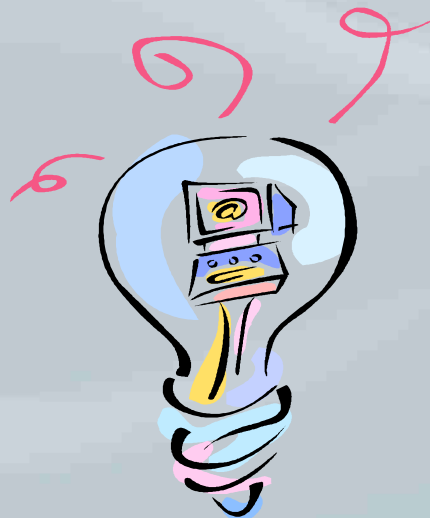


EMC – CISPR15

Methods of measurement of radio disturbance
characteristics of electrical lighting and similar equipment

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CISPR 15 – Overview

► I The standard

- I Scope
- I Normative references
- I What to measure
- I Application of limits
- I Operating conditions
- I LED Luminaires

I Methods of measurement

- I Insertion Loss
- I Disturbance Voltages
- I Radio Electromagnetic Disturbance
- I New: CDN-E Method



CISPR 15 – Scope and current status

→ This standard applies to the emission (radiated and conducted) of radiofrequency disturbances from:

- all lighting equipment with a primary function of generating and/or distributing light intended for illumination purposes, and intended either for connection to the low voltage electricity supply or for battery operation;
- the lighting part of multi-function equipment where one of the primary functions of this is illumination;
- independent auxiliaries exclusively for use with lighting equipment;
- UV and IR radiation equipment;
- neon advertising signs;
- street/flood lighting intended for outdoor use;
- transport lighting (installed in buses and trains).

→ Excluded from the scope of this standard are:

- lighting equipment operating in the ISM frequency bands (as defined in Resolution 63 (1979) of the ITU Radio Regulation);
- lighting equipment for aircraft and airports;
- apparatus for which the electromagnetic compatibility requirements in the radio-frequency range are explicitly formulated in other IEC or CISPR standards.

NOTE Examples are:

- built-in lighting devices in other equipment, for example scale illumination or neon devices;
- photocopiers;
- slide projectors;
- lighting equipment for road vehicles.



CISPR 15 – Normative references

CISPR15 IEC:2005+A1:2006 – RF

- I IEC 60050 : 1990
- I IEC 60155 : 1993
- I IEC 60598-1 : 2003
- I IEC 61000-4-6 : 2003
- I CISPR 11 : 2003
- I CISPR 16 : 2003
- I CISPR 22 : 2005

IEC 60050(161):1990, *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electromagnetic compatibility*

IEC 60155:1993, *Glow-starters for fluorescent lamps*

IEC 60598-1:2003, *Luminaires – Part 1: General requirements and tests*

IEC 61000-4-6:2003, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

CISPR 11:2003, *Industrial, scientific and medical (ISM) radio-frequency equipment – Electromagnetic disturbance characteristics – Limits and methods of measurement*

CISPR 16-1-1:2003, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus*

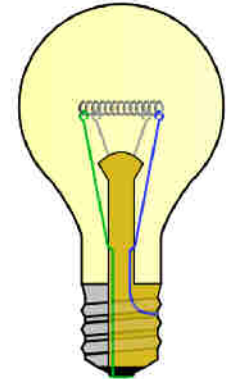
CISPR 16-1-2:2003, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-2: Radio disturbance and immunity measuring apparatus – Ancillary equipment – Conducted disturbances*

CISPR 16-1-4:2003, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-4: Radio disturbance and immunity measuring apparatus – Ancillary equipment – Radiated disturbances*

CISPR 16-2-1:2003, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-1: Methods of measurement of disturbances and immunity – Conducted disturbance measurements*

CISPR 22:2005, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement*

CISPR 15 – What to measure ?



I Insertion Loss

- I 150 kHz – 1605 kHz (dB)

I Disturbance Voltage

- I 9 kHz – 30 MHz (dB μ V)
- I QP and AVG detector
- I Mains, Load & Control terminals

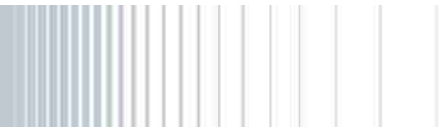
I Radiated EM disturbance

- I Magnetic field : 9 kHz – 30 MHz (dB μ A) - Limit line acc. loop diameter
- I Electric Field: 30 MHz – 300 MHz (dB μ V/m) – acc. CISPR 22 @ 10m
- I QP detector
- I Alternative method : CDN METHOD



CISPR 15 – Application of limits

- Indoor luminaires
- Independent auxiliaries exclusively for use with lighting equipment
- Self-ballasted lamps
- Outdoor lighting appliances
- UV and IR radiation appliances
- Transport lighting
- Neon and other advertising signs
- Self-contained emergency lighting luminaires
- Replaceable starters for fluorescent lamps



CISPR 15 – Operating conditions



I Lighting equipment

- I Normal operating conditions as given in IEC 60598 for luminaires

I Supply voltage and frequency

- I +/- 2% of the rated voltage & at nominal frequency of the mains supply

I Ambient conditions

- I Within 15 & 25 Degr.

I Lamps

- I Type (highest wattage rating allowed)
- I Ageing time (at least 2h up to 100h depending on lamp type)
- I Stabilisation time (5 / 15 / 30 min depending on lamp type)

I Replaceable starters

- I If necessary (IEC60155) replace by standardized capacitor



CISPR 15 – Evolution in Luminaires

The difference with Edison and others



Edison



110/230VAC

Nearly Disturbance

Easy Control

Halogen



12VDC/230VAC

Transformers

Easy control

Drive Circuit

Fluorescent



8..230VAC/DC

Transformers

E-Ballasts

Drive Circuits

LED



Any Voltage – Endless possibilities

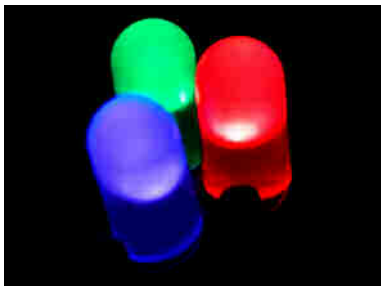
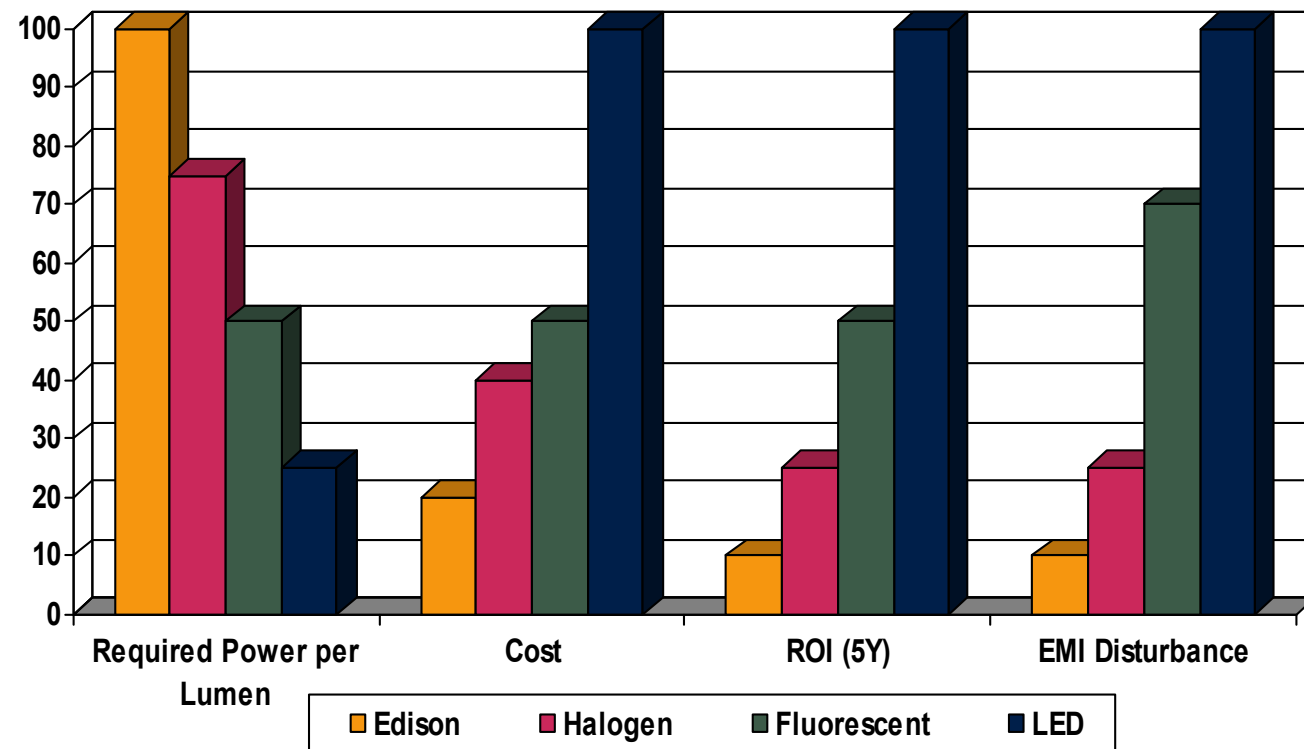
Transformers / LED Invertor

Complex Drivers

High frequencies

CISPR 15 – LED Luminaires

The difference with Edison and others



CISPR 15 – LED Luminaires

The approach by...

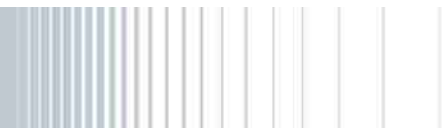


EMC
Standards

Manufacturers

EMC
Labs

Working
groups



CISPR 15 – LED Luminaires

The approach by...



I E.g. TUV Rheinland...

In regard to EMC testing for LED products for lighting purposes, at this moment, there are no specific EMC standards available, TUV Rheinland Taiwan will use the EN 60115 and EN 61547 standards for testing such products.

LED luminaires, like all electrical products, must fulfill the requirements of EMC Directive 2004/108/EC. The primary circuits of electronic converters for LED lighting sources are very similar to switching-mode power adapters, the same EMC considerations should be observed when the product is in the design phase. In addition, regarding the EN 61010-1-2 standard, which limits the harmonic content of input current, special consideration must be paid to the requirement that lighting equipment has to be classified as Class C, since the limits for Class C are quite strict.

A test report issued by TUV Rheinland confirms for the buyer in Europe that the product in question fulfills the requirements of the EMC Directive and that the prerequisites for EMC rules regarding CE-Mark affixation are fulfilled.

CISPR 15 – LED Luminaires

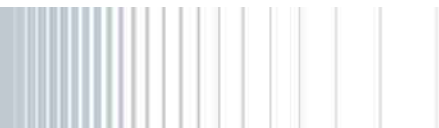
The approach by...



Joint CELMA / ELC Guide on LED related standards

2nd Edition, April 2010

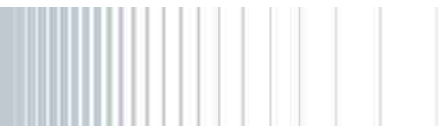
www.celma.org – www.elcfed.org



CISPR 15 – LED Luminaires

TABLE 1 list of standards related to LED products

IEC/EN 60598	Luminaire requirements
IEC/EN 62031	LED Modules for General Lighting – Safety Specifications
IEC XXXXX	LED Module for General Lighting - Performance
Pr. IEC 62560	Lamps - Self-ballasted LED-lamps for general lighting services by voltage > 50 V - Safety specifications 34A/1354/CDV
Pr. IEC 62612	Lamps – Self-ballasted LED-lamps for general lighting services >50 V - Performance requirements 34A/1343/CD
IEC/TR 61341 ed. 2	Method of measurement of centre beam intensity and beam angle(s) of reflector lamps
IEC 61231	International lamp coding system (ILCOS)
Pr. IEC 62504	LED Terms & Definitions - 34A/1355/DTS
IEC/EN 60061	Lamp Caps and holders
IEC/EN 60838-2-2	Connectors for LED-modules
IEC/EN 61347-1	Lamp control gear - Part 1: General and safety requirements
IEC/EN 61347-2-13	Lamp control gear - Part 2-13: Particular requirements for d.c. or a.c. supplied electronic controlgear for LED modules
IEC/EN 62384 + A1	DC or AC supplied electronic control gear for LED modules - Performance requirements
IEC 62386-207	Digital addressable lighting interface - Part 207: Particular requirements for control gears; led modules (device type 6)
IEC/EN 60825-1	Safety of laser products (see Annex A)
IEC/EN 61000-3-2:	EMC - Limits for harmonic current emissions
IEC/EN 61000-3-3:	EMC - Limitation of voltage changes, voltage fluctuations and flicker
IEC/EN 61547:	EMC - Immunity requirements
EN 55015:	EMC - Radio disturbance characteristics
EN 62471: 2008 (IEC 62471:2006 modified) (CIE S 009:2002)	Photobiological safety of lamps and lamp systems (see Annex A to the Guide)
IEC TR 62471-2	Photobiological safety of lamps and lamp systems - Part 2: guidance on manufacturing requirements relating to non-laser optical radiation safety (see Annex A to the Guide)



CISPR 15 – LED Luminaires

The approach by...

Some LED manufacturer's declarations of conformity...



Manufacturer A:

Labelling Information and Conformity to Standards

The products comply with the constructional standards: BS EN 60598 Part 1 + A1, BS EN 62031, BS EN 60598-2-1, BS EN 55015 + A1, BS EN 61457 + A1, BS EN 60825-1 + A1 + A2

Model: CHR-120-CW Made in UK

Input: 110 to 230 Vac 50 Hz

25 Watts



Manufacturer B:

ELECTROMAGNETIC COMPATIBILITY

VLM DC transformers and LED modules fulfil the limits prescriptions of the european directive EMC89/336/CEE. The immunity and radio interferences standards involved are: EN 50082-1, EN 61457, EN 61000-3-2, EN 55015.



CISPR 15 – Overview

I The standard

- I Scope
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- I What to measure
- I Application of limits
- I Operating conditions
- I LED Luminaires

► I Methods of measurement

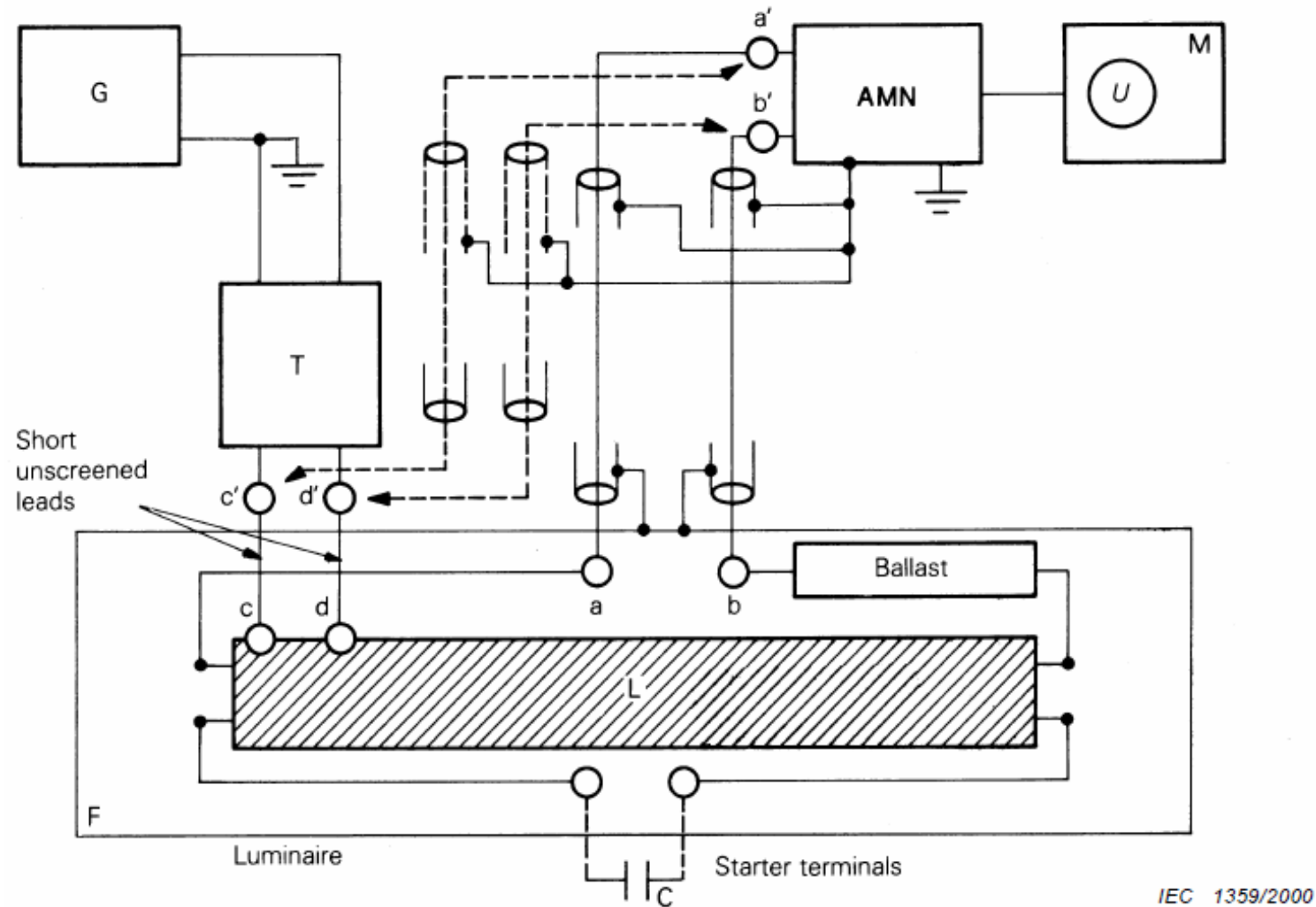
- I Insertion Loss
- I Disturbance Voltages
- I Radio Electromagnetic Disturbance
- I New: CDN-E Method



ROHDE & SCHWARZ

CISPR 15 – Insertion loss measurement

Test setup (example)



CISPR 15 – Insertion loss measurement

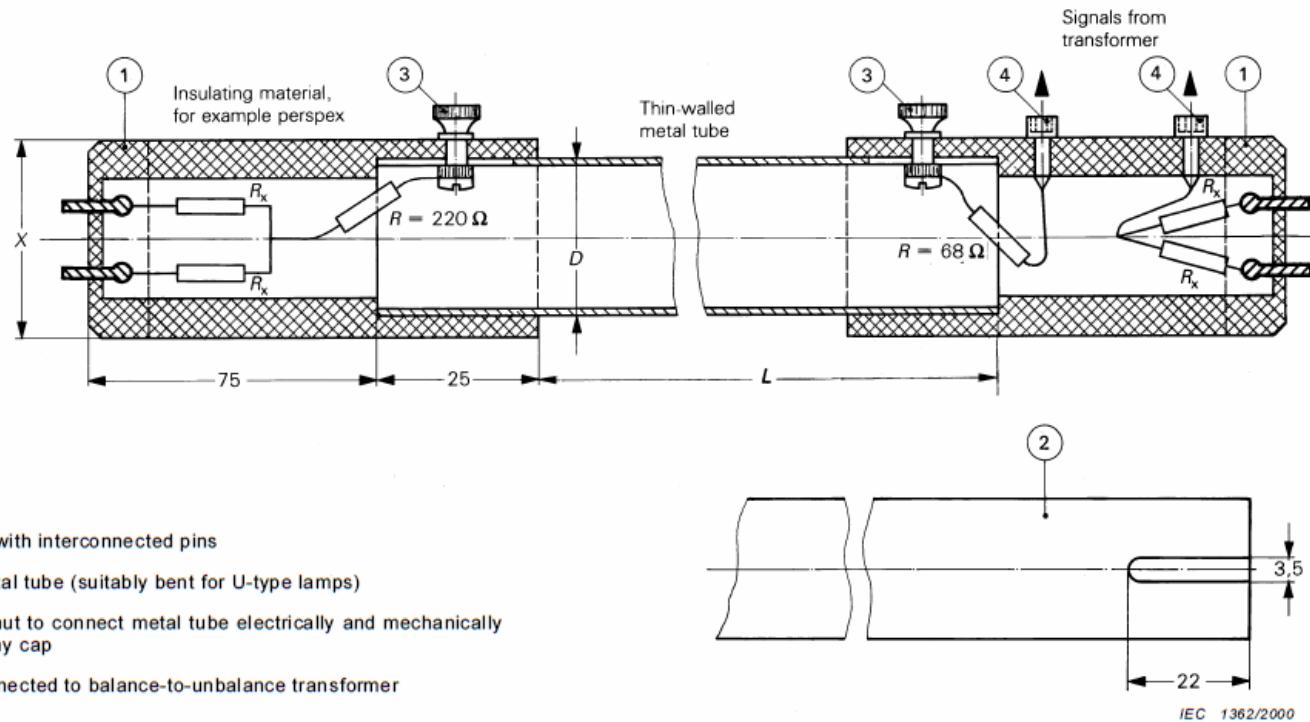
Test setup (example)

- The insertion loss is the ratio between 2 voltages $20 \times \log(U1/U2)$
- U1: connect the output terminals of the transformer to the AMN
- U2: insert the dummy lamp between the transformer and measure at the AMN
- Need for
 - RF signal generator
 - BALUN (balance-to-unbalance convertor)
 - EMI receiver, or RF Millivoltmeter
 - AMN (LISN) (CISPR-16)
 - Dummy lamp(s)
 - Some wiring
- Limits acc. Table 1 : 150 kHz – 1605 kHz



CISPR 15 – Insertion loss measurement

Example of a Dummy Lamp



Length of real fluorescent lamp minus 0,15 m	L	
Nominal diameter of fluorescent lamp (mm)	25	38
Diameter D of metal tube (mm)	$20 \pm 0,5$	$28 \pm 0,5$
Diameter X of normal cap (mm)	4	35

NOTE Tolerances in dimensions: ± 1 in the last decimal, tolerances in resistances: $\pm 5 \%$, unless otherwise specified.

The value of resistance R_x is $4,8 \Omega$.

Figure 4a – Configuration of linear and U-type dummy lamps

CISPR 15 – Method of disturbance voltages

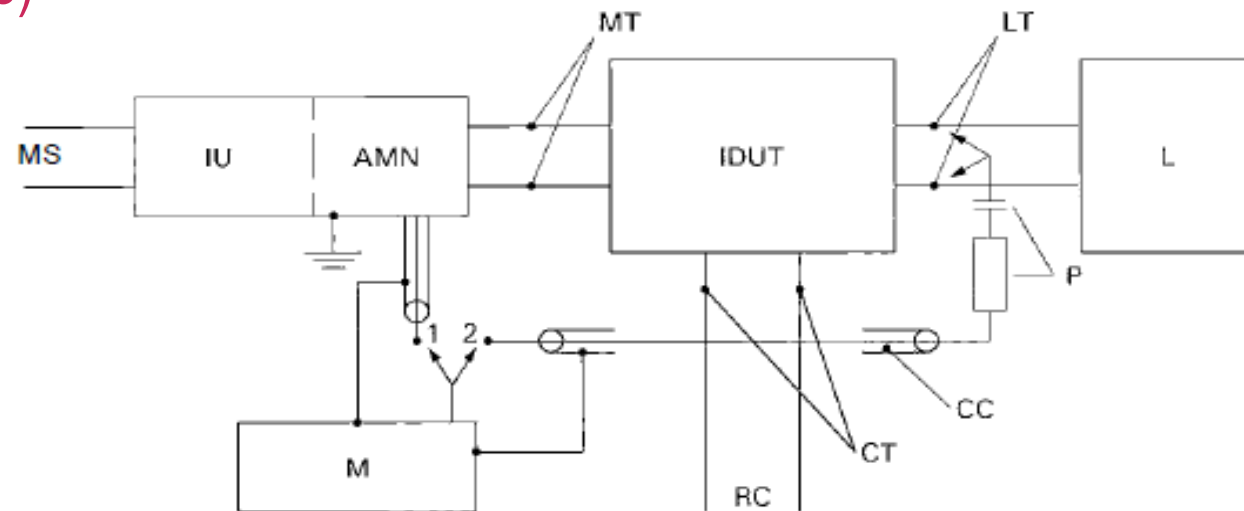
What is disturbance voltage ?

- I **Typical conducted EMI measurement using an EMI Receiver with QP and AVG detector**
- I **Mains**
 - I Via AMN (LISN) directly on the terminals
 - I Limits acc. Table 2a (9 kHz – 30 MHz)
- I **Load terminal**
 - I Via a proper 1500 Ohms RF Voltage probe
 - I Limits acc. Table 2b (150 kHz – 30 MHz)
- I **Control terminal**
 - I Via ISN's acc CISPR 22
 - I Limits acc. Table 2c (150 kHz – 30 MHz)



CISPR 15 – Method of disturbance voltages

Test setup (example)



- MS = Mains supply
- IU = Isolating unit
- AMN = $50 \Omega/50 \mu\text{H} + 5 \Omega$ (or $50 \Omega/50 \mu\text{H}$) artificial mains V-network as specified in CISPR 16-1-2
- MT = Mains terminals
- IDUT = Independent device under test
- LT = Load terminals
- L = Load
- P = Probe ($R \geq 1500 \Omega$ and $C \geq 0,005 \mu\text{F}$)
- CC = Coaxial cable
- CT = Control terminals
- M = CISPR measuring receiver
- RC = Remote control (if any)

Switch positions and probe connections:
 1 For mains measurements
 2 For load measurements

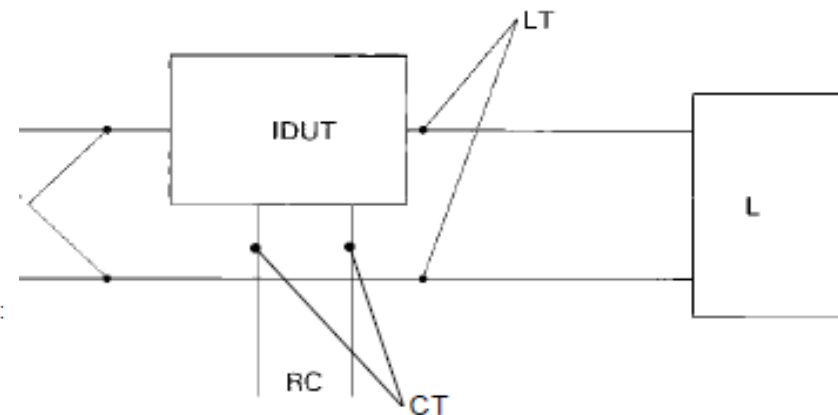


Figure 5 – Measuring arrangements for an independent light regulating device, transformer or convertor

IEC 1706/01



CISPR 15 – Method of radio EM disturbances

I MAGNETIC Field measurement using an EMI receiver

- I Triple loop antenna with appropriate diameter (2/3/4m)
- I Measurement in 3 directions (X-Y-Z)
- I Setup acc. CISPR 16-1-4



CISPR 15 – Method of radio EM disturbances

I **ELECTRIC Field measurement using an EMI receiver**

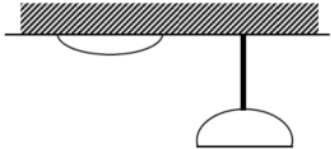
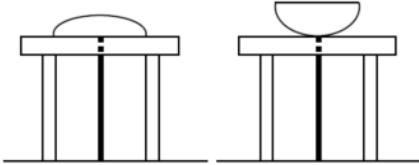
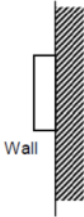
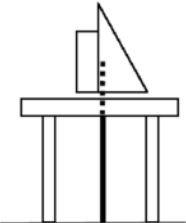
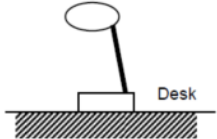
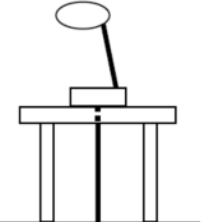
- I By the amendment 1 to Ed.7 of CISPR 15, radiated disturbance measurements in the frequency range from 30 – 300 MHz become applicable

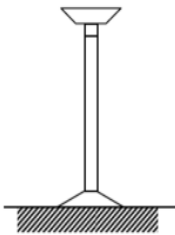
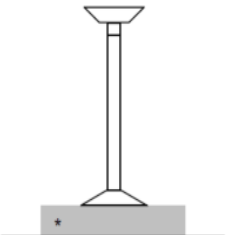
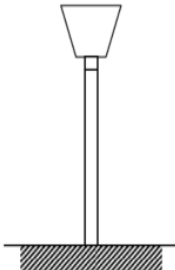
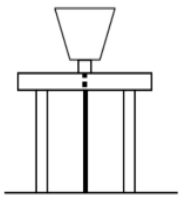
- I The measurement shall be performed
 - At a distance of 10m in an OATS or Semi Anechoic Chamber
 - In accordance with CISPR 22 (clause 10)
 - Examples of test arrangement are given in annex C



CISPR 15 – Method of radio EM disturbances

Annex C

Typical luminaires	Arrangement during CISPR 22 measurement
Ceiling mounted/ Pendant luminaires 	
Wall mounted luminaire 	
Desk mounted luminaire 	

Floor standing luminaire 	
	* Insulating support 0,1 m ± 25 % high
Pole mounted luminaire 	

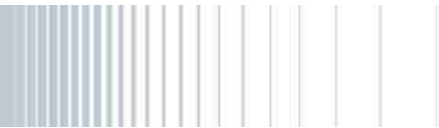


CISPR 15 – Method of radio EM disturbances

CDN Method (Annex B)

I **ELECTRIC field measurement – Alternative method with CDN**

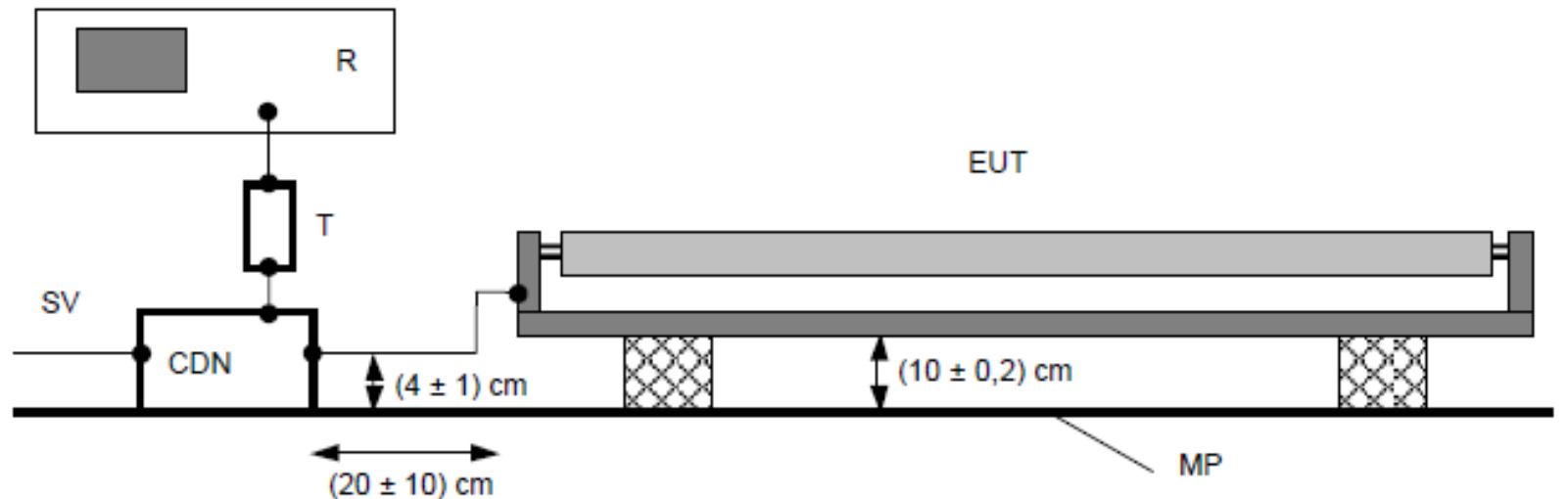
- I Common mode voltage measurement
- I Need for CDN acc. EN61000-4-6
- I Voltage at the RF output of each CDN is measured with EMI Receiver and
 - 120 kHz BW & QP detector
 - Take into account the CDN voltage division factor
 - Take into account the 6dB attenuator
- I Unfortunately the typical CDN's acc. EN61000-4-6 was not really accepted by a joint task force of CISPR/A and CISPR/F with respect to measurement method and validation procedures.
- I **But ! Nowadays alternative CDNE's are available up to 300 MHz, with additional parameter specification**
 - for phase of the common mode impedance of 150 Ohms
 - for phase and magnitude of the differential mode impedance of 100 Ohms



CISPR 15 – Method of radio EM disturbances

CDN Method (Annex B)

I ELECTRIC field measurement – Alternative method with CDN



Components

R Measuring receiver
SV Supply voltage
MP Earthed metal plate

CDN Coupling-decoupling network
EUT Equipment under test
T 6 dB, 50 Ω attenuator

Figure B.1 – Test set-up for CDN method

CISPR 15 – Method of radio EM disturbances

CDN Method (Annex B)

I Measurement of Voltage Division Factor when using CDN-'E'

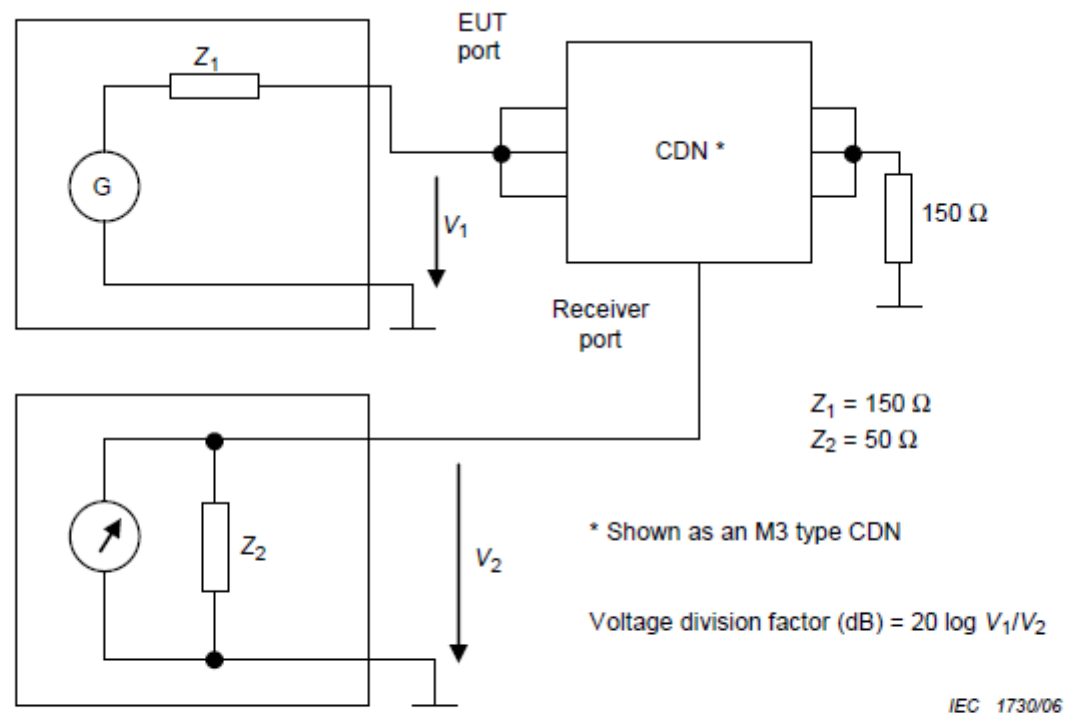


Figure B.2 – Calibration set-up for determining CDN voltage division factor

NOTE See IEC 61000-4-6 for further guidance on calibration set-up, including details of 150 Ω to 50 Ω adaptors.

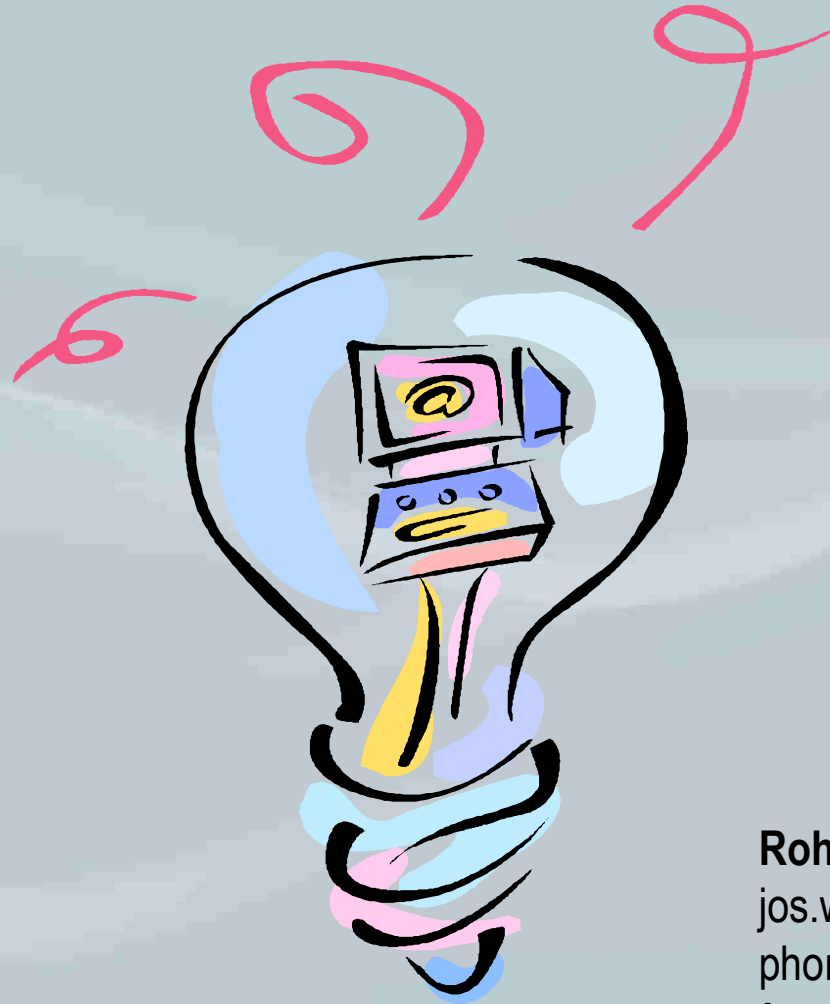
CISPR 15 – Solutions from R&S

We offer:

- I State-of-the-art EMI Receivers**
- I Various LISN's (AMN's – V-Networks)**
- I Voltage Probes**
- I Triple Loop Antennas**
- I Dummy Lamps**
- I Coupling-Decoupling-Networks (CDN-'E')**
- I EMI Software (EMC32)**
- I Anechoic Chambers**
- I Consultancy, design, integration, installation and training**
- I Calibration, service and maintenance**



CISPR 15 – Any questions ?



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