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Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148,5 kHz - Part 7: Equipment impedance

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Signalübertragung auf elektrischen Niederspannungsnetzen im Frequenzbereich 3 kHz bis 148,5 kHz -- Teil 7: Geräteimpedanzen

Transmission de signaux sur les réseaux électriques basse tension dans la bande de fréquences de 3 kHz à 148,5 kHz -- Partie 7: Impédance des appareils

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CENELEC
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Foreword

This European Standard was prepared by SC 205A, Mains communicating systems, of Technical Committee CENELEC TC 205, Home and Building Electronic Systems (HBES).

The text of the draft was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 50065-7 on 2000-08-01.

The following dates were fixed :

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2002-06-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2003-04-01

Annexes designated "normative" are part of the body of the standard.
Annexes designated "informative" are given for information only.
In this standard, annexes A, B, C and D are informative.

EN 50065 consists of the following parts, under the general title: Signalling on low voltage electrical installations in the frequency range 3 kHz to 148,5 kHz

Part 1	General requirements, frequency bands and electromagnetic disturbances
Part 2-1	Immunity requirements for mains communications equipment and systems operating in the range of frequencies 95 kHz to 148,5 kHz and intended for use in residential, commercial and light industrial environments
Part 2-2	Immunity requirements for mains communications equipment and systems operating in the range of frequencies 95 kHz to 148,5 kHz and intended for use in industrial environments
Part 2-3	Immunity requirements for mains communications equipment and systems operating in the range of frequencies 3 kHz to 95 kHz and intended for use by electricity suppliers and distributors
Part 4-1	Low voltage decoupling filters – Generic specification
Part 4-2	Low voltage decoupling filters – Safety requirements
Part 4-3	Low voltage decoupling filters – Incoming filter
Part 4-4	Low voltage decoupling filters – Impedance filter
Part 4-5	Low voltage decoupling filters – Segmentation filter
Part 4-6	Low voltage decoupling filters – Phase coupler
Part 7	Equipment impedance

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Introduction

Mains communication equipment connected to the low voltage network will load the mains with their inherent impedance.

In general, many types of equipment connected to the same low voltage communication network will present a summative load impedance for transmitters injecting signals onto the mains network.

As a result, the mains impedance, which is time variable, will in general decrease and the attenuation increase, deteriorating the communication over the mains network.

The aim of this standard is to limit the deterioration in communication due to the contribution of the loads formed by other communication equipment connected to the same low voltage network and operating in the same frequency band or adjacent frequency bands.

This standard will therefore specify the suitable minimum impedance (modulus) of the communication equipment impedance in this operating frequency range for both transmitting and receiving mode in order to minimise mutual interference.

An informative annex is included with this part of the standard, identifying characteristics that can influence performance of equipment connected to the same mains network.

1 Scope

This standard applies to electrical equipment, excluding decoupling filters, using signals in the frequency range 3 kHz to 148,5 kHz for data transmission on low voltage electrical networks, either on the public supply network or within installations in consumers' premises.

It specifies requirements for mains communication equipment with respect to the load impedance of the mains.

It does not specify the impedance of external components that are not necessary for the normal functioning of the communication equipment.

2 Normative references

This European Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies (including amendments).

EN 50065-1	2001	Signalling on low voltage electrical installations in the frequency range 3 kHz to 148,5 kHz – Part 1: General requirements, frequency bands and electromagnetic disturbances
CISPR 16-1	1993	Specification for radio disturbance and immunity measuring apparatus and methods - Part 1: Radio disturbance and immunity measuring apparatus
IEC 60050-161		International Electrotechnical Vocabulary – Chapter 161: Electromagnetic compatibility

3 Definitions

For the purpose of this standard the following definitions apply. Further, the definitions given in the International Electrical Vocabulary IEC 60050-161 apply.

3.1
Type 1 equipment
the equipment using signals in the frequency range 3 kHz to 95 kHz (see 4.1 of EN 50065-1)

3.2
Type 2 equipment
the equipment using signals in the frequency range 95 kHz to 148,5 kHz (see 4.2 of EN 50065-1)

3.3
bandwidth, BW
see 6.2.1 of EN 50065-1

4 Requirements

The minimum values of the impedance modulus for Type 1 equipment and Type 2 equipment, either in receiving operating mode (RX) and transmitting operating mode (TX), are defined in the following tables.

The abbreviations “Out BW” and “In BW” (for BW, see 3.3) in Table 2 mean “outside the bandwidth” and “inside the bandwidth” respectively.

For example, a system operating in the frequency range from 40 kHz to 60 kHz has an inside bandwidth of 20 kHz and the outside bandwidth range from 3 kHz to 40 kHz and from 60 kHz to 95 kHz.

These requirements apply for the design of equipment satisfying the impedance requirements for both Type 1 and Type 2. If the impedance requirements (see Tables 1, 2, 3 and 4) are not satisfied, an appropriate decoupling filter shall be used.

Table 1 – Minimum impedance modulus value $|Ze|$ of Type 1 equipment working in the frequency range 3 kHz to 9 kHz

Frequency range	3 kHz to 9 kHz		9 kHz to 95 kHz		95 kHz to 148,5 kHz	
Operating mode	RX	TX	RX	TX	RX	TX
$\|Ze\|$	10 Ω	Free	10 Ω	Free	10 Ω	10 Ω

Table 2 - Minimum impedance modulus value $|Ze|$ of Type 1 equipment working in the frequency range 9 kHz to 95 kHz

Frequency range	3 kHz to 9 kHz		9 kHz to 95 kHz			95 kHz to 148,5 kHz	
Operating mode	RX	TX	RX		TX	RX	TX
$\|Ze\|$	10 Ω	Free	Out BW Free [1)]	In BW 50 Ω	Free	5 Ω	3 Ω

[1)] The free value is indicated for single system. For multiple systems, that is when more than one system operates in the same frequency range on the same network, a finite minimum impedance modulus value of 10 Ω is recommended.

Table 3 - Minimum impedance modulus value |Ze| of Type 2 equipment working in the frequency range 95 kHz to 148,5 kHz

Frequency range	3 kHz to 9 kHz		9 kHz to 95 kHz		95 kHz to 148,5 kHz	
Operating mode	RX	TX	RX	TX	RX	TX
|Ze|	10 Ω	10 Ω	5 Ω	5 Ω	5 Ω	Free

Table 4 - Minimum impedance modulus value |Ze| of Type 2 equipment working in the frequency range 3 kHz to 9 kHz using the common mode signalling [1)]

Frequency range	3 kHz to 9 kHz		9 kHz to 95 kHz		95 kHz to 148,5 kHz	
Operating mode	RX	TX	RX	TX	RX	TX
|Ze|	5 Ω	Free	5 Ω	5 Ω	10 Ω	10 Ω

1) Common-mode injection devices may disturb the normal operation of residual current protection devices and cause serious safety hazards to the user. Therefore, common-mode injection shall not be used unless otherwise explicitly allowed in local regulations (see EN 50065-1).

These impedance values have to be measured in accordance with clause 5.

5 Test method

5.1 General

Two test methods are proposed the "impedance analyser method" and the "voltage ratio method".

The "impedance analyser method" allows the measurement of real and imaginary parts of the impedance of the device under test (DUT). This method is the reference method.

The "voltage ratio method" only indicates if the modulus of the impedance of the DUT is above or below the limit.

5.2 Test conditions

The mains communication equipment (DUT) shall be connected with all external components that are necessary for operation.

For mains communication equipment incorporated in appliances, the test must be carried out only on the communication equipment.

The test must be carried out with respect to in band and out of band frequency range which the communication equipment operates.

The DUT impedance shall be measured in receiving operating mode (RX) and transmitting operating mode (TX).

5.3 Impedance analyser measuring method

The value of the impedance of the Device Under Test (DUT) shall be measured using an indirect method based on the use of the artificial mains, CISPR 16-1 V-network, defined in EN 50065-1.

This method applies to devices working in differential mode.

The measuring equipment is shown in Figure 1. The transformer is necessary to provide the galvanic isolation between the LV mains neutral (N) and the ground (GND) of the CISPR 16-1 V-network.

The earth termination of the device under test, when this termination is present, shall not be connected to the ground termination (GND) of the artificial mains network.

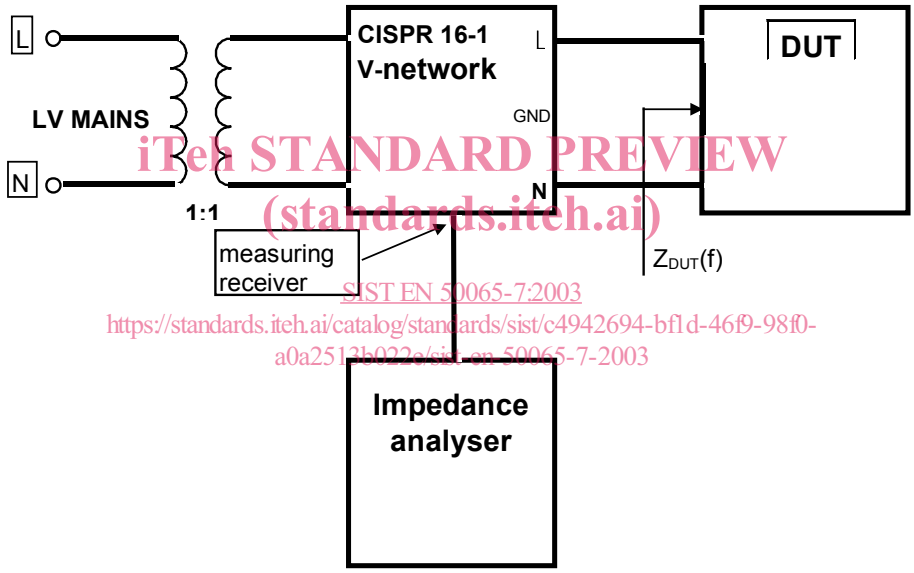

Figure 1 - Block diagram of the measuring set-up

The impedance of the DUT is calculated as follows :

- step 1: evaluation of the Z-parameters (Z_{11}, Z_{22}, Z_{12}, Z_{21}) of the CISPR 16-1 V-network as a two port network (see annex C);
- step 2: measurement of the input impedance ($Z_m(f)$) when the DUT is connected to the V-network output port;
- step 3: calculation of $Z_{DUT}(f)$ using the Z-parameters and $Z_m(f)$.

In annex C, a possible calculation method is shown using the Z-parameters.

5.4 Voltage ratio method

The measuring method is based on the use of the artificial mains, CISPR 16-1 V-network defined in EN 50065-1 for measuring the output voltage of the mains communication devices.

This method does not apply to devices working in common mode.

The measuring equipment for measuring the signal output voltage, as defined in EN 50065-1, is replaced by a signal generator having an output impedance of 50 Ω, working at the measuring frequency and having an output voltage not exceeding 100 dB(μV)rms. Using the relevant switch on the V-network, the generator shall be connected to Line.

A differential voltmeter tuned at the measuring frequency with a bandwidth ≤ 200 Hz is connected by a high-pass filter blocking the 50 Hz signal and having a high input impedance

1) in parallel with the DUT,

2) between ground (GND) and neutral (N) of the CISPR 16-1 V-network.

The input impedance value of this set (differential voltmeter plus high-pass filter) has to be greater than 20 x $|Z_{ART}|$, where Z_{ART} is the impedance of the artificial mains network as defined in EN 50065-1.

The earth termination of the device under test, when this termination is present, shall not be connected to the ground termination (GND) of the artificial mains networks.

The block diagram of the measuring set-up is shown in Figure 2.

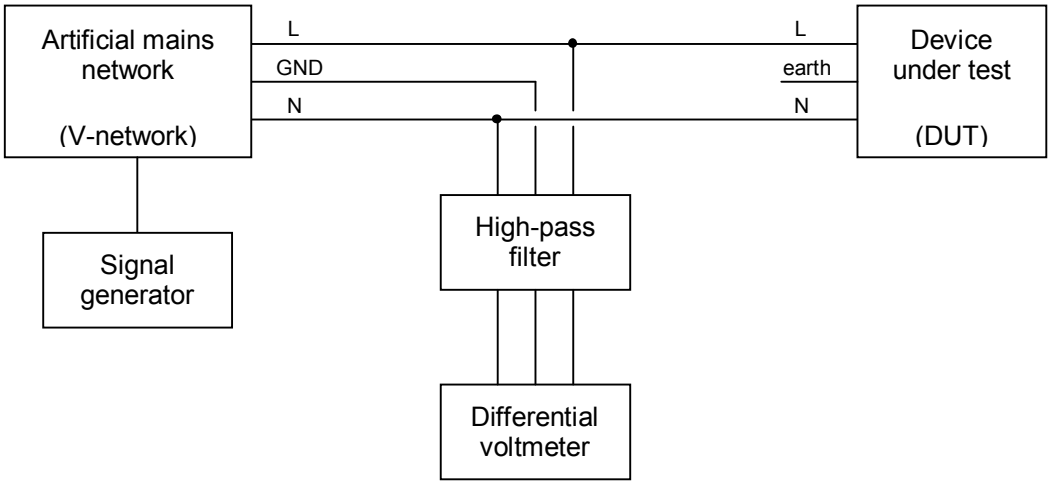

Figure 2 – Block diagram for measuring set-up