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CISPR 16-1-2

Edition 2.0 2017-11

INTERNATIONAL STANDARD

NORME INTERNATIONALE

INTERNATIONAL SPECIAL COMMITTEE ON RADIO INTERFERENCE
COMITÉ INTERNATIONAL SPÉCIAL DES PERTURBATIONS RADIOÉLECTRIQUES

BASIC EMC PUBLICATION
PUBLICATION FONDAMENTALE EN CEM

AMENDMENT 1
AMENDEMENT 1

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

**Spécifications des méthodes et des appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques –
Partie 1-2: Appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques – Dispositifs de couplage pour la mesure des perturbations conduites**

CISPR 16-1-2:2014-03/AMD1:2017-11(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 33.100.10; 33.100.20

ISBN 978-2-8322-4890-4

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FOREWORD

This amendment has been prepared by subcommittee CISPR A: Radio-interference measurements and statistical methods, of IEC technical committee CISPR: International special committee on radio interference.

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

FDIS	Report on voting
CIS/A/1222/FDIS	CIS/A/1232/RVD

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

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

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- withdrawn,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

3.1.3
asymmetric voltage

Replace the existing definition and note by the following new definition and new note:

RF disturbance voltage appearing between the electrical mid-point of the individual terminals or leads in a two- or multi-wire circuit and reference ground, sometimes called the CM voltage

Note 1 to entry If, in case of an LV AC mains power port, V_a is the vector voltage between one of the mains terminals and reference ground, and V_b is the vector voltage between the other mains terminal and reference ground, the asymmetric voltage is half the vector sum of V_a and V_b, i.e. $(V_a + V_b)/2$.

3.1.4
symmetric voltage

Replace the existing definition and note by the following new definition and new note:

RF disturbance voltage appearing between any pair of wires not comprising the wire at ground potential in a two- or multi-wire circuit, such as a single-phase mains supply or a bundle of twisted pairs in a communication cable, sometimes called the DM voltage

Note 1 to entry In case of an LV AC mains power port, the symmetric voltage is the vector difference $(V_a – V_b)$.

3.1.5
unsymmetric voltage

Replace the existing definition and notes by the following new definition and new note:

RF disturbance voltage appearing between an individual terminal or lead and reference ground, in a two- or multi-wire circuit

Note 1 to entry The unsymmetric voltage is the voltage measured by the use of a V-AMN. It denotes the amplitude of the vector voltage, V_a or V_b (mentioned in the Note 1 to entry in 3.1.3 and 3.1.4).

3.1.6
artificial mains network
AMN

Replace the existing Note 1 to entry by the following new note:

Note 1 to entry There are two basic types of this network, the V-network (V-AMN) which couples the unsymmetric voltages, and the delta-network (Δ-AMN), which couples symmetric (DM) and asymmetric (CM) voltages separately.

The addition of a new Note 4 to entry applies to the French language only.

3.1.14
reference ground plane
RGP

Replace the existing definition and note by the following new definition and new notes:

flat, conductive surface that is at the same electric potential as reference ground, which is used as a common reference, and which contributes to a reproducible parasitic capacitance with the surroundings of the EUT

Note 1 to entry A reference ground plane is needed for the measurement of conducted disturbances, and serves as reference for the measurement of unsymmetric and asymmetric disturbance voltages.

Note 2 to entry In some regions, the term ‘reference earth’ is used in place of ‘reference ground’.

Add, after the existing definition 3.1.14, the following new definition and note:

3.1.15
artificial network
AN
network that provides a defined impedance to the EUT at radio frequencies, couples the disturbance voltage to the measuring receiver, and decouples the test circuit from the mains network or other power lines or from signal lines with associated equipment

Note 1 to entry There are four basic types of this network, the V-network (V-AN) which couples the unsymmetric voltages, the delta-network (Δ-AN), which couples symmetric (DM) and asymmetric (CM) voltages separately, the Y-network (Y-AN) and the coaxial (screened cable) network which couple asymmetric (CM) voltages.

3.2 Abbreviations

Delete the abbreviation AN from the existing list.

Add, to the existing list, the following new abbreviations:

CM	Common mode
Δ-AMN	Artificial mains Δ-network (‘Δ’ is pronounced ‘delta’)
Δ-AN	Artificial Δ-network (‘Δ’ is pronounced ‘delta’)
DM	Differential mode

LV Low voltage

V-AMN Artificial mains V-network

V-AN Artificial V-network

UM Unsymmetric mode

4 Artificial mains networks

Replace the existing title by the following new title:

4 Artificial networks for AC mains and other power ports

4.1 General

Replace the existing text, including Notes 1 and 2, by the following new text and new notes:

An AN is required to provide a defined impedance at radio frequencies at the terminals of the EUT's port under test, to isolate the test circuit from unwanted RF signals on the laboratory AC or DC supply mains, other power source or load connected to the EUT but not subject to testing in relation with that EUT, and to couple the disturbance voltage to the measuring receiver.

For use with measurements on LV AC mains power ports, there are two basic types of AMN, the V-AMN, which couples the unsymmetric voltages, and the Δ-AMN, which couples the symmetric and the asymmetric voltages separately. Use of practical implementations of these AMNs is not restricted to LV AC mains power ports. In principle they can be used for measurements on any kind of power port. The user of such artificial networks is recommended to consult the respective product standard for guidance. The information and advice in this standard for the AMN is hence valid for use of that AMN or another AN at power ports other than LV AC mains power ports.

The AN or AMN is furnished with three ports, the port for connection to the laboratory AC or DC supply mains or other power source or load (power/load port), the port_for connection of the EUT (EUT port), and the disturbance output port for connection of the measuring receiver (receiver port).

NOTE 1 Examples of circuits of AMNs and ANs are given in Annex A.

NOTE 2 This clause specifies impedance and isolation requirements for ANs including the corresponding measurement methods. Some background and rationale on the AMN related uncertainties are given in 6.2.3 of CISPR/TR 16-4-1:2009 and in CISPR 16-4-2.

4.2 AMN impedance

Replace the existing title by the following new title:

4.2 AN impedances

Replace the existing text, including the note, by the following new text and new note:

The specification of the UM termination impedance of a V-AN includes the magnitude and the phase of the impedance measured at an EUT terminal with respect to the reference ground, when the V-AN's receiver port is terminated with 50 Ω.

In case of a Δ-AMN or Δ-AN, the specification of the termination impedances includes the magnitude and phase of the asymmetric (CM) termination impedance and the magnitude and phase of the symmetric (DM) termination impedance. The asymmetric termination impedance is measured with the two (or more) active EUT terminals joined together relative to the reference ground (as in Figure E.2). The symmetric termination impedance is measured between each active pair of EUT terminals without relation to reference ground and requires the use of a balun (see Figure K.2). For the impedance measurements, also for Δ-ANs the receiver port shall be terminated by 50 Ω.

The impedance at the EUT terminals of the AN defines the termination impedance presented to the EUT's port under test. For this reason, when a disturbance output terminal is not connected to the measuring receiver, it shall be terminated by 50 Ω. To assure accurate termination into 50 Ω of the receiver port, a 10 dB attenuator shall be used either inside or external to the AN, the VSWR of which (seen from either side) shall be less than or equal to 1,2 to 1. The attenuation shall be included in the measurement of the voltage division factor (see 4.11).

The impedance between each conductor (except PE, if any) of the EUT port and reference ground shall comply with the provisions of 4.3, 4.4, 4.5 or 4.6, as appropriate, for any value of external impedance, including a short circuit connected between the corresponding mains or other power supply terminal and reference ground of the power/load port. This requirement shall be met at all temperatures which the AN may reach under normal conditions for continuous currents up to the specified maximum. The requirement shall also be met for peak currents up to the specified maximum.

NOTE Because EUT connectors are not optimized for radio frequencies up to 30 MHz, the measurement of the network impedance is carried out with special measurement adaptors to enable short-length connections. The OSM (open/short/matched) calibration of the network analyzer is used to characterize the adaptors, taking the insertion loss and the conductor lengths of the adaptors into account.

4.6 150 Ω artificial mains V-network (V-AMN) for use in the frequency range 150 kHz to 30 MHz

Replace the existing title and text by the following:

4.6 (Void)

4.7 150 Ω artificial mains delta-network (Δ-AMN) for use in the frequency range 150 kHz to 30 MHz

Replace the existing title and text (including Figure 4) by the following new title, new text and new tables:

4.7 150 Ω artificial delta-network (Δ-AN) for mains and other power ports for use in the frequency range 150 kHz to 30 MHz

4.7.1 Requirements

In the frequency range of interest from 150 kHz to 30 MHz the AN shall have an impedance of magnitude (150 ± 30) Ω with a phase angle not exceeding 40°, both between the EUT terminals not including reference ground and between these two EUT terminals joined together and the reference ground; see Table 8.

For proper performance in the range 150 kHz to 30 MHz, the AN shall also meet the characteristics specified in Table 9 in the frequency range 9 kHz to 150 kHz. Adherence to these characteristics does not however qualify the 150 Ω Δ-AN for use with measurements of disturbance voltages in the range below 150 kHz. If necessary, another Δ-AN needs to be specified for such measurements.

Table 8 – Parameters of the 150 Ω Δ-AN (150 kHz to 30 MHz)

	Description of the parameter	Nominal value and tolerance
1	Frequency range	150 kHz to 30 MHz
2	Asymmetric (CM) termination impedance at the EUT port, magnitude and phase	(150 ± 30) Ω (0 ± 40)°
3	Symmetric (DM) termination impedance at the EUT port, magnitude and phase [a]	(150 ± 30) Ω (0 ± 40)°
4	Longitudinal conversion loss (LCL) at the EUT port [b]	≥ 26 dB (symmetric 150 Ω system)
5	Asymmetric (CM) insertion loss power/load port – EUT port	≥ 20 dB (asymmetric 50 Ω system)
6	Symmetric (DM) insertion loss power/load port – EUT port	≥ 20 dB (symmetric 150 Ω system) > 40 dB, with external capacitor
7	Discharge resistors for blocking capacitors in the current path (for measurements on DC power ports	≥ 1,5 MΩ

[a] If needed, product committees can define a different symmetric termination impedance.

[b] The LCL of the AN should be significantly larger than the internal LCL of the EUT.

Table 9 – Parameters of the 150 Ω Δ-AN (9 kHz to 150 kHz)

	Description of the parameter	Nominal value and tolerance
1	Extended frequency range	9 kHz to 150 kHz
2	Asymmetric (CM) termination impedance at the EUT port, magnitude only	≥ 10 Ω (power/load port open)
3	Symmetric (DM) termination impedance at the EUT port, magnitude only	≥ 1 Ω (power/load port open)
4	Longitudinal conversion loss (LCL) at the EUT port	≥ 26 dB (symmetric 150 Ω system)
5	Asymmetric (CM) insertion loss of power/load port to EUT port	≥ 20 dB at 150 kHz (asymmetric 50 Ω system), decreasing with decreasing frequency with 40 dB/decade
6	Symmetric (DM) insertion loss of power/load port to EUT port	≥ 20 dB at 150 kHz > 40 dB with external capacitor (symmetric 150 Ω system), decreasing with decreasing frequency with 40 dB/decade

NOTE Specifications are given for proper operation of typical EUTs only – not for disturbance measurements < 150 kHz.

4.7.2 Measurement of the Δ-AN parameters

Measurements for determination of characteristics of the Δ-ANs are described in Annex K.

4.7.3 Current carrying capacity and series voltage drop

The maximum continuous currents and the maximum peak current shall be specified. The voltage applied to the EUT when passing continuous currents up to the maximum shall be not less than 95 % of the mains or other power supply voltage at the mains or other power input terminals of the Δ-AN.

Annex A – AMNs

Replace the existing title of this annex by the following new title:

Annex A
(normative)

Characteristics and their measurement, circuit schemes and examples of modern implementations of AMNs and other ANs for use with power or load ports of EUTs

A.5 An example of the 150 Ω artificial mains V-network

Replace the existing title and text by the following:

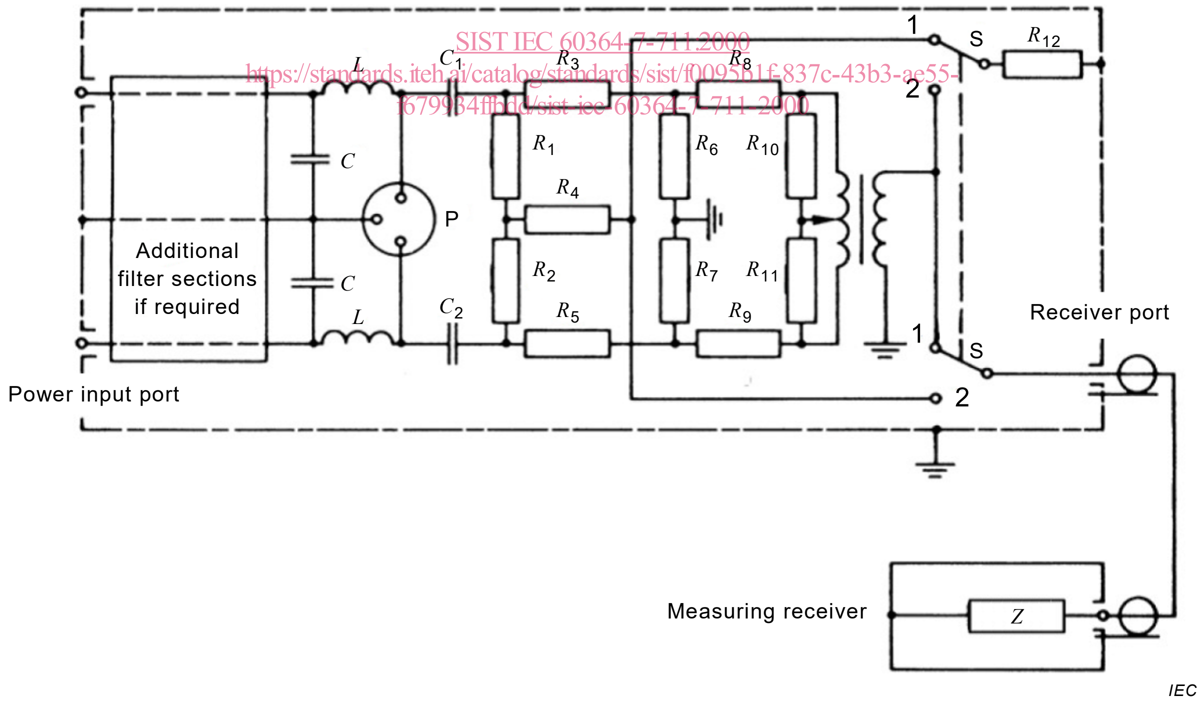
A.5 (Void)

A.6 Example of the 150 Ω artificial mains delta-network

Replace the existing title and text (including Figure A.2 and Table A.5) by the following new title, new text, new figures and tables:

A.6 Examples of the 150 Ω Δ-AN

Figure A.2 shows a suitable circuit for a delta-network. The component values are given in Table A.5.



Key

P EUT port of the AN

1 switch position for measurement of the symmetric voltage component

2 switch position for measurement of the asymmetric voltage component

S double pole double throw switch

Z measuring receiver input impedance

Figure A.2 – Example of a 150 Ω Δ-AN for low current drain across the AN for the measurement of asymmetric and symmetric disturbance voltages

Table A.4 – Component values of the 150 Ω Δ-AN shown in Figure A.2

Component	Value
R_1, R_2	118,7 (120) Ω
R_3, R_5	152,9 (150) Ω
R_4	390,7 (390) Ω
R_6, R_7	275,7 (270) Ω
R_8, R_9	22,8 (22) Ω
R_{10}, R_{11}	107,8 (110) Ω
R_{12}	50 Ω
C_1, C_2	0,1 µF
L, C	Suitable value to achieve specified impedance

NOTE 1 The turns ratio of the balanced to unbalanced transformer is assumed to be 1:2,5 with centre tap.

NOTE 2 Resistance values shown in brackets are the nearest preferred values (± 5 % tolerance).

Calculations give the following network performance. Values in brackets are based on the resistance values in brackets.

Insertion loss AE port to EUT port:	Symmetric	20	(20) dB
	Asymmetric	20	(19,9) dB
Termination impedance at EUT port:	Symmetric	150	(150) Ω
	Asymmetric	150	(148) Ω

Another example for a 150 Ω Δ-AN is shown in Figure A.7. Such delta-networks are commercially available with rated current throughputs up to 100 A DC and 1 500 V DC rated voltage.

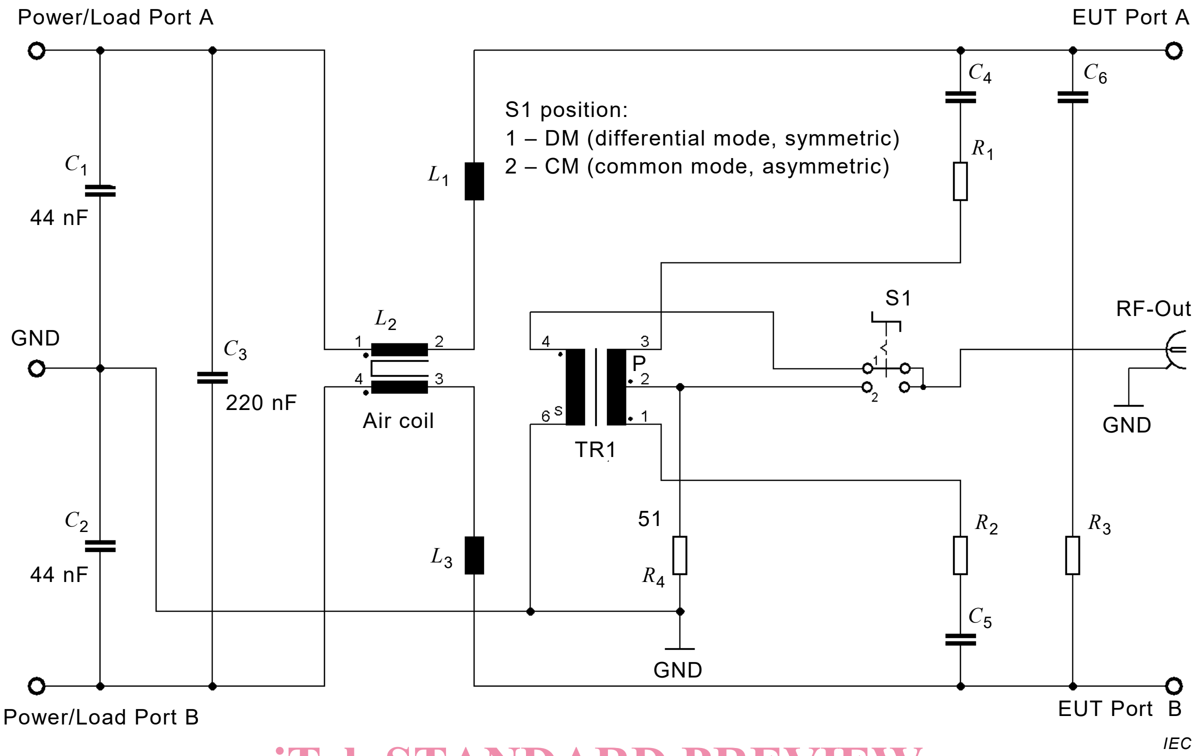


Figure A.7 – Example of a 150 Ω Δ-AN for high current drain across the AN for the measurement of asymmetric and symmetric disturbance voltages

Add, after the existing Annex J, the following new Annex K: