British Standard

BRITISH STANDARD

BS EN
50091-2 : 1996

Specification for

Uninterruptable power systems (UPS)

Part 2. EMC requirements

The European Standard EN 50091-2 : 1995 has the status of a British Standard

ICS 29.020; 29.200

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee PEL/22, Static power converter equipment, upon which the following bodies were represented:

Engineering Equipment and Materials Users' Association
Federation of the Electronics Industry
GAMBICA (BEAMA Ltd.)
Institution of Incorporated Executive Engineers
Power Supply Manufacturers' Association (PSMA (BEAMA Ltd.))
Railway Industry Association
Transmission and Distribution Association (BEAMA Ltd.)
Co-opted member

This British Standard, having been prepared under the direction of the Electrotechnical Sector Board, was published under the authority of the Standards Board and comes into effect on
15 September 1996

Amendments issued since publication

Amd. No.	Date	Text affected

The following BSI references relate to the work on this standard:
Committee reference PEL/22
Draft for comment 95/202062 DC

ISBN 0 580 25519 0

Contents

National foreword

This British Standard has been prepared by Technical Committee PEL/22 and is the English language version of EN 50091-2 : 1995 *Uninterruptable power systems (UPS)* Part 2: *EMC requirements* published by the European Committee for Electrotechnical Standardization (CENELEC)

Cross-references

Publication referred to	Corresponding British Standard
EN 55011 : 1991	BS EN 55011 : 1991 *Specification for limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment*
EN 55022 : 1994[1)]	BS EN 55022 : 1995 *Limits and methods of measurement of radio interference characteristics of information technology equipment*
	BS 5406 *Disturbances in supply systems caused by household appliances and similar electrical equipment.*
EN 60555-1 : 1987	Part 1 : 1988 *Glossary of terms*
EN 60555-2 : 1987	BS EN 61000 *Electromagnetic compatibility* Part 3-2 : 1995[2)] *Limits — Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)*
EN 60555-3/A1 : 1991	Part 3 : 1988 *Specification of voltage fluctuations*
	BS EN 61000 *Electromagnetic compatibility (EMC)* Part 4. *Testing and measurement techniques*
EN 61000-4-1 : 1994	Section 4.1 : 1995 *Overview of immunity tests. Basic EMC publication*
EN 61000-4-11 : 1994	Section 4.11 : 1994 *Voltage dips, short interruptions and voltage variations immunity tests*
	BS 6667 *Electromagnetic compatibility for industrial-process measurement and control equipment*
IEC 801-1 : 1984	Part 1 : 1985 *General introduction*
	BS EN 60801 *Electromagnetic compatibility for industrial-process measurement and control equipment*
IEC 801-2 : 1991	Part 2 : 1993 *Electrostatic discharge requirements*
	BS 6667 *Electromagnetic compatibility for industrial-process measurement and control equipment*
IEC 801-3 : 1984	Part 3 : 1985 *Method of evaluating susceptibility to radiated electromagnetic energy*
	DD ENV 61000 *Electromagnetic compatibility (EMC)* Part 2. *Environment*
IEC 1000-2-2 : 1990	Section 2.2 : 1993 *Compatibility levels for low frequency conducted disturbances and signalling in public low-voltage supply systems*
	BS 4727 *Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms* Part 1. *Terms common to power telecommunications and electronics*
IEC 50 (161) : 1990	Group 09 : 1991 *Electromagnetic compatibility*

Compliance with a British Standard does not of itself confer immunity from legal obligations.

[1)] EN 55022 : 1987 which was identical with BS 6527 : 1988 has been superseded by EN 55022 : 1994.

[2)] BS EN 61000-3-2 : 1995 superseded BS 5406 : Part 2 : 1988 which was identical with EN 60555-2 : 1987.

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 50091-2

September 1995

ICS 29.020; 29.200

Descriptors: Power electronics, uninterruptable power system, UPS, electromagnetic compatibility requirements, EMC, electromagnetic compatibility for uninterruptable power systems

English version

Uninterruptable power systems (UPS)
Part 2: EMC requirements

Alimentations sans interruption (ASI)
Partie 2: Prescriptions pour la compatibilité électromagnétique (CEM)

Unterbrechungsfreie Stromversorgung (USV)
Teil 2: EMV-Anforderungen

This European Standard was approved by CENELEC on 1995-03-06. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

Foreword

This European Standard was prepared by CENELEC BTTF 60-4.

It was submitted to the CENELEC Unique Acceptance Procedure (UAP) in April 1994 and was approved by CENELEC as EN 50091-2 on 1995-03-06.

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) 1996-03-01

– latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1996-03-01

For products which have complied with the relevant national standard before 1996-03-01, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 2001-03-01.

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

Contents

1 Introduction

1.1 Scope

This EMC Standard applies to single UPS units or UPS systems comprising a number of interconnected UPS and associated control/switchgear forming a single power system, intended to be installed in any operator accessible area or in separated electrical locations, connected to either industrial or public low voltage supply networks.

This product EMC Standard will take precedence over all aspects of the Generic Standards and no additional testing is necessary.

The requirements have been selected so as to ensure an adequate level of electromagnetic compatibility (EMC) for UPS at public and industrial locations. These levels cannot however cover extreme cases which may occur in any location, but with extremely low probability.

It takes account of the differing test conditions necessary to encompass the range of physical sizes and power ratings of UPS.

A UPS unit or system shall meet the relevant requirements of this Standard as a stand-alone product. EMC phenomena produced by any customers' load connected to the output of the UPS equipment shall not be taken into account.

Special installation environments are not covered nor are fault conditions of UPS taken into account.

This Standard does not cover d.c. supplied electronic ballasts (IEC 924 and IEC 925) or UPS based on rotating machines.

1.2 Object

This section states:

– EMC requirements;
– test methods;
– minimum performance levels.

1.3 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.

prEN 50091-3 (in preparation)	*Uninterruptable power systems (UPS)* Part 3: *Performance requirements*
EN 55011 : 1991	*Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment* (CISPR 11 : 1990, modified)
EN 55022 : 1987	*Limits and methods of measurement of radio interference characteristics of information technology equipment*
EN 60555-1 : 1987	*Disturbances in supply systems caused by household appliances and similar electrical equipment* Part 1: *Definitions*
EN 60555-2 : 1987	*Disturbances in supply systems caused by household appliances and similar electrical equipment* Part 2: *Harmonics*
EN 60555-3/A1 : 1991	*Disturbances in supply systems caused by household appliances and similar electrical equipment* Part 3: *Voltage fluctuations* (IEC 555-3/A1 : 1990 + corrigendum 1990)
EN 61000-4-1 : 1994	*Electromagnetic compatibility (EMC)* Part 4: *Testing and measurement techniques* Section 1: *Overview of immunity tests; basic EMC publication* (IEC 1000-4-1 : 1992)
EN 61000-4-11 : 1994	*Electromagnetic compatibility (EMC)* Part 4: *Testing and measurement techniques* Section 11: *Voltage dips, short interruptions and voltage variations immunity tests* (IEC 1000-4-11 : 1994)
IEC 83 : 1979	*Plugs and socket-outlets for domestic and similar general use*
IEC 801-1 : 1984	*Electromagnetic compatibility for industrial-process measurement and control equipment* Part 1: *General introduction*
IEC 801-2 : 1991	*Electromagnetic compatibility for industrial-process measurement and control equipment* Part 2: *Electrostatic discharge requirements*
IEC 801-3 : 1984	*Electromagnetic compatibility for industrial-process measurement and control equipment* Part 3: *Radiated electromagnetic field requirements*
IEC 801-4 : 1988	*Electromagnetic compatibility for industrial-process measurement and control equipment* Part 4: *Electrical fast transient/burst requirements*
IEC 801-5 (in preparation)	*Electromagnetic compatibility for industrial-process measurement and control equipment* Part 5: *Surge immunity requirements*

IEC 1000-2-2 : 1990	*Electromagnetic compatibility (EMC)* Part 2: *Environment* Section 2: *Compatibility levels for low frequency conducted disturbances and signalling in public low voltage supply systems*
IEV 50(161) : 1990	*International electrotechnical vocabulary (IEV)* — Chapter 161: *Electromagnetic compatibility*
CISPR 16 : 1987	*CISPR Specification for radio interference measuring apparatus and measurement method*

1.4 Definitions

Definitions related to EMC and to relevant phenomena may be found in Chapter 161 of the IEV and in IEC and CISPR publications. The following particular definitions are used in this standard:

Port: Particular interface of the specified UPS with the external electromagnetic environment (see figure 1).

Enclosure port: The physical boundary of the UPS through which electromagnetic fields may radiate or impinge.

2 Emission

Disturbances in the frequency range from 0 Hz to 1,0 GHz are covered.

The emission requirements have been selected so as to ensure that disturbances generated by UPS operating normally do not exceed a level which could prevent other apparatus from operating as intended.

NOTE 1. The limits in this standard may not, however, provide fully, protection against interference to radio and television reception when the UPS is used closer than 10 m to the receiving antenna(e) for Class B-UPS and 30 m for Class A-UPS.

NOTE 2. In special cases, for instance when highly susceptible apparatus is being used in proximity, additional mitigation measures may have to be employed to reduce the electromagnetic emission further below the specified levels.

2.1 General requirements

The equipment shall comply with the emission limits of **2.3** to **2.5**.

The tests shall be made with the UPS in the following conditions:

– rated input voltage;

– normal and stored energy mode of operation;

– linear load that results in the highest interference level.

The objective of **2.4** and **2.5** is to define limits and test methods for UPS indicated in the scope in relation to electromagnetic emissions which may cause interference in other apparatus, e.g. radio receivers.

These emission limits represent essential electromagnetic compatibility requirements.

Test requirements are specified for each port considered. Refer to annex A for test methodology.

2.2 Classification of UPS

UPS products shall be classified in two ways for electromagnetic emissions:

a) **UPS for unrestricted sales distribution**

Where the sales distribution of the UPS is unrestricted and not dependent on the technical competence of the customer or user for the further employment of the UPS, it is described with the term: 'unrestricted sales distribution' and implements harder emission limits in accordance with the essential EMC protecting requirements. Products in this category are classified as class A-UPS or class B-UPS.

Class A-UPS

UPS suitable for use in all establishments other than domestic and those directly connected to a low voltage public supply network which supplies buildings used for domestic purposes.

(For all UPS connected by industrial plugs and sockets or permanently connected and UPS fitted with national plugs and sockets marketed solely for industrial use.)

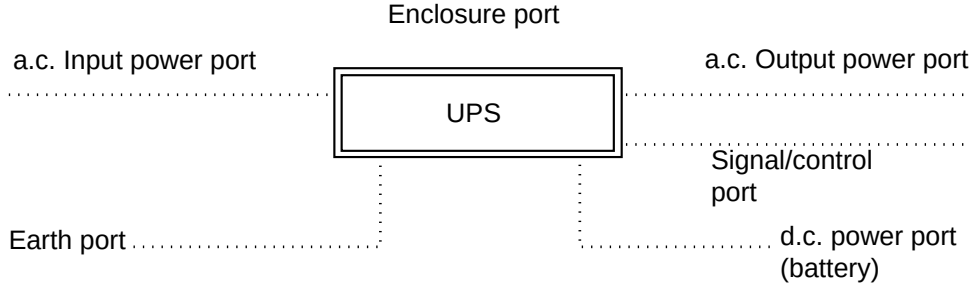


Figure 1. Examples of ports

The following wording shall be included in the instructions for use.

'**WARNING**. This is a class A-UPS product. In a domestic environment, this product may cause radio interference, in which case, the user may be required to take additional measures'.

Class A-UPS shall meet class A-UPS limits of this standard.

NOTE. Although class A-UPS limits have been derived for industrial and commercial establishments, administrations may allow, with whatever additional measures are necessary, the installation and use of class A-UPS equipment in a domestic establishment or in an establishment connected directly to domestic power supplies.

Class B-UPS

UPS suitable for use in all establishments including domestic and those establishments directly connected to a public low voltage network which supplies buildings used for domestic purposes. (All UPS connected by national plugs and sockets (IEC 83), except those clearly marked and marketed only for industrial applications.)

Class B-UPS shall meet class B-UPS limits of this standard.

b) **UPS for restricted sales distribution**

Where the sales distribution is restricted to only customers and users with a high technical competence, it is described as 'restricted sales distribution' and implements higher emission limits, because for economic reasons both partners, the manufacturer and customer in partnership and agreement, have to ensure the essential EMC protecting requirement for the specific resulting installation by choice of emission limits or by measurements 'in-situ' together with all different equipment and boundary conditions.

The following wording shall be included in the instructions for use:

'**WARNING**. This is a product for restricted sales distribution to informed partners. Installation restrictions or additional measures may be needed to prevent disturbances'.

This category is limited to UPS whose rated output current is greater than 25 A intended to be installed in commercial or industrial buildings with its own electricity supply transformer and a minimum 30 m boundary to all other establishments and/or consumers.

NOTE. The emission limits for restricted sales distribution are shown in the relevant tables and implement the draft recommendation of CISPR/B (Secretariat) 62 : 1990 giving requirements for a practical solution in relevant environments using limits from EN 55011 and CISPR/B (Secretariat) 62 : 1990 (under review).

2.3 General measurement conditions

The measurements shall be made in the operating mode producing the largest emission in the frequency band being investigated consistent with normal applications. UPS operating modes, normal mode and stored energy mode shall be covered.

An attempt should be made to maximize the emission by varying the test set up configuration of the test sample.

UPS with additional mains terminals (ports) for the connection of separate supplies for static bypass and/or maintenance bypass circuits, these terminals (ports) shall, wherever possible, be temporarily connected to the normal a.c. input port supply. Conducted emission tests in **2.4** shall include measurement of these additional circuits.

If the UPS is part of a system, or can be connected to auxiliary accessories, then the UPS shall be tested while connected to the minimum configuration of auxiliary accessories necessary to exercise the ports or terminated in an equivalent impedance.

UPS a.c. outputs shall be loaded with linear load capable of exercising the unit under test for any load condition within its output rating.

The configuration and mode of operation during measurement shall be precisely noted in the test report. Refer to annex A for test set-up and measurement criteria. For 'in-situ' testing, see **A.8.3**.

The tests shall be carried out somewhere within the specific operating environment range for the UPS and at its rated supply voltage, unless otherwise indicated.

2.3.1 *Documentation for the purchaser/user*

a) Documentation for the purchaser/user. The purchaser/user shall be informed if special measures have to be taken to achieve compliance, e.g. the use of shielded or special cables. Any restriction on the length of the a.c. output cables shall also be indicated.

b) Documentation which shall be available to the purchaser/user upon request. A list of auxiliary accessories together with the UPS complying with the emission requirements shall be made available.

2.3.2 *Applicability*

Measurements are made on the relevant ports of the UPS.

2.4 Conducted emissions

2.4.1 *Limits of mains terminal interference voltage*

The test unit shall not exceed the limits of either table 1 or table 2 according to the rated output current, and the class of UPS under test.

The UPS shall meet both the average and quasi-peak limit when using, respectively, an average detector receiver and a quasi-peak detector receiver and measured in accordance with the methods described in **A.5**.

If the average limit is met when using a quasi-peak detector receiver, the test unit shall be deemed to meet both limits and measurement with the average detector receiver is unnecessary.

If reading on the measuring receiver shows fluctuations close to the limit, the reading shall be observed for at least 15 s at each measurement frequency; the highest reading shall be recorded with the exception of any brief isolated high reading which shall be ignored.

a) UPS for unrestricted sales distribution

Table 1. Limits of mains terminal interference voltage frequency range 0,15 MHz to 30 MHz for class A-UPS and class B-UPS equipment

Frequency range (MHz)	**Limits** (dB (μV))			
	Class A-UPS		**Class B-UPS**	
	Quasi-peak	**Average**	**Quasi-peak**	**Average**
0,15 to 0,50	79	66	66 to 56[1)]	56 to 46[1)]
0,50 to 5	73	60	56	46
5 to 30	73	60	60	50

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

b) UPS for restricted sales distribution

UPS which have a rated output current exceeding 25A.

Table 2. Limits of mains terminal interference voltage frequency range 0,15 MHz to 30 MHz

UPS rating	**Frequency range (MHz)**	**Limits** (dB (μV))	
		Quasi-peak	**Average**
25–100 A	0,15 to 0,50	100	90
	0,50 to 5,0	86	76
	5,0 to 30,0	90 to 70[1)]	80 to 60[1)]
101–400 A	0,15 to 0,50	130	120
	0,50 to 5,0	125	115
	5,0 to 30,0	115	105
> 400 A	0,15 to 0,50	Under consideration	Under consideration
	0,5 to 5,0		
	5,0 to 30,0		

[1)] The limits decrease linearly with the logarithm of the frequency

2.4.2 *Limits of a.c. output interference voltage*

Conducted disturbances at the output of the UPS shall be less than the amplitude in table 1 or table 2 plus 14 dB according to the rated output current.

These limits only apply to UPS where the output cable, as declared by the manufacturer in his user instructions, can exceed 10 m in length.

The values shall be measured using a voltage probe in accordance with **A.1.3**.

2.4.3 *Limits of signal ports (informative)*

See annex C (informative).

2.4.4 *Limits of d.c. ports*

Where a UPS is provided with terminals for the connection of an external battery source, this port shall be included in the test set-up.

For table-top units, the battery and its enclosure shall be installed in a position permitted by the manufacturer's instructions. Measurement of its emission shall be part of the radiated emission test.

For floor-standing units, the external battery and its enclosure shall be positioned 0,8 m from the UPS and wired in accordance with the manufacturer's instructions. Compliance is checked by the radiated emission test.

For large units, where the battery will be installed at a distance from the UPS, the port shall be wired in accordance with the manufacturer's instructions and a test battery or power supply fitted to the battery end of the cables to enable measurement in stored energy mode.

Only if the wiring is not shielded in installation shall measurement of the port be necessary except as a radiated emission test limit for d.c. ports (under consideration).

2.4.5 *Low frequency emissions*

Input current harmonics

If the application is within the scope of EN 60555-2, the limits and test methodology shall apply.

NOTE. This subclause is under consideration pending revision of EN 60555-2 : 1987.

2.5 Radiated emissions

2.5.1 *E field*

The test unit shall meet the limits of table 3. If the reading on the measuring receiver shows fluctuations close to the limit, the reading shall be observed for at least 15 s at each measurement frequency; the highest reading shall be recorded with the exception of any brief isolated high reading which shall be ignored.

Limits for radiated emission in the frequency range below 30 MHz are under consideration.

a) **UPS for unrestricted sales distribution**

Table 3. Limits of radiated emission in the frequency range 30 MHz to 1000 MHz

Frequency range (MHz)	**Quasi-peak limits** (dB (μV/m))	
	Class A-UPS Test distance 10 m	**Class B-UPS Test distance 10 m**
30 to 230	40	30
230 to 1000	47	37

The lower limit shall apply at the transition frequency.

NOTE 1. If the emission measurement at 10 m cannot be made because of high ambient noise levels or for other reasons, measurement may be made at closer distance.

NOTE 2. Additional provisions may be required for cases where interference occurs.

b) **UPS for restricted sales distribution**

UPS whose rated output current exceeds 25 A.

Table 4. Limits of radiated emission in the frequency range 30 MHz to 1000 MHz

Frequency range (MHz)	**Quasi-peak limits** (dB (μV/m))
	Test distance 30m
30 to 230	Under consideration Table 3 class A-UPS shall apply until other limits are determined
230 to 1000	

2.5.2 *H field (optional)*

See annex B (informative).

2.5.3 *Limits of interference power (under consideration)*

See annex A (normative).

3 Immunity

Immunity requirements in the frequency range 0 Hz to 1 GHz are covered.

These test requirements represent essential electromagnetic compatibility immunity requirements. Test requirements are specified for each port considered.

The levels given in this clause do not cover cases in industrial environments and in extreme cases which may occur in any location but with an extremely low probability. For such cases higher levels may be required.

NOTE. In special cases situations will arise where the level of disturbances may exceed the levels specified in this standard, e.g. where a hand-held transmitter is used in proximity to a UPS. In these instances special mitigation measures may have to be employed.

3.1 General requirements and performance criteria

The equipment shall as a minimum, comply with the immunity limits of **3.2** to **3.6**. The performance criteria adequate for UPS are given in table 5.

Table 5. Performance criteria for immunity tests

Item	**Criterion A**	**Criterion B**
Output characteristics	Static tolerances of relevant section of prEN 50091-3 (in preparation)	Dynamic tolerances of relevant section of prEN 50091-3 (in preparation)
External and internal indications and metering	Change only during test	Change only during test
Control signals to external devices	No change	Change according to the mode of operation
Mode of operation	No change	Change only temporarily

The tests shall be made with the UPS in the following conditions:

– rated input voltage;

– normal mode of operation;

– linear load at rated active output power.

The UPS shall be specified with the proper level in case of different levels of performance criteria.

For the following tests refer to annex D for test methodology.

Attenuation tests as in annex E can be combined with the relevant immunity tests when performed on the mains input terminals of the UPS.

3.2 Immunity to electrostatic discharges

The UPS in operation shall withstand electrostatic discharges carried out in accordance with IEC 801-2 : 1991.

– Minimum requirement: level 3

– Performance criterion: B

3.3 Immunity to radiated electromagnetic fields

The operating UPS shall be protected against radiated electromagnetic fields in accordance with IEC 801-3 : 1984.

– Minimum requirement: level 2.

– Performance criterion: A.

3.4 Immunity to fast transients

The operating UPS shall withstand common mode (fast electrical transients) conducted disturbances to levels given in IEC 801-4 : 1988.

– Minimum requirement: level 2.

– Performance criterion: A.

The tests shall be made on all power cables and on battery connecting cables (when the length exceeds 3 m); for I/O-signal and control cables the level is divided by 2.

The method of test shall be using a coupling clamp according to IEC 801-4, subclause **6.3**, whichever the power range will be. The minimum duration of the test shall be 1 min.

3.5 Immunity to surges

Under consideration (future IEC 801-5).

3.6 Immunity to low frequency signals

The UPS in operation shall withstand the low frequency conducted disturbances and signalling in the mains for mains compatibility as specified in IEC 1000-2-2 and as detailed in annex D (clause **D.6**).

Compliance is checked by simulating the above conditions and the UPS shall continue to operate without degradation of the specified performances.

Annex A (normative)

Electromagnetic emission – test methods

The purpose of these tests is to measure the levels of electro-magnetic emission produced by the UPS propagated by conduction and radiation.

This clause mainly concerns continuous electromagnetic emissions.

Due to the range of physical size and power ratings the manufacturer may choose the most appropriate test site and configuration that is best to physically accommodate the UPS.

In some cases, e.g. for multi-module systems, the only solution will be a site installed evaluation. Therefore, the following test set-ups and methods provide, as far as possible, the general criteria to cater for most UPS.

A.1 Measuring equipment

A.1.1 *Measuring instruments*

Receivers with quasi-peak detectors and receivers with average detectors shall be in accordance with CISPR 16.

NOTE. Measuring instruments having other detector characteristics may be used provided the measurement of the disturbance values can be proved to be the same. Attention is drawn to the convenience of using a panoramic receiver or a spectrum analyser, particularly if the working frequency of the equipment under test changes appreciably during the work cycle.

A.1.2 *Artificial mains network (AMN)*

Measurement of the mains terminal disturbance voltage shall be made using an artificial mains network consisting of 50 Ω/50 μH network as specified in CISPR 16, section **2**, clause **8**.

The artificial network is required to provide a defined impedance at RF across the mains supply at the point of measurement and also to provide for isolation of the equipment under test from ambient noise on the power lines.

A.1.3 *Voltage probe*

The voltage probe in accordance with the requirements of subclause **7.2.3** of EN 55011 and shown in figure A.2 shall be used where specified for UPS outputs and when the artificial mains network cannot be used due to the current rating of the input of the UPS. The probe is connected sequentially between each line and the reference earth chosen (metal plate, metal tube).

The probe consists mainly of a blocking capacitor and a resistor such that the total resistance between the line and earth is at least 1500 Ω. The effect on the accuracy of measurement of the capacitor or any other device which may be used to protect the measuring receiver against dangerous currents shall be either less than 1 dB or allowed for in calibration.

The ground connector of the probe is to be connected to reference ground with a low impedance. Length of this connection shall be less than 1/10 of the wavelength of the maximum measurement frequency (30 MHz <1 m), but also below 3 MHz, not longer than 10 m.

A.1.4 *Antennas*

In accordance with the requirements of subclause **7.2.4** of EN 55011.

A.2 Test unit configuration

A.2.1 Where not specified herein, the UPS shall be configured, installed, arranged and operated in a manner consistent with typical applications. Interface cables/loads/devices shall be connected to at least one of each type of interface port of the UPS, and where practical, each cable shall be terminated in a device typical of actual usage.

Where there are multiple interface ports of the same type, additional interconnecting cables/loads/devices may have to be added to the UPS depending upon the results of preliminary tests.

The number of additional cables should be limited to the condition where the addition of another cable does not affect the emission level of more than 2 dB. The rationale for the selection of the configuration and loading of ports shall be included in the test report.

A.2.2 Interconnecting cables should be of the type and length specified in the individual equipment requirements. If the length can be varied, the length shall be selected to produce maximum emission.

A.2.3 If shielded or special cables are used during the tests to achieve compliance, then a note shall be included in the instruction manual advising of the need to use such cables.

A.2.4 Excess lengths of cables shall be bundled at the approximate centre of the cable with the bundles from 0.3 m to 0.4 m in length. If it is impractical to do so because of cable bulk or stiffness, or because the testing is being done at a user installation, the disposition of the excess cable shall be precisely noted in the test report.

A.2.5 Any set of results must be accompanied by a complete description of the cable and equipment orientation so that results can be repeated. If there are conditions of use, those conditions shall be specified and documented, e.g. cable length, cable type, shielding and grounding. These conditions shall be included in the instructions to the user.

A.2.6 When an equipment is being evaluated which interacts with other equipment to form a system, then the evaluation may be carried out using either additional equipment to represent the total system or with the use of simulators. In either method care shall be taken to ensure that the equipment under test is evaluated with the effects of the rest of the system or simulators satisfying the ambient noise conditions specified in **A.5.5**. Any simulator used in place of an actual equipment shall properly represent the electrical and in some case the mechanical characteristics of the interface, especially with respect to RF signals and impedances as well as cable configuration and types.

NOTE. This procedure is required to permit the evaluation of equipments which will be combined with other equipments from different manufacturers to form a system.

A.2.7 For UPS whose battery is external to the unit where possible it shall be included in the test set-up and installed in accordance with manufacturer's instructions.

Where this is not possible, or the battery is supplied by others including its housing, then this shall be noted in the test report.

A.2.8 A.C. outputs shall be loaded with resistive devices and be capable of adjustment to obtain the required levels of active power loading for the UPS under test.

A.2.9 The test unit situation relative to the ground plane shall be equivalent to that occurring in use, i.e. floor standing equipment is placed on a ground plane or on an isolating floor (e.g. wood) close to a ground plane, and portable equipment is placed on a non-metallic table.The power and signal cables shall be oriented with respect to the ground plane in a manner equivalent to actual use. The ground plane may be of metal.

NOTE. Specific ground plane requirements are given in **A.5.3** for terminal voltage measurements and in **A.8.1** for field strength measurements.

A.3 Determination of maximum emission configuration(s)

Initial testing shall identify the frequency that has the highest emission relative to the limit while operating the UPS in typical modes of operation and cable positions in a test set-up which is representative of typical system configurations. The identification of the frequency of highest emission with respect to the limit shall be found by investigating emissions at a number of significant frequencies as detailed, to give confidence that the probable frequency of maximum emission has been found and that the associated cable, UPS configurations and mode of operation identified.

For initial testing, the UPS shall be set up in accordance with figures A.4 through A.11. The distances between the UPS and peripherals are set according to the figures, and only the cables are to be manipulated in order to find the maximum.

For table-top systems during this process, cables should be manipulated within the range of typical configurations. For floor-standing equipment, the cables should be located in the same manner as the user would install them and no further manipulation need be made. If the manner of cable installation is not known, or if it changes with each installation, cables for floor-standing equipment shall be manipulated to the extent practical to produce the maximum level of emissions.

Final measurements shall be conducted as in **A.5**, **A.6** and **A.7** for terminal interference voltage and interference field strength measurements, respectively.

A.4 Operation of the equipment under test (UPS)

The UPS shall be operated at the rated (nominal) operating voltage and typical load conditions for which it is designed. Loads may be actual or simulated. The test programme or other means of exercising the equipment should ensure that various parts of a system are exercised in a manner that permits detection of all system emissions, in any mode of operation of the UPS.

A.5 Method of measurement of mains terminal interference voltage

A.5.1 *Measuring receivers*

Measurements shall be carried out using quasi-peak and average detector receivers described in **A.1.1**.

A.5.2 *Artificial mains network (AMN)*

An artificial mains network as described in **A.1.2** shall be used.

Connection of the test unit to the artificial mains network is required and the test unit is located so that the distance between the boundary of the test unit and the closest surface of the artificial mains network is 0,8 m.

Where a mains flexible cord is provided by the manufacturer, this shall be 1 m long or if in excess of 1 m the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0,4 m in length.

Where a mains cable is specified in the manufacturer's installation instructions a 1 m length of the type specified shall be connected between the test unit and the artificial mains network.

The test unit shall be arranged and connected with cables terminated in accordance with the manufacturer's instructions.

Earth connections, where required for safety purposes, shall be connected to the reference earth point of the network and where not otherwise provided or specified by the manufacturer shall be 1 m long and run parallel to the mains connection at a distance of not more than 0,1 m.

Other earth connections (e.g. for EMC purposes), either specified or supplied by the manufacturer for connection to the same ultimate terminal as the safety earth connection, shall also be connected to the reference earth of the network.

It may not be possible to measure at some frequencies because of conducted ambient noise which couples from local broadcast service fields. A suitable additional radio-frequency filter may be inserted between the artificial mains network and the mains supply, or measurements may be performed in a shielded enclosure. The components forming the additional radio-frequency filter should be enclosed in a metallic screen directly connected to the reference earth of the measuring system. The requirements for the impedance of the artificial mains network should be satisfied, at the frequency of the measurement, with the additional radio-frequency filter connected.

Exception

For UPS whose power rating is beyond the normal ratings of AMNs, it shall be permitted to measure the mains terminal voltage by use of a voltage probe, in accordance with CISPR 16 and shown in figure A.2.

Where this is done, the mains supply current rating shall be at least the same rating as will be the mains supply of the installed UPS, in order to match as best possible the site mains source impedance.

A.5.3 ***Ground plane***

The test unit, if unearthed and non-floor-standing, shall be placed 0,4 m from a reference ground plane consisting of a horizontal or vertical metal surface of at least 2 m by 2 m and shall be kept at least 0,8 m from any other metal surface or other ground plane not being part of the test unit. If the measurement is made in a screened enclosure, the distance of 0,4 m may be referred to one of the walls of the enclosure.

Floor-standing test units are subject to the same provisions with the exception that they shall be placed on a floor, the point(s) of contact being consistent with normal use. The floor may be of metal but shall not make metallic contact with the floor supports of the test unit(s). A metal floor may replace the reference ground plane. The reference ground plane shall extend at least 0,5 m beyond the boundaries of the test unit and have minimum dimensions of 2 m by 2 m.

The reference earth point of the artificial mains network shall be connected to the reference ground plane with a conductor as short as possible, having a length to width ratio of less than 3:1 or bolted to reference ground-plane.

A.5.4 ***Equipment set-up for conducted emission measurements***

The UPS shall be configured and operated in accordance with the requirements of A.2 and set-up in accordance with figures A.4 through A.9 for table-top equipment and floor-standing equipment.

Table-top UPS shall be placed upon a non-metallic table 0,8 m above the horizontal ground plane (see **A.5.3**) and 0,4 m from a vertical ground plane which is connected to the horizontal ground plane.

Equipment designed for both table-top or floor operation shall be tested only in the table-top configuration, unless the typical installation is floor-standing, when the respective configuration is used.

Equipment designed for wall mounted operation shall be tested as table-top UPS. The orientation of the equipment shall be consistent with that of normal operation.

A mains port is connected, via its mains cord, to an artificial mains network (AMN), unless being tested in accordance with the exception of **A.5.2** at a test site or 'in-situ'. A.C. output port is connected to a load bank. A signal port is connected, via its signal cable, to an impedance stabilization network (ISN) when intended for connection to an external signal line in practice.

A.5.5 ***Measurement of conducted emission***

As described in **A.3**, the one UPS configuration, the one cable configuration and mode of operation which produced the highest emission relative to the limit is found.

Use this configuration to measure and record data. Of those emissions no greater than 20 dB below the limit, record at least the six highest emission frequencies relative to the limit from the current-carrying mains ports and telecommunications ports of the UPS. The specific conductor for each emission shall be identified.

The emission from a signal port shall, when so specified, be measured as current instead of voltage by means of a current probe, in accordance with CISPR 16, section **2**, clause **10**.

A.6 Method of measurement a.c. output ports (where applicable)

The a.c. output port shall be connected to a resistive load bank and the a.c. output active power increased slowly from zero to the maximum rated value to determine worst case disturbance voltage.

The load should be purely resistive to avoid errors of measurement with non-sinusoidal waveforms.

The disturbance voltage shall be measured by a voltage probe with a characteristic outlined in CISPR 16 and shown in figure A.2.

The disturbance voltage shall not exceed the limits of **2.4.2** when measured at the UPS output terminations to the load equipment.

The effect of accuracy of measurement of the voltage probe capacitor or other device which may be used to protect the measuring receiver against dangerous currents shall be either < 1 dB or allowed for in calibration.

Typical connection method is shown in figure A.6 for connection of the voltage probe. Connection length shall be limited, where practicable, to 2 m in length or additional loss adjustment taken into account.

The probe shall measure each output termination to reference earth and results recorded.

Where practical, the load shall be positioned 0,8 m from UPS under test with load cable length of 1 m.

If the UPS mains input is connected via an artificial mains network (AMN) this shall remain in circuit in order to maintain the defined impedance of the supply.

A.7 Method of measurement of radiated emission

Measurements shall be conducted with a quasi-peak detector instrument in the frequency range of 30 MHz to 1000 MHz.

Measurements of the radiated field shall be made at a distance measured from the boundary of the test unit. The boundary is defined by an imaginary straight line periphery describing a simple geometric configuration encompassing the test unit. All UPS inter-system cables and connecting UPS shall be included within this boundary.

The specific measurement distances for class A-UPS and class B-UPS are given in **2.5.1**.

A.7.1 ***Measuring receivers***

The measuring receivers shall be in accordance with the requirements of section **1** of CISPR 6.

A.7.2 ***Antennas***

In accordance with the requirements of subclause **7.2.4** of EN 55011.

A.8 Measurement site

A.8.1 ***Test site***

In accordance with the requirements of clause **8** of EN 55011.

A.8.2 ***Alternative test sites***

In some cases it may be necessary to conduct tests at sites that do not have all the characteristics described in **A.8.1**. Evidence shall be obtained that the errors due to such alternative sites do not invalidate the results obtained. Figure A.3 is an example of an alternative site. A ground plane not satisfying all the requirements of **A.8.1** is another example.

A.8.3 ***User installation testing***

In some cases, measurements of class A-UPS or a restricted sales distribution UPS whose output current exceeds 25 A at the user's installation might be necessary.

These measurements shall be made preferably at the boundary of the user's premises; if such boundary is less than 30 m from the test unit, the measurements shall be made at a distance of 30 m from the test unit.

The number of measurements made in azimuth shall be as great as reasonably practical, but there shall be at least four measurements in orthogonal directions, and measurements in the direction of any existing equipment which may be adversely affected.

This form of compliance verification is specific to the installation site since the site characteristics affect the measurement. Additional type-tested and compliant UPS may be added to the test unit without invalidating the compliance status of the measurement.

A.9 Equipment set-up for radiated emission tests

The UPS shall be configured and operated in accordance with the requirements of **A.5.4** and set up in accordance with figure A.10 for table-top equipment and figure A.11 for floor-standing equipment.

Table-top UPS shall be placed upon a non-metallic table 0,8 m above the horizontal ground plane of the radiated emission test site.

Floor-standing UPS shall be placed directly on the ground plane, the point(s) of contact being consistent with normal use but separated from metallic contact with the ground plane by up to 12 mm of insulation.

Equipment designed for both table-top and floor-standing operation shall be tested only in the table-top configuration unless the typical installation is floor-standing, when the respective configuration is used.

Equipment designed for wall mounted operation shall be tested as table-top UPS. The orientation of the equipment shall be consistent with that of normal operation.

A.9.1 ***Radiated emission measurements***

As described in **A.4**, the one UPS configuration, the one cable configuration and mode of operation which produced the highest emission relative to the limit is found. This configuration is used to measure and record data.

Variations in aerial heights, aerial polarization and UPS azimuth shall be explored while the frequency spectrum is monitored to produce the highest emission relative to the limit.

Of those emissions no greater than 20 dB below the limit, record at least the six highest emission frequencies relative to the limit. Record the antenna polarization for each reported emission.

A.9.2 ***Measurement in the presence of high ambient signals***

In accordance with the requirements of subclause **10.4** of EN 55022.

A.10 Measurement of interference power

The authorities in certain countries believe that, in the case of class B-UPS equipment the measurement of, and limits for interference power are more suitable for regulatory and control purposes than are the measurement of, and limits for field strength of the interference. Therefore, the measurement of and limits for interference power are under consideration.

A.11 Assessment of conformity of equipment

In accordance with the requirements of clause **6** of EN 55011.

For general information see CISPR publication 16, Section 9: *Statistical consideration in the determination of limits of radio interference.*

A.12 Measurement of radiated magnetic disturbances produced by the UPS (H field) – optional

Refer to annex B for test limits.

From 10 kHz to 30 MHz, the magnetic component of the field radiated by the test unit is measured.

If measurements are taken in a shielded enclosure, its dimensions are such that antennas are always located at least 1 m from each of the walls. The device under test is placed on its grounded surface 1 m $\pm$ 0.2 m from the floor. Measurements are taken at a distance D = 3 m from the most disturbance producing side of the device under test.

The most disturbance-producing side is defined as the one emitting the highest signal in the frequency band under consideration. The choice of this side and the orientation of the measuring antenna are made simpler by using a spectrum analyzer. The measurement distance is counted from the antenna's centre of phase.

Measurements are taken using a shielded loop aerial, as shown in figure A.1. The frame is oriented in a vertical plane so that it receives the maximal magnetic field.

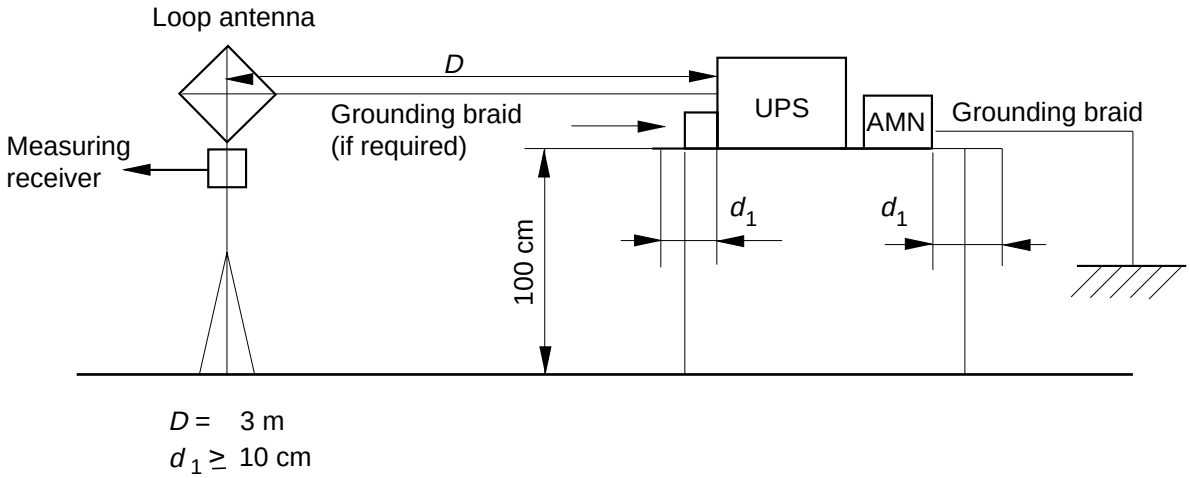


Figure A.1 Test set-up for measuring radiated disturbances

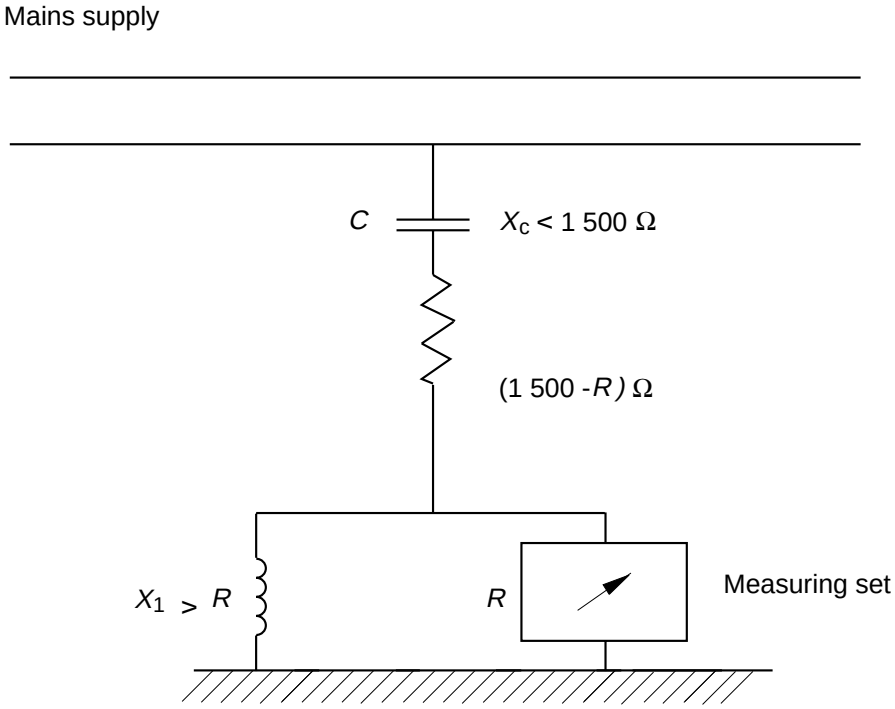
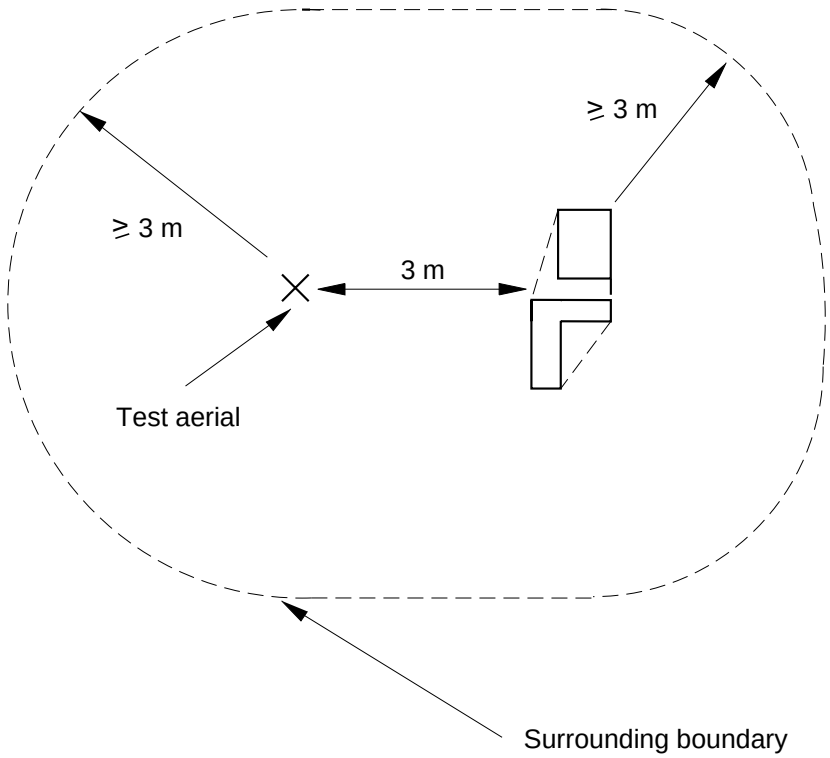
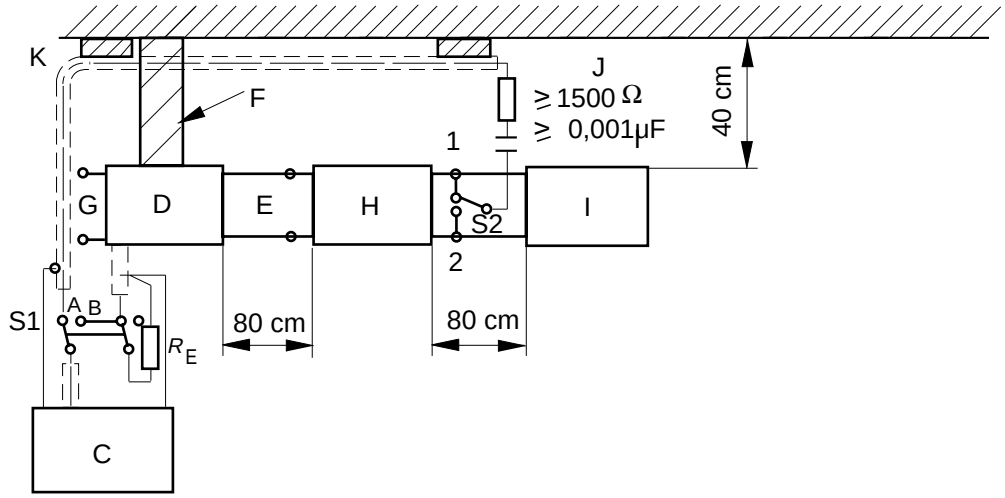


Figure A.2 Circuit for disturbance voltage measurements on mains supply or UPS output



There shall be no reflecting object inside the volume defined on the ground by the line corresponding to this figure and defined in height by a horizontal plane ≥ 3 m above the highest element of either aerial or equipment under test.
NOTE. See **A.8.2** for applicability of the alternative test site.

Figure A.3 Minimum alternative test site



Key

A = Load measuring switch position
B = Mains measuring switch position
C = RFI measuring receiver
D = Artificial mains network (AMN)
E = AMN to UPS power connection
F = Groundstrap (lgth/width 3:1 max.)
G = Input power connections
H = UPS
I = Load
J = Voltage probe
K = Reference ground
R_E = Terminating resistor (50 Ω)

NOTES.
1. The test ground of the RFI measuring must be securely fastened to the AMN ground.
2. When the switch is in position A, the measuring set terminal on the AMN must be terminated with the appropriate terminating resistor, R_E.
3. For UPS and/or loads of protection class 1, the ground safety conductor must be connected to the ground of the artificial mains network.
4. The distance between the load terminals 1 and 2 of the UPS and the load should be 0,8 m. The connecting lines between them shall not exceed 1 m.

Figure A.4 Set-up for measurement of conducted emission for table-top units

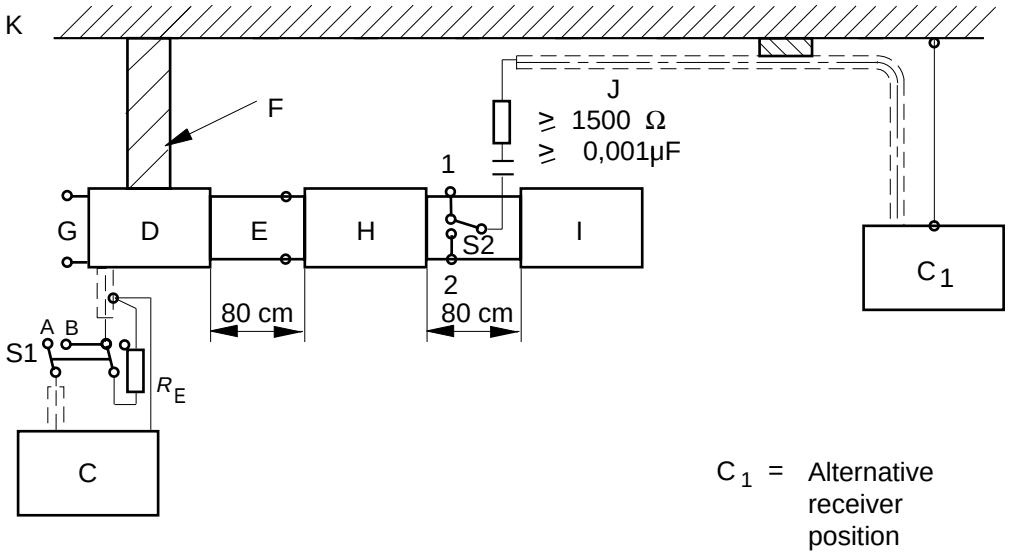
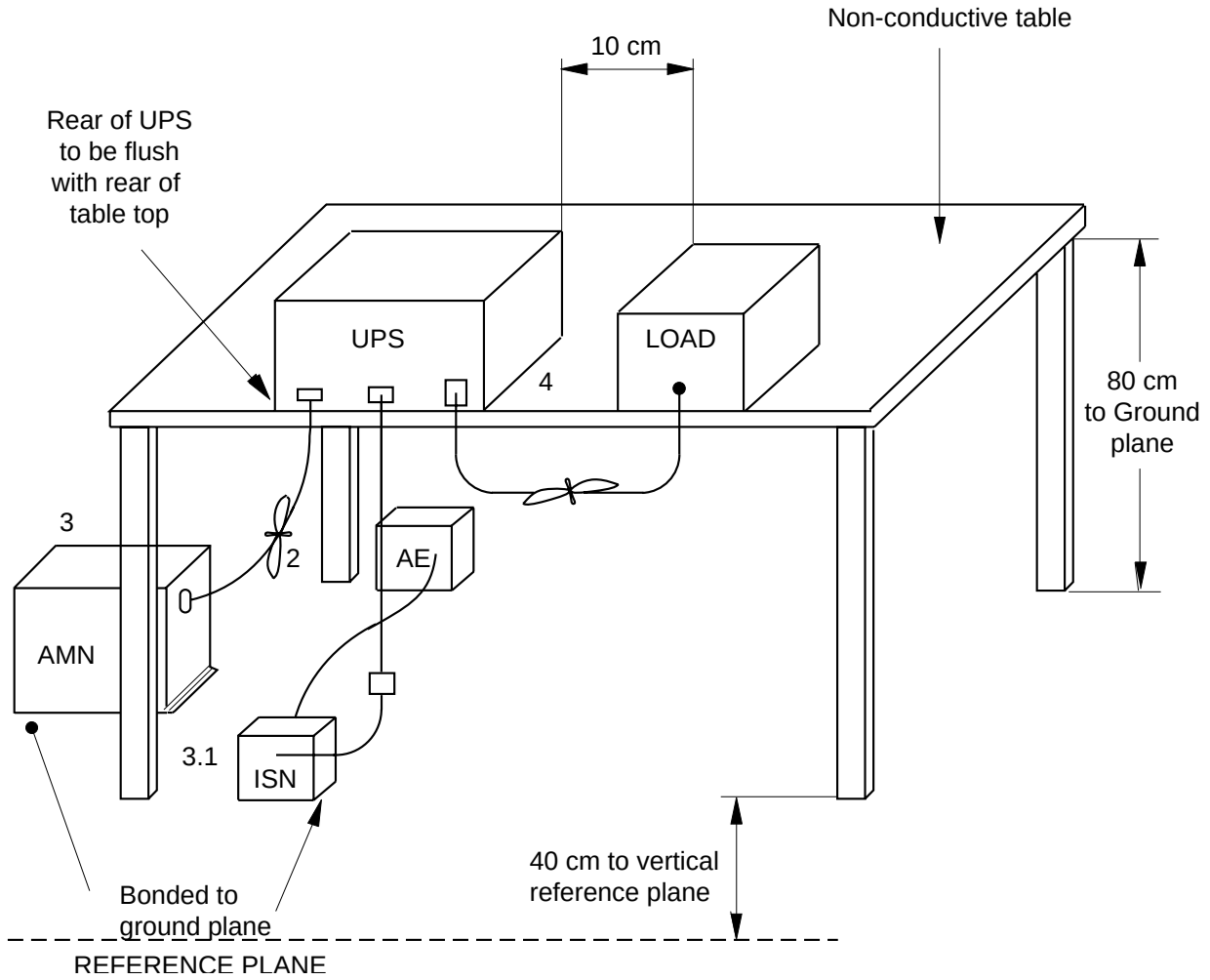


Figure A.5 Test set-up for floor-mounted units



Key

AE = Auxiliary Equipment
ISN = Impedance Stabilization Network
AMN = Artificial Mains network

NOTES.
1. Interconnecting cables which hang closer than 0,4 m to the ground-plane shall be folded back and forth forming a bundle 0,3-0,4 m long, hanging approximately in the middle between ground-plane and table.

2. Excess mains cord shall be bundled in the centre or shortened to approximate length.

3. UPS connected to one AMN. All AMNs and ISNs may alternatively be connected to a vertical ground-plane or metal wall (see figure A.10).

3.1 AMN and ISN 0,8 m from UPS and at least 0,8 m from other units and other metal planes.

3.2 Mains cords and signal cables shall be positioned for their entire lengths, as far as possible, at 0,4 m from the vertical ground-plane.

4. External battery assembly to be positioned as for normal use (where applicable). I/O signal cable intended for external connection. The end of the I/O cables which are not connected to an AE may be terminated if required using correct terminating impedance.
If used, the current probe shall be placed at 0,1 m from the ISN.

Figure A.6 Test configuration table-top equipment (conducted emission measurement)

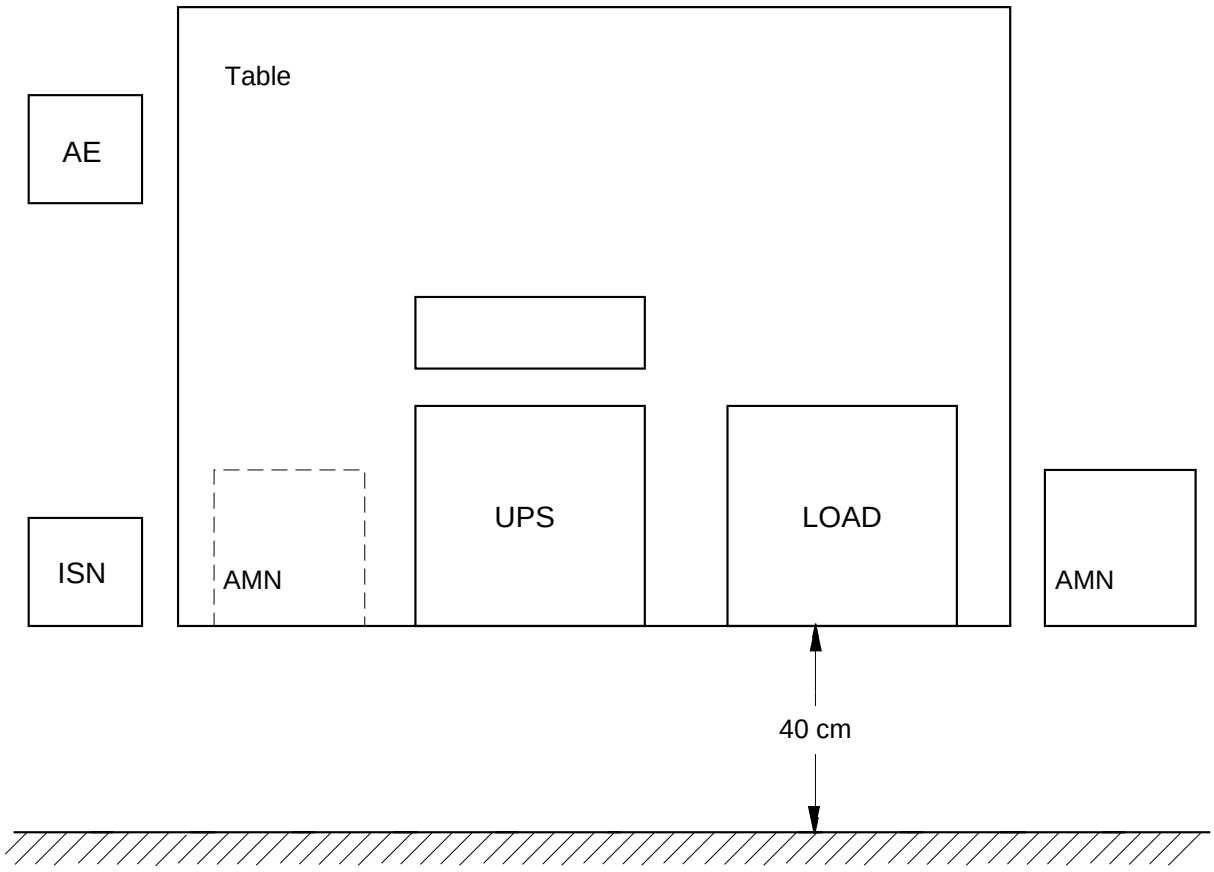


Figure A.7 Test configuration table-top equipment (conducted emission measurement) plan view

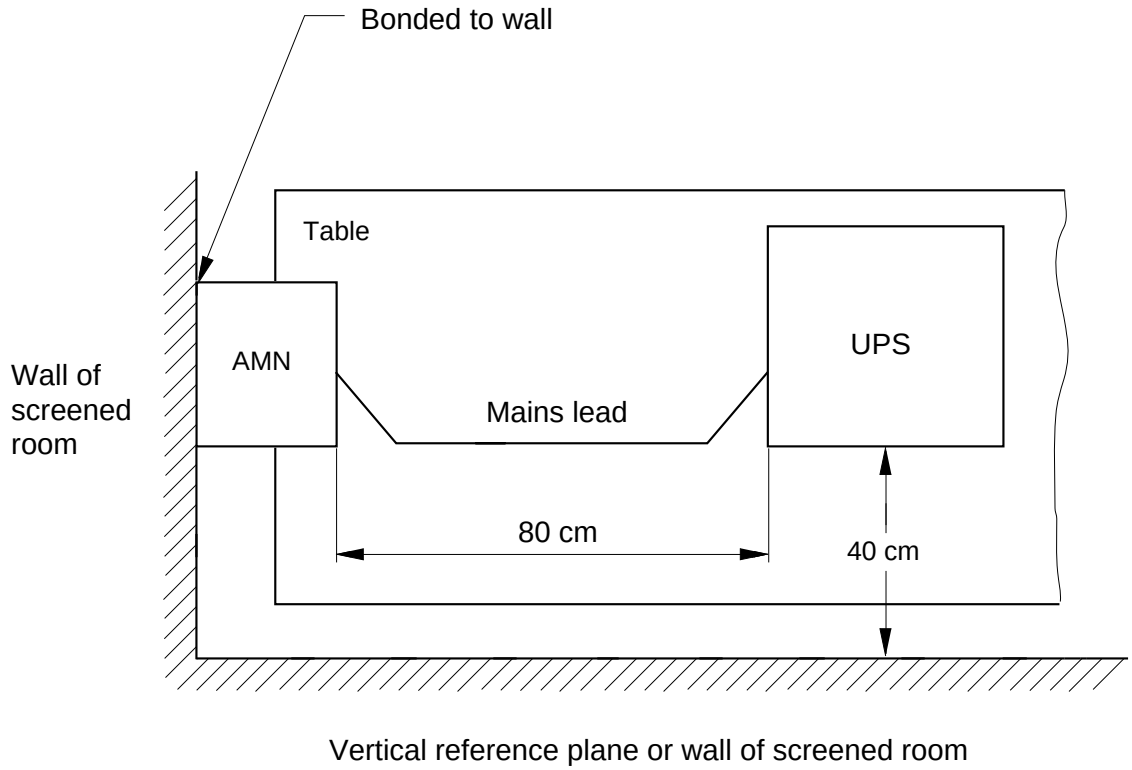
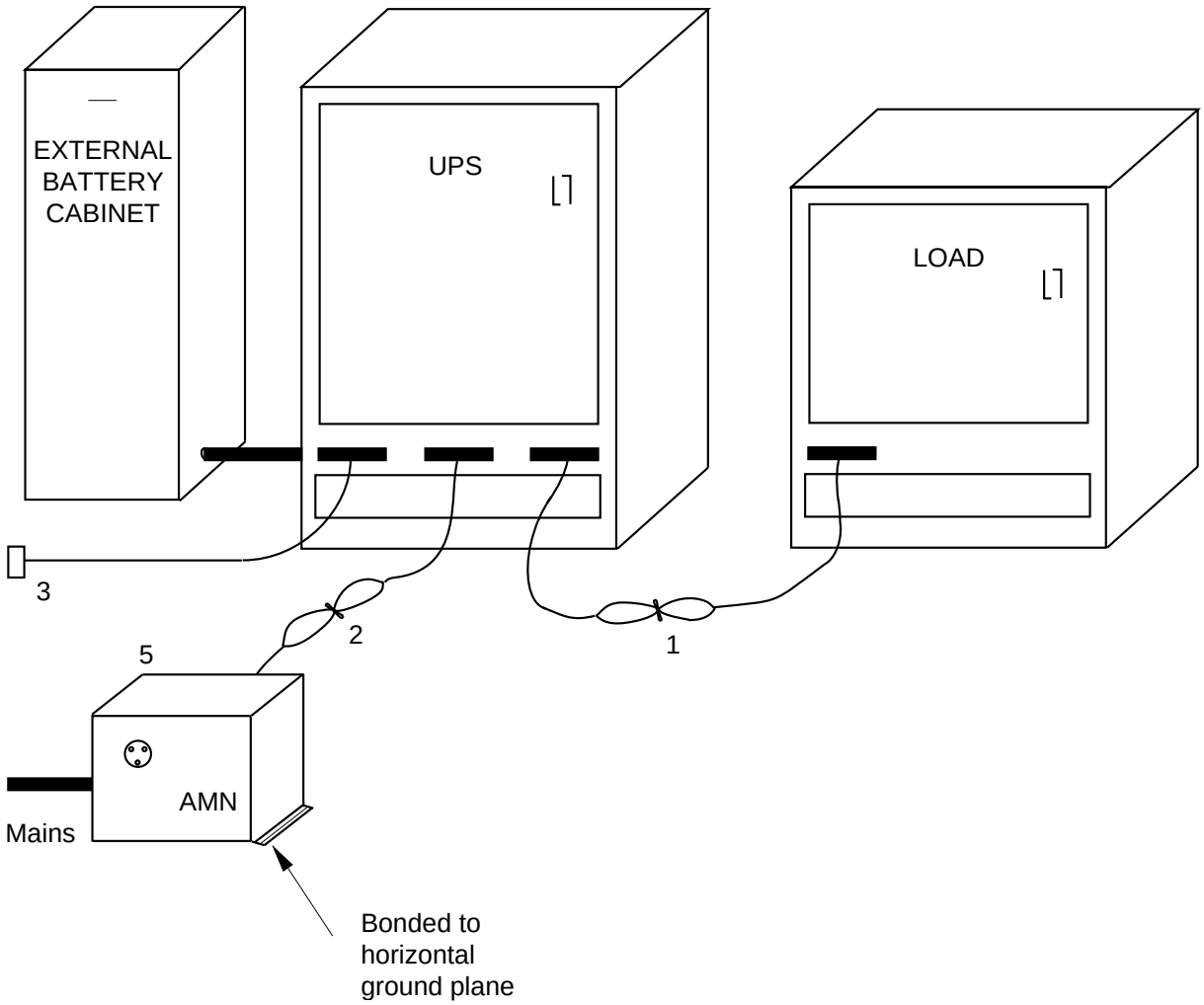


Figure A.8 Alternative test configuration table-top equipment (conducted emission measurement) plan view



NOTES.
1. Excess I/O cables shall be bundled in centre. If bundling is not possible the cables shall be arranged in a serpentine fashion.

2. Excess mains cord shall be bundled in the centre or shortened to appropriate length.

3. The end of the I/O cables which are not connected to a peripheral may be terminated if required for proper operation using correct terminating impedance.

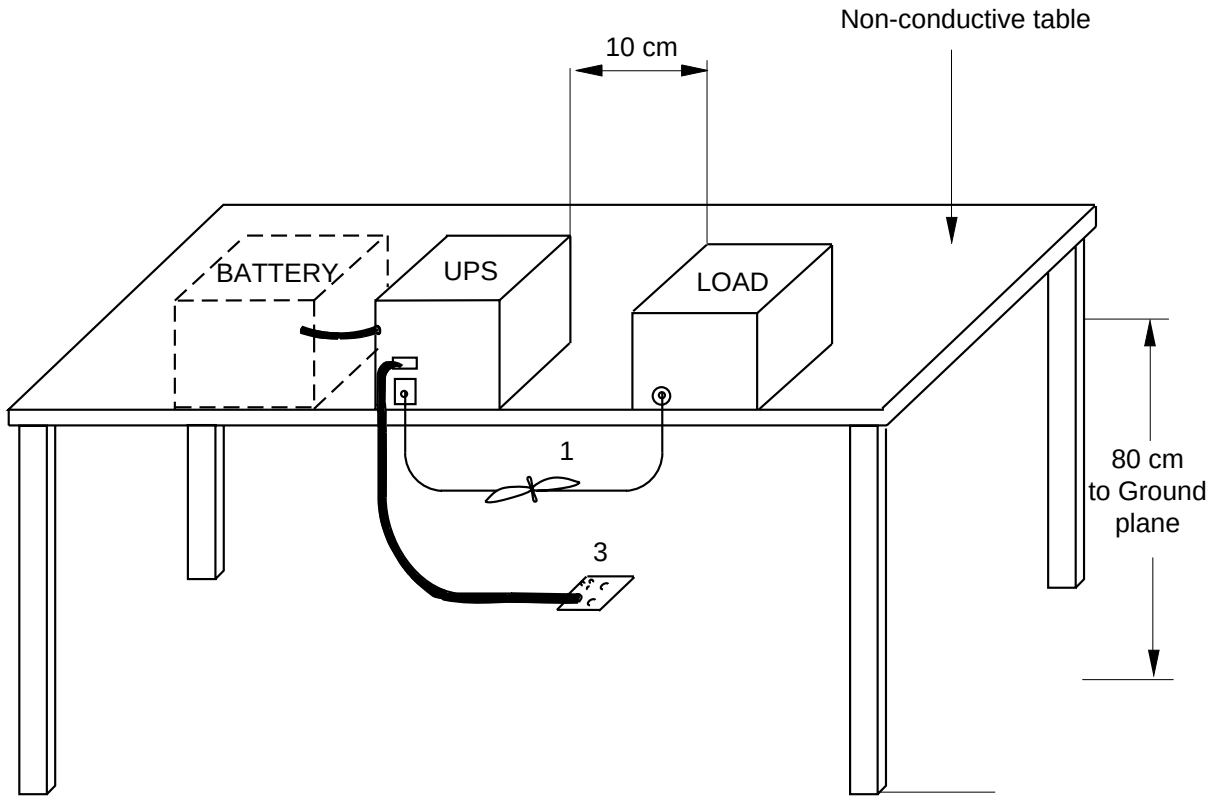
4. UPS and cables shall be insulated (up to 12 mm) from horizontal ground-plane.

5. UPS connected to one AMN. AMN can be placed on top of or immediately beneath the ground-plane.

6. If used, the current probe shall be placed at 0,1 m from the ISN.

7. External battery (where applicable) shall be positioned and wired as for a normal site configuration.

Figure A.9 Test configuration floor-standing equipment (conducted emission measurement)



NOTES.
1. Interconnecting cables which hang closer than 0,4 m to the ground-plane shall be folded back and forth forming a bundle 0,3 m to 0,4 m long, hanging approximately in the middle between ground-plane and table.

2. The end of the I/O cables which are not connected to a peripheral may be terminated if required for proper operating using correct terminating impedance.

3. Mains junctions box(s) shall be flush with and bonded directly to the ground-plane.

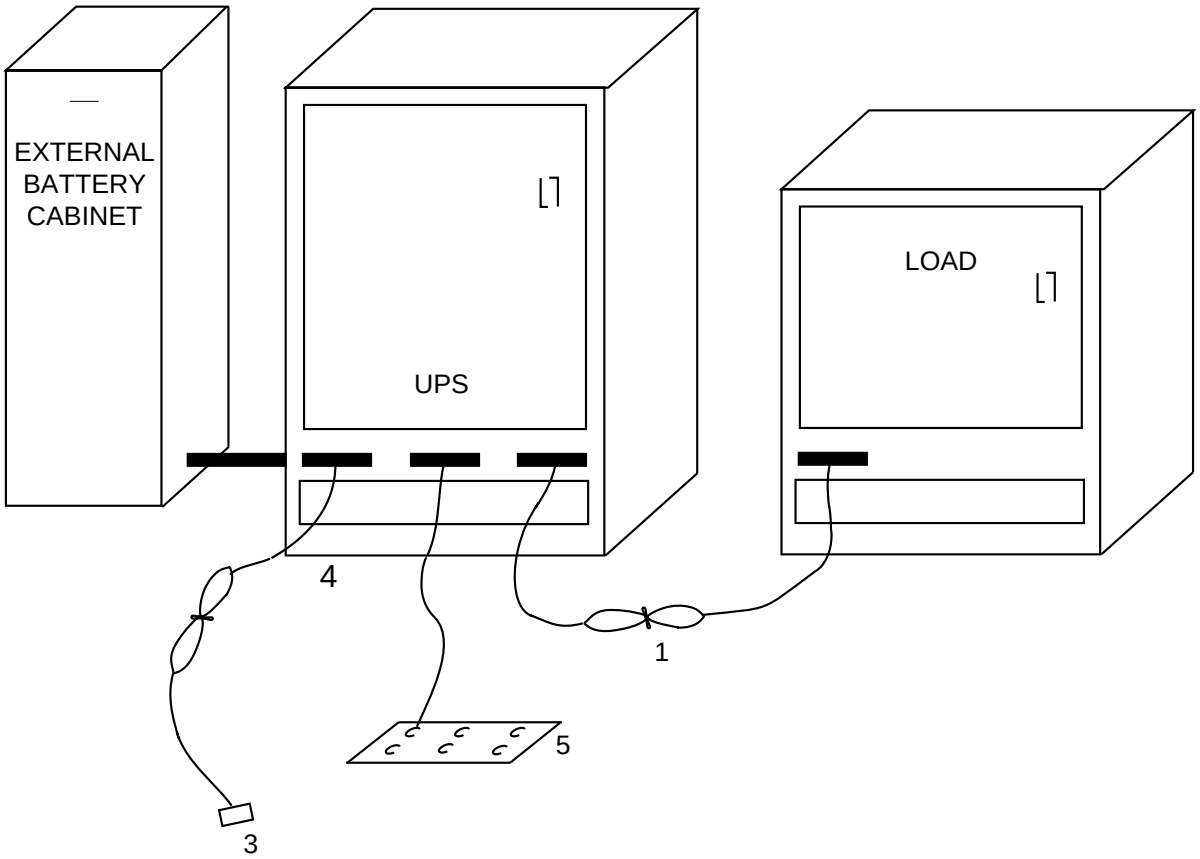
3.1. If used, the AMN shall be installed under the ground-plane.

4. External battery (where applicable) to be positioned and wired for normal site configuration.

5. Peripherals shall be placed at a distance of 0,1 m.

6. Mains cables shall drape to the floor and then routed to receptacle. No extension cords shall be used to mains receptacle.

Figure A.10 Test configuration table-top equipment (radiated emission requirement)



NOTES.
1. Excess I/O cables shall be bundled in centre. If bundling is not possible the cables shall be arranged in a serpentine fashion.

2. Excess mains cords shall be bundled in the centre or shortened to appropriate length.

3. The end of the I/O cables which are not connected to a peripheral shall be bundled in the centre and may be terminated if required with correct impedance.

4. UPS and cables shall be insulated (up to 12 mm) from ground-plane.

5. Mains junction box(s) shall be flush with and bonded directly to the ground-plane.

5.1. If used, the AMN should be installed under the ground-plane.

6. Mains and signal cables shall drape to the floor.

7. External battery (where applicable) shall be positioned and wired as for a normal installed condition.

Figure A.11 Test configuration floor-standing equipment (radiated emission measurement)

Annex B (informative)

Electromagnetic emission limits of magnetic field – H field (optional where requested by purchaser)

B.1 When measured by a loop antenna the following limits apply when measured at 3 m distance in accordance with figure A.1.

a) UPS which has a rated output current less or equal to 25 A.

Frequency range in MHz	**Quasi-peak limits in** (dB / μA/m)	
	Class A-UPS	**Class B-UPS**
0,01 to 0,15	52,0 to 28,5[1)]	40,0 to 16,5[1)]
0,15 to 1,0	28,5 to 12,0	16,5 to 0
1 to 30	12,0 to 1,5	0 to −10,5
In all frequency ranges, the limit value reduces linearly with the logarithm of the frequency.		
[1)] Not mandatory up to 150 kHz.		

b) UPS which has a rated output current greater than 25 A.

Frequency range in MHz	**Quasi-peak limits in** (dB / μA/m)	
	Class A-UPS	**Class B-UPS**
0,01 to 0,15	64,0 to 40,5[1)]	52,0 to 28,5[1)]
0,15 to 1,0	40,5 to 24,0	28,5 to 12,0
1 to 30	24,0 to 13,5	12,0 to 1,5
In all frequency ranges, the limit value reduces linearly with the logarithm of the frequency.		
[1)] Not mandatory up to 150 kHz.		

NOTE. UPS which have a rated current >100 A are under consideration.

Annex C (informative)

Electromagnetic emission limits of signal ports

Table C.1 (Only if the cable lengths exceed 10 m in length.)

Port	**Frequency range**	**Limits**	**Basic standard**
Signal, control	0,15 – 0,5 MHz Limit decreasing linearly with log. frequency	40 – 30 dBV (μA) quasi-peak 30 - 20 dB (μA) average	CISPR Publication 22 Amendment under consideration class B
	0,5 – 30 MHz	30 dB (μA) quasi-peak 20 dB (μA) average	

Annex D (normative)

Electromagnetic immunity – test methods

D.1 General

The purpose of these tests is to measure the degree of immunity of UPS systems for electromagnetic disturbances.

Due to the range of physical size and power ratings the manufacturer may choose the most appropriate test site and configuration that is best to physically accommodate the UPS.

D.1.1 *Test environment*

It is preferred to do the immunity tests in a laboratory environment, in which all tests shall be performed on a metallic ground plane, projecting at least 0,5 m beyond the UPS on all sides, however with a minimal size of 1 m × 1 m.

Floor-standing UPS shall be placed on a dry wooden pallet of 0,1 m height.

UPS intended for table-top use shall be placed on a wooden table of 0,8 m height.

The equipment under test is further referenced as UPS.

D.2 Electrostatic discharge

The immunity to electrostatic discharges shall be tested according to IEC 801-2 : 1991, level 3. The test shall be applied only to such points and surfaces of the UPS which are accessible to personnel during normal usage, as well as to a horizontal and a vertical coupling plane of 0,5 m × 0,5 m.

The test generator of IEC 801-2 : 1991 shall be used, where a discharge is made from a charged capacitor of 150 pF through 330 Ω with a rise time of less than 1 ns.

At least 10 discharges, of each polarity, shall be applied to the selected test points on the UPS and vertical coupling plane.

D.3 Immunity to radiated electromagnetic fields

D.3.1 The immunity test to radiated electromagnetic fields shall be performed according to IEC 801-3 : 1984, level 2.

The test equipment, test facility, calibration, test set-up and procedure shall be in accordance with the relevant clauses of IEC 801-3 : 1984.

D.3.2 *Arrangement of wiring*

In accordance with subclause **7.3** of IEC 801-3 : 1984.

D.4 Immunity to fast transients

D.4.1 The immunity test for repetitive fast transients is required on all cables that can be connected to the UPS, unless they are declared by the manufacturer to be shorter than 3 m.

D.4.2 The equipment shall be tested according to IEC 801-4, level 2, with an open terminal generator voltage of 1 kV for the power supply lines, and 0,5 kV for the I/O, data and control lines.

The pulses have a rise time of 5 ns, decay 50 ns, a repetition frequency of 5 kHz, and are present for 15 ms each 300 ms for a total duration of at least 1 min on each cable.

If the UPS has a protective earth terminal, it shall be connected to the ground plane with a short wire; if the protective earth is incorporated in the mains cable, the 'far' end of the protective earth wire shall be connected to the ground plane. No additional earthing connections are allowed.

D.4.3 ***Coupling method***

A capacitive coupling clamp according to subclause **6.3** of IEC 801-4 : 1988 shall be placed not more than 1 m from the UPS on any incoming or outgoing cable.

Each conductor of the mains input side including the earth conductor shall be tested separately this way. At all other cables, a multi-conductor cable or a shielded cable is regarded as one cable, and shall be tested as a whole in the capacitive clamp.

D.5 Immunity to surges

This test is under consideration.

As an indication, a test according to IEC 801-5 (in preparation) level 3 can be performed.

A unidirectional pulse from a test generator with open terminal voltage of 2 kV, and rise/fall times of (1,2/50) μs is applied between all mains terminals of the UPS and ground. Both polarities are to be tested.

The preferred test method of IEC 801-5 with 20 mH series inductors in each mains line is suitable only for equipment up to 500 W and therefore not applicable to UPS.

The test set-up with an isolating input power transformer according to IEC 801-5, figure A.2, shall therefore be used for single and three phase equipment.

The internal impedance of the surge generator shall be:

– 12 Ω for testing between power lines and ground;

– 42 Ω for testing between signal lines and ground.

Where testing between lines is required, the test voltage shall be 1 kV and the source impedance 2 Ω.

NOTE. The unidirectional pulse of IEC 801-5 represents the effects of lightning. In the future IEC 1000-4-5 the unidirectional wave is likely to be replaced by the ring wave immunity test, which comes closer to the actual waveform on LV mains terminals. The rise time of the ring wave is 0,5 μs, the oscillation frequency is 100 kHz, and the damping is critical.

D.6 Immunity to low frequency signals

D.6.1 ***Power line harmonics and inter-harmonics***

The operating UPS shall withstand the low frequency conducted disturbances in the mains, as specified in IEC 1000-2-2. Compliance is checked by simulating the conditions below and the UPS shall continue to operate without degradation of the specified performances.

D.6.1.1 *Single phase equipment*

The test shall be performed according to subclause **A.1.1.4**b of IEC 1000-4-1. As a minimum, testing shall be performed with a single sinusoidal disturbing voltage of 10 V r.m.s., at a frequency which is slowly varied from 140 Hz to 360 Hz.

D.6.1.2 *Three phase equipment*

The test set-up and voltage level for each phase is identical to the set-up for single phase equipment, however, a three phase variable frequency generator is used (static or rotating). The frequency is slowly varied from 140 Hz to 360 Hz.

The test shall be performed for both rotating sequences of the disturbing three phase signal.

If the equipment has a neutral terminal, it shall be connected and tested as in the single phase test, but only at a frequency close to three times the line frequency.

D.6.2 ***Power line unbalance (three phase UPS systems only)***

Three phase systems shall be tested for amplitude and phase unbalance on the power line input.

An unbalance signal is made with a single phase transformer. For the amplitude unbalance test, the transfer ratio of the transformer shall be 230/5 V, and the connection is as in figure D.1. The test shall be performed both with the shown and with the reversed connection of the primary side of the transformer.

The phase unbalance test is done with a 400/5 V transformer, connected as in figure D.2. The test shall be performed both with the shown and the reversed connection of the primary side of the transformer.

The unbalance tests are performed on one line only.

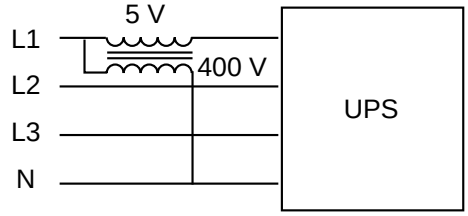


Figure D.1. Amplitude unbalance

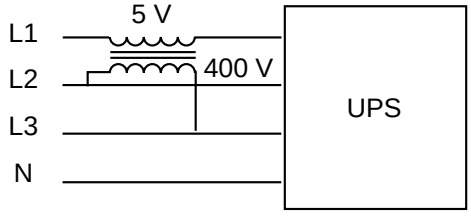


Figure D.2. Phase unbalance

D.6.3 ***Immunity to voltage dips***

Under consideration.

The test can be performed according to EN 61000-4-11. Only short interruptions are tested.

D.6.3.1 *Single phase equipment*

As a minimum, 100 % dip for 0,5 period, and 100 % dip for 10 periods shall be tested.

D.6.3.2 *Three phase equipment*

The 100 % dip for 0,5 period shall be tested on each line separately. The 100 % dip for 10 periods shall be a total mains failure on all phases.

Annex E (normative)

Attenuation test method (Under consideration)

E.1 General requirements

Attenuation is defined as the mitigation in dB of any mains borne transients or high frequency noise which are applied to the input port(s) of the UPS and appear attenuated at the output of the UPS at the point of connection to the customer load or wiring system.

Where the manufacturer declares an attenuation value in his specification, compliance shall be checked by measurement using the test methods indicated below .

E.2 Mains borne transient attenuation

During the fast transient and surge tests given in **3.4** and **3.5** for electromagnetic immunity, the maximum amplitude of the applied transient appearing at the UPS a.c. output terminals shall be measured.

The UPS shall be tested in the normal mode of operation.

Tests should be done for both common and differential mode for surge transients and common mode only for fast transients.

The attenuation shall be calculated in dB, as being the ratio of voltage peak values, and the manufacturer shall specify the reference load conditions.

Minimum requirements are under consideration.

E.3 Radio frequency attenuation

This test is under consideration.

Annex F (informative)

Relationship with EU mandate(s)/directive(s)

This standard gives the essential requirements to comply with the EMC Directive 89/336/EEC.

Compliance with this standard gives presumption of conformity to the essential requirements of this Directive.

List of references

See national foreword.

BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Tel: 020 8996 9000. Fax: 020 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: 020 8996 9001. Fax: 020 8996 7001.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: 020 8996 7111. Fax: 020 8996 7048.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: 020 8996 7002. Fax: 020 8996 7001.

Copyright

BSI
389 Chiswick High Road
London
W4 4AL