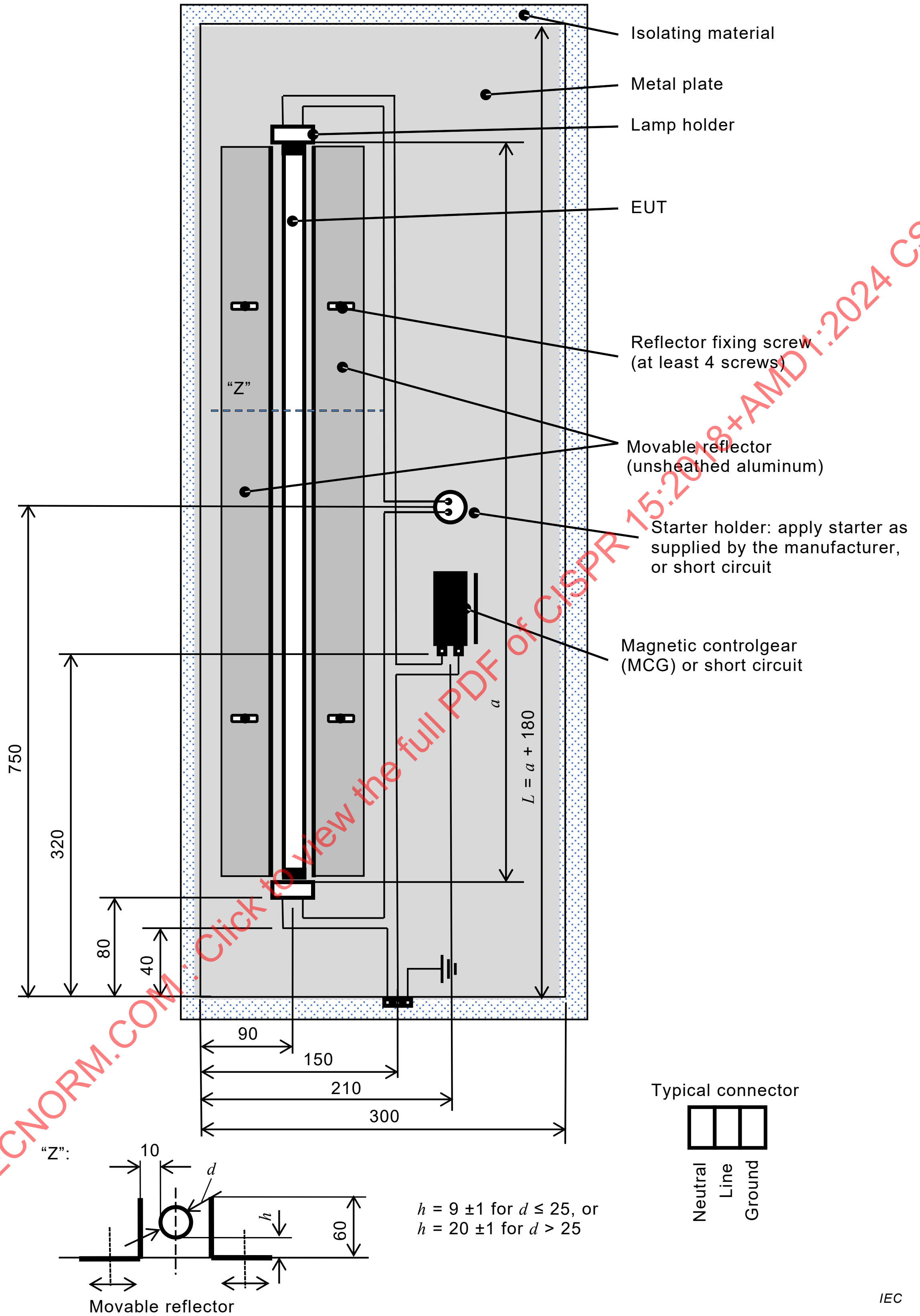
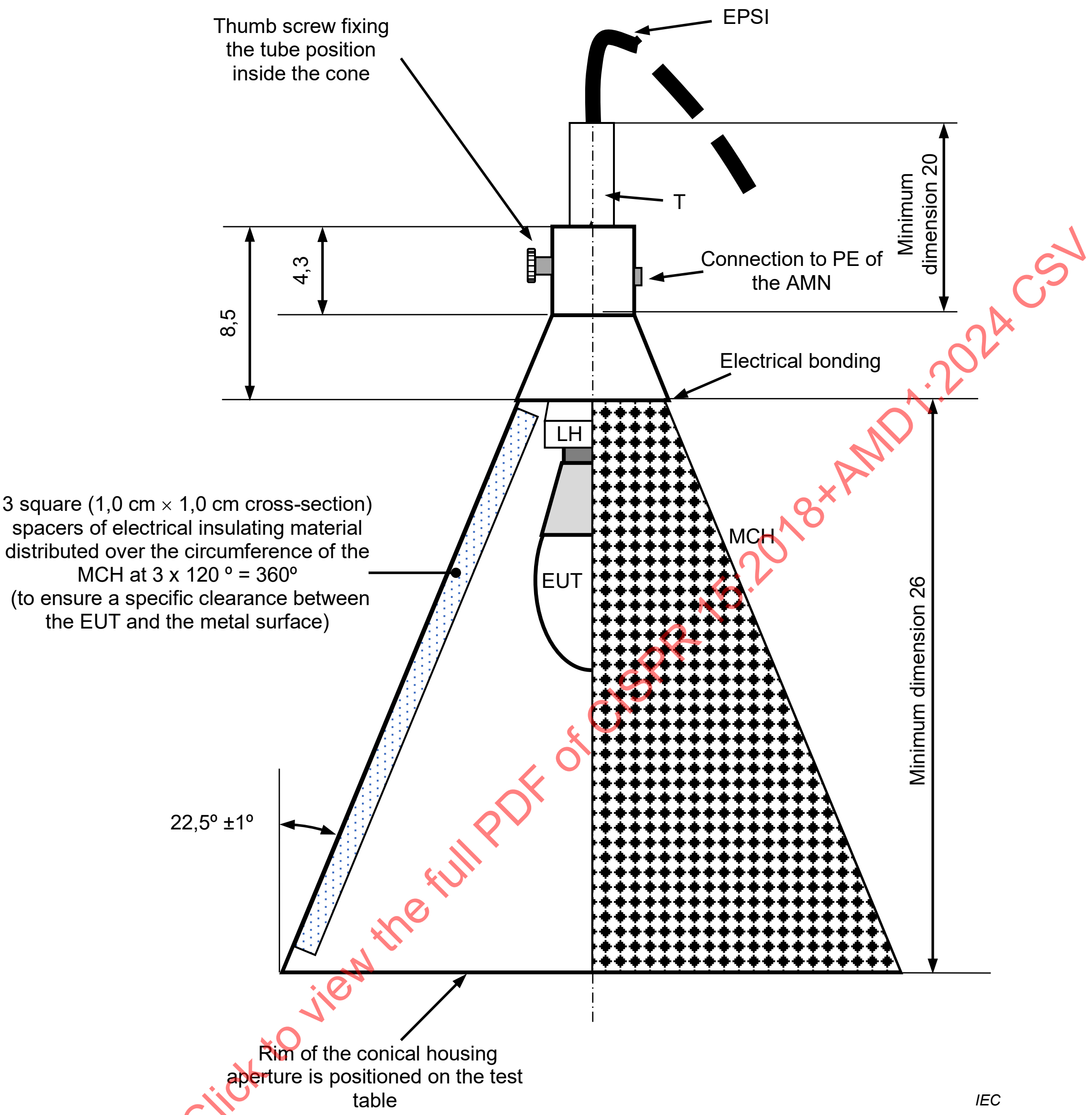


Figure A.1 – Reference luminaire for double-capped lamp adapter, double-capped self-ballasted lamp, double-capped semi-luminaire and double-capped retrofit lamp used in linear fluorescent lamp luminaires (see A.4.1)

Dimensions in centimetres



Key

T Tube: outer diameter 1,9 cm, inner diameter 1,6 cm

LH Lamp holder

EUT Self-ballasted lamp under test

MCH Perforated metal conical housing, for example 5 mm squares

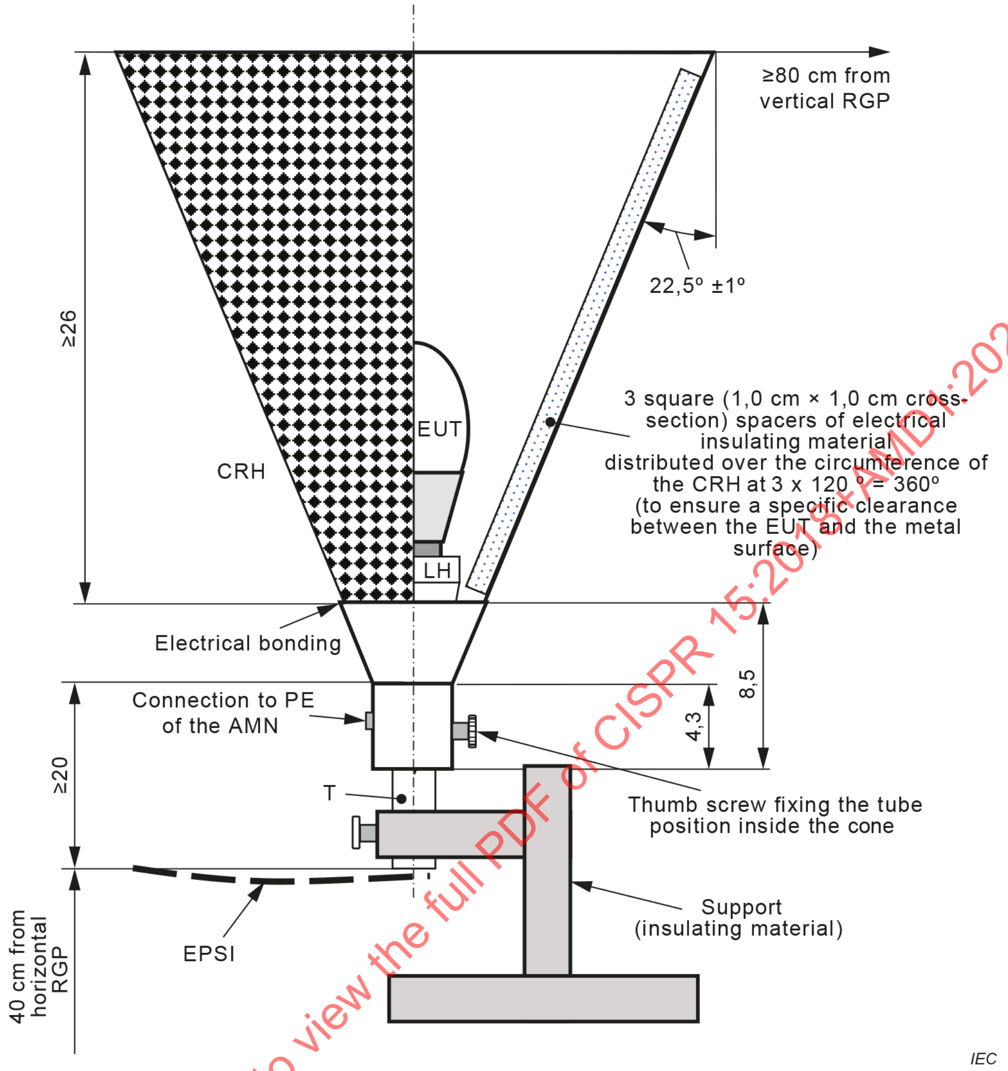
EPSI Electric power supply interface

NOTE 1 Tolerances in dimensions: ± 1 mm, unless otherwise specified.

NOTE 2 For good reference, adjust the lamp to the position nearest to the lamp holder.

NOTE 3 For good reference, the lampholder is of insulating material.

Dimensions in centimetres



Key

T	Tube: outer diameter 1,9 cm, inner diameter 1,6 cm
LH	Lamp holder
EUT	Self-ballasted lamp under test
CRH	Conical reference housing, made of perforated metal, e.g. 5 mm squares
PE	Protective earth
AMN	Artificial mains network
EPSI	Electric power supply interface

NOTE 1 Tolerances in dimensions: ±1 mm, unless otherwise specified.

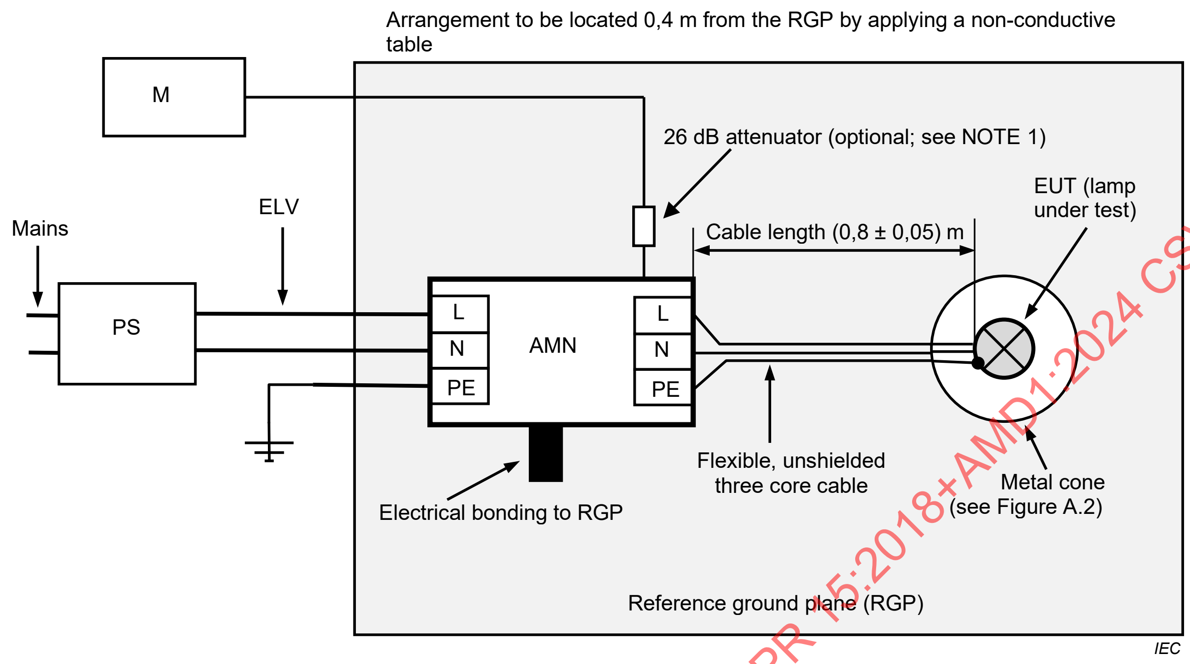
NOTE 2 Adjust the tube T such that the lamp holder is nearest to the inside tip of the cone CRH.

NOTE 3 The lamp holder is of insulating material.

NOTE 4 Alternative styles of support are allowed.

Figure A.2 – Conical ~~metal~~ reference housing for single capped lamps (see A.1.1)

TOP VIEW



~~**Key**~~

~~PS Power supply (appropriate power supply e.g. magnetic transformer or universal power supply)~~

~~L Line~~

~~N Neutral~~

~~PE Protective earth~~

~~AMN Artificial mains network~~

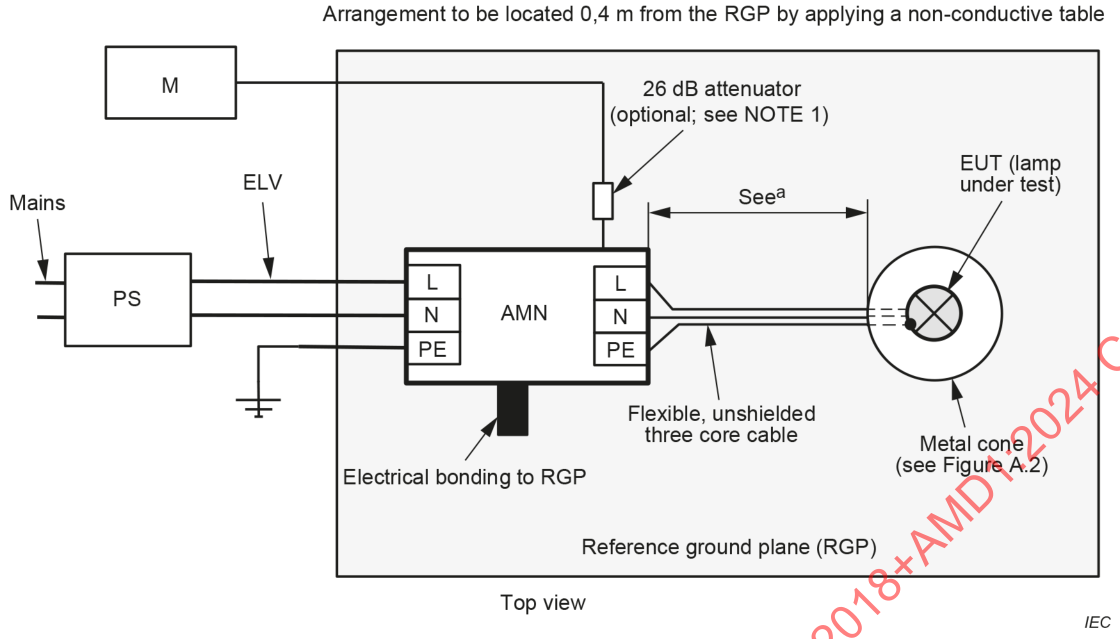
~~ELV Extra low voltage~~

~~M CISPR measuring receiver~~

~~This arrangement shows a top view and uses a horizontal reference ground plane. The same setup can also be employed at a distance of 0,4 m aside of a vertical reference ground plane (see CISPR 16-2-1 and Clause B.5 and Figure B.3 of this document for details of the arrangement). The AMN shall be placed on and bonded to the RGP. Alternatively, it can be placed on the non-conductive table and bonded to the RGP by means of a very wide, low impedance conductor. In either case, the bonding strap shall satisfy the requirements in 5.3 of CISPR 16-2-1:2014.~~

~~NOTE 1 If the 26 dB attenuator is used, the limits given in Table 1 are applied. If no attenuator is used, the limits of Table 4 apply. See 6.4.7a). A 26 dB attenuator between the AMN and receiver is also for protecting the receiver against possible high signal levels at the ELV terminals.~~

~~NOTE 2 The ground of the flexible unshielded cable between AMN and EUT is connected to the conical metal housing.~~



Key

PS	Power supply (appropriate power supply, e.g. magnetic transformer or universal power supply)
L	Line
N	Neutral
PE	Protective earth
AMN	Artificial mains network
ELV	Extra low voltage
M	CISPR measuring receiver

This arrangement shows a top view and uses a horizontal reference ground plane. The same setup can also be employed at a distance of 0,4 m aside of a vertical reference ground plane (see CISPR 16-2-1 and Clause B.5 and Figure B.3 of this document for details of the arrangement). The AMN shall be placed on and bonded to the RGP. Alternatively, it can be placed on the non-conductive table and bonded to the RGP by means of a very wide, low impedance conductor. In either case, the bonding strap shall satisfy the requirements in 5.3 of CISPR 16-2-1:2014 and CISPR 16-2-1:2014/AMD1:2017.

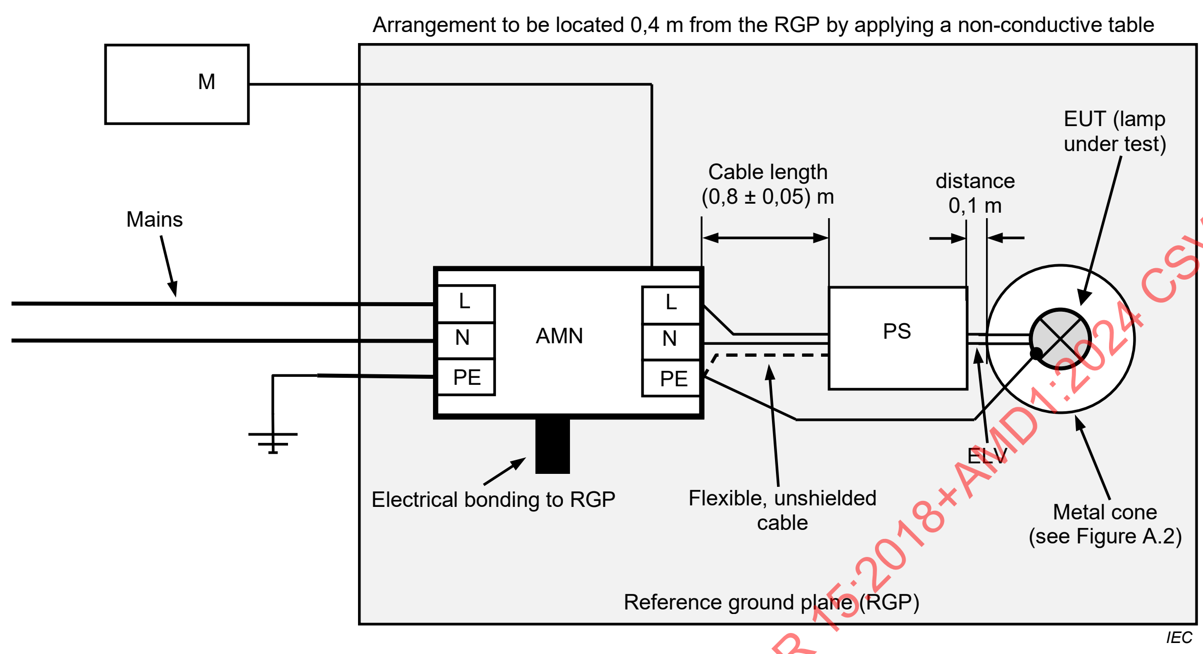
NOTE 1 If the 26 dB attenuator is used, the limits given in Table 1 are applied. If no attenuator is used, the limits of Table 4 apply. See 6.4.7 a). A 26 dB attenuator between the AMN and receiver is also for protecting the receiver against possible high signal levels at the ELV terminals.

NOTE 2 The ground of the flexible unshielded cable between AMN and EUT is connected to the conical metal housing.

[a] The distance between the closest point of the AMN and the closest point of the conical reference housing shall be (0,8 ± 0,05) m. The cable length between the conical reference housing and the AMN shall be no longer than 1 m.

Figure A.3 – Arrangements for conducted disturbance measurements from non-restricted ELV lamps (see A.5.1)

TOP VIEW



~~This arrangement shows a top view and uses a horizontal reference ground plane. The same setup can also be employed at a distance of 0,4 m aside of a vertical reference ground plane (see CISPR 16-2-1 and Clause B.5 and Figure B.3 of this document for details of the arrangement). The AMN shall be placed on and bonded to the RGP. Alternatively, it can be placed on the non-conductive table and bonded to the RGP by means of a very wide, low impedance conductor. In either case, the bonding strap shall satisfy the requirements in 5.3 of CISPR 16-2-1:2014.~~

~~The ground cable between AMN and EUT is connected to the conical metal housing. If the PS also requires a PE connection, it shall be connected to the PE of the AMN.~~

~~**Key**~~

~~PS Appropriate power supply specified by the manufacturer~~

~~L Line~~

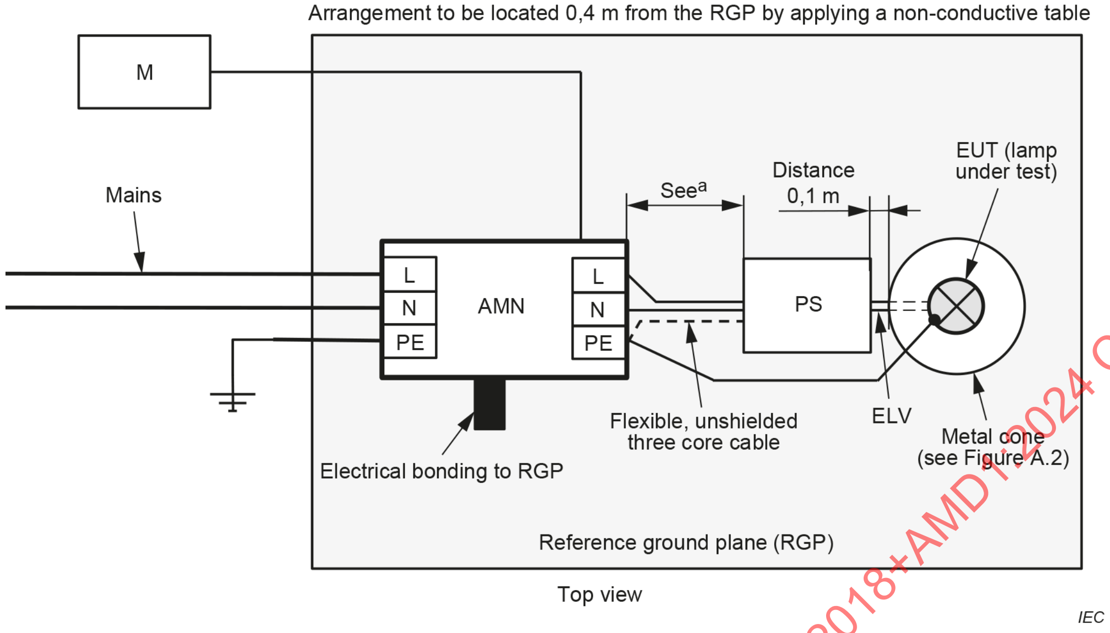
~~N Neutral~~

~~PE Protective earth~~

~~AMN Artificial mains network~~

~~ELV Extra low voltage~~

~~M CISPR measuring receiver~~



Key

PS Appropriate power supply specified in the instructions for use

L Line

N Neutral

PE Protective earth

AMN Artificial mains network

ELV Extra low voltage

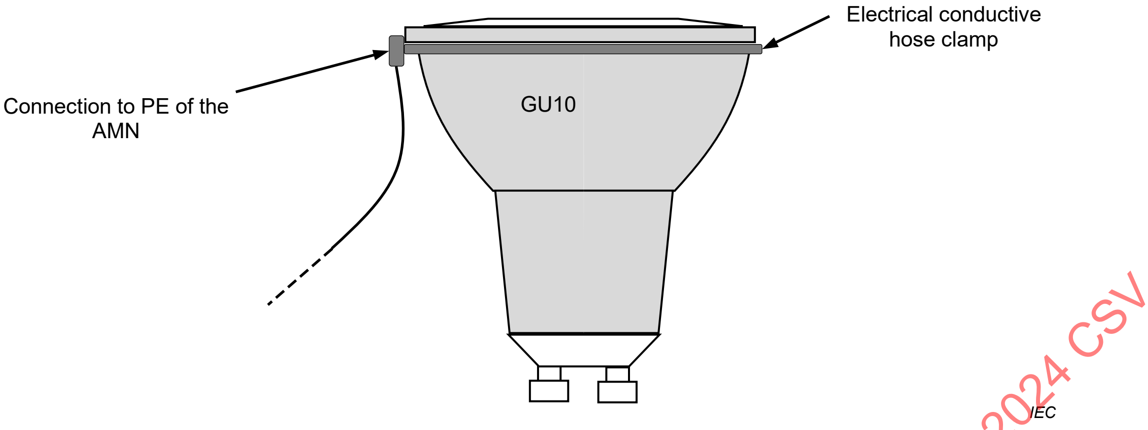
M CISPR measuring receiver

This arrangement shows a top view and uses a horizontal reference ground plane. The same setup can also be employed at a distance of 0,4 m aside of a vertical reference ground plane (see CISPR 16-2-1 and Clause B.5 and Figure B.3 of this document for details of the arrangement). The AMN shall be placed on and bonded to the RGP. Alternatively, it can be placed on the non-conductive table and bonded to the RGP by means of a very wide, low impedance conductor. In either case, the bonding strap shall satisfy the requirements in 5.3 of CISPR 16-2-1:2014 and CISPR 16-2-1:2014/AMD1:2017.

The ground cable between AMN and EUT is connected to the conical metal housing. If the PS also requires a PE connection, it shall be connected to the PE of the AMN.

[a] The distance between the closest point of the AMN and the closest point of the PS shall be (0,8 ± 0,05) m. The cable length between the PS and the AMN shall be no longer than 1 m.

Figure A.4 – Arrangements for conducted disturbance measurements from restricted ELV lamps (see A.5.1)

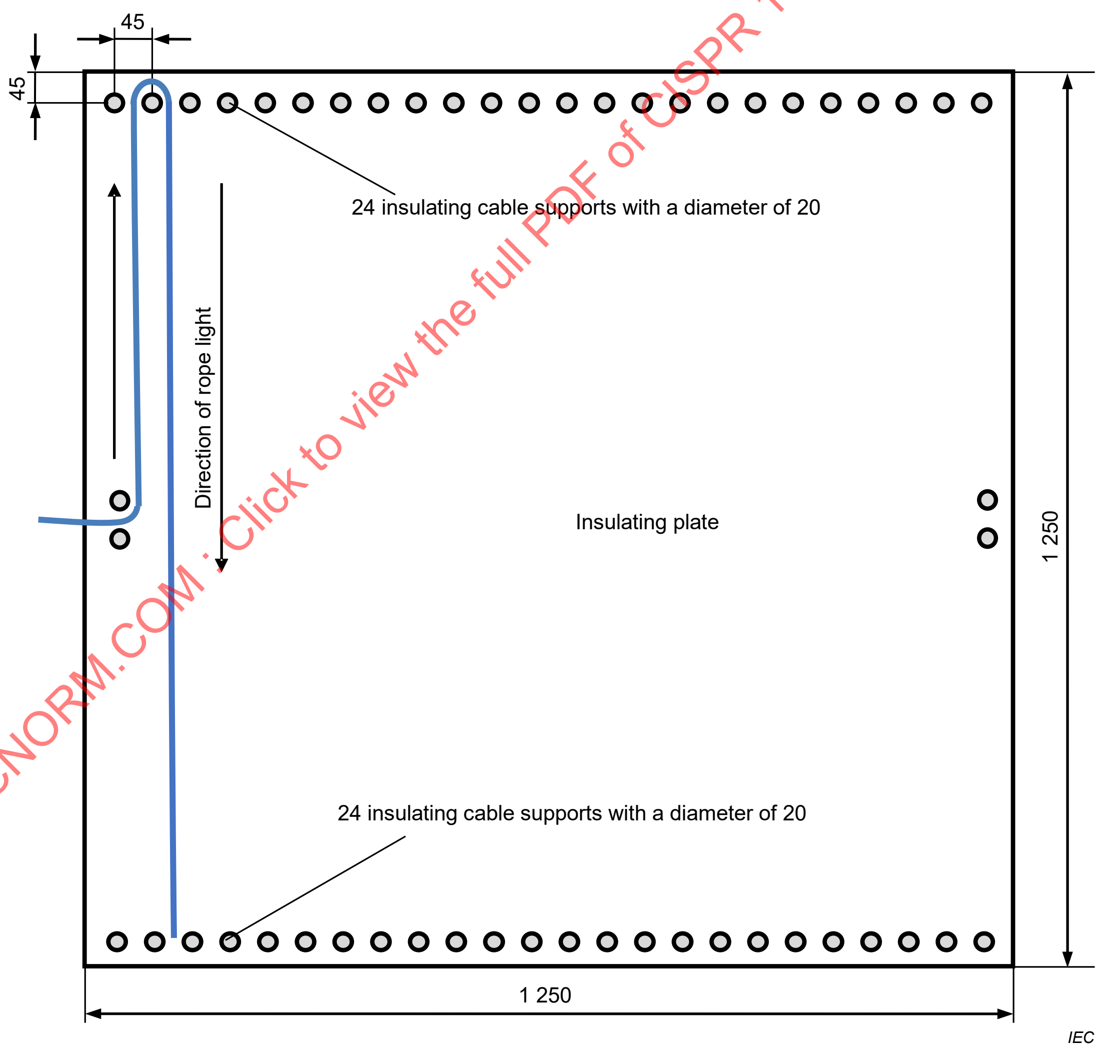


Key

GU10 Self -ballasted lamp with a GU10 bayonet cap

Figure A.5 – Hose-clamp reference luminaire for self-ballasted lamps with a GU10 bayonet cap (see A.1.1)

Dimensions in millimetres



NOTE All dimensions have a 5 % tolerance.

Figure A.6 – Support plate for arranging long cables and rope lights (see 9.3.2, Clauses A.3 and B.3)

Annex B
(normative)

Test arrangements for conducted disturbance measurements

B.1 General

This annex gives more details on the test arrangements for conducted emission measurements. It concerns details on the positioning of the EUT, the cables, auxiliary equipment and the ancillary equipment (like measurement probes).

B.2 Arrangement of cables connected to interfaces of wired network ports

B.2.1 Arrangements of electric power supply cables

The ~~output terminals~~ separation distance between the closest point of the artificial mains network (50 Ω/50 μH + 5 Ω AMN that meets the requirements as specified in CISPR 16-1-2:2014 and CISPR 16-1-2:2014/AMD1:2017 in both 9 kHz to 150 kHz and 150 kHz to 30 MHz frequency ranges) and the ~~electric power supply terminals~~ closest point of the EUT shall be ~~positioned~~ (0,8 ± 0,05) m ~~apart and~~. The two shall be connected by the two power conductors of a flexible three-core or two-core cable of (~~0,8~~ 1,0 ± 0,05) m length.

If the electric power supply cable of the EUT is longer than necessary to be connected to the AMN, the length of this cable in excess of ~~0,8~~ 1,0 m shall be folded back and forth parallel to the lead so as to form a bundle with a length ~~between 0,3 m and~~ up to 0,4 m.

If the cable on which the measurements are to be made is shorter than the required distance between the EUT and the AMN, it shall be extended to the necessary length.

In case there is a conflict between the distances indicated in Figure B.1 to Figure B.3 and the cable length specified in this paragraph, then the latter takes precedence.

~~In specific cases, like very large EUTs, the above stated cable length requirements may be impossible to be complied with. In case of deviations from the above stated power supply cable length are required, these, together with the corresponding justification, shall be stated in the test report.~~

In specific cases, such as for very large EUTs, it can be impossible to comply with both the above stated cable length and EUT-AMN separation distance requirements. In such cases, the EUT (or AMN) shall be positioned to obtain the distance (0,8 ± 0,05) m between AMN and EUT, and the mains supply cable between the EUT and AMN shall be connected with a straight routing such as to achieve minimum length of at least 1,0 m (see Figure B.4).

If the electric power supply cable of the EUT includes the protective earth conductor, the earthing conductor at the end of the power supply cable opposite the EUT shall be connected to the AMN reference ground.

Where a protective earth conductor is required, but is not included in the lead, the connection of the protective earth line of the appliance to the AMN reference ground shall be made by a wire not longer than necessary to be connected to the AMN running parallel to the electric power supply cable at a distance of not more than 0,1 m from it.

If the EUT's power supply cable is equipped with disturbance mitigation features (such as in-line EMI filter), then these shall be included unaltered in the tested setup even in situations where the cable length needs to be adjusted to comply with the length requirement.

B.2.2 Arrangement of other than electric power supply cables

EUTs that have interfaces, designated as network ports, to connect other than the electric power supply cables (see B.2.1) to AuxEq (e.g. DALI controller, LAN switch, power-over-Ethernet switch) shall be mounted on an insulating table in accordance with Figure B.1a, Figure B.2 and Figure B.3.

The cable length requirement is (~~0,8~~ 1,0 ± 0,05) m and the cable is arranged in accordance with the applicable test method given in 8.4.

If the EUT's cable is equipped with disturbance mitigation features (such as in-line EMI filter), then these shall be included unaltered in the tested setup even in situations where the cable length needs to be adjusted to comply with the length requirement.

B.3 Arrangement of cables connected to interfaces of local wired ports

B.3.1 General

This clause applies to the arrangement of EUT interfaces classified as local wired ports (see 5.3.3).

EUTs that have such interfaces, categorized as local wired ports, to connect to AuxEq (e.g. load, starter, ignitor, controlgear, sensors, power switch, LAN switch, components, etc.) shall be mounted on an insulating table together with the interconnecting cable and the AuxEq.

The interconnecting cable of the local wired port being assessed shall be arranged as specified in B.3.2 to B.3.4.

In case of multiple identical local wired ports, only the cable of the local wired port being assessed shall be arranged as specified in this subclause. The other local wired ports shall be terminated with AuxEq using a short cable. See also Clause B.4.

B.3.2 Cables of local-wired ports indirectly connected to a network

Cables of local-wired ports that are indirectly connected to a network can have any length in practice (3.4.10). Depending on the maximum length specified ~~by the manufacturer~~ in the instructions for use, one of the following cable arrangements shall be applied:

a) For cables ≤ 3 m, measurements shall be performed with a cable of 0,8 m ± 20 %, or with the smaller maximum length indicated ~~by the manufacturer~~ in the instructions for use. The cable shall be a flexible cable, of sufficient cross-section, and shall be arranged in a straight line.

b) For cables > 3 m, measurements shall be performed twice, once with a cable of 0,8 m ± 20 % as in a) above and secondly with the maximum permissible cable length arranged on the support plate specified in Figure A.6. If the maximum permissible cable length exceeds 25 m, then the second measurement shall be performed with a length of 25 m.

c) Where ~~the manufacturer gives~~ strict installation and application instructions are specified, including the arrangement of the cable, the measurements shall be performed under these conditions. If the ~~manufacturer's~~ application instructions require a shielded cable to be used or that the non-shielded cable is installed inside a metallic conduit, the measurements shall be performed under these conditions; otherwise, the cable length requirements in a) or b) shall be observed, as applicable based on the cable length specified ~~by the manufacturer~~ in the instructions for use.

The indication of the maximum permissible cable length shall be shown clearly in the installation instructions and/or on the type label of the EUT.

If the EUT's cable is equipped with disturbance mitigation features (such as in-line EMI filter), then these shall be included unaltered in the tested setup even in situations where the cable length needs to be adjusted to comply with the length requirement.

B.3.3 Cables of local-wired ports other than the type mentioned in B.3.2

Cables of local-wired ports that are not indirectly connected to a network can have any length ≥ 3 m in practice (3.4.10). Depending on the maximum length, or particular installation or application instructions specified by the manufacturer, one of the following cable arrangements shall be applied:

a) Measurements shall be performed twice, once with a load cable of 0,8 m ± 20 % as in a) above and secondly with the maximum permissible cable length arranged on the support plate specified in Figure A.6. If the maximum permissible cable length exceeds 25 m, then the second measurement shall be performed with a length of 25 m.

b) Where the manufacturer gives strict installation and application instructions are specified, including the arrangement of the cable, the measurements shall be performed under these conditions. If the manufacturer's application instructions require a shielded cable to be used or that the non-shielded cable is installed inside a metallic conduit, the measurements shall be performed under these conditions; otherwise, the cable length requirements in a) shall be observed, as applicable based on the cable length specified by the manufacturer in the instructions for use.

The indication of the maximum permissible cable length shall be shown clearly in the installation instructions and/or on the type label of the EUT.

If the EUT's cable is equipped with disturbance mitigation features (such as in-line EMI filter), then these shall be included unaltered in the tested setup even in situations where the cable length needs to be adjusted to comply with the length requirement.

B.3.4 Power-supply cables of an ELV lamp

For the power-supply interface of an ELV lamp, which is also a local wired port indirectly connected to a network, the specific test arrangement of A.5.1 applies.

B.3.5 Arrangement of measurement probes

For voltage probe measurements, the voltage probe shall be placed at a distance of (10 ± 5) cm from the EUT. Screened EUT interfaces are measured using the CISPR 16-2-1 method where the screen is connected to the RGP by means of a 150 Ω resistor, the voltage probe shall be placed in parallel with the 150 Ω resistor.

For current probe measurements, the current probe shall be placed at a distance of (30 ± 5) cm from the EUT. The current probe shall encompass all the leads of the interface connected to the EUT, in order to measure the common-mode mode current. Screened EUT interfaces are measured using the CISPR 16-2-1 method where the screen is connected to the RGP by means of a 150 Ω resistor.

As an example, Figure B.2 shows this principle for a module. It also applies for conducted measurements at a local wired port of a luminaire.

B.4 Loading and termination of cables

As a general principle, all cables of the EUT that are subject to the conducted disturbance tests (see 5.3.5) shall be terminated and loaded, as indicated in 7.9. Interfaces designated as network ports shall be terminated with AANs or AMNs, as applicable to each interface. Figure B.2 shows this principle for a module. It also applies for a luminaire.

Tests are generally executed sequentially. All EUT cables, not only the cables under test, shall be terminated during all measurements.

The measurement port of AMNs or AANs shall be terminated with 50 Ω if the receiver is not connected (if the AMN or the AAN functions as a termination).

B.5 Luminaires

The measuring circuit is given in Figure B.1a and the measurement arrangements in Figure B.3.

If the luminaire is provided with an earth terminal, it shall be connected to the reference earth of the AMN. This connection shall be made by means of the earth conductor contained in the power cable to the luminaire. Where this arrangement is not common practice, the earth connection shall be made by means of a lead, the same length as the power cable and running parallel to the power cable at a distance of not more than 0,1 m.

If the luminaire is provided with an earth terminal, but the manufacturer states that it need not be earthed, it shall be measured twice: once with and once without the earth connection. In both cases, the luminaire shall comply with the requirements.

The following three options for the arrangement of the luminaire can be used.

a) The luminaire shall be placed on an insulating table, such that the base of the luminaire (usually the opposite side of the optical window) is on the insulating table at 0,4 m from a horizontal reference ground plane and the light output (optical window) is generally directed away from the RGP. See Figure B.3a.
b) The luminaire shall be placed on an insulating table of 80 cm or greater height, such that the base of the luminaire (usually the opposite side of the optical window) is positioned vertically (at 90° with the insulating table's top) and at a distance of 40 cm from a vertical reference ground plane. The light output is generally directed away from the reference ground plane. See Figure B.3b.
c) The luminaire shall be placed on an insulating table, such that the base of the luminaire is on the insulating table at least 0,8 m from the floor. The longest side of the luminaire is positioned parallel with a vertical reference ground plane at a distance of 0,4 m. The light output is generally directed away from the floor. See Figure B.3c.

NOTE In case of the option a), the EUT can also be rotated 90° such that the EUT base is perpendicular to the RGP.

For each arrangement in addition the following applies.

All conductive surfaces other than the reference ground plane shall be separated by at least 0,8 m from the EUT. The reference ground plane shall have dimensions of at least 2 m × 2 m and shall extend by at least 0,5 m beyond the projection of the boundaries of the system under test (EUT, AuxEq and all cables). All AMNs and AANs shall be bonded to the reference ground plane by means of low impedance connections (as per CISPR 16-2-1:2014 and CISPR 16-2-1:2014/AMD1:2017). The cables that run from the AMN and the AAN to the EUT shall be separated ~~(10 ± 5)~~ > 10 cm from each other except close to the EUT and AMN/AAN connectors (see Figure B.1). In case of multiple connectors at the EUT side, ensure that the cables are separated > 10 cm from each other.

B.6 Modules

In case of internal, mounted or replaceable modules, the EUT (module) shall be connected as shown in Figure B.1b.

In case of external modules, the EUT (module) shall be connected as shown in Figure B.2.

The measurement arrangements given in Figure B.3 apply.

The length, type and arrangement of the cables between the EUT (module) and the AuxEq (loads, starter, ignitor, control terminals, sensors, switches, components, etc.) shall be as specified in Clause B.2 and B.3.

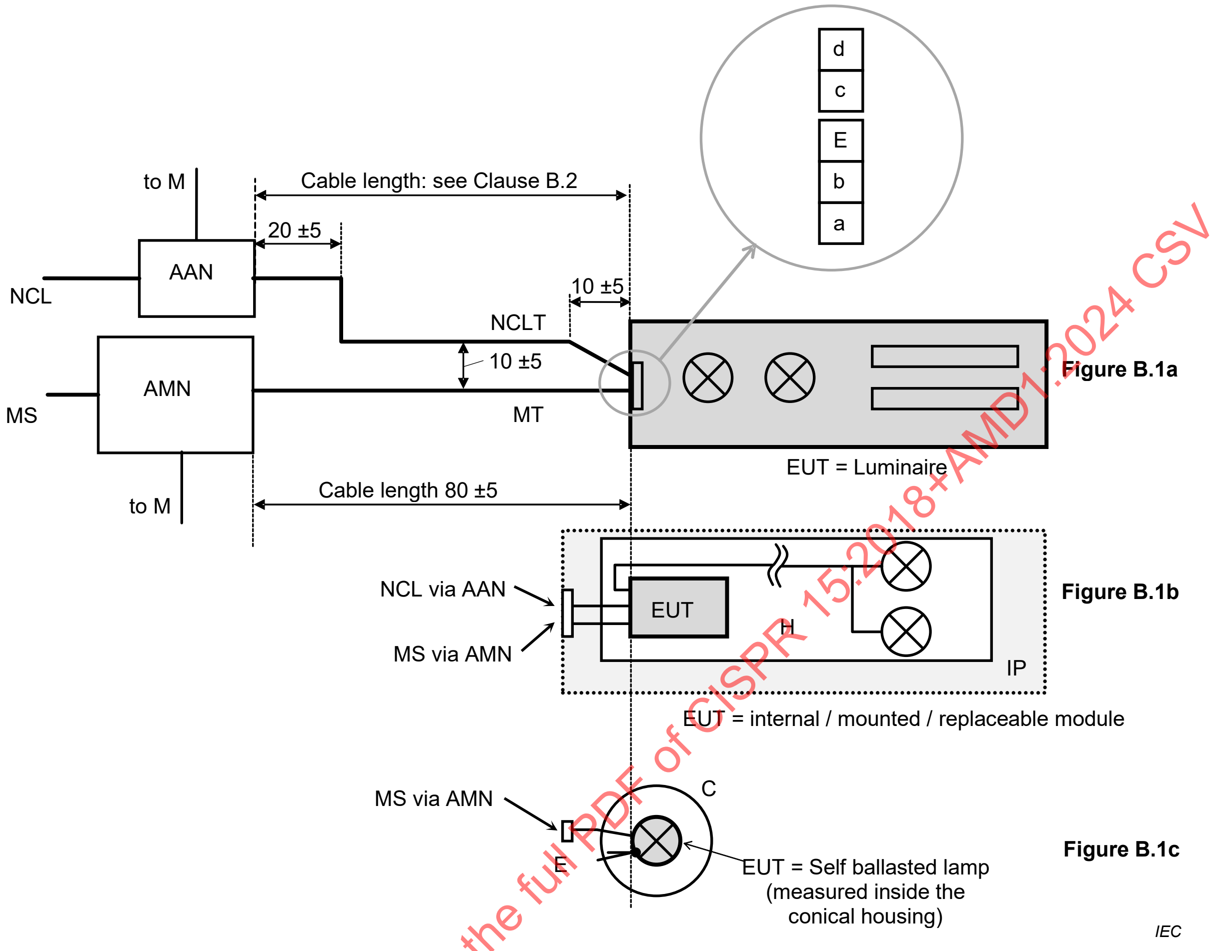
AuxEq shall be connected to the EUT as specified ~~by the manufacturer~~ in the instructions for use, while observing the requirements in Clause B.2 and B.3.

The total arrangement of EUT and AuxEq and cable(s) shall be measured in accordance with Clause B.5.

If the EUT (module) is intended for power supply via USB from an AC/USB adapter, the type of USB cable shall be

– as delivered with the EUT or
– as declared in the instruction for use or
– a USB cable with a length of at least 40 cm without connected data lines.

Dimensions in centimetres



Key

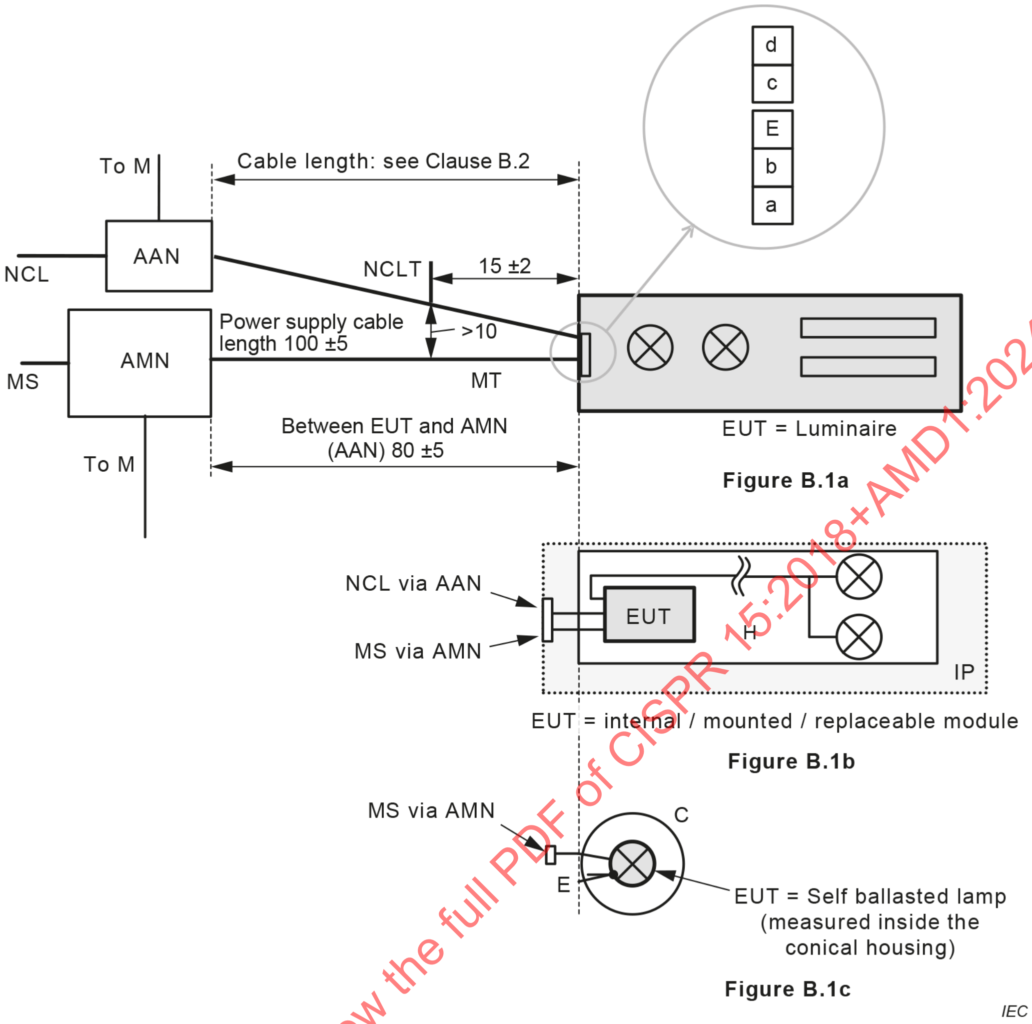
AMN	Artificial mains network	H	Host (see NOTE)
AAN	Asymmetric artificial network	a – b	Supply terminals
MS	Mains supply	c – d	Control terminals
M	Measuring receiver	C	Conical metal housing
MT	Mains supply terminal	E	Earth terminal
NCL	Network control line	IP	Piece of insulating material (see NOTE)
NCLT	Network control line terminal		

See Figure B.3 for details on the arrangement and the possible orientations with respect to the RGP.

For cable lengths of the mains supply cables, see B.2.1 and for cable lengths of other than mains supply cables, see B.2.2 and Clause B.3.

NOTE The host is often realized by assembling the parts of the host on a wooden plate. Strictly speaking, the IP is not required, but optional, for convenience of making a host.

Dimensions in centimetres



Key

AMN	Artificial mains network	H	Host (see NOTE)
AAN	Asymmetric artificial network	a – b	Supply terminals
MS	Mains supply	c – d	Control terminals
M	Measuring receiver	C	Conical reference housing
MT	Mains supply terminal	E	Earth terminal
NCL	Network control line	IP	Piece of insulating material (see NOTE)
NCLT	Network control line terminal		

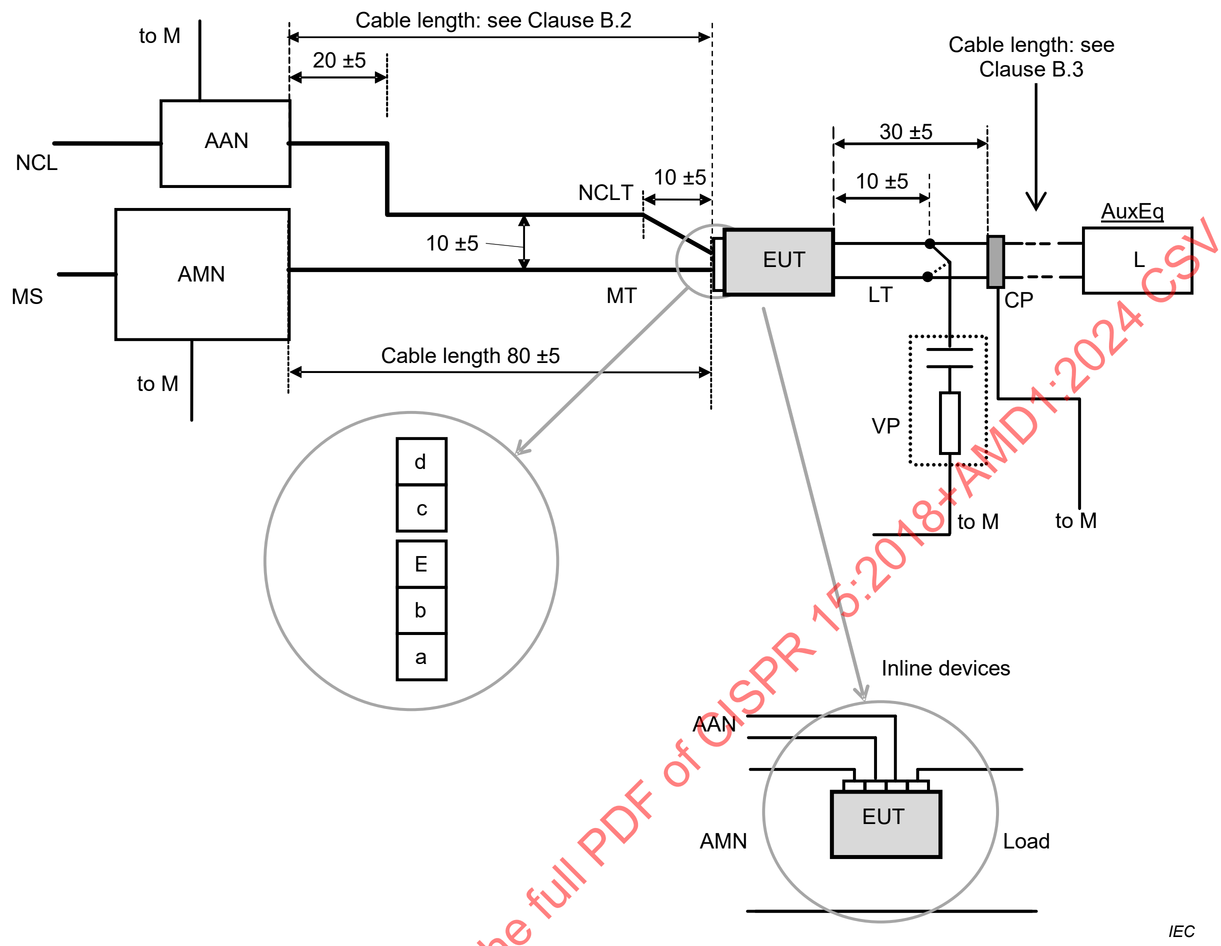
See Figure B.3 for details on the arrangement and the possible orientations with respect to the RGP.

For cable lengths of the mains supply cables, see B.2.1 and for cable lengths of other than mains supply cables, see B.2.2 and Clause B.3.

NOTE The host is often realized by assembling the parts of the host on a wooden plate. Strictly speaking, the IP is not required, but optional, for convenience of making a host.

Figure B.1 – Circuit for measuring conducted disturbances from a luminaire (Figure B.1a), an internal/mounted/replaceable module (Figure B.1b) and a single capped self-ballasted or independent non-gas-discharge lamp Figure B.1c)

Dimensions in centimetres



Key

a – b	Supply terminals	MS	Mains supply
c – d	Control terminals	MT	Mains terminals
AAN	Asymmetric artificial network	NCL	Network control line
AMN	Artificial mains network	NCLT	Network control line terminal
CP	Current probe	RC	Remote control (if any)
E	Earth terminal	VP	Voltage probe
L	Load		
LT	Load terminals		
M	CISPR measuring receiver (for AMN and AAN: replace by 50 Ω if not connected)		

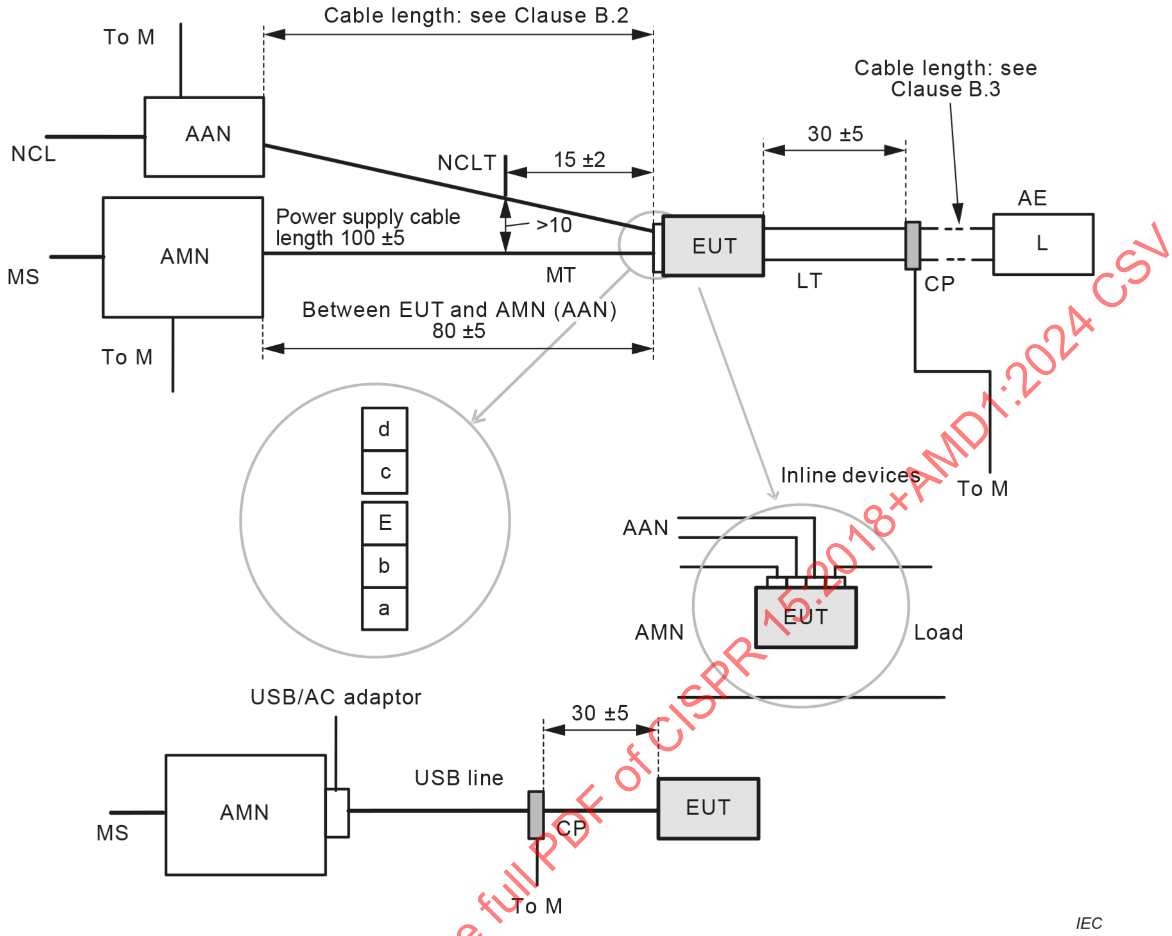
The earth of the measuring receiver and the earth terminal of the EUT shall be connected to the AMN ground.

For load terminal voltage measurement, the length of the coaxial cable between the probe and the measuring receiver shall not exceed 2 m.

Where an inline device is inserted in only one lead of the supply, measurements shall be made by connecting the second supply lead as indicated in the lower figure.

See Figure B.3 for details on the arrangement.

Dimensions in centimetres



Key

a – b	Supply terminals	MS	Mains supply
c – d	Control terminals	MT	Mains terminals
AAN	Asymmetric artificial network	NCL	Network control line
AMN	Artificial mains network	NCLT	Network control line terminal
CP	Current probe		
E	Earth terminal		
L	Load		
LT	Load terminals		
M	CISPR measuring receiver (for AMN and AAN: replace by 50 Ω if not connected)		

The earth of the measuring receiver and the earth terminal of the EUT shall be connected to the AMN ground.

Where an inline device is inserted in only one lead of the supply, measurements shall be made by connecting the second supply lead as indicated in the figure under inline devices.

See Figure B.3 for details on the arrangement.

Figure B.2 – Circuit for measuring conducted disturbances from an external module

Dimensions in centimetres

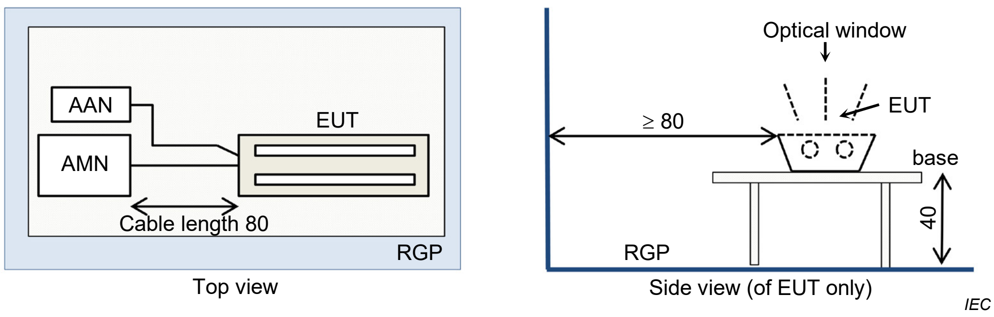


Figure B.3a – Horizontal RGP setup (option 1)

Dimensions in centimetres

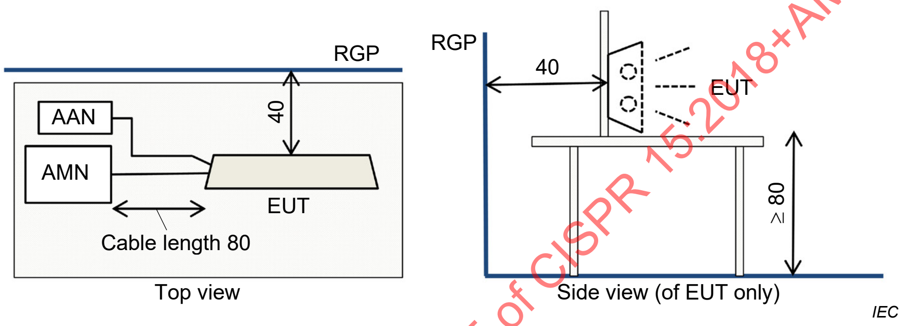


Figure B.3b – Vertical RGP setup (option 2)

Dimensions in centimetres

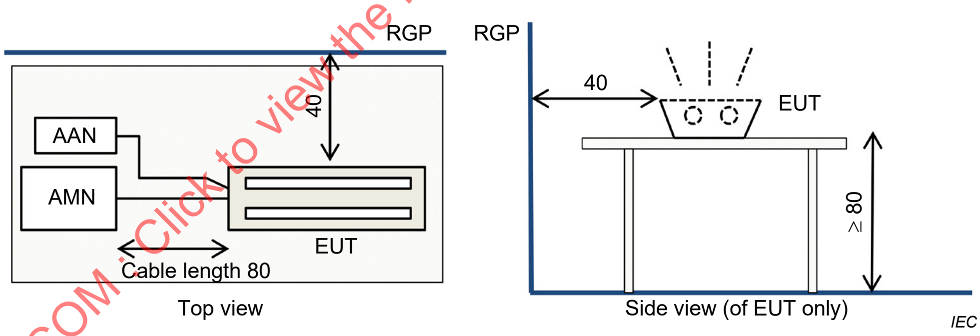


Figure B.3c – Vertical RGP setup (option 3)

See Figure B.1, Figure B.2 and Clause B.5 for details on the measuring circuits, bonding of the AAN and AMN to the RGP and arrangement of the cables.

Dimensions in centimetres

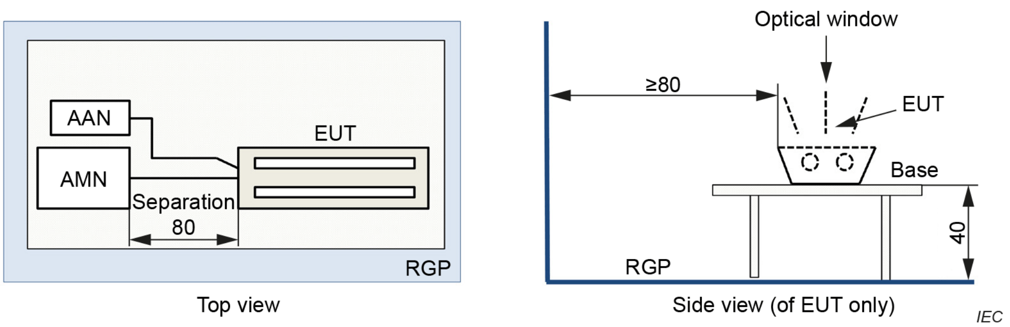


Figure B.3a – Horizontal RGP setup (option 1)

Dimensions in centimetres

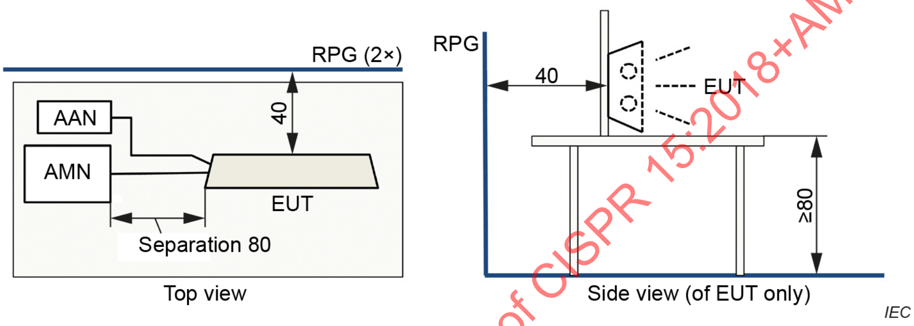


Figure B.3b – Vertical RGP setup (option 2)

Dimensions in centimetres

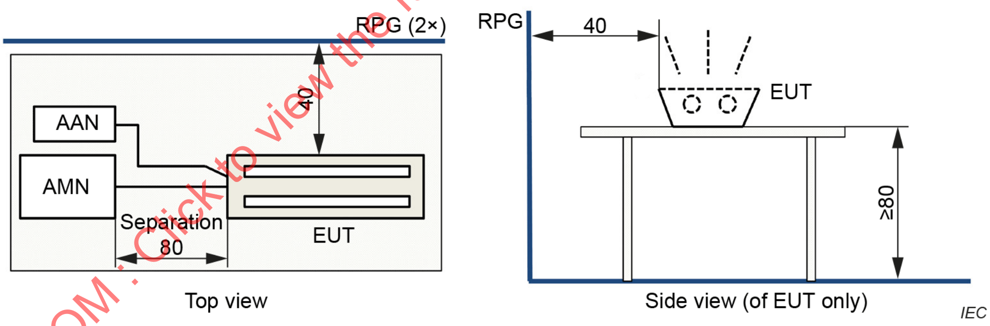


Figure B.3c – Vertical RGP setup (option 3)

See Figure B.1, Figure B.2 and Clause B.5 for details on the measuring circuits, bonding of the AAN and AMN to the RGP and arrangement of the cables.

Figure B.3 – Measuring arrangements for conducted disturbances (see Clause B.5)

Dimensions in centimetres

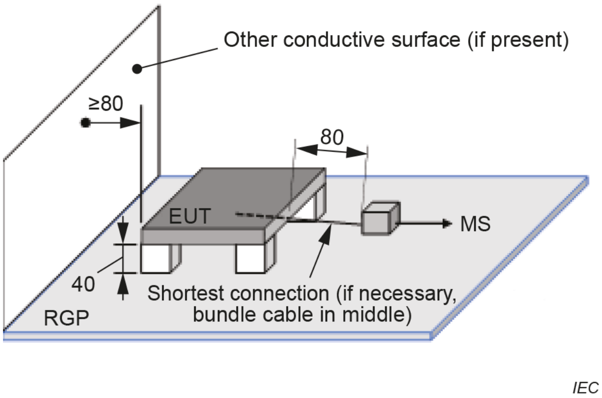


Figure B.4a – horizontal RGP

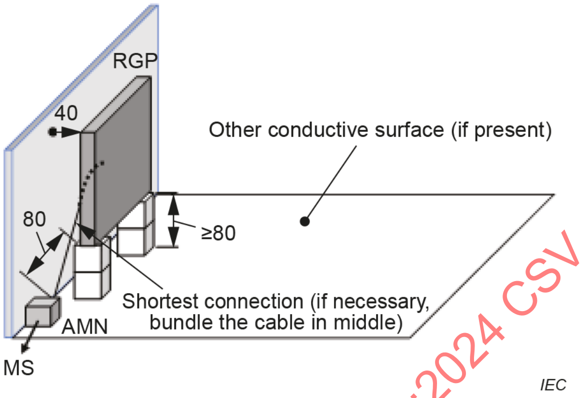


Figure B.4b – vertical RGP

The AMN may also be placed at a distance from the RGP provided that a good low impedance connection can be maintained.

NOTE Floor standing equipment is placed at up to 15 cm from the horizontal RGP on an insulating support.

Figure B.4 – Measuring arrangement for conducted disturbances (in specific cases, like very large EUTs)

Annex C
(normative)

Test arrangements for radiated disturbance measurements

C.1 General

This annex gives test arrangements for radiated emission measurements of the EUT on an OATS, SAC, FAR, FSOATS or in a LLAS in accordance with CISPR 16-2-3:2016, CISPR 16-2-3:2016/AMD1:2019 and CISPR 16-2-3:2016/AMD2:2023.

C.2 Arrangements of electric power supply cables

When the OATS or SAC measurement method is applied, to improve the reproducibility, the mains supply cable of the EUT should be terminated with a CDNE bonded to the reference-ground plane and the receiver port of the CDNE terminated with a 50 Ω impedance.

C.3 Arrangement of cables other than electric power supply cables

Apply CISPR 16-2-3 for arrangement of cables other than electric power supply cables.

C.4 Arrangements of EUT, auxiliary equipment and associated equipment for ≥ 30 MHz

C.4.1 General

General principles for arranging the EUT, auxiliary equipment and associated equipment as specified in CISPR 16-2-3 apply for the radiated disturbance measurement methods that apply (Table 12).

Examples for the arrangement of EUT, auxiliary equipment and associated equipment are given for the following cases:

– luminaires; see Figure C.3;
– internal, mounted and replaceable modules; see Figure C.4;
– external modules; see Figure C.5.

C.4.2 EUT arrangements for table-top, wall-mounted or ceiling-mounted applications

Figure C.1 gives examples of the arrangement of the EUT for table-top, wall-mounted or ceiling-mounted applications. The positioning table depicted in Figure C.1 is the standard positioning table of 0,8 m height that is used in radiated emission measurements.

C.4.3 EUT arrangements for floor-standing and pole-mounted applications

Figure C.2 gives the arrangement of the EUT for floor-standing and pole-mounted applications. The positioning table depicted in Figure C.2 is the standard positioning table of 0,8 m height that is used in radiated emission measurements.

C.5 Loading and termination of cables

As a general principle, all cables of the EUT that are subject to the radiated disturbance tests shall be terminated and loaded, as indicated in 7.9. Electric power supply cables should be terminated with a CDNE in accordance with Clause C.2.

C.6 Arrangements of EUT, auxiliary equipment and associated equipment for ≤ 30 MHz

C.6.1 General

The general principles specified in CISPR 16-2-3:2016, CISPR 16-2-3:2016/AMD1:2019 and CISPR 16-2-3:2016/AMD2:2023 for arranging the EUT, auxiliary equipment and associated equipment shall apply, unless otherwise specified in the standard.

Example arrangements are provided in C.6.2 for EUTs having a wired interface that connects to single conductor cables.

C.6.2 EUT with wired interfaces that connect to single conductor cables

The arrangement shall be in accordance with 9.3.2.1.

Figure C.6 illustrates example arrangements for EUTs with an external wired interface connecting to single conductor cables. The supporting plate shall be as in Figure A.6.

In case the EUT cable is longer than the length necessary to form the required 1 m^2 loop, the excess length shall be folded non-inductively back and forth parallel to the cable such that it forms a bundle with a length up to 0,4 m. However, if the EUT cable is of excessive length (which would result in an unpractically thick bundle) and it cannot be shortened as necessary, the excess length shall be routed outside the LLAS. In the latter case, the outgoing cable shall be kept close together with the ingoing cable and this pair shall leave the LLAS sphere through the same octant as the other EUT cables that leave the LLAS, per the requirements in CISPR 16-1-4:2019 and CISPR 16-1-4:2019/AMD1:2020.

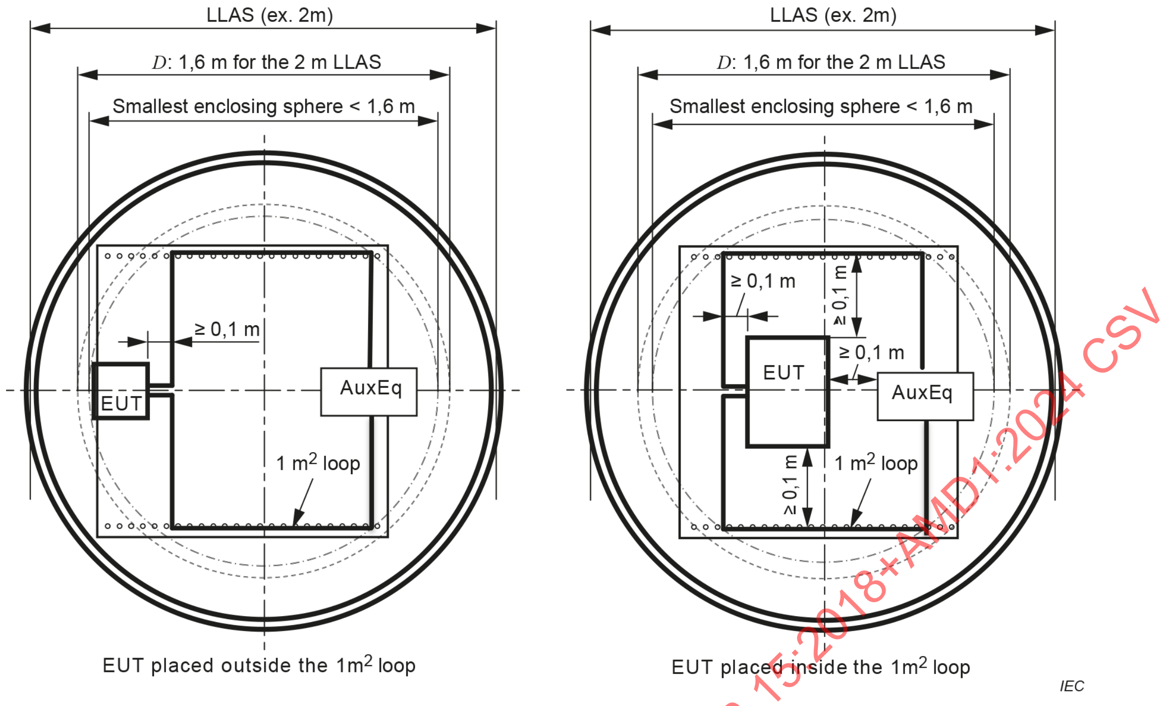
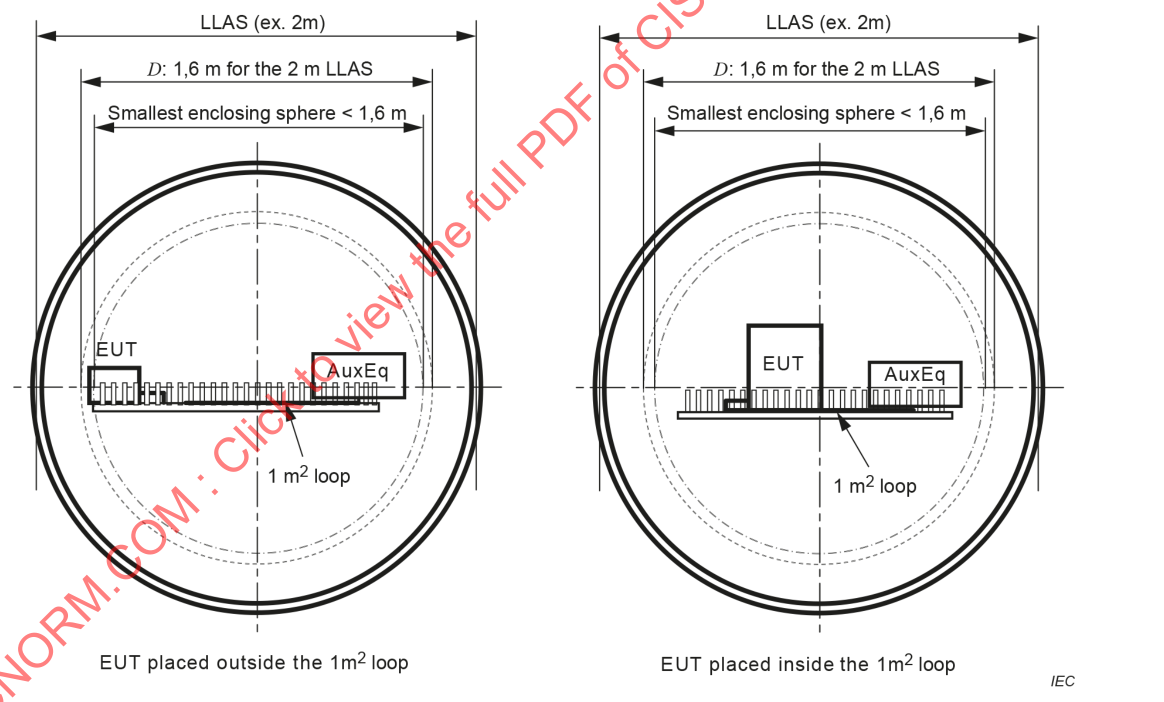


Figure C.6a – Top view



NOTE Mains supply lead (not shown in these figures) exits LLAS in accordance with CISPR 16-1-4:2019AMD1:2020, Figure C.6.

Figure C.6b – Side view

Figure C.6 – Arrangements of EUTs with interfaces connecting to single conductor cables

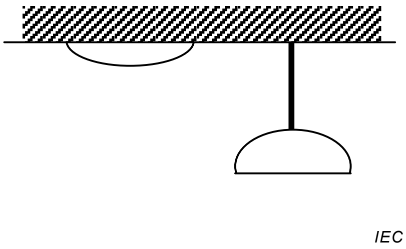
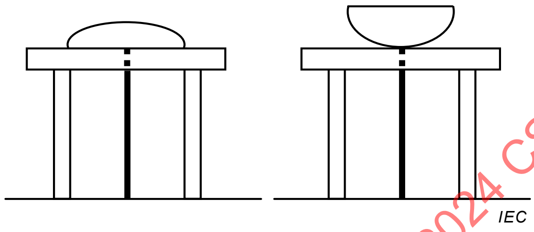
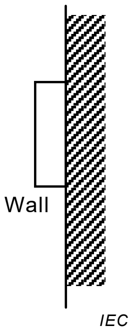
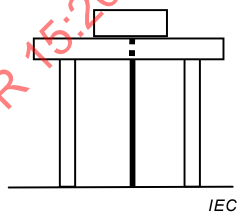
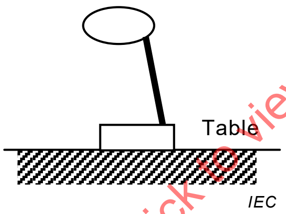
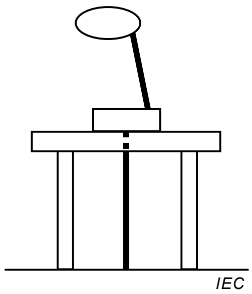
Typical applications	Arrangement during measurement
Ceiling mounted/pendant luminaires 	
Wall mounted luminaire 	
Table luminaire 	

Figure C.1 – EUT arrangement of ceiling-, wall-mounted and table-top applications during the radiated (OATS, SAC or FAR) disturbance measurement

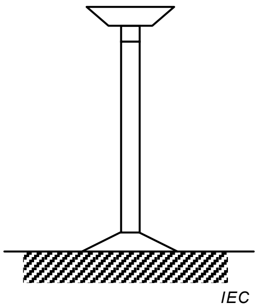
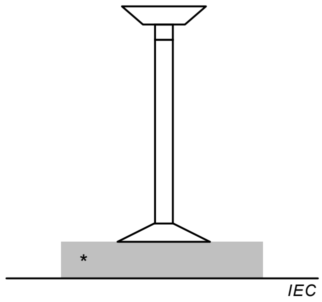
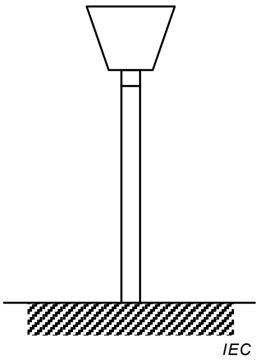
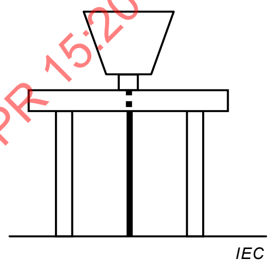
Typical applications	Arrangement during measurement
Floor standing luminaire 	 * Insulating support up to 15 cm high
Pole mounted luminaire 	

Figure C.2 – EUT arrangement of floor-standing and pole-mounted applications during the radiated (OATS, SAC or FAR) disturbance measurement

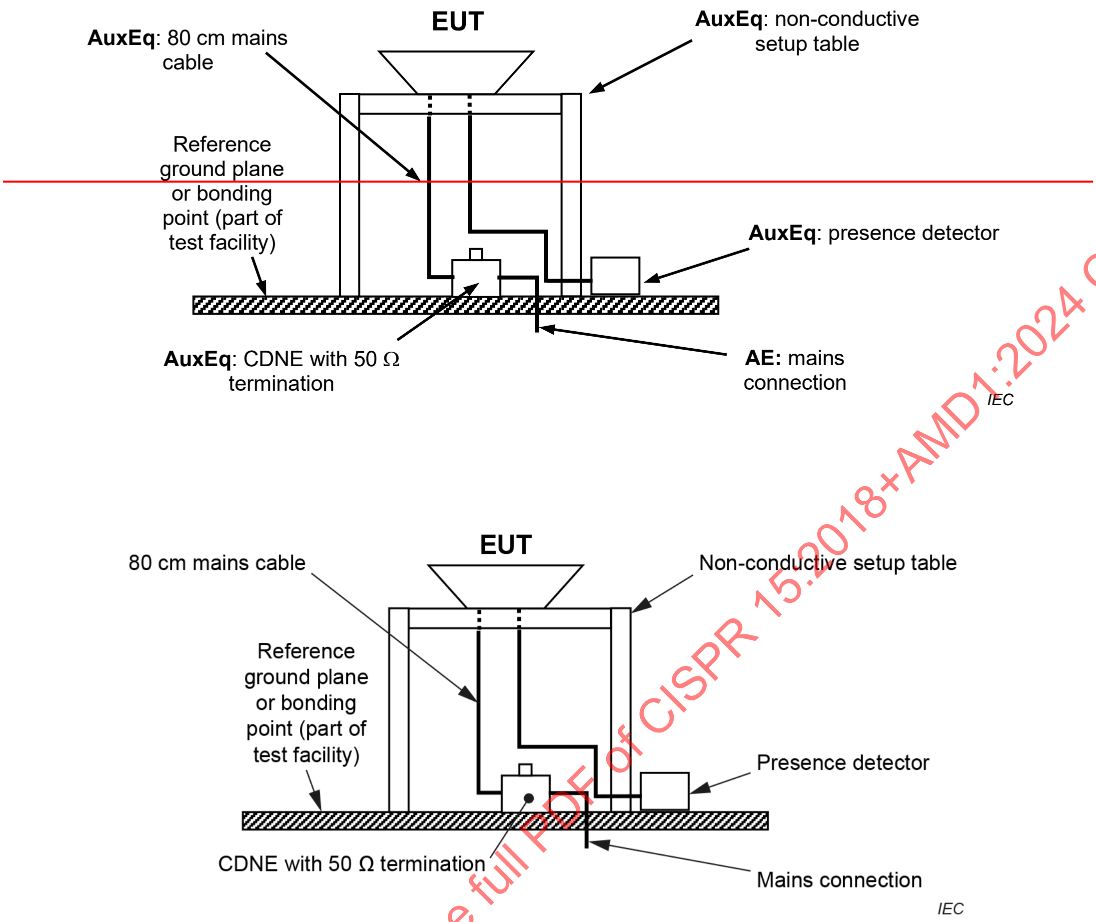
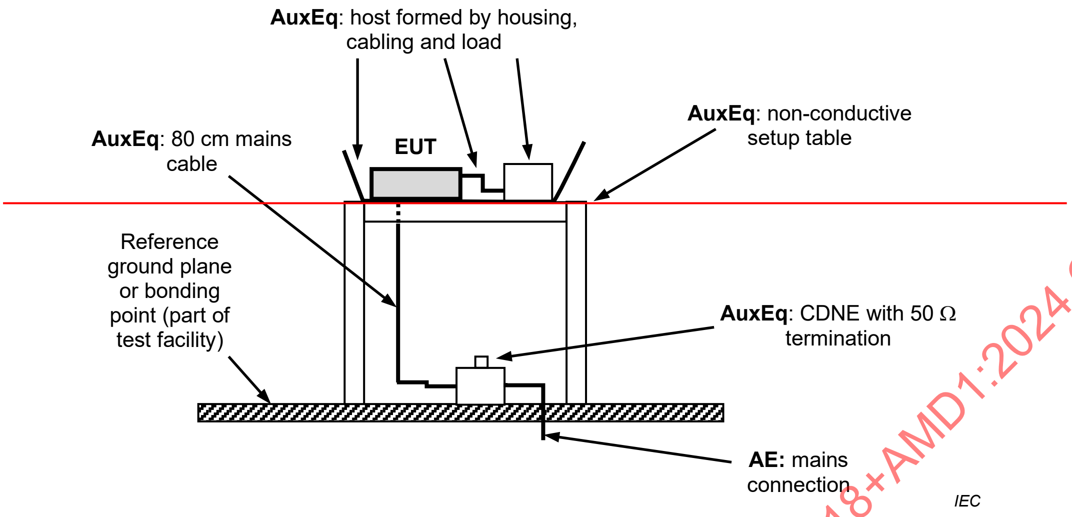


Figure C.3 – Example of arrangement of a luminaire during the radiated (OATS, SAC or FAR) disturbance measurement



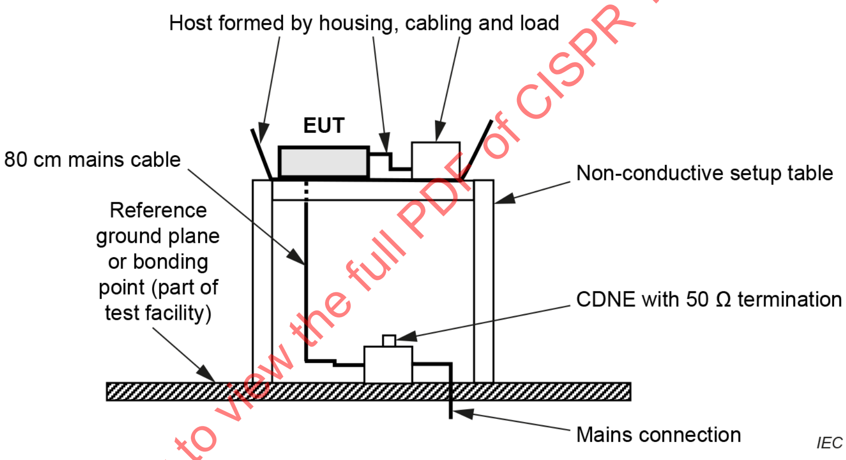
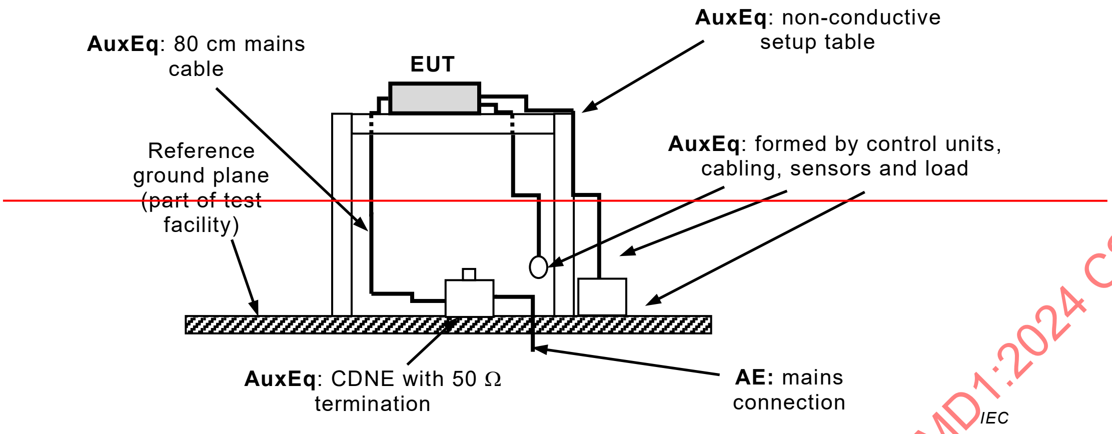


Figure C.4 – Example of arrangement of an internal module during the radiated (OATS, SAC or FAR) disturbance measurement



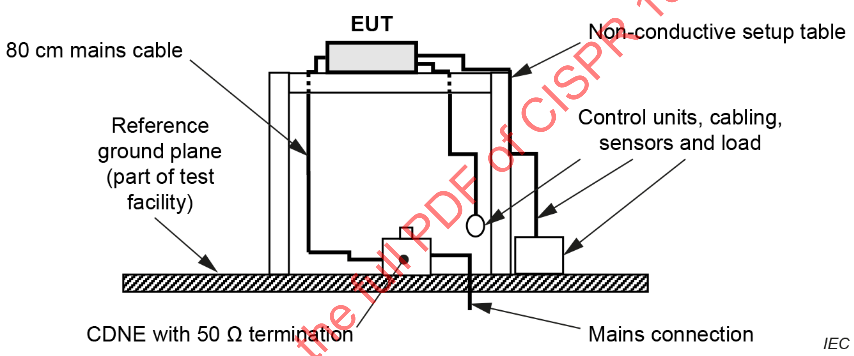


Figure C.5 – Example of arrangement of an external module during the radiated (OATS, SAC or FAR) disturbance measurement

Annex D
(informative)

Examples of application of limits and test methods

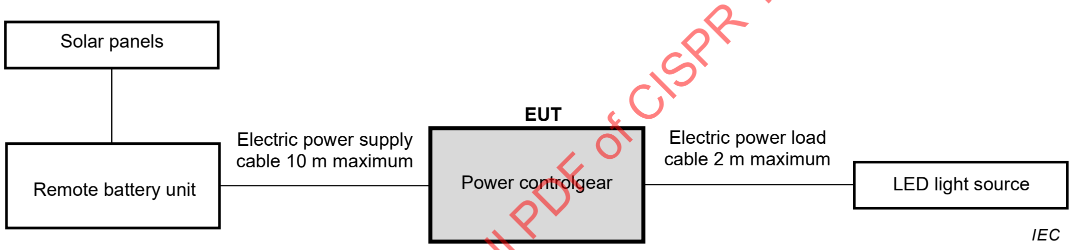
D.1 General

A number of examples are given in this annex to explain the methodology described in Clause 5, Clause 6 and Figure 4 to find the requirements that apply for a certain EUT.

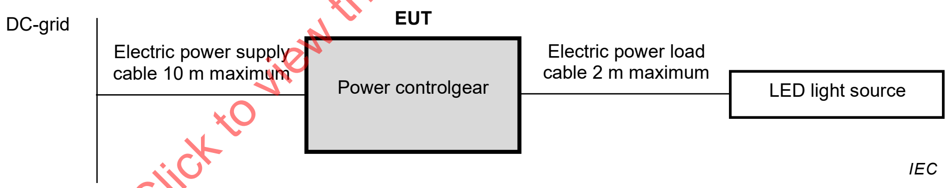
D.2 Case 1: Power controlgear with remote battery connection

D.2.1 EUT description

The EUT is a light source driver that can be connected to a remote battery unit or a DC-grid. The maximum dimension of the EUT is 25 cm. The length of the DC power supply cable may be 10 m maximum. A generic LED light source of maximally 75 W can be connected to the load interface of the driver with a twin wire of maximally 2 m. There is no restriction on the routing of the two leads over the load cable (they may run separately). See Figure D.1.



Application 1



Application 2

Figure D.1 – Case 1 EUT

D.2.2 Interfaces, ports and limits

An overview of the interfaces of the Case 1-EUT, the associated ports and the limits that apply is given in Table D.1.

Table D.1 – Case 1: Summary of interfaces, applicable ports and limits

Interface	Port	Reason	Limits	Test method
Enclosure + cables	Enclosure port > 30 MHz	~~Default~~ An enclosure is always present. Measurement is always required.	Table 10 and Table 14, if applicable	One of the ~~optional~~ radiated methods in Table 12
	Enclosure port < 30 MHz	Leads of the load cable ~~may~~ can run separately (see 5.3.4.1)	Table 8 or Table 9, if applicable	~~LAS method (EUT size < 1,6 m) with load interface having 1 m² loop area~~ LLAS or small loop antenna method, with load interface arranged in 1 m² loop
~~Electric power load~~ Load interface	No local wired port; Enclosure port > 30 MHz	Cable length ~~is less than~~ < 3 m~~; hence cable shall be connected to a load during radiated test applying~~ (see Clause C.3)	Table 10 and Table 14, if applicable	Radiated test is already done (see above)
DC input	Application 1: Local wired port	Interface not directly connected to a network, but length > 3 m	Table 1 limits which are more severe (starting at 9 kHz) than ~~Table 5 or~~ Table 6 limits; hence this interface is tested against the limits of Table 1 (see 5.3.6)	See ~~8.2~~ Clause 8
	Application 2: Wired network port	Interface connected to a network		

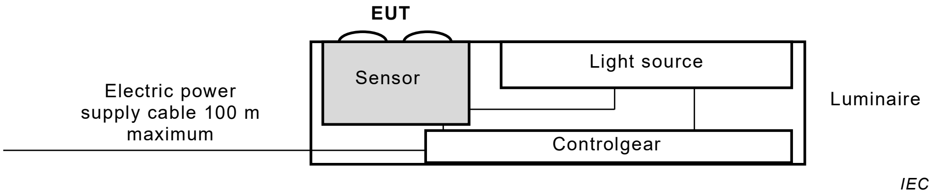
D.3 Case 2: Universal presence and light detector

D.3.1 EUT description

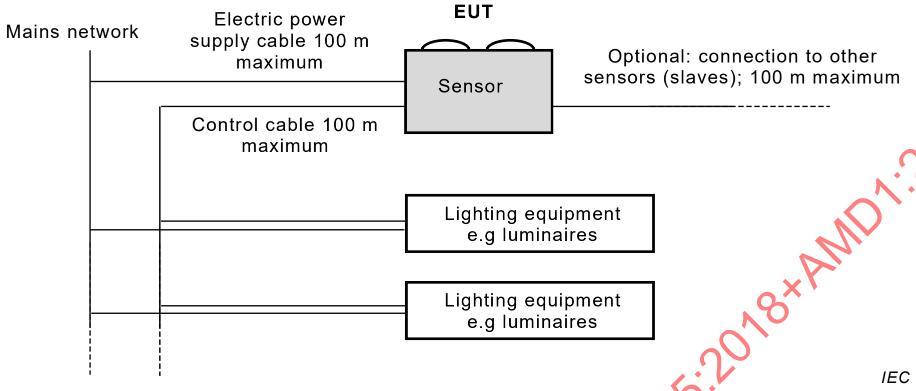
The EUT is an independent presence and light detector. The sensor detects the presence of persons and measures the intensity of light. The sensor can be applied as an independent module for installation in luminaires or for separate application in a ceiling (an installation). The sensor has an interface for connection to the mains network and it has an interface for connection to the load that is switched. An optional interface (for installations) is present for coupling other sensors of the same type for extension of the sense area (slaved sensors). Maximum length of each cable that can be connected to the sensor is 100 m. The schematic diagram is given in Figure D.2.

D.3.2 Interfaces, ports and limits

For the two possible application scenario's, the EUT can be considered as an independent internal module (6.4.3), and as an independent external module (6.4.4). For each of these applications a test is to be executed (6.4.2). An overview of the interfaces of the Case 2-EUT, the associated ports and the limits that apply for the two applications, is given in Table D.2 and Table D.3.



Application 1: Inside a luminaire



Application 2: Independent sensor in an installation

Figure D.2 – Case 2 EUT

Table D.2 – Case 2 – Application 1: Summary of interfaces, applicable ports and limits

Interface	Port	Reason	Limits	Test method
Enclosure port	Enclosure port > 30 MHz	Default	Table 10 and Table 14, if applicable	One of the ~~optional~~ radiated methods in Table 12
	No enclosure port < 30 MHz	Inside the sensor no large loop current are present and the wires of the power supply cable run together (see 5.3.4.1)	N.A.	N.A.
Electric power supply cable	Network port	Interface connected to a network (the mains power supply)	Table 1	See Clause B.5 Measuring circuit: see Figure B.1b Arrangement: one of the three options from Figure B.3.

Table D.3 – Case 2 – Application 2: Summary of interfaces, applicable ports and limits

Assessment	Port	Reason	Limits	Test method
Enclosure port	Enclosure port > 30 MHz	Default	Table 10 and Table 14, if applicable	One of the ~~optional~~ radiated methods in Table 12
	No enclosure port < 30 MHz	Inside the sensor no large loop current is present, and the wires of the power supply cable run together (see 5.3.4.1)	N.A.	N.A.
Electric power supply cable	Network port	Interface connected to a network (the mains power supply)	Table 1	See Article B.5 Measuring circuit: see Figure B.2 Arrangement: one of the three options from Figure B.3.
Control cable 100 m maximum	Local wired port	Interface indirectly connected to a network (the mains power supply) through the load	~~Table 5 or~~ Table 6	See ~~8.5.2.2,~~ 8.5.2.3, B.3.2.b) and Figure B.2 and apply the support plate of Figure A.6.
Slave mode interface (connection to other sensors)	Local wired port	Interface is not connected to a network; however its length is > 3 m	~~Table 5 or~~ Table 6	See ~~8.5.2.2,~~ 8.5.2.3, B.3.3 and Figure B.2 and apply the support plate of Figure A.6.

D.4 Case 3: Driver with three load interfaces

D.4.1 EUT description

The EUT is an independent LED driver for use in installations. The LED driver is to be connected to the mains (220 V to 240 V). The driver can be controlled (switching, dimming) using a DALI interface for connection to a DALI bus (network). An additional interface is present for connection of an optional NTC thermistor inrush current limiter. An array of LED light sources can be connected to each of the three load interfaces (24 V). The maximum length between the driver and each array of LED light sources is 4 m. A temperature control interface can optionally be added to monitor the temperature of the light sources connected. In the latter case, the temperature control leads and the load leads are combined in one cable for each of the three load interfaces. The length of this temperature control interface is also 4 m maximum. The individual wires within each cable connected to the driver (power supply cable, each load cable and control cables) are to be routed together. The schematic diagram is given in Figure D.3.

D.4.2 Interfaces, ports and limits

An overview of the interfaces of the Case 3 – EUT, the associated ports and the limits that apply is given in Table D.4. The EUT can be considered as an independent external module (6.4.4).

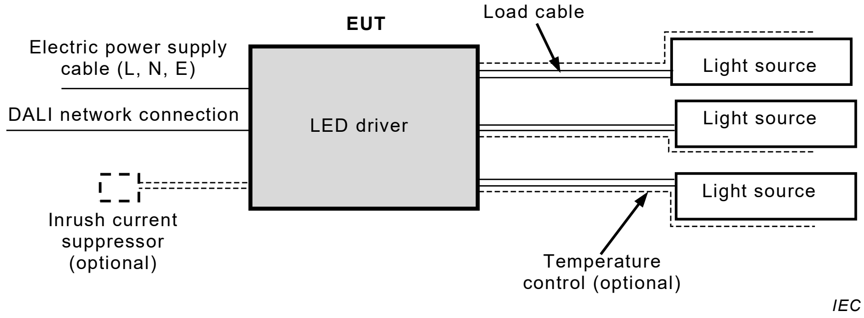


Figure D.3 – Case 3 EUT

Table D.4 – Case 3: Summary of interfaces, applicable ports and limits

Assessment	Port	Reason	Limits	Test method
Enclosure port	Enclosure port > 30 MHz	Default	Table 10 and Table 14, if applicable	One of the optional radiated methods in Table 12
	No enclosure port < 30 MHz	The driver specification does not allow large loops (see 5.3.4.1)	N.A.	N.A.
Electric power supply cable	Network port	Interface connected to a network (the mains power supply)	Table 1	See Clause B.5 Measuring circuit: see Figure B.2 Arrangement: one of the three options from Figure B.3.
Each of the three electric power load cables 4 m maximum	Local wired port	Each interface is not connected to a network but its length is larger than 3 m.	Table 5 or Table 6	It is sufficient to test one of the three load ports as they are of the same kind; see 5.3.5.
Temperature control interface	Local wired port	Each interface is not connected to a network but its length is larger than 3 m.	Table 5 or Table 6. Limits of Table 6 are most practical as with the current probe method, a single measurement can be done with the power load cable and the temperature control cable.	The conducted disturbance of this interface is measured together with the disturbance from the load port by using the current-probe method.
Interface for connection inrush current limiter	Enclosure port > 30 MHz	Interface is not connected to a network and its length is less than 3 m.	Table 10	Radiated test is already done (see above)
DALI interface	Network port	Interface is connected to a DALI network (4.3.2).	Table 2 or Table 3	See 5.3.2.2.

D.5 Case 4: Ethernet powered OLED

D.5.1 EUT description

The EUT is an OLED luminaire of which the power is delivered through an Ethernet CAT 5 interface having a length of maximally 15 m. No other wired interfaces are present. See Figure D.4.

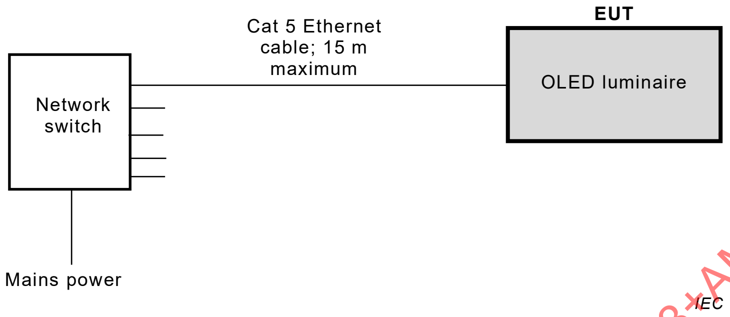


Figure D.4 – Case 4 EUT

D.5.2 Interfaces, ports and limits

An overview of the interfaces of the Case 4-EUT, the associated ports and the limits that apply is given in Table D.5.

Table D.5 – Case 4: Summary of interfaces, applicable ports and limits

Assessment	Port	Reason	Limits	Test method
Enclosure port	Enclosure port > 30 MHz	Default	Table 10 and Table 14, if applicable	One of the ~~optional~~ radiated methods in Table 12
	No enclosure port < 30 MHz	The Ethernet wire specification does not allow separation of individual wires; no external loops are present. Also within the luminaire no large loops with high currents (OLED technology) are present (see 5.3.4.1)	N.A.	N.A.
Ethernet interface	Network port	Interface is connected to an Ethernet network switch (4.3.2).	Table 2 or Table 3	See 5.3.2.2.

D.6 Case 5: Stand-alone occupancy-daylight sensor

D.6.1 EUT description

The EUT is a simple stand-alone combined daylight sensor, movement detector and controller which can be connected to maximally two AC fed luminaires of a specific type. The sensor enables switching or dimming of the luminaire depending on local presence of persons and the level of daylight. The two control interfaces to the luminaire are balanced three-lead wired interfaces and a proprietary protocol for controlling those luminaires is used. The same interfaces also provide the necessary power to the sensor. The length of each control interface is limited to 2,5 m maximum. The schematic diagram of the application is given in Figure D.5.

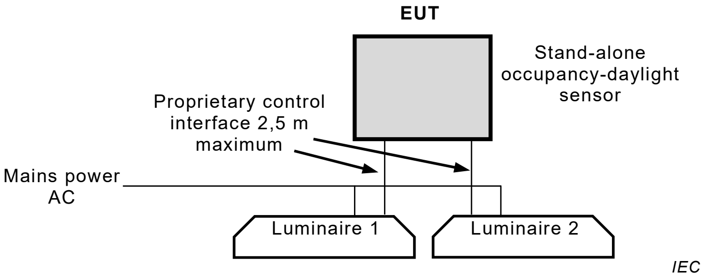


Figure D.5 – Case 5 EUT

D.6.2 Interfaces, ports and limits

An overview of the interfaces of the Case 5-EUT, the associated ports and the limits that apply is given in Table D.6.

Table D.6 – Case 5: Summary of interfaces, applicable ports and limits

Assessment	Port	Reason	Limits	Test method
Enclosure port	Enclosure port > 30 MHz	Default	Table 10 and Table 14, if applicable	One of the ~~optional~~ radiated methods in Table 12
	No enclosure port < 30 MHz	Both the EUT itself and the two wired interfaces will not cause large dipole moments. (see 5.3.4.1)	N.A.	N.A.
Each of the two control interfaces	Local wired port	Interface is indirectly connected to a network (it is connected to a luminaire, which is connected to an AC mains network)	~~Table 5 or~~ Table 6	It is sufficient to test one of the two load ports as they are of the same kind; see 5.3.5.

Annex E
(informative)

Statistical considerations in the determination of EMC compliance of mass-produced products

E.1 General

CISPR limits have been developed, taking into account the inherent variability of the EMC performance of mass-produced equipment. The CISPR limits are based on the recommendation that, for type approval of mass-produced equipment on a statistical basis, at least 80 % of the mass-produced equipment should comply with the disturbance limits with at least 80 % confidence.

NOTE Further information on the various methods for statistical evaluation of mass-produced equipment can be found in CISPR TR 16-3 [5][2] and CISPR TR 16-4-3 [3].

Type tests are generally made on units which are representative of mass-produced equipment.

Accordingly, type tests should be made either:

a) On a sample of at least 3 units, according to one of the methods given in Clause E.2 to E.5, or
b) For simplicity's sake, on one unit only.

Subsequent tests are recommended from time to time on equipment taken at random from production, especially if option b) above has been followed.

E.2 Test method based on a general margin to the limit

The type test method for conducted or radiated disturbance measurements can be based on application of the statistical method using a general margin to the limit as outlined in CISPR TR 16-4-3 [3].

In this type test method, the disturbance $x(f)$ is measured for each of n items ($n \geq 3$) of the test sample as a function of the frequency f for each of the limits and associated measurement method that apply for the EUT.

The equipment that is type tested using this method can be expected to be compliant with the relevant limit when the measured disturbance values $x_i(f)$ of all individual items of the sample are below the limit $L(f)$ with an additional margin to the limit which is not less than the value of the sample-size dependent margin M_n given in Table E.1:

$$x_i(f) + M_n \leq L(f), \text{ for each item } 1 \leq i \leq n, \tag{E.1}$$

2 Numbers in square brackets refer to the Bibliography.

Table E.1 – General margin to the limit for statistical evaluation

Sample size (n)	3	4	5	6
General margin M_n to the limit (dB)	3,8	2,5	1,5	0,7

NOTE The values in Table E.1 are based on a standard deviation of 6,0 dB assumed for the disturbances, caused by equipment in the scope of this document. For further information, see CISPR TR 16-4-3 [3]. It is important that the manufacturer of mass products verifies whether the assumption of the expected standard deviation of the product is valid or not.

Since in reality the standard deviation in most cases will be lower, it is recommended to use one of the methods in Clause E.3 or E.4, when this method of Clause E.2 fails.

In Table E.1, values are given only for a sample size up to n = 6. For a larger sample size, the binomial distribution method is more suitable as described in Clause E.4.

E.3 Test method based on the non-central t-distribution

E.3.1 Practical implementation by using frequency sub-ranges

The type test method for conducted or radiated disturbance measurements can be based on application of the statistical method using the non-central t-distribution as outlined in CISPR TR 16-4-3 [3]. The t-distribution method calculates the highest measured disturbance levels at distinct frequencies in the frequency range applicable for the particular disturbance measurement method. In practice however, a number of difficulties may arise:

– the limit levels vary over the frequency range;
– the frequencies at which the highest disturbance levels are measured vary for the individual units of a sample.

For this reason, in practice, the method is to be applied by dividing the whole frequency range for a particular measurement method into subranges. The average value and the standard deviation are then calculated using the measured disturbance levels that are normalised to the limit level as a function of frequency as follows:

$$d(f) = x(f) - L(f) \qquad \text{(E.2)}$$

where

$d(f)$ is the difference between the disturbance level and the limit level (relative disturbance level) at the specific frequency f in dB;

$x(f)$ is the measured disturbance level in dB(µV), dB(µA), dB(µA/m) or dB(µV/m);

$L(f)$ is the disturbance limit at the specific frequency in dB(µV), dB(µA), dB(µA/m) or dB(µV/m).

The relative disturbance level $d(f)$ is calculated as a function of frequency. The difference is negative where the measured value is below the limit and positive where it is above the limit.

For all n items in the sample (label i), the maximum values of the relative disturbance level $d(f)$ is calculated as follows for each of the frequency sub-ranges specified in E.3.2:

$$d_i = \max\{d(f)\} \qquad \text{(E.3)}$$

The equipment that is type tested using this method can be expected to be compliant with the relevant limit when the following condition is met for the maximum relative disturbance level d_i in each of the subranges that apply for the particular measurement method:

$$\bar{d} + k s_n \le 0 \qquad \text{(E.4)}$$

where

$\bar{d}$ is the arithmetic mean of the maximum relative disturbance values d_i of each of the n items in the sample calculated for each frequency sub-range as follows (in dB):

$$\bar{d} = \frac{1}{n}\sum_{i=1}^{n} d_i \qquad \text{(E.5)}$$

s_n is the standard deviation of the maximum relative disturbance values d_i of n items in the sample calculated as follows:

$$s_n^2 = \sum_{i=1}^{n} (d_i - \bar{d})^2 / (n - 1) \qquad \text{(E.6)}$$

k is the factor derived from tables of the non-central t-distribution which ensures, with 80 % confidence, that 80 % or more of the production are below the limit L; the value of k depends on the sample size n and is stated in Table E.2.

Table E.2 – Sample size and corresponding k factor in a non-central t-distribution

n	3	4	5	6	7	8	9	10	11	12
k	2,04	1,69	1,52	1,42	1,35	1,30	1,27	1,24	1,21	1,20

E.3.2 Frequency sub-ranges

The statistical evaluation given in E.3.1 should be carried out separately for the following frequency sub-ranges:

- 9 kHz to 50 kHz;
- 50 kHz to 150 kHz;
- 150 kHz to 500 kHz;
- 500 kHz to 5 MHz;
- 5 MHz to 30 MHz;
- 30 MHz to 100 MHz;
- 100 MHz to 230 MHz;
- 230 MHz to 300 MHz;
- 300 MHz to 500 MHz;
- 500 MHz to 1 000 MHz.

NOTE The frequency sub-ranges have been chosen such that the boundaries coincide with the frequencies where the limit curve shows a transition or a discontinuity. In case of large ranges, also additional sub-ranges are applied.

The test may fail due to artefacts in the results that may occur due to start and stop frequencies of frequency sub-ranges. The cause of those artefacts is explained in E.3.3.

E.3.3 Data distortion occurring at a sub-range boundary

If all measured values are under the limit and the test failed only due to a large standard deviation, then it should be investigated whether this large standard deviation has been caused by a maximum of x_i at the borderline between two frequency sub-ranges. In this case, the evaluation should be done according to Clause E.4.

Figure E.1 illustrates the possible difficulties if a maximum of the measured disturbances occurs at the borderline of two frequency sub-ranges. "U" is the measured disturbance voltage; "f" is the frequency. Here two units with different characteristics out of a sample are shown. For broadband disturbances, the value of the maximum as well as the frequency of the maximum can change from unit to unit. Differences as shown in Figure E.1 between unit 1 and unit 2 of a sample are typical. The average value and standard deviation is calculated from the maximum disturbance levels all units (of which two are shown) for each sub-range. In this example, the calculated standard deviation is much higher for subrange 1 than subrange 2 (e.g. consider how different the values of x_1 and x_2 are at the borderline). Although the average for subrange 1 is much lower than subrange 2, after taking into consideration the large value of S_n multiplied by the factor from Table E.2, in rare cases this could lead to not fulfilling the criterion on Equation (E.4). Since this is simply a consequence of the arbitrary way in which the frequency sub-ranges have been defined, no statistically meaningful conclusion can be drawn regarding compliance. In this case, it is recommended to repeat the evaluation in a newly defined subrange such that occurrence of maximum values at sub-range boundaries is avoided.

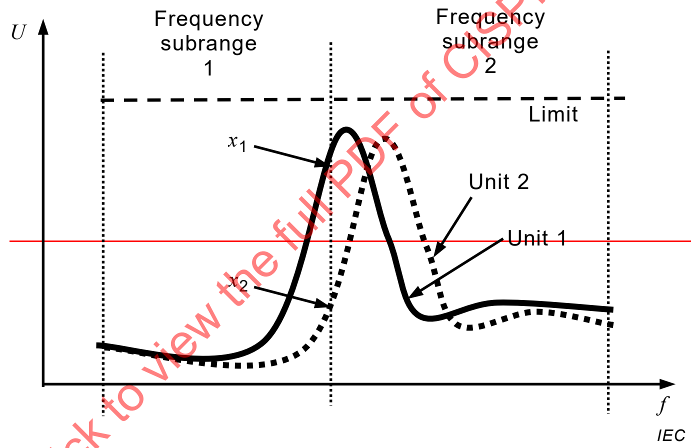


Figure E.1 – Illustration of difficulties in case the maximum value of the disturbance is at the boundary of a sub-range

E.4 Test method based on the binomial distribution

The type test method for conducted or radiated disturbance measurements can be based on application of the statistical method using a binominal distribution as outlined in CISPR TR 16-4-3 [3]. This method is based on the verification of the condition that from a test sample of size n, the number of units that generate a disturbance level above the applicable limit do not exceed c, as given in Table E.3.

Table E.3 – Application of the binomial distribution

n	7	14	20	26	32
c	0	1	2	3	4

E.5 Application of larger sample size

Should the test on the initial sample not fulfil one of the Clauses E.2, E.3 or E.4, then more units may be tested and the result combined with those from the first sample. The combined result can then be checked for the larger sample size.

Bibliography

[1] CISPR TR 16-4-5:2006, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-5: Uncertainties, statistics and limit modelling – Conditions for the use of alternative test methods*
CISPR TR 16-4-5:2006/AMD1:2014

[2] CISPR TR 16-4-1:2009, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-1: Uncertainties, statistics and limit modelling – Uncertainties in standardized EMC tests*

[3] ~~CISPR TR 16-4-3:2004, *Specification for radio disturbance and immunity measuring apparatus and methods. Part 4-3: Uncertainties, statistics and limit modelling – Statistical considerations in the determination of EMC compliance of mass-produced products*~~
~~CISPR TR 16-4-3:2004/AMD1:2006~~

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[6] IEC 60050-731:1991, *International Electrotechnical Vocabulary (IEV) – Part 731: Optical fibre communication*
IEC 60050-731:1991/AMD1:2016
IEC 60050-731:1991/AMD2:2017

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IEC 60155:1993/AMD1:1995
IEC 60155:1993/AMD2:2006

[8] IEC 60449, *Voltage bands for electrical installations of buildings*[3]

[9] IEC 61000-6-3:2006, *Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments*
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[10] IEC 61347-1:2015, *Lamp controlgear – Part 1: General and safety requirements*
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[12] IEC PAS 62825:2013, *Methods of measurement and limits for radiated disturbances from plasma display panel TVs in the frequency range 150 kHz to 30 MHz*

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[13] ITU Radio Regulations Resolutions and Recommendations: 2012, RESOLUTION 63 (REV.WRC-12), *Protection of radiocommunication services against interference caused by radiation from industrial, scientific and medical (ISM) equipment;* http://www.itu.int/dms_pub/itu-s/oth/02/02/S02020000244503PDFE.pdf [viewed 2018-02-05]

[14] CISPR 12, *Vehicles, boats and internal combustion engines – Radio disturbance characteristics – Limits and methods of measurement for the protection of off-board receivers*

[15] CISPR 14-1, *Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus – Part 1: Emission*

[16] CISPR 30 (all parts), *Test methods on electromagnetic emissions*

[17] CISPR 11:2015, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*

INTERNATIONAL ELECTROTECHNICAL COMMISSION

CISPR 15
Edition 9.0 2018-05

LIMITS AND METHODS OF MEASUREMENT OF RADIO DISTURBANCE CHARACTERISTICS OF ELECTRICAL LIGHTING AND SIMILAR EQUIPMENT

INTERPRETATION SHEET 1

This interpretation sheet has been prepared by subcommittee CISPR F: Interference relating to household appliances tools, lighting equipment and similar apparatus, of IEC technical committee CISPR: International special committee on radio interference.

The text of this interpretation sheet is based on the following documents:

DISH	Report on voting
CIS/F/777/DISH	CIS/F/790/RVDISH

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

CISPR 15 interpretation sheet on the worst-case mode of operation

Introduction

Subclause 7.5 specifies the operating modes of lighting equipment that must be considered during an emission test. A few examples are given to support the explanation of what 'different operating modes' means. The list of examples is of course not exhaustive. Apparently, the example of 'colour shifting' is not clear enough and it is sometimes interpreted as if any possible colour and/or correlated colour temperature (CCT) setting that lighting equipment may produce shall be assessed during measurements. Many types of LED lighting may be set in many different colours and CCTs. Compared to other operational-mode related influence quantities such as light level regulation, flashing or radio communication, the risk of not capturing the maximum level of electromagnetic (EM) disturbances due to different colour or CCT settings is very small, provided that all channels of a LED driver used to change colour or CCT are operative. The 'colour shifting'-example was meant for example for a mode where the light output continuously switches from one colour to another with a certain repetition frequency (e.g. applied for entertainment, events etc.), instead of emitting a single stable colour and/or CCT.

ICS 33.100.10

CISPR 15:2018-05/ISH1:2019-11(en)

Question

What is the meaning of example 'colour shifting' as mode of operation to be considered during testing? What colour and/or colour temperature should be selected in case lighting equipment can be set in a wide range of colours and/or CCTs?

Interpretation

The example 'colour shifting' in the first paragraph of 7.5 of CISPR 15:2018 must not be interpreted as if any possible colour and/or CCT setting that lighting equipment may produce shall be assessed during measurements.

Generally, according to 7.5 the worst case shall be found by prescanning every mode of operation over at least one repetition interval of the specific mode.

Alternatively, measurements can be performed using the setting(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.

A reason could be that highest level of electromagnetic (EM) disturbances will be captured if all channels of a LED driver used to create different colours and/or CCTs are operative. The number of channels applied depends on the LED-driver/LED-light-source architecture. Often, maximum EM disturbances can be achieved by selecting a white colour and/or a CCT setting in the middle of the specified CCT range.

EXAMPLE Colour variation and CCT variation may be achieved using a 5-channel LED driver powering three LED strings for colour (RGB) setting and two cool white and warm white LED strings for CCT setting. Hence, in case the lighting equipment under test is capable to operate at different colours and/or CCTs, a white colour and/or a single CCT in the middle of the specified CCT range may be selected[1].

1 7.4 of CISPR 15:2018, also still applies.

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE

____

LIMITS AND METHODS OF MEASUREMENT OF RADIO DISTURBANCE CHARACTERISTICS OF ELECTRICAL LIGHTING AND SIMILAR EQUIPMENT

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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This consolidated version of the official IEC Standard and its amendment has been prepared for user convenience.

CISPR 15 edition 9.1 contains the ninth edition (2018-05) [documents CIS/F/733/FDIS and CIS/F/736/RVD], its interpretation sheet (2019-11), and its amendment 1 (2024-07) [documents CIS/F/851/FDIS and CIS/F/854/RVD].

This Final version does not show where the technical content is modified by amendment 1. A separate Redline version with all changes highlighted is available in this publication.

International Standard CISPR 15 has been prepared by subcommittee CIS/F: Interference relating to household appliances tools, lighting equipment and similar apparatus, of IEC technical committee CISPR: International special committee on radio interference.

This ninth edition cancels and replaces the eighth edition published in 2013 and its Amendment 1:2015. This edition constitutes a technical revision.

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

a) full editorial revision and restructuring;
b) the restriction to mains and battery operation is deleted in the scope;
c) radiated disturbance limits in the frequency range 300 MHz to 1 GHz have been introduced;
d) the load terminals limits and the CDNE (alternative to radiated emissions) limits have changed;
e) deletion of the insertion-loss requirements and the associated Annex A;
f) introduction of three basic ports: wired network ports, local wired ports and the enclosure port;
g) introduction of a more technology-independent approach;
h) replacement of Annex B (CDNE) by appropriate references to CISPR 16-series of standards;
i) modified requirements for the metal holes of the conical housing;
j) new conducted disturbance measurement method for GU10 self-ballasted lamp;
k) addition of current probe measurement method and limits for various types of ports (in addition to voltage limits and measurement methods);
l) introduction of the term ‘module’ (instead of independent auxiliary) and requirements for measurement of modules using a host (reference) system;
m) modified specifications for stabilization times of EUTs;
n) for large EUT (> 1,6 m), addition of the magnetic field measurement method using a 60 cm loop antenna at 3 m distance (method from CISPR 14-1) as an alternative to the 3 m and 4 m LAS.

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

FDIS	Report on voting
CIS/F/733/FDIS	CIS/F/736/RVD

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

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

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

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

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION to Amendment 1

This Amendment includes the following significant technical changes with respect to CISPR 15:2018.

a) The voltage probe method for the conducted disturbance measurement of local wired port other than the electrical power supply interface of ELV lamps has been deleted.

b) Limits and measurement methods have been introduced for radiated disturbance of the enclosure port in the frequency range 1 GHz to 6 GHz.

c) The test set-up for the conical metal housing for single capped lamps has been rotated.

d) The arrangement of cables connected to interfaces of wired network ports has been modified. Cable length has been extended to 1,0 m.

e) Measuring arrangements for conducted disturbances for very large EUTs have been clarified.

f) Annex E regarding statistical methods has been deleted.

LIMITS AND METHODS OF MEASUREMENT OF RADIO DISTURBANCE CHARACTERISTICS OF ELECTRICAL LIGHTING AND SIMILAR EQUIPMENT

1 Scope

This document sets out requirements for controlling the emission (radiated and conducted) of radiofrequency disturbances from:

– lighting equipment (3.3.16) and modules, except for the types excluded in the second paragraph;
– the lighting part of multi-function equipment where this lighting part is a primary function;

NOTE 1 Examples are lighting equipment with visible-light communication.

– UV and IR radiation equipment for residential and non-industrial applications;
– simple advertising signs (see 3.3.1);
– decorative and entertainment lighting (see 3.3.6);
– emergency signs.

Excluded from the scope of this document are:

– components or modules intended to be built into lighting equipment and which are not user-replaceable;
– lighting equipment intended exclusively for aircraft or airfield facilities (runways, service facilities, platforms). However, general-purpose lighting that can be installed in many locations, including installations not related to aircraft or airfield, is not excluded from the scope of this document;
– installations;
– equipment for which the electromagnetic compatibility requirements in the radio-frequency range are explicitly formulated in other IEC standards, even if they incorporate a built-in lighting function.

NOTE 2 Examples of exclusions are:

– equipment with built-in lighting devices for display back lighting, scale illumination and signalling;
– video signs and dynamic displays (in scope of CISPR 32);
– range hoods, refrigerators, freezers (in scope of CISPR 14);
– photocopiers, projectors (in scope of CISPR 32);
– lighting equipment for road vehicles (in scope of CISPR 12);
– maritime equipment (in scope of IEC TC 18 and TC 80);
– lighting equipment operating in the ISM frequency bands (in scope of CISPR 11).

The frequency range covered is 9 kHz to 400 GHz. No measurements need to be performed at frequencies where no limits are specified in this document.

Multi-function equipment which is subjected simultaneously to different clauses of this document and/or other standards need to meet the provisions of each clause/standard with the relevant functions in operation.

For equipment outside the scope of this document and which includes lighting as a secondary function, there is no need to separately assess the lighting function against this document, provided that the lighting function was operative during the assessment in accordance with the applicable standard.

NOTE 5 Examples of equipment with a secondary lighting function can be range hoods, fans, refrigerators, freezers, ovens and TV with ambient lighting.

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

Within the remainder of this document, wherever the term "lighting equipment" or "EUT" is used, it is meant to be the electrical lighting and similar equipment falling in the scope of this document as specified in this clause.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60038, *IEC standard voltages*

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

IEC 60050-845:1987, *International Electrotechnical Vocabulary – Chapter 845: Lighting*

IEC 60061-1, *Lamp caps and holders together with gauges for the control of interchangeability and safety – Part 1: Lamp caps*

IEC 60081, *Double-capped fluorescent lamps – Performance specifications*

IEC 60598-1:2014, *Luminaires – Part 1: General requirements and tests*
IEC 60598-1:2014/AMD1:2017

IEC 60921, *Ballasts for tubular fluorescent lamps – Performance requirements*

IEC 61000-4-20:2010: *Electromagnetic compatibility (EMC) – Part 4-20: Testing and measurement techniques – Emission and immunity testing in transverse electromagnetic (TEM) waveguides*

IEC 61195, *Double-capped fluorescent lamps – Safety specifications*

IEC 62504:2014, *General lighting – Light emitting diode (LED) products and related equipment – Terms and definitions*

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

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

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

CISPR 16-1-4:2019/AMD1:2020
CISPR 16-1-4:2019/AMD2:2023

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*
CISPR 16-2-1:2014/AMD1:2017

CISPR 16-2-3:2016, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-3: Methods of measurement of disturbances and immunity – Radiated disturbance measurements*
CISPR 16-2-3:2016/AMD1:2019
CISPR 16-2-3:2016/AMD2:2023

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*
CISPR 16-4-2:2011/AMD1:2014
CISPR 16-4-2:2011/AMD2:2018

CISPR TR 30-1:2012, *Test method on electromagnetic emissions – Part 1: Electronic control gear for single- and double-capped fluorescent lamps*

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

ISO/IEC 17025:2005[1], *General requirements for the competence of testing and calibration laboratories*

3 Terms, definitions and abbreviated terms

3.1 General

For the purposes of this document, the terms and definitions given in IEC 60050-161, IEC 62504, IEC 60050-845 and the following apply.

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

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

3.2 General terms and definitions

3.2.1
base of the luminaire
mounting surface of the luminaire in normal use, usually the side opposite of the optical window

3.2.2
clock frequency
fundamental frequency of any signal used in the EUT excluding those generated inside an integrated circuit (IC) and which are solely used inside the same IC without being accessible

1 This edition was replaced by ISO/IEC 17025:2017 but the listed edition applies.

outside that IC, and excluding those used exclusively for radio transmission or radio receiving functions

Note 1 to entry: High frequencies are often generated inside integrated circuits (IC) by phase-locked-loop (PLL) circuits from lower clock oscillator frequencies outside the IC.

3.2.3
ELV
extra-low voltage
voltage which does not exceed 50 V AC or 120 V ripple free DC between conductors or between any conductor and earth (voltage band 1 of IEC 60449) applied to load interfaces supplying power to lighting equipment, excluding interfaces used for communication or data transfer

Note 1 to entry: Ripple free is conventionally defined for sinusoidal ripple voltage as ripple content of not more than 10 % RMS: the maximum peak value does not exceed 140 V for a nominal 120 V ripple-free DC system.

[SOURCE: IEC 61347-1:2015 + AMD1:2017, 3.27, modified – The definition has been rephrased.]

3.2.4
inductive power transfer
process of inductive transfer of electrical energy over time from a source to a separate load when these are placed in physical (but not electrical) contact or in close proximity with each other

EXAMPLE: Examples are rechargeable luminaires incorporating inductive power transfer or electrodeless lamps with inductive power transfer.

Note 1 to entry: If in addition a radio technology, as defined by the ITU, is used or superimposed to the power transfer function of inductive power transfer equipment for the purpose of data communication then the applicable standards for this radio technology apply.

Note 2 to entry: Any propagation of electromagnetic energy outside of the system of inductive power source and load is seen as electromagnetic disturbance and therefore subject to assessment by this standard.

3.2.5
optical window
side of the lighting equipment from which the light emanates

3.2.6
primary function
function of an equipment as specified in the instructions for use

3.2.7
secondary function
any function of an equipment not being essential for fulfilling the primary function as specified in the instructions for use

3.2.8
test arrangement
specific arrangement of the EUT, cabling and auxiliary equipment during the test

3.3 Terms and definitions related to equipment

3.3.1
simple advertising sign
unit which makes use of lighting for advertising, traffic signage, road signs or the like

EXAMPLE Neon tube advertising signs, emergency signs, inner-illuminated signs.

3.3.2
ancillary equipment
transducers (e.g. current probes and artificial networks) and other equipment (e.g. cables, preamplifiers, attenuators, filters, adapters) connected to a measuring receiver or the EUT and used in the disturbance signal transfer between the EUT and the measuring receiver

3.3.3
associated equipment
AE
apparatus, that is not part of the system under test, but needed to help exercise the EUT

EXAMPLE: Equipment to generate lighting control signals.

Note 1 to entry: See also Figure 2.

Note 2 to entry: The emission from the associated equipment should not influence the emission of the EUT.

[SOURCE: CISPR 16-2-3:2016, 3.1.5, modified – The example and Notes to entry have been added.]

3.3.4
auxiliary equipment
AuxEq
peripheral equipment that is part of the system under test

EXAMPLE: In CISPR TR 30-1 or CISPR TR 30-2, the reference luminaire, in case a ballast or driver is tested.

Note 1 to entry: See also Figure 2.

[SOURCE: CISPR 16-2-3:2016; 3.1.6, modified – The example and the Note to entry have been added.]

3.3.5
controlgear
electrical device between the supply and one or more light source(s) which may serve to transform the supply voltage, limit the current of the light source(s) to the required value, provide starting voltage and preheating current, prevent cold starting, correct power factor, reduce radio interference, include means for dimming, and further control functions

Note 1 to entry: This definition deviates from IEC 60598-1.

[SOURCE: IEC 62504:2014; 3.6.1, modified – The abbreviation 'LED' in the term is removed and various modifications in the definition.]

3.3.6
decorative and entertainment lighting
equipment that emits light for atmospheric, artistic or ambiance purposes

Note 1 to entry: Examples of decorative lighting include LED strip lights, rope lights, and projectors for illuminating building walls or statues in coloured and/or patterned light. Usually, these types of lighting equipment are static, but they can shift through various colours or patterns.

Note 2 to entry: Examples of entertainment lighting include stage, theatre and sky beam lights. Usually, these types of lighting equipment also include some movement, such as dynamically changing the direction of the projected light.

3.3.7
double-capped lamp adapter
component designed to be installed into luminaires which are constructed for lamps of one tube diameter (according IEC 60081 and IEC 61195) and one specific tube length for the purpose of allowing them to receive lamps of another tube diameter or another tube length instead

Note 1 to entry: A lamp adapter may incorporate a switch or a fuse or an electronic lamp controlgear for HF lamp operation.

3.3.8
double-capped self-ballasted lamp
unit which cannot be dismantled without being permanently damaged, provided with one or more light sources and two lamp caps and any additional elements necessary for starting and stable operation of the light source

Note 1 to entry: See Notes 1 and 2 to entry given in 3.3.21.

3.3.9
double-capped semi-luminaire
unit similar to a self-ballasted lamp but designed to utilize a replaceable light source and/or starting device

Note 1 to entry: Semi-luminaires for compact fluorescent lamps and for incandescent lamps, sometimes called adapters, are devices equipped, on the one side, with an IEC 60061-1 standardized lamp cap to allow mounting in a standard lampholder and, on the other side, with a lampholder to allow the insertion of a replaceable light source.

Note 2 to entry: The light source component and/or starting device of a semi luminaire is readily replaceable.

Note 3 to entry: For gas-discharge technologies, the ballast component is not replaceable and is not disposed of each time a light source is replaced.

3.3.10
double-capped retrofit lamp
tubular lamp applying a technology alternative to fluorescent technology and which can be used as a replacement for double-capped fluorescent lamps without requiring any internal modification in the luminaire and which, after installation, maintains the same level of safety of the replaced lamp in the luminaire

Note 1 to entry: The replacement of a glow starter according to IEC 60155 with LED replacement starter having the same dimensions and fit, for the correct functioning of the double-capped LED lamp is not considered as a modification to the luminaire.

3.3.11
electrodeless lamp
gas discharge lamp in which the power required to generate light is transferred from outside the lamp envelope to the gas inside via an electric or magnetic field

3.3.12
equipment-under-test
EUT
equipment in the scope of this document subjected to EMC (emission) compliance (conformity assessment) tests

EXAMPLE: The EUT may be a luminaire including lamp(s), a self-ballasted lamp, a rope light or a module.

Note 1 to entry: See also Figure 2.

[SOURCE: CISPR 16-2-3:2016, 3.1.14, modified – Definition is modified and the example and Note 2 to entry have been added.]

3.3.13
lamp
unit containing one or more light sources and one or two standardised caps for interfacing

3.3.14
LED light source
device containing an LED or collection of LEDs used for the purpose of illumination

3.3.15
light source
device emitting light produced by a transformation of electrical energy

Note 1 to entry: Lighting equipment emits light in the range from visible wavelength 400 nm to 780 nm.

[SOURCE: IEC 60050-845:1987, 845-07-01, modified – The definition has been rephrased and the Note to entry has been added.]

3.3.16
lighting equipment
device that can be used as an independent unit to illuminate a scene, objects or their surroundings so that they can be seen, and components and modules designed to be used in or with such a device or assembly of devices

Note 1 to entry: Examples of lighting equipment are luminaires, self-ballasted lamps, ELV-lamps and modules which are used for general purpose lighting, street/flood lighting intended for outdoor use, lighting installed in or on transport vehicles and which is not in the scope of CISPR 12.

[SOURCE: IEC 60050-845:1987, 845-09-01, modified – The definition has been rephrased.]

3.3.17
luminaire
lighting equipment which distributes, filters or transforms the light transmitted from one or more lamps or light sources and which includes all the parts necessary for supporting, fixing and protecting the lamps, but not usually the lamps themselves, and, where necessary, circuit auxiliaries, together with the means to connect them to the supply, the driver, control units, cabling, housing and mounting are included

Note 1 to entry: This definition comes from the definition given in the luminaire product standard IEC 60598-1. In the latter standard a luminaire does not include a lamp, unless the lamp is an integral part. For the purpose of emission testing in this document however, a luminaire always contains a lamp or a light source or resistive load.

[SOURCE: IEC 60598-1:2014, 1.2.1, modified – The definition has been rephrased.]

3.3.18
module
electronic or electrical part which serves a specific function or functions of a lighting application and may contain radio-frequency sources, which is intended for application in a luminaire or in an installation by an end user and which is intended to be marketed and/or sold separately from a lighting apparatus or system

Note 1 to entry: Examples are: self-ballasted lamp, starter, controlgear, wall dimmer, control unit, LED module.

3.3.19
passive EUT
equipment which, by its inherent nature and physical characteristics such as absence of active and fast variation or switching of currents or voltages, is incapable of generating or contributing to electromagnetic emissions which exceed a level allowing radio reception to happen as intended

Note 1 to entry: A passive EUT is not likely to produce any electromagnetic disturbances. See 6.2.

Note 2 to entry: Mains rectifier diodes and an electronic starter that is only active during the starting phase is considered to be a passive component.

3.3.20
restricted ELV lamp
ELV lamp with specific restrictions on the type of power supply and/or the cable length that can be applied to it, as specified in the instructions for use

Note 1 to entry: ELV lamps without detailed description of restrictions are non-restricted.

3.3.21
self-ballasted lamp
self-contained unit incorporating a light source and any additional elements that may be necessary for starting and ensuring a stable operation of the light source which cannot be dismantled without being permanently damaged and which is connected to a lamp holder or luminaire via one or two IEC 60061-1 standardized lamp caps

Note 1 to entry: The light source component of a self-ballasted lamp is not replaceable.

Note 2 to entry: For gas-discharge technologies, the ballast component is part of the self-ballasted lamp; it is not part of the luminaire.

Note 3 to entry: The term "self-ballasted lamp" is used as a general term for designating all lamps that can operate independent of other external accessories or auxiliary equipment, except for a lampholder. This includes gas-discharge technologies as well as LED and OLED technologies.

[SOURCE: IEC 60598-1:2014, 1.2.59, modified – The definition has been rephrased, Notes 2 and 3 to entry have been modified and Note 4 to entry has been deleted.]

3.3.22
semi luminaire
device (sometimes called adapter) equipped, on the one side, with any IEC-standardised lamp cap system to allow mounting in a standard lampholder and, on the other side, with a lampholder to allow the insertion of a replaceable light source with a cap

3.3.23
UV and IR radiation equipment
optical radiation equipment operating at a wavelength between 780 nm to 1 mm or 1 nm to 400 nm

EXAMPLE: Examples are appliances used for medical and cosmetic care, and for instant zone heating.

[SOURCE: IEC 60050-731:1991 + AMD1:2016, 731-01-05 and 731-01-06, modified – The definitions have been combined.]

3.3.24
user-replaceable
components or modules which can be replaced by the end-user

3.4 Terms and definitions related to interfaces and ports

3.4.1
AC electric power supply interface
connection point to an external AC electrical supply network

3.4.2
communication/data/network interface
point of connection for data and signalling transfers intended to interconnect widely dispersed systems via such means as direct connection to multi-user telecommunications networks (e.g. local area networks like Ethernet, token ring, etc.)

3.4.3
control interface
point at which a conductor or cable is attached to the lighting equipment for the purpose of controlling the function of the equipment

3.4.4
DC electric power supply interface
connection point to an external DC electrical supply network

3.4.5
electric power supply interface
connection point at which a conductor or cable carrying the primary electrical power needed for the operation (functioning) of the lighting equipment is connected, and through which also conducted electromagnetic disturbance may couple to the electromagnetic environment

Note 1 to entry: It is possible to connect cables to such an interface for transmission of electric power from DC and/or AC mains power distribution systems which has a topology such that an electromagnetic disturbance easily couples to the electromagnetic environment.

3.4.6
enclosure port
artificial non-intentional wireless interface of the lighting equipment through which electromagnetic disturbances can radiate into the environment

Note 1 to entry: Based on IEC 61000-6-3:2006/AMD1:2010, 3.1.2.

Note 2 to entry: The artificial interface can consist of for instance seams and apertures in the physical metallic enclosure, but also limited lengths of each of its wired interfaces. In the frequency range above 30 MHz typically one third of a wavelength of the length of the wired interfaces can contribute to radiated disturbances. Therefore, also included are wired interfaces to auxiliary equipment which are intended to be connected with cables of less than 3 m length.

3.4.7
electrical interface
connection point of equipment at which a conductor or cable is attached for various purposes such as powering, control or communication

EXAMPLES: See Figure 3.

3.4.8
functional earth
terminal of equipment intended for connection to an external grounding conductor for functional and/or electromagnetic compatibility purposes

3.4.9
load interface
connection point of the lighting equipment providing electrical energy to another item of lighting equipment

3.4.10
local wired port
interface of the lighting equipment which directly connects to cables that are not connected to a network and have a length greater than or equal to 3 m, or that are indirectly connected to a network via auxiliary equipment

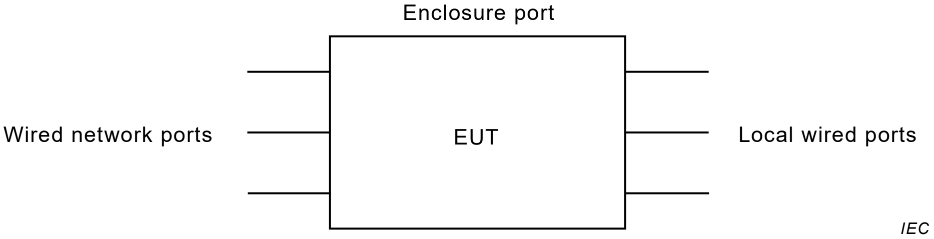
EXAMPLE: Examples are, the electrical power supply interface of ELV lamp, an interface of a driver for connecting a long (≥ 3 m) load cable with a light source, a control interface of a sensor for connecting a short (< 3 m) control cable with an AC mains-fed luminaire. See Annex D for examples.

Note 1 to entry: Such a port can emit electromagnetic disturbances.

3.4.11
network
electrical installation consisting of equipment and interconnecting cables or wiring for the transmission and distribution of electrical power, electrical signal for data transmission or communication or alike

3.4.12
port
particular category of an interface of an EUT which provides a coupling path for electromagnetic disturbances from the EUT into the electromagnetic environment specific for that category

Note 1 to entry: See Figure 1.



NOTE The enclosure port may include other wired interfaces, with lengths less than 3 m (see 3.4.6).

Figure 1 – EMC-ports of an EUT

3.4.13
protective earth
equipment terminal intended for connection to an external conductor for protection against electrical shock in case of a fault

3.4.14
wired network port
wired interface of the lighting equipment which connects to cables that are directly connected to a network and through which conducted electromagnetic disturbances may be coupled to that network

3.5 Abbreviated terms

AAN	asymmetric artificial network
AC	alternating current
AE	associated equipment
AMN	artificial mains network
AuxEq	auxiliary equipment
CDNE	Coupling Decoupling Network Emission
CISPR	Comité International Spécial des Perturbations Radioélectriques
CM	common mode
CP	current probe
CVP	capacitive voltage probe
dB	decibel
DC	direct current
DALI	Digital Addressable Lighting Interface
DM	differential mode
E	earth terminal
ELV	extra-low voltage
EMC	electromagnetic compatibility
EUT	equipment under test
FAR	fully anechoic room
FE	functional earth
FSOATS	free space open area test site
Fx	clock frequency
GHz	gigahertz

GU10	glass U-shaped housing and cap of a multifaceted reflector (MR) light bulb
Hz	hertz
IEC	International Electrotechnical Commission
IEV	International Electrotechnical Vocabulary
IR	infrared
ISM	industrial, scientific and medical
ITE	information technology equipment
ITU	International Telecommunication Union
kHz	kilohertz
L	line
LAN	local area network
LED	light emitting diode
LLAS	large loop antenna system
MHz	megahertz
µA	microampere
µF	microfarad
µV	microvolt
N	neutral
N.A.	not applicable
nF	nanofarad
OATS	open area test site
OLED	organic light emitting diode
PE	protective earth
PWM	pulse width modulation
RF	radio frequency
RGP	reference-ground plane
SAC	semi anechoic chamber
SSL	solid state lighting
TEM	transverse electromagnetic
TR	technical report
UV	ultraviolet
VBW	video bandwidth

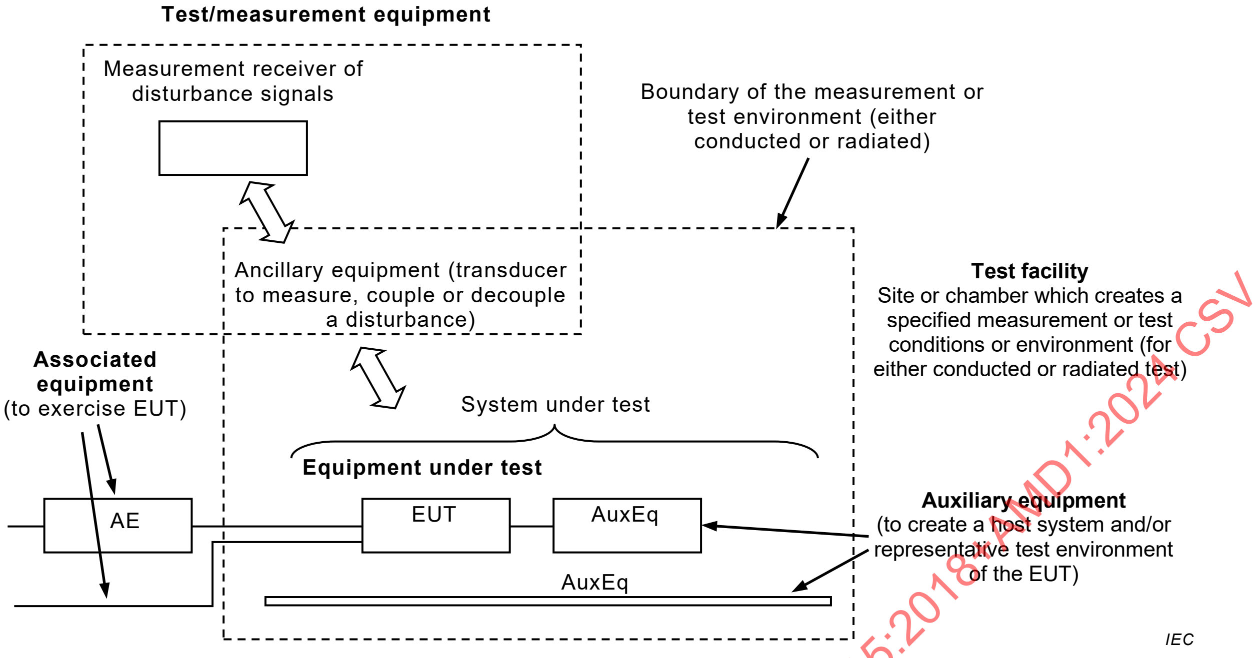


Figure 2 – Generic depiction of the definitions of test-, ancillary-, auxiliary- and associated equipment w.r.t. EUT and the test/measurement environment (definitions given in CISPR 16-2-3)

4 Limits

4.1 General

The requirements for an EUT are given in this clause on the basis of three possible EMC ports that can apply to each of the EUT interfaces: enclosure port, wired network port, and local wired port. The port classification and the application of limit for each possible interface of an EUT is specified in Clause 5 and in Clause 6.

Disturbance limits are specified for specific types of detectors, i.e. quasi-peak or average detectors (see the specification of the CISPR receiver in CISPR 16-1-1). If the applicable limits over a specific frequency range are specified for both quasi-peak and average detectors, provided the disturbance levels of the EUT are measured using the quasi-peak detector, and are found to meet the average limits, then, the EUT shall be deemed to meet both limits and the measurement with the average detector need not to be carried out for that frequency range.

In case different methods with associated limits can be applied, the test report shall state which method and corresponding limits were used.

NOTE The limits in this document have been determined on a probabilistic basis. In exceptional cases, additional provisions are required.

4.2 Frequency ranges

In 4.3, 4.4 and 4.5, limits and measurement methods for radio disturbance characteristics are given as a function of frequency range. No measurements need to be performed at frequencies where no limits are specified.

4.3 Limits and methods for the assessment of wired network ports

4.3.1 Electric power supply interface

The limits and measurement method for the assessment of conducted disturbance voltages at the AC or DC electric power supply interface terminals for the frequency range 9 kHz to 30 MHz are given in Table 1.

Table 1 – Disturbance voltage limits at the electric power supply interface

Frequency range	Limits [a] dB(μV)		Method
	Quasi-peak	Average	
9 kHz to 50 kHz	110	–	CISPR 16-2-1 and 8.3
50 kHz to 150 kHz	90 to 80[b]	–	
150 kHz to 0,5 MHz	66 to 56[b]	56 to 46[b]	
0,5 MHz to 5,0 MHz	56[c]	46[c]	
5 MHz to 30 MHz	60	50	

[a] At the transition frequency, the lower limit applies.

[b] The limit decreases linearly with the logarithm of the frequency in the ranges 50 kHz to 150 kHz and 150 kHz to 0,5 MHz.

[c] For lighting equipment incorporating exclusively electrodeless lamps, the limit in the frequency range of 2,2 MHz to 3,0 MHz is 73 dB(μV) quasi-peak and 63 dB(μV) average.

NOTE In the US, lighting devices are classified as either a non-consumer (Class A) or consumer (Class B) device. These classification limits are similar to the Class A and Class B equipment categories in CISPR 32:2015 and CISPR 32:2015/AMD1:2019.

4.3.2 Wired network interfaces other than power supply

The limits and measurement methods for the assessment of conducted disturbance voltages at wired network interfaces other than power supply for the frequency range 150 kHz to 30 MHz are given in Table 2 and Table 3.

Either of the methods and the associated limits from Table 2 or Table 3 can be applied to demonstrate compliance.

Table 2 – Disturbance voltage limits at wired network interfaces other than power supply

Frequency range (MHz)	Limits dB(μV)		Method
	Quasi-peak	Average	
0,15 to 0,50	84 to 74	74 to 64	CISPR 16-2-1 and 8.4
0,50 to 30	74	64	

NOTE 1 The limits decrease linearly with the logarithm of the frequency in the range 0,15 MHz to 0,5 MHz.

NOTE 2 The disturbance voltage limits are derived for use with an asymmetric artificial network (AAN) which presents a common mode (asymmetric mode) impedance of 150 Ω to the measured interface.

Table 3 – Disturbance current limits at wired network interfaces other than power supply

Frequency range (MHz)	Limits dB(μA)		Method
	Quasi-peak	Average	
0,15 to 0,50	40 to 30	30 to 20	CISPR 16-2-1 and 8.4
0,50 to 30	30	20	

NOTE 1 The limits decrease linearly with the logarithm of the frequency in the range 0,15 MHz to 0,5 MHz.

NOTE 2 The disturbance current limits are derived for use of a common mode (asymmetric mode) impedance of 150 Ω. Hence the conversion factor applied is 20 log(150) = 44 dBΩ.

4.4 Limits and methods for the assessment of local wired ports

This standard differentiates between two categories of "local wired port". These are:

a) EUT interface that indirectly connects to a network, via auxiliary equipment (this includes the electrical power supply interface of ELV lamps);

b) EUT interface that does not connect to a network, directly or indirectly, and which can be connected to cables having a length equal to or greater than 3 m.

For these two sub-categories of "local wired port", as listed above, limits for conducted disturbances are prescribed in this subclause.

Interfaces that are not connected to a network and having a length less than 3 m shall not be assessed for conducted disturbances.

The limits and methods applicable to the electrical power supply interfaces of ELV lamps are given in Table 1 and Table 4, for restricted and non-restricted ELV lamps, respectively, with additional requirements for the test method in 6.4.7.

Table 4 – Disturbance voltage limits of local wired ports: electrical power supply interface of non-restricted ELV lamps

Frequency range	Limits [a c d] dB(μV)		Method
	Quasi-peak	Average	
9 kHz to 50 kHz	136	–	CISPR 16-2-1 and A.5.1
50 kHz to 150 kHz	116 to 106[b]	–	
150 kHz to 0,5 MHz	92 to 82[b]	82 to 72[b]	
0,5 MHz to 5,0 MHz	82	72	
5 MHz to 30 MHz	86	76	

[a] At the transition frequency, the lower limit applies.

[b] The limit decreases linearly with the logarithm of the frequency in the ranges 50 kHz to 150 kHz and 150 kHz to 0,5 MHz.

[c] The limits in this table apply if no 26 dB attenuator is applied (see Figure A.3).

[d] Disturbance voltage limits for restricted ELV lamps are given in Table 1 (see 6.4.7).

The limits and methods given in Table 6 shall apply to local wired ports other than electrical power supply interfaces of ELV lamps.

Table 6 – Disturbance current limits at local wired ports: local wired ports other than electrical power supply interface of ELV lamp

Frequency range MHz	Limits dB(μA)		Method
	Quasi-peak	Average	
0,15 to 0,50	40 to 30	30 to 20	CISPR 16-2-1 See 8.5.2.3
0,50 to 30	30	20	
NOTE The limits decrease linearly with the logarithm of the frequency in the range 0,15 MHz to 0,5 MHz.			

4.5 Limits and methods for the assessment of the enclosure port

4.5.1 General

This subclause gives radiated disturbance limits for the enclosure port as a function of frequency range.

4.5.2 Frequency range 9 kHz to 30 MHz

Radiated-field disturbance limits in the frequency range of 9 kHz to 30 MHz are given in Table 8 and Table 9.

The limits in Table 8 are expressed in terms of a current measured in a large loop-antenna system (LLAS) as specified in CISPR 16-1-4. This current is a measure for the magnetic field level around the EUT. This limit, applicable for the quasi-peak detector of the CISPR receiver, is given for three different sizes of large loop antenna systems in the frequency range 9 kHz to 30 MHz.

The range of maximum dimensions of the EUT for each of the three loop-antenna diameters is given in Table 7.

For EUT dimensions larger than 1,6 m, the limits given in Table 9 associated with the magnetic field loop antenna measurement method specified in 9.3.3 can be applied.

The limits in Table 8 and Table 9 provide different options. The test report shall state which method was used and which limits were applied.

Table 7 – Maximum EUT dimension that can be used for testing using LLAS with different diameters

Maximum dimension of the EUT, D m	Loop antenna diameter m
$D \leq 1,6$	2
$D \leq 2,6$	3
$D \leq 3,6$	4
No minimum EUT dimensions are given for the 3 m and 4 m LLAS. However, it is recommended to apply the smallest size of LLAS that is appropriate for the size of the EUT. If a small EUT is tested in a large LLAS (i.e. EUT smaller than 1,6 m tested in a 3 m or 4 m LLAS, or EUT smaller than 2,4 m tested in a 4 m LLAS), it shall be confirmed that the LLAS is able to detect EUT generated emissions with at least 10 dB of margin above the measuring instrument's noise floor.	

Table 8 – LLAS radiated disturbance limits in the frequency range 9 kHz to 30 MHz

Frequency range	Quasi-peak limits for three loop diameters dB(μA)			Method
	2 m	3 m	4 m	
9 kHz to 70 kHz	88	81	75	CISPR 16-2-3 and 9.3.2
70 kHz to 150 kHz	88 to 58[a]	81 to 51[a]	75 to 45[a]	
150 kHz to 3,0 MHz	58 to 22[a b]	51 to 15[a b]	45 to 9[a b]	
3,0 MHz to 30 MHz	22	15 to 16[c]	9 to 12[c]	

[a] Decreasing linearly with the logarithm of the frequency.

[b] For lighting equipment incorporating exclusively electrodeless lamps, the limit in the frequency range of 2,2 MHz to 3,0 MHz is 58 dB(μA) for 2 m, 51 dB(μA) for 3 m and 45 dB(μA) for 4 m loop diameter.

[c] Increasing linearly with the logarithm of the frequency.

4.5.3 Frequency range 30 MHz to 1 GHz

Radiated-field disturbance limits and measurement methods in the frequency range of 30 MHz to 1 GHz are given in Table 10 in terms of quasi-peak values of the electric field component.

Table 10 provides different options. The test report shall state which method was used and which limits were applied.

Table 9 – Loop antenna radiated disturbance limits in the frequency range 9 kHz to 30 MHz for equipment with a dimension > 1,6 m

Frequency range MHz	Limits at 3 m distance Quasi-peak dB(μA/m)	Method
0,009 to 0,070	69	9.3.3
0,070 to 0,150	69 to 39 [b]	
0,150 to 4,0	39 to 3 [a b]	
4,0 to 30	3	

[a] For lighting equipment incorporating exclusively electrodeless lamps, the limit in the frequency range of 2,2 MHz to 3,0 MHz is 39 dB(μA/m).

[b] Decreasing linearly with logarithm of frequency.

Table 10 – Radiated disturbance limits and associated measurement methods in the frequency range 30 MHz to 1 GHz

Testing method [a]	Reference [g]	Frequency range MHz	Quasi-peak limits [d]
OATS or SAC at 10 m distance	CISPR 16-2-3	30 to 230 230 to 1 000	30 dB(μV/m) 37 dB(μV/m)
OATS or SAC at 3 m distance	CISPR 16-2-3	30 to 230 230 to 1 000	40 dB(μV/m) 47 dB(μV/m)
FAR at 3 m distance	CISPR 16-2-3	30 to 230 230 to 1 000	42 to 35 [e] dB(μV/m) 42 dB(μV/m)
TEM-waveguide [b]	IEC 61000-4-20	30 to 230 230 to 1 000	30 dB(μV/m) 37 dB(μV/m)

Testing method [a]	Reference [g]	Frequency range MHz	Quasi-peak limits [d]
CDNE method [c, f]	CISPR 16-2-1	30 to 100 100 to 200 200 to 300	64 to 54 [e] dB(μV) 54 dB(μV) 54 to 51 [e] dB(μV)

[a] Any of the methods and the associated limits can be applied to demonstrate compliance.

[b] The TEM-waveguide is limited to EUTs without cables attached and with a maximum size according to 6.2 of IEC 61000-4-20:2010 (the largest dimension of the enclosure at 1 GHz measuring frequency is one wavelength, 300 mm at 1 GHz). The results taken in a TEM waveguide are converted to field strength for comparison with OATS-based limits at 10 m distance.

[c] The CDNE method and the associated limits up to 300 MHz can be only applied for EUTs with clock frequencies below or equal to 30 MHz. In such a case, the product is deemed to comply with the requirements between 300 MHz and 1 000 MHz. The CDNE-limits between 200 MHz and 300 MHz specified in Table 10 are more stringent than the limits given in CISPR 15:2013. An increasing margin (up to 10 dB at 300 MHz) has been applied between 200 MHz and 300 MHz. If the CDNE test fails, then any of the other methods and associated limits can still be applied [a].

[d] At the transition frequency, the lower limit applies.

[e] The limit decreases linearly with the logarithm of the frequency.

[f] The EUT size limitation of CISPR 16-2-1 does not apply. For the CDNE method, the largest dimensions of the EUT are 3 m x 1 m x 1 m (l x w x h). The CDNE restrictions apply to the EUT only, and not the wiring or the total dimension of the system under test, see Figure 2.

[g] See also 9.3.4.

NOTE In the US, lighting devices are classified as either a non-consumer (Class A) or consumer (Class B) device. These classification limits are similar to the Class A and Class B equipment categories in CISPR 32:2015 and CISPR 32:2015/AMD1:2019.

4.5.4 Frequency range 1 GHz to 6 GHz

Radiated disturbance measurements in this frequency range shall be performed up to the frequency determined in accordance with Table 13, based on the highest clock frequency of the EUT. However, if the clock frequencies of the EUT are not known, radiated disturbance measurements shall be performed up to 6 GHz.

Table 13 – Radiated measurement highest frequency

Highest clock frequency Fx	Highest measurement frequency
Fx ≤ 108 MHz	1 GHz
108 MHz < Fx ≤ 500 MHz	2 GHz
500 MHz < Fx ≤ 1 GHz	5 GHz
Fx > 1 GHz	5 × Fx up to a maximum of 6 GHz

Radiated disturbance limits and measurement methods in the frequency range of 1 GHz to 6 GHz are given in Table 14 in terms of peak and average values of the electric field component.

Table 14 – Radiated disturbance requirements at frequencies above 1 GHz

Frequency range MHz	Testing method	Testing distance m	Detector type / bandwidth	Limits dB(μV/m)
1 000 to 3 000	FSOATS	3	Average / 1 MHz	50
3 000 to 6 000				54

1 000 to 3 000			Peak / 1 MHz	70
3 000 to 6 000				74

Apply across the frequency range from 1 000 MHz to the highest required frequency of measurement derived from Table 13.

Allowed measurement distances:1 m, 3 m, 5 m, or 10 m.

Where a different measurement distance is chosen, other than the reference testing distance defined (3 m), the limit is offset based upon the following formula:

$L_{new} = L_{def} - 20 \log (d_{meas}/d_{ref})$

where

L_{new} is the new limit at the reference distance in dB(μV/m);

L_{def} is the defined limit at the measurement distance in dB(μV/m);

d_{meas} is the measurement distance in metres;

d_{ref} is the reference distance in metres.

An FSOATS may be a SAC/OATS with RF absorber on the RGP or a FAR, see specific details in CISPR 16-2-3:2016, CISPR 16-2-3:2016/AMD1:2019 and CISPR 16-2-3:2016/AMD2:2023.

NOTE In the US, lighting devices are classified as either a non-consumer (Class A) or consumer (Class B) device. These classification limits are similar to the Class A and Class B equipment categories in CISPR 32:2015 and CISPR 32:2015/AMD1:2019.

5 Application of the limits

5.1 General

The applicability of limits for EUTs is given in Clause 5. Additional guidelines/requirements for the applicability of the limits to specific kinds of EUTs are given in Clause 6. See Figure 4.

The general operational conditions for the EUT are given in Clause 7. The measurement methods for conducted and radiated disturbances are specified in Clause 8 and Clause 9.

5.2 Identification of the interfaces subject to test

If the EUT does not fall in one of the categories specified in Clause 6, then the applicable test cases for the various EUT interfaces shall be derived as follows.

First, the EMC-relevant physical properties of the EUT and its wired interfaces are to be determined; see Figure 3 for guidance. For each wired interface in turn a decision is then made as to whether it is connected to a network in a direct way, indirect way or not at all. Once the types of interface and possible connections are known, each interface is allocated to one of the three possible standardised EMC ports as detailed below:

- enclosure port;
- wired network port;
- local wired port.

The applicable test method, associated test arrangement and limits shall then be selected for each interface in turn, depending upon its port classification and, as per the requirements in 5.3.

5.3 Application of limits to the interfaces

5.3.1 General

A flow chart depicting the decision process for the application of limits is given in Figure 4.

5.3.2 Conducted disturbance requirements for the wired network port

5.3.2.1 Conducted disturbance requirements for the electrical power supply interface

The disturbance voltage limits and measurement method of the electrical power supply interfaces in the frequency range 9 kHz to 30 MHz are given in Table 1.

These limits apply for electrical power supply interfaces that are directly connected to a power supply network (Figure 4).

5.3.2.2 Conducted disturbance requirements for wired network interfaces other than power supply

The limits specified in this subclause apply for wired network interfaces other than power supply that are directly connected to a network (Figure 4).

The disturbance voltage limits and measurement method of wired network interfaces other than power supply (e.g. for communication or data transfer) in the frequency range 150 kHz to 30 MHz are given in Table 2 for use with an asymmetric artificial network (AAN). If no coupling network is available for the interface in question, then the current limits given in Table 3 shall be applied using the current measurement method given in 8.4.

5.3.3 Conducted disturbance requirements for local wired ports

These limits apply for interfaces of the following type (Figure 4):

1) indirectly connected to a network via other equipment, including power supply interface of ELV lamp;
2) not connected to a network and with a length greater than or equal to 3 m.

For local wired ports other than power supply interface of ELV lamp, the disturbance current limits given in Table 6 shall be applied using the measurement method given in 8.5.2.3. The method of measurement and the applicable limits for the power supply interface of ELV lamp are described in 6.4.7.

NOTE Interfaces that are not connected to a network and with a length less than 3 m are assessed through the enclosure port test. Nonetheless, the electrical power supply interface of ELV lamp is always subject to conducted emissions test, as per 6.4.7.

5.3.4 Radiated disturbance requirements for the enclosure port

5.3.4.1 Frequency range 9 kHz to 30 MHz

Radiated-field disturbance limits in the frequency range of 9 kHz to 30 MHz (Table 8 or Table 9) apply to the enclosure port of the EUT. However, the EUT needs to be tested for radiated emissions within 9 kHz to 30 MHz only if the application, construction or technology of the EUT can cause large magnetic dipole moments. In case of doubt, or if no such information is available then the test is to be done. A large dipole moment is obtained if a substantial disturbance current is running in a loop that encompasses a large surface, such as (but not limited to) the following cases:

– the instructions for use allow external wired interfaces connected to the EUT by single-conductor cables;
– the EUT applies internal single-conductor and separated interconnect wiring (or PCBs tracks) that cause loops and an associated magnetic dipole;
– EUTs that apply technologies with inductive power transfer.

EXAMPLES Luminaires that have separated supply lines; electrodeless lamps with inductive power transfer and rechargeable luminaires incorporating inductive power transfer are considered to be equipment with large magnetic dipole moments. DC-fed LED light sources and magnetic 50 Hz or 60 Hz wound ballasted luminaires are examples of lighting equipment that are considered to have very small dipole moments and therefore do not need to be tested.

If the EUT is incapable of generating a large magnetic dipole moment, then no test is required and the EUT is deemed to comply with the radiated-field disturbance limits in the frequency range of 9 kHz to 30 MHz.

5.3.4.2 Frequency range 30 MHz to 1 000 MHz

The EUT shall be evaluated for radiated emissions in the 30 MHz to 1 000 MHz range by testing in accordance with one of the methods in Table 10.

When the CDNE method is used and all clock frequencies of the EUT are below or equal to 30 MHz, then the product is deemed to comply with the requirements between 300 MHz and 1 000 MHz if the emissions comply with the limits in the 30 MHz to 300 MHz frequency range as specified in Table 10.

5.3.4.3 Frequency range 1 GHz to 6 GHz

The EUT shall be tested for radiated disturbance in the range 1 GHz to 6 GHz in accordance with Table 14.

5.3.5 Multiple interfaces of the same type

Where the EUT has more than one interface of the same type, they shall be selected for testing as follows:

- if there are multiple similar interfaces connected to the same card or module, then it is acceptable to assess one of those interfaces;
- where there are ports of the same type on different cards or modules, then it is acceptable to assess one typical port on each card or module types.

The above is applicable to conducted emissions measurements on network ports and local wired ports only.

The test report shall identify the ports assessed. All other interfaces and ports are deemed to comply with the applicable limits in CISPR 15 provided the above requirements were followed in selecting the ports for testing and provided all tested ports were demonstrated to be compliant with the applicable limits of CISPR 15.

5.3.6 Interfaces that can be categorised as multiple types of ports

If a single interface satisfies the definition of more than one type of port defined in this publication, it is subject to the requirements that apply for each of the port types it satisfies.

EXAMPLE A power-over-Ethernet can be identified as both a wired network port (Ethernet-connection) and a local-wired port (DC power supply). For the wired network port (Ethernet-connection), the limits in either Table 2 or Table 3 would apply. For the local-wired port (DC power supply) the limits in Table 6 apply. In this case, the disturbance current limits of Table 3 and Table 6 are the same. In this example, the limits for either type of port are basically the same. Broadband over power and powerline communication are other examples where the interface in question can be categorized as different kinds of wired network ports (4.3).

6 Product specific limit application requirements

6.1 General

This clause includes limit application requirements for specific types of lighting equipment and shall be used in conjunction with the general requirements in Clause 5. Clause 5 applies for equipment not listed in Clause 6 (first decision box in Figure 4).

Product specific application notes referring to particular measurement set-ups or operating conditions are given in Annex A.

6.2 Passive EUT

A passive EUT is deemed to fulfil the requirements of this document without further testing. Examples of such equipment include: luminaires suitable for incandescent lamps or self-ballasted lamps, transformers for incandescent or self-ballasted lamps that do not regulate the voltage by means of active electronic components, luminaires fitted with only LEDs and passive components. Mains rectifier diodes are considered passive components.

NOTE Where in this document, the term "incandescent lamp" is used, all types of incandescent lamps including halogen lamps are meant.

EXAMPLE Incandescent lamps are generally also passive equipment. Although it should be noted that some types of incandescent lamps with very long filaments can generate excessive disturbances.

EUT with electromagnetic controlgear can be considered to contain only passive components. However due to the physical characteristic of discharge lamps, further assessment is required. Such equipment shall comply with the disturbance voltage limits at the electric power supply interface terminals given in Table 1. However, luminaires for discharge lamps containing only passive controlgear and fitted with a power factor correction capacitor or suppression capacitor (at least 47 nF) across the mains terminals are deemed to comply with the requirements of this document without measurement. Compliance can be achieved by inspection.

6.3 Rope lights

6.3.1 General

Rope lights e.g. Christmas lights, lighting chains, are used for different applications both indoor and outdoor in the areas of general and effect lighting. Depending upon the application and construction, different light source or lamp technologies can be applied, e.g. incandescent lamps or LED lamps. The controlgear for rope lights can be independent or integrated. Also rope lights without controlgear are feasible.

6.3.2 Requirements for rope lights

Rope lights with active switching electronic components shall comply with the disturbance voltage limits at mains terminals given in Table 1 and with the radiated disturbance limits given in Table 8 or Table 9 if applicable, and in Table 10 and Table 14 if applicable.

The setup and test arrangements are specified in Clause A.3.

6.4 Components and modules

6.4.1 General

This subclause specifies how to configure a system under test in case the EUT is a component or module that is intended to be marketed and/or sold separately from a lighting apparatus or system and thus to be applied by an end user in a lighting apparatus or system.

Different types of components or modules can be distinguished, for example the EUT can be (Figure 5):

- a replaceable component or module, for example a self-ballasted lamp, an ELV lamp or starter;
- an external component or module, for example an independent driver or igniter, a wall dimmer or a remote control;
- an internal component or module, for example a driver;

- a mounted component or module, for example a light source, an adapter or a network interface card.

Internal, mounted, replaceable or external components or modules shall be assessed with at least one representative host system as auxiliary equipment.

The port(s) of any component or module being assessed shall be terminated in accordance with 7.9. The functions of the host that are specific to the component or module being assessed shall be exercised during the measurements. Components or modules shown to meet the requirements of this document in one representative host are deemed to meet the requirements of this publication when used in any host. The host and components or modules used during measurements shall be listed in the test report.

The host or the type of luminaire and associated circuits shall be suitable and representative for use with the component or module as specified in the instructions for use. This shall be based on analysing various possible typical applications for the specific component or module such that the selected host is representative of typical use in terms of mitigation of disturbances from the component or module in question.

Disturbances from auxiliary equipment (including the host) itself shall be sufficiently below the applicable limit levels.

Requirements for specific types of component or modules are given in 6.4.3 through 6.4.10.

6.4.2 Modules having multiple applications

Modules whose functionality and connectivity allows them to be replaceable, internal, mounted and/or external shall be tested in each of those applicable configurations. Where it can be shown that one particular configuration provides a worst case, testing in this configuration is sufficient to show compliance.

6.4.3 Internal modules

For internal modules, the applicability of the limits is determined using the process given in 5.3. That process shall be applied to each of the interfaces of the host that may be affected by emissions (conducted or radiated) generated by the module under test. For those interfaces of the host that are not tested, the test report shall include a justification why they were deemed not to be affected by emissions generated by the module under test.

The host, that includes the module as EUT, is tested as a luminaire in accordance with Clause B.6 (Figure B.1b) and Clause C.4 (Figure C.4) or CDNE setup according CISPR 16-2-1:2014 and CISPR 16-2-1:2014/AMD1:2017. Examples of the host (reference luminaire) are given in CISPR TR 30-1:2012 and CISPR TR 30-2:2012.

NOTE The host or reference luminaire is considered as the EUT and therefore the limitation of the CDNE method to EUTs having not more than two cables (CISPR 16-2-1:2014, 9.1 c) is applicable to the host and not to the internal module.

6.4.4 External modules

For external modules the applicability of the limits is determined using the process given in 5.3 for each of the interfaces of the module.

NOTE For external modules, the host that is applied is auxiliary equipment. The disturbance is measured at the terminals of the EUT (module under test). See for instance Clause D.3 (Case 2- application 2).

External modules as EUT are measured separately to make sure that the auxiliary equipment (host) does not alter the measurement result (no mutual interaction). Details on the arrangement of external modules are given in Clause B.6 (Figure B.2) and Clause C.4 (Figure C.5) or CDNE setup according CISPR 16-2-1.

6.4.5 Single capped self-ballasted lamps

Single capped self-ballasted lamps shall comply with the disturbance voltage limits at electric power supply interface given in Table 1 with the radiated disturbance limits given in Table 8 or Table 9 if applicable, and in Table 10 and Table 14 if applicable.

The setup and test arrangements for single capped self-ballasted lamps are specified in Clause A.1.

6.4.6 Double-capped self-ballasted lamps, double-capped lamp adapters, double-capped semi-luminaires and double-capped retrofit lamps used in fluorescent lamp luminaires

Double-capped self-ballasted lamps, double-capped lamp adapters, double-capped semi-luminaires and double-capped retrofit lamps used in fluorescent lamp luminaires shall comply with the electric power supply interface voltage limits given in Table 1 and with the radiated disturbance limits given in Table 8 or Table 9 if applicable, and in Table 10 and Table 14 if applicable.

The test methods are specified in Clause A.4.

6.4.7 ELV lamps

ELV lamps shall comply with one of the following requirements:

a) Non-restricted (see 3.3.20) extra-low voltage (ELV) lamps, intended for connection to symmetrical ELV networks, shall comply with the conducted disturbance voltages of local wired ports of Table 4 at the ELV interface, measured in accordance with the method specified A.5.1, and with the radiated disturbance limits of Table 8 or Table 9 if applicable, and in Table 10 and Table 14 if applicable, measured in accordance with the method specified in A.5.2.

   NOTE 1 The insertion loss of the applied controlgear is typically 26 dB based on measurements on real configurations.

   NOTE 2 Special care is taken that no overloading of the receiver occurs.

   NOTE 3 The 26 dB addition is not applied to the assessment of radiated disturbances.

b) Restricted ELV lamps (see 3.3.20) shall comply with the mains disturbance voltage limits of Table 1, measured in accordance with the method specified A.5.1, and with the radiated disturbance limits of Table 8 or Table 9 if applicable, and in Table 10 and Table 14 if applicable, measured in accordance with the method specified in A.5.2.

NOTE 4 ELV lamps with active electronic circuit are not intended for the connection to unsymmetrical ELV networks.

6.4.8 Single-capped semi-luminaires

Single-capped semi-luminaires shall comply with the requirements given in Clause 5, with a typical lamp satisfying the load requirements as specified in 7.4.

Single-capped semi-luminaires shall be arranged, setup and measured as a self-ballasted lamp. The test methods are specified in Clause A.1.

6.4.9 Independent igniters

Independent igniters for fluorescent and other discharge lamps shall comply with the mains disturbance voltage limits of Table 1, and they are tested in a circuit as described in Clause A.6.

6.4.10 Replaceable starters for fluorescent lamps

If the replaceable starter contains active switching electronic components, it shall comply with the mains disturbance voltage limits of Table 1, while it is applied and tested in a relevant host, i.e. a single lamp luminaire equipped with a lamp of the highest power rating for which the starter is designed. The instructions for use shall specify the type of luminaire and associated circuit(s), which are suitable for use with the starter. The host that includes the replaceable starter as EUT is tested as a luminaire in accordance with Clause B.5.

If replaceable starters incorporate a capacitor having a value between 0,005 µF and 0,02 µF and which is connected parallel to the contact pins of the starter it is deemed to comply with the requirements of this document without testing.

7 Operating and test conditions of the EUT

7.1 General

When measurements of disturbances of the EUT are being made, the equipment shall be operated under the conditions specified in 7.2 to 7.9.

The EUT is to be tested under normal operating conditions, for example, as given in IEC 60598-1 for luminaires.

The possible special conditions given in Clause 8 and Clause 9 for the different methods of measurement shall be applied additionally, as appropriate.

7.2 Switching

The disturbance caused by manual or automatic operation of a switch (external or included in equipment) to connect or disconnect the mains shall be disregarded. This includes manual on/off switches or, for example, switches activated by sensors or ripple control receivers. However, switches which might be operated more often than once in a 10 seconds period (e.g. such as those of advertising signs) are not included in this exemption (see 7.5).

7.3 Supply voltage and frequency

During the tests, the EUT shall be operated at the rated voltage specified for the equipment. The supply voltage shall be within ±2 % of the selected nominal test voltage.

For single-phase equipment with a rated voltage range of:

– 100 V to 127 V, testing shall be carried out at one nominal voltage within this range; the recommended test voltage is 120 V;
– 200 V to 240 V, testing shall be carried out at one nominal voltage within this range; the recommended test voltage is 230 V;
– 100 V to 240 V, testing shall be carried out at one nominal voltage within the range 100 V to 127 V (recommended value is 120 V), and at one nominal voltage within the range 200 V to 240 V (recommended value is 230 V). However, if the lighting equipment is intended for a specific region, it may be tested only at the corresponding nominal voltage in the applicable voltage range for that region. This decision shall be recorded in the test report.

Multi-phase equipment shall be tested applying the same principles set-out above.

For three-phase equipment with a rated voltage range of:

– 200 V to 240 V, testing shall be carried out at one nominal voltage within this range; the recommended test voltage is 220 V;

– 380 V to 450 V, testing shall be carried out at one nominal voltage within this range; the recommended test voltage is 400 V.

EUTs that can be operated from either an AC or DC supply shall be measured in both conditions.

If the rated frequency range includes 50 Hz and 60 Hz, a measurement at either 50 Hz or at 60 Hz shall be performed. The emissions at the other mains frequency are then covered by this measurement.

7.4 Rated lamp load and light regulation

If the EUT has a range of lamp loads it shall be measured with the maximum rated lamp load only.

If the EUT has the possibility to reduce the output power (dimming), the electromagnetic disturbance of the EUT shall be measured at the maximum and minimum light output.

Phase-cut dimmers are operated in the worst case setting as determined during a pre-test.

7.5 Operating modes

If the EUT is capable of being used in different operating modes – e.g. flashing, running illumination, communication by light modulation, colour shifting, emergency, charging, etc. – then measurements shall be performed in the worst-case mode of operation, i.e. the mode of operation with the highest emission relative to the limit.

NOTE 1 Multiple charge regimes can be used by some battery technologies during charging, i.e. fast, trickle, stand by, PWM, etc., for applications in torches, emergency lighting, etc.

The worst case shall be found either by pre-scanning every mode of operation over at least one repetition interval of the specific mode, or by using the setting(s) that are expected to produce the highest amplitude emissions relative to the limit.

NOTE 2 Maximum electromagnetic disturbances can often be captured by operating all channels of an LED driver that are needed to create different colours and/or correlated-colour-temperatures (CCT). The number of channels applied depends on the LED-driver/LED-light-source architecture.

NOTE 3 Maximum electromagnetic disturbances can often be captured by selecting a white colour and/or a CCT setting in the middle of the specified CCT range.

EXAMPLE Colour variation and CCT variation can be achieved using a five-channel LED driver powering three LED strings for colour (RGB) setting and two cool white and warm white LED strings for CCT setting. Hence, in case the lighting equipment under test is capable of operating at different colours and/or CCTs, a white colour and/or a single CCT in the middle of the specified CCT range can be selected.

The reasons for the selection shall be given in the test report.

7.6 Ambient conditions

Measurements shall be carried out in normal laboratory conditions. The ambient temperature shall be within the range from 15 °C to 30 °C or within the range specified by the instructions for use if more restricted.

7.7 Lamps

7.7.1 Type of lamps used in lighting equipment

Disturbance measurements of lighting equipment shall be carried out with the lamp for which the lighting equipment is designed.

When the lighting equipment incorporates more than one lamp, all lamps shall be operated simultaneously.

7.7.2 Ageing times

The light source(s) or lamp(s) that is/are part of the EUT shall be stable units. Some light source technologies need a minimum time of ageing to reach a state where its performance characteristics are stable for the purpose of this test.

Unless otherwise stated in this document or specified in the instructions for use, the following ageing times shall be applied:

– 2 h for incandescent technologies;
– 100 h for discharge technologies.

For LED and OLED technologies no ageing time is required from an EMC-testing point of view.

7.8 Stabilization times

Prior to a measurement, the EUT including the light source(s) or lamp(s) that is (are) part of the EUT shall be operated until stabilization has been reached. Unless otherwise stated in this document or specified in the instructions for use, the following stabilization time shall be applied:

– 30 min for EUTs that include gas discharge technologies.
– 1 min for EUTs that do not include gas discharge technologies.

7.9 Operation and loading of wired interfaces

7.9.1 General

Interfaces or connections that are designated as wired ports shall be operated with typical wiring and loads or terminations in accordance with the manufacturer's specification. Any transmission protocol required shall be typical for normal use and as specified in the instructions for use.

7.9.2 Interface intended for a continuous signal or data transmission

If the interface is intended for a continuous signal transmission (e.g. PWM), the signal transmission shall be in operation during the measurement of all ports of the EUT. A continuous signal or data transmission may be required to maintain the status (e.g. dimming level) of the EUT or of the equipment connected to the EUT.

7.9.3 Interface not intended for a continuous signal or data transmission

If the transmission is not continuous or a continuous data transmission is not necessary to maintain the status of the EUT (e.g. dimming command sent via a DALI protocol), continuous transmission during the tests shall not be applied.

7.9.4 Load

The load of an EUT shall be applied as follows:

– load interfaces which are suitable for both incandescent lamps and other types of lighting equipment (e.g. self-ballasted lamps) shall be tested with non-inductive resistive loads;

  NOTE Incandescent lamps are also considered as non-inductive resistive loads.

– load interfaces which are suitable only for lighting equipment other than incandescent lamps, shall be tested with the appropriate lighting equipment as specified in the instructions for use.

The load level requirements are given in 7.4.

8 Methods of measurement of conducted disturbances

8.1 General

This clause specifies the measurement methods, EUT arrangements and procedures associated with the conducted disturbance measurements and include specific requirements that take precedence over those provided in the basic standards. Details on specific EUT-arrangements for conducted disturbance measurements are given in Annex B.

8.2 Measurement instrumentation and methods

Conducted disturbances at the different ports shall be measured by applying instrumentation, test sites, procedures and method as indicated in the references of Table 11.

Table 11 – Overview of standardized conducted disturbance measurement methods

Interface	Limits	Frequency range	Reference
Electric power supply interface	Table 1	9 kHz to 30 MHz	CISPR 16-1-1:2019 (receiver) CISPR 16-1-2:2014 and CISPR 16-1-2:2014/AMD1:2017 (AMN) CISPR 16-2-1:2014 and CISPR 16-2-1:2014/AMD1:2017 (measurement method)
Wired network interfaces other than power supply interface (e.g. for communication or data transfer) [a]	Table 2	150 kHz to 30 MHz	CISPR 16-1-1:2019 (receiver) CISPR 16-1-2:2014 and CISPR 16-1-2:2014/AMD1:2017 (AAN, artificial network, CVP) CISPR 16-2-1:2014 and CISPR 16-2-1:2014/AMD1:2017 and 8.4 (measurement method)
	Table 3	150 kHz to 30 MHz	CISPR 16-1-1:2019 (receiver) CISPR 16-1-2:2014 and CISPR 16-1-2:2014/AMD1:2017 (current probe) CISPR 16-2-1:2014 and CISPR 16-2-1:2014/AMD1:2017 and 8.4 (measurement method)
Local wired port – electrical power supply interface of ELV lamps	Table 1 or Table 4	9 kHz to 30 MHz	CISPR 16-1-1:2019 (receiver) CISPR 16-1-2:2014 and CISPR 16-1-2:2014/AMD1:2017 (AMN) CISPR 16-2-1:2014 and CISPR 16-2-1:2014/AMD1:2017 and A.5.1 (measurement method)
Local wired port – other than the electrical power supply interface of ELV lamps	Table 6	150 kHz to 30 MHz	CISPR 16-1-1:2019 (receiver) CISPR 16-1-2:2014 and CISPR 16-1-2:2014/AMD1:2017 (current probe) CISPR 16-2-1:2014 and CISPR 16-2-1:2014/AMD1:2017 and 8.5.2.3 (measurement method)

[a] Depending on the EUT port under test and on the selected test method, the applicable limit will be Table 2 or Table 3 or both.

In addition to the requirements given in the basic standards, the following requirements for the EUT arrangement and measurement procedure apply.

8.3 Electrical power supply interface disturbance measurement

The disturbance voltage measurement shall be performed as per the method of CISPR 16-2-1 at the electrical power supply interface of the EUT by means of the circuits and arrangement described in Annex B for the relevant type of equipment. An artificial mains V-network 50 Ω / 50 µH + 5 Ω that satisfies the requirements of CISPR 16-1-2 in both the 9 kHz to 150 kHz and 150 kHz to 30 MHz frequency ranges shall be used.

8.4 Disturbance measurement of wired network interfaces other than power supply

Conducted disturbance measurement from wired network interfaces other than power supply (e.g. for communication or data transfer) shall be measured using the applicable procedure as described in CISPR 16-2-1:2014 and CISPR 16-2-1:2014/AMD1:2017, depending on the type of the interface under test. Annex H of CISPR 16-2-1:2014 provides a description of each measurement procedure, as well as the applicability criteria of each procedure to the specific EUT interfaces.

In case of unscreened balanced interfaces measured using an AAN, if no cable longitudinal conversion loss (LCL) is specified in the instructions of use of the EUT, the requirements for the AAN corresponding to Cat. 3 LCL shall be applied.

Depending on the measurement procedure selected, the limits in Table 2, Table 3, or both Table 2 and Table 3 apply (see Annex H of CISPR 16-2-1:2014).

The AAN, artificial network, current probe, and CVP shall comply with the applicable requirements in CISPR 16-1-2:2014 and CISPR 16-1-2:2014/AMD1:2017. The AAN, artificial network and CVP, if used, shall be bonded to the reference ground plane (see Annex B).

8.5 Local wired port disturbance measurement

8.5.1 Electrical power supply of ELV lamps

The method for conducted disturbance measurements at the electrical power supply interface of ELV lamps is specified A.5.1.

8.5.2 Other than electrical power supply of ELV lamps

8.5.2.1 General

The methods for conducted disturbance measurements at local wired ports other than the ELV interface of an ELV lamp shall be as per CISPR 16-2-1 and the following subclauses.

8.5.2.3 Current probe measurement method

When a current probe is used for measuring conducted disturbances on local wired ports, the measuring circuit shown in Figure B.2 shall be applied. See also B.3.5.

The current probe shall be in accordance with 5.1 of CISPR 16-1-2:2014.

9 Methods of measurement of radiated disturbances

9.1 General

This clause provides details on the measurement methods, EUT arrangements and procedures associated with the radiated disturbance measurements and include specific requirements that take precedence over those provided in the basic standards. Details on specific EUT arrangements for radiated disturbance measurements are given in Annex C.

9.2 Intentional wireless transmitters

If intentional wireless transmitters are part of the EUT, the emission from the wireless transmitters shall not be considered as part of the radiated disturbance (see Clause 1). This can be done either by switching off the wireless function of the EUT (if possible and if it does not compromise the typical non-intentional emissions) or by ignoring the intentional radiated emission in the corresponding frequency band.

NOTE For intentional wireless transmitters, applicability of country/region specific regulations is considered.

9.3 Measurement instrumentation and methods

9.3.1 General

Radiated disturbances at the different ports shall be measured by applying instrumentation, test sites, procedures and method as indicated in the references of Table 12.

Table 12 – Overview of standardized radiated disturbance measurement methods

Method	Limits	Frequency range	Reference
LLAS	Table 8	9 kHz to 30 MHz	CISPR 16-1-1 (receiver) CISPR 16-1-4 (instrumentation: antennas and test site) CISPR 16-2-3 (measurement method)
Loop antenna	Table 9	9 kHz to 30 MHz	CISPR 16-1-1 (receiver) CISPR 16-1-4 (instrumentation: antennas and test site) 9.3.3 (measurement method)
OATS/SAC	Table 10	30 MHz to 1 GHz	CISPR 16-1-1 (receiver) CISPR 16-1-4 (instrumentation: antennas and test site) CISPR 16-2-3 (radiated measurement method)
FAR	Table 10	30 MHz to 1 GHz	CISPR 16-1-1 (receiver) CISPR 16-1-4 (instrumentation: antennas and test site) CISPR 16-2-3 (measurement method)
TEM	Table 10	30 MHz to 1 GHz	CISPR 16-1-1 (receiver) IEC 61000-4-20 (measurement method and instrumentation)
CDNE	Table 10	30 MHz to 300 MHz	CISPR 16-1-1 (receiver) CISPR 16-1-2 (instrumentation: coupling devices – CDNEs) CISPR 16-2-1 (CDNE measurement method)
FSOATS	Table 14	1 GHz to 6 GHz	CISPR 16-1-1 (receiver) CISPR 16-1-4 (instrumentation: antennas and test site) CISPR 16-2-3 (radiated measurement method)

In addition to the requirements given in the basic standards, the following requirements for the EUT arrangement and measurement procedure apply.

9.3.2 LLAS radiated disturbance measurement 9 kHz to 30 MHz

9.3.2.1 EUT setup

The magnetic component shall be measured by means of a large loop antenna system (LLAS) as described in CISPR 16-1-4. The EUT shall be placed in the centre of the LLAS as shown in

Annex C of CISPR 16-1-4:2010. The requirements for routing the cables from the EUT and for the positioning of the EUT inside the LLAS given in CISPR 16-1-4 shall be applied.

If the instructions for use allow external wired interfaces to be connected to the EUT by single-conductor cables (which can cause loops and associated magnetic dipoles; see 5.3.4.1), then the EUT shall be tested by configuring each of these external interfaces with a single-conductor wiring having a rectangular loop with an area of (1 ± 0,05) m^2. The support plate of Figure A.6 can be used to establish this 1 m^2 loop. The system under test, i.e. the EUT including its external interfaces arranged in one or more 1 m^2 loops, shall be arranged such that it fits within the smallest possible sphere while at the same time complying with the following requirements:

– distance between the EUT's enclosure and the plane of any of its interfaces arranged in 1 m^2 loops is equal to or greater than 10 cm;
– distance between the loop area of any two adjacent EUT interfaces arranged in 1 m^2 loops is equal to or greater than 10 cm.

The EUT and its interfaces arranged in 1 m^2 loops shall be placed such that this imaginary sphere is concentric with the LLAS. Example LLAS test arrangements for EUTs that include a 1 m^2 loop are given in Annex C.

9.3.2.2 Measurements in three directions

The current induced in the LLAS is measured in accordance with 7.2 of CISPR 16-2-3:2016. By means of a coaxial switch, the three field directions of the EUT can be measured in sequence. The measurement results for each direction shall comply with the limits.

9.3.3 Loop antenna radiated disturbance measurement 9 kHz to 30 MHz

The measurements shall be performed at a distance of 3 m with a small loop antenna compliant with 4.3 and 4.4 of CISPR 16-1-4:2019 and of CISPR 16-1-4:2019/AMD2:2023.

The following setup requirements and measurement method apply:

1) The measurement shall be performed on an OATS or SAC;

   NOTE Validation requirements for below 30 MHz measurements are under development by CISPR/A; see IEC PAS 62825 for some guidance.

2) The height of the centre of the small loop antenna shall be 1,3 m above the test site's ground plane;
3) The loop antenna shall be positioned in the two vertical positions with respect to the GRP, i.e. vertical coaxial and vertical coplanar;
4) The measurement distance shall be between the projections onto the ground plane of the centre of the small loop antenna and the EUT boundary;
5) The EUT shall be arranged in accordance with Clause C.4;
6) The EUT shall be rotated for each orientation of the loop antenna and the maximum value recorded for each loop antenna orientation shall comply with the limits given in Table 9.

9.3.4 Radiated disturbance measurement 30 MHz to 1 GHz

9.3.4.1 OATS or SAC method

The setup requirements and test method of CISPR 16-2-3 apply when tests are made using the radiated method on an OATS or SAR. Specifics on EUT-arrangements can be found in Annex C.

To improve the reproducibility, the mains supply cable of the EUT shall be terminated with a CDNE (as defined in CISPR 16-1-2) positioned on the reference-ground plane (if applicable) and the receiver port of the CDNE terminated with a 50 Ω impedance.

9.3.4.2 FAR method

The setup requirements and test method of CISPR 16-2-3 apply when tests are made using the radiated method in a FAR. Specifics on EUT-arrangements can be found in Annex C.

To improve the reproducibility, the mains supply cable of the EUT shall be terminated with a CDNE (as defined in CISPR 16-1-2) positioned on the reference-ground plane (if applicable) and the receiver port of the CDNE terminated with a 50 Ω impedance.

9.3.4.3 TEM method

The setup requirements and test method of IEC 61000-4-20 apply when tests are made using the radiated method in a TEM cell.

9.3.4.4 CDNE-method

The setup requirements and test method of CISPR 16-2-1 apply when tests are made using the CDNE.

9.3.5 Radiated disturbance measurement 1 GHz to 6 GHz

The setup requirements and test method of CISPR 16-2-3:2016, CISPR 16-2-3:2016/AMD1:2019 and CISPR 16-2-3:2016/AMD2:2023 apply when tests are made using the radiated method on an FSOATS. Specifics on EUT arrangements can be found in Annex C.

When using a spectrum analyser, the VBW shall be 1 MHz or higher. The recommended VBW is 3 MHz.

10 Compliance with this document

Where this document gives options for evaluating particular EMC characteristics with a choice of test methods and associated limits, any one of these options may be used.

The equipment complies with the requirements of this document with respect to the addressed EMC characteristics when one of the test methods returns a test result compliant with the applicable requirements.

NOTE In any situation involving the retesting of equipment, reproducibility of test results is best achieved if the original test method is used.

11 Measurement uncertainty

Where guidance for the calculation of the instrumentation uncertainty of a measurement is specified in CISPR 16-4-2, this shall be followed, and for these measurements the determination of compliance with the limits in this document shall take into consideration the measurement instrumentation uncertainty in accordance with CISPR 16-4-2. Calculations to determine the measurement result and any adjustment of the test result required when the test laboratory uncertainty is larger than the value for U_{CISPR} given in CISPR 16-4-2 shall be included in the test report.

12 Test report

General requirements of 5.10 of ISO/IEC 17025:2005 for compiling a test report apply. Sufficient details shall be provided to facilitate reproducibility of the measurements. This shall include photographs of the EUT and the measurement configuration where this is appropriate.

The test report shall include the following information:

– dimensions of the EUT;
– the below 30 MHz radiated-field disturbance method used and the associated limits that have been applied (4.5.2);
– the above 30 MHz radiated-field disturbance method used and the associated limits that have been applied (4.5.3);
– when using the CDNE method to show compliance to 1 GHz, a statement that the clock frequency is below 30 MHz;
– the wired interfaces that have been assessed together with the assigned port, the method used and associated limits (5.3);
– in case of module measurements, description and arrangement of the host and modules used during measurements (6.4);
– the adjustment of the test result required when the test laboratory uncertainty is larger than the value for U_{CISPR} given in CISPR 16-4-2;
– deviations from cable length requirements, in case of conflicting lengths of cables with other requirements on cable lengths or dimensions in the test setup (B.2.1);
– tested operating mode(s) of the EUT and reason for selection;
– controller settings, in case the EUT is capable of operating at different manually adjustable settings for light colour and/or intensity;
– selected repetition frequency during testing, in case the EUT is capable of operating with automatic change of light colour and/or light intensity.

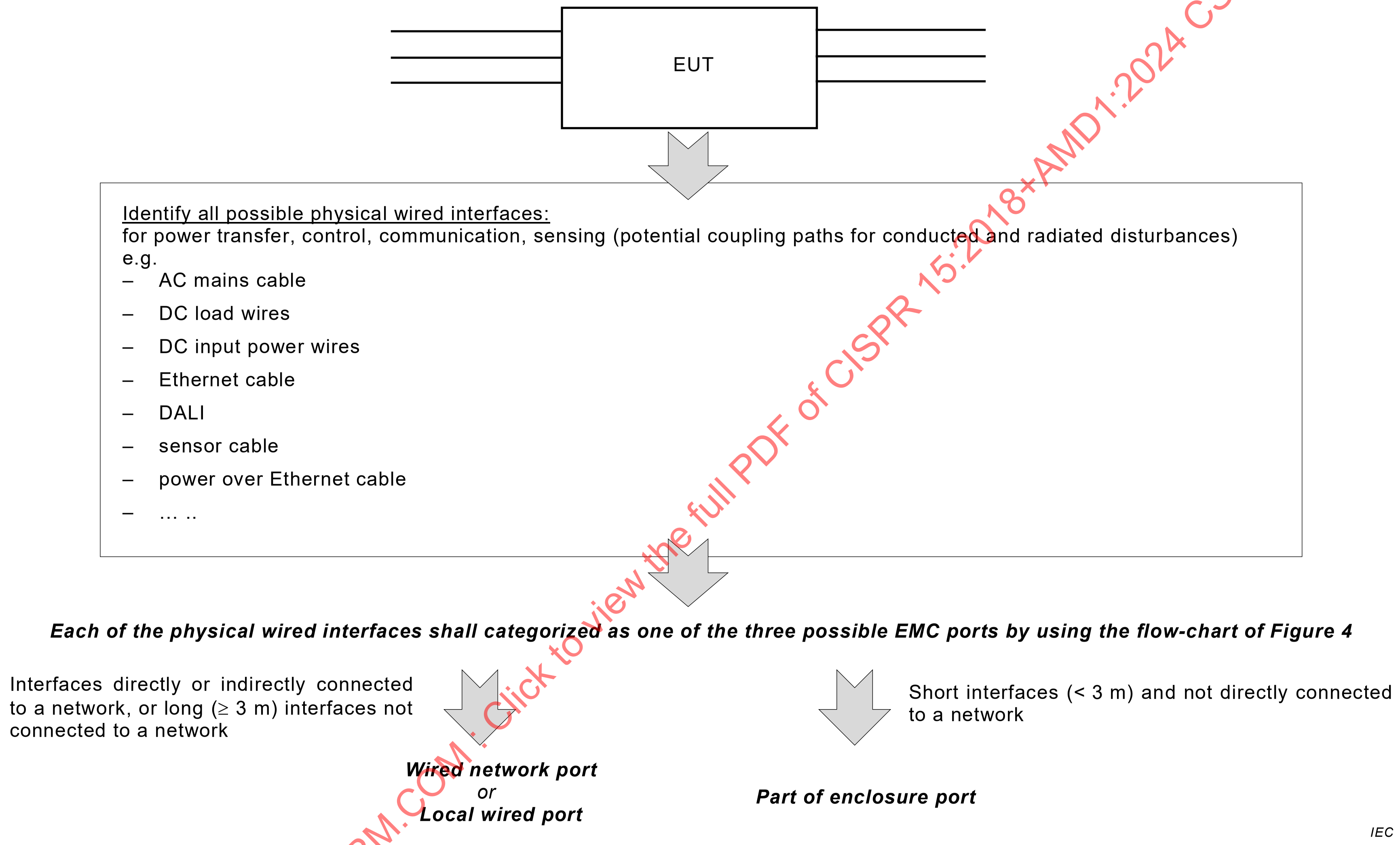


Figure 3 – EUT and its physical interfaces

NOTE 1 Apply limits and associated measurement methods given in Clause 4

NOTE 2 If wired interfaces of the same kind are present, the applicability of the test and arrangement for each of these similar interfaces is explained in 5.3.5

NOTE 3 Wired network port means electric power supply, communication or data transfer interfaces (see 3.4.14)

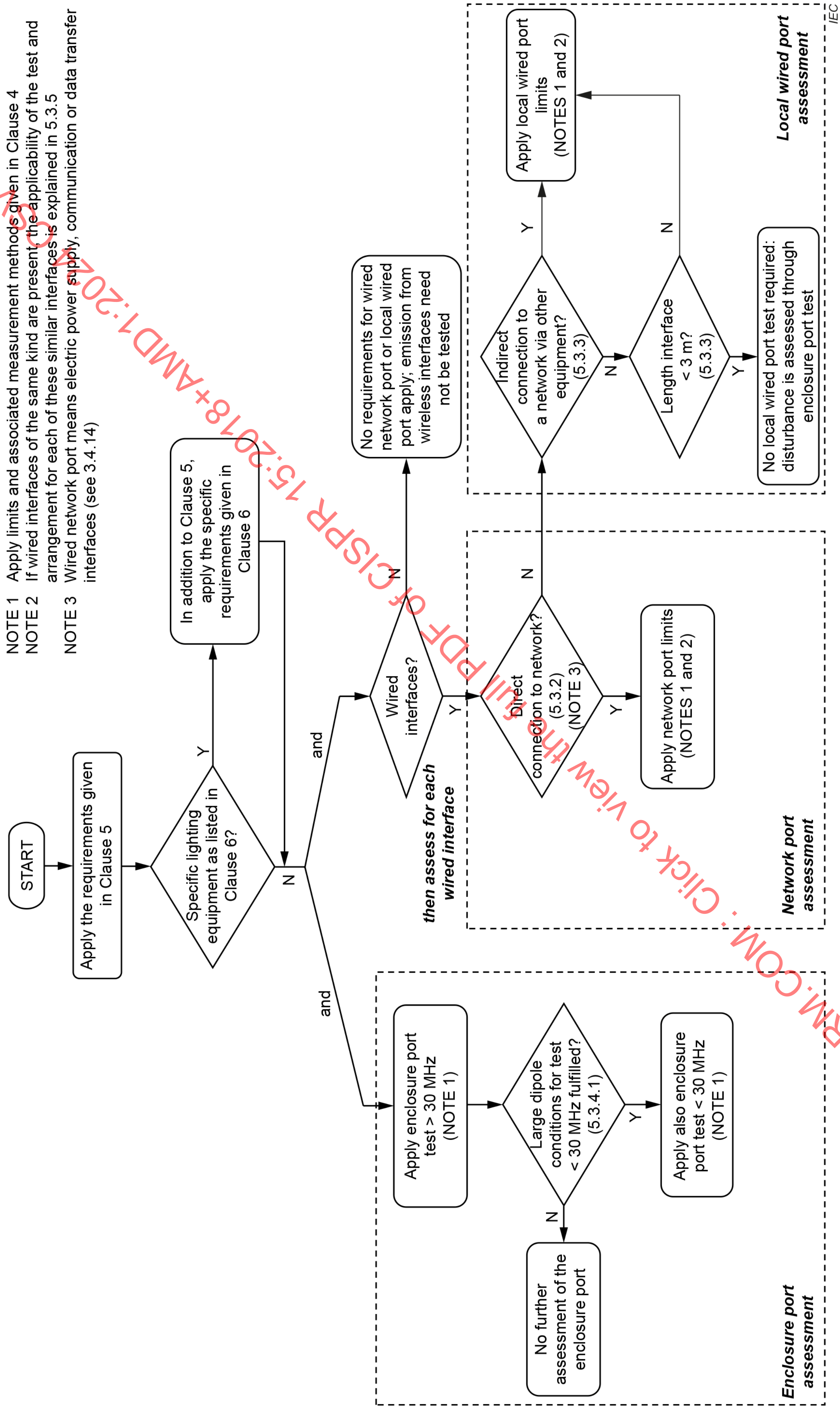


Figure 4 – Decision process on the application of limits to the EUT