

Australian Standard[®]

Uninterruptible power systems (UPS)

Part 2: Electromagnetic compatibility (EMC) requirements



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 - Energy Networks Association
 - Monash University
-

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Australian Standard[®]

Uninterruptible power systems (UPS)

Part 2: Electromagnetic compatibility (EMC) requirements

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PREFACE

This Standard was prepared by the Standards Australia Committee EL-027, Power Electronics, to supersede AS 62040.2—2001.

The objective of this Standard is to provide manufacturers, users and regulators with requirements for electromagnetic compatibility (EMC) for uninterruptible power systems (UPS).

This Standard is identical with, and has been reproduced from IEC 62040-2, Ed. 2.0 (2005), *Uninterruptible power systems (UPS)—Part 2: Electromagnetic compatibility (EMC) requirements*.

As this Standard is reproduced from an International Standard, the following applies:

- (a) Its number does not appear on each page of text and its identity is shown only on the cover and title page.
- (b) In the source text ‘this part of IEC 62040’ should read ‘this part of AS 62040’.
- (c) A full point should be substituted for a comma when referring to a decimal marker.

The terms ‘normative’ and ‘informative’ are used to define the application of the annex to which they apply. A normative annex is an integral part of a standard, whereas an informative annex is only for information and guidance.

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STANDARDS AUSTRALIA

Australian Standard**Uninterruptible power systems (UPS)
Part 2: Electromagnetic compatibility (EMC) requirements**

1 Scope

This part of IEC 62040 applies to UPS units intended to be installed

- as a unit or in UPS systems comprising a number of interconnected UPS and associated control/switchgear forming a single power system; and
- in any operator accessible area or in separated electrical locations, connected to low-voltage supply networks for either industrial or residential, commercial and light industrial environments.

This part of IEC 62040 is intended as a product standard allowing the EMC conformity assessment of products of categories C1, C2 and C3 as defined in this part of IEC 62040, before placing them on the market.

Equipment of category 4 is treated as a fixed installation. Checking is generally done after installation in its final place of use. Sometimes partial checking may be done before. See Annex E.

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 of occurrence.

This part of IEC 62040 takes into account 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 part of IEC 62040 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 part of IEC 62040 does not cover d.c. supplied electronic ballast or UPS based on rotating machines.

This part of IEC 62040 states:

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

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

References to international standards that are struck through in this clause are replaced by references to Australian or Australian/New Zealand Standards that are listed immediately thereafter and identified by shading. Any Australian or Australian/New Zealand Standard that is identical to the International Standard it replaces is identified as such.

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

~~IEC 61000-2-2:2002, *Electromagnetic compatibility (EMC) – Part 2-2: Environment – Compatibility levels for low frequency conducted disturbances and signalling in public low-voltage power supply systems*~~

AS/NZS 61000.2.2, *Electromagnetic compatibility (EMC), Part 2.2: Environment – Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems*

IEC 61000-3-2:2000, *Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)*

~~IEC 61000-4-1:2000, *Electromagnetic compatibility (EMC) – Part 4-1: Testing and measurement techniques – Overview of IEC 61000-4 series*~~

AS/NZS 61000.4.1, *Electromagnetic compatibility (EMC), Part 4.1: Testing and measurement techniques – Overview of IEC 61000-4 series*

IEC 61000-4-2:1995, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3:2002, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

~~IEC 61000-4-4:2004, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*~~

AS/NZS 61000.4.4, *Electromagnetic compatibility (EMC), Part 4.4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5:1995, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

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

IEC 61000-4-8:1993, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

~~IEC 62040-3:1999, *Uninterruptible power systems (UPS) – Part 3: Method of specifying the performance and test requirements*~~

AS 62040.3, *Uninterruptible power systems (UPS), Part 3: Method of specifying the performance and test requirements*

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

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

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-161 related to EMC and to relevant phenomena apply, together with the following.

3.1

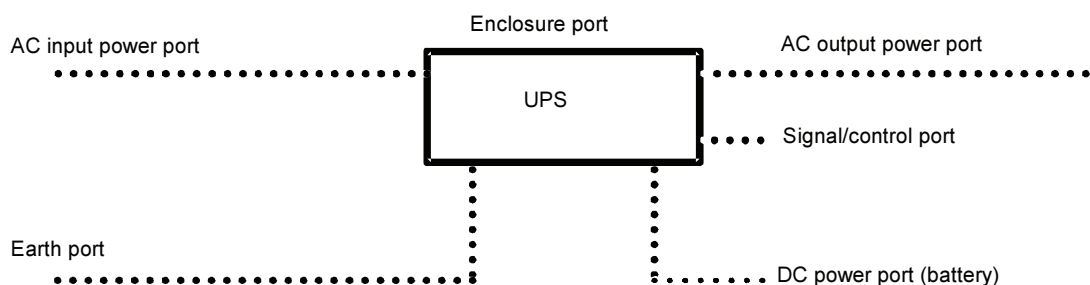
port

particular interface of the UPS with the external electromagnetic environment (see Figure 1)

3.2

enclosure port

physical boundary of the UPS through which electromagnetic fields may radiate or impinge



IEC 1655/05

Figure 1 – Examples of ports

4 Environment

The following examples of environment cover the majority of UPS installations.

- First environment: environment that includes residential, commercial and light industrial premises directly connected without intermediate transformers to a public low-voltage mains supply.
- Second environment: environment that includes all commercial, light industry and industrial establishments other than those directly connected to a low-voltage mains that supplies buildings used for residential purposes.

5 UPS Categories

5.1 UPS of category C1

This category includes UPS intended for use without any restriction in the first environment. Such UPS are suitable for use in residential establishments.

Category C1 UPS shall meet the category C1 UPS emission limits and withstand the immunity requirements of Table 5.

5.2 UPS of category C2

This category includes UPS with an output current not exceeding 16 A and intended for use without any restriction in the second environment. Such UPS may also be used in the first environment when connected:

- through industrial plugs and sockets or
- through national plugs and sockets or
- permanently.

Category C2 UPS shall meet the category C2 UPS emission limits and withstand the immunity requirements of Table 6.

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

WARNING: This is a category C2 UPS product. In a residential environment, this product may cause radio interference, in which case the user may be required to take additional measures.

5.3 UPS of category C3

This category includes UPS with an output current exceeding 16 A and intended for use in the second environment. Such UPS are suitable for use in commercial or industrial installations having a minimum boundary of 30 m from other buildings classified as first environment.

Category C3 UPS shall meet category C3- UPS emission limits and withstand the immunity requirements of Table 6.

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

WARNING: This is a product for commercial and industrial application in the second environment – installation restrictions or additional measures may be needed to prevent disturbances.

5.4 UPS of category C4

This category includes UPS intended for use in complex environments and subject to an agreement between supplier and customer regarding applicable emission and immunity levels.

The UPS of category C4 is not limited by current ratings.

5.5 Categories and environment

If the environment has been determined as the first environment, UPS of category C1 or C2 should be used.

If the environment has been determined as the second environment, UPS of category C2 or C3 should be used.

If the environment is not covered exclusively either by the first or second environment, UPS of category C4 should be used.

6 Emission

6.1 General

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 reach a level which could prevent other apparatus from operating as intended.

NOTE 1 The limits in this part of IEC 62040 may not, however, fully provide protection against interference to radio and television reception when the UPS is used closer than 10 m to the receiving antenna for category C1 or C2 UPS and 30 m for category C3 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.

6.2 General requirements

UPS shall comply with the emission limits of 5.3 to 5.4.

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 5.4 is to define limits and test methods for UPS defined in the scope of this part of IEC 62040 in relation to electromagnetic emissions which may cause interference in other apparatus, for example, 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.

6.3 General measurement conditions

6.3.1 General

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 investigated.

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

For UPS with additional mains terminals (ports) for the connection of separate supplies for static by-pass and/or maintenance by-pass circuits, these terminals (ports) shall, wherever possible, be temporarily connected to the normal a.c. input port supply. Conducted emission tests in 5.3 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 be terminated in an equivalent impedance.

UPS a.c. outputs shall be loaded with a linear load capable of operating 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 Annex E. The tests shall be carried out within the specific operating environment range for the UPS and at its rated supply voltage, unless otherwise indicated.

6.3.2 Documentation for the purchaser/user

- a) The purchaser/user shall be informed if special measures have to be taken to achieve compliance, for example, the use of shielded or special cables. Any restriction on the length of the a.c. output cables shall also be indicated.
- b) Notwithstanding that the scope of supply of the UPS shall comply with any local regulation, documentation 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.

6.3.3 Applicability

Measurements are made on the relevant ports of the UPS.

6.4 Conducted emissions

6.4.1 Limits of mains terminal interference voltage

The UPS shall not exceed the limits of either Tables 1 or 2 according to the category of UPS and the rated output current 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 Clause A.6.

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 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.

- a) UPS of category C1 and C2

Table 1 – Limits of mains terminal interference voltage frequency range 0,15 MHz to 30 MHz for category C1 UPS and category C2 UPS equipment

Frequency range MHz	Limits dB(μV)			
	Category C1 UPS		Category C2 UPS	
	Quasi-peak	Average	Quasi-peak	Average
0,15 to 0,50	66 to 56 ^a	56 to 46 ^a	79	66
0,50 to 5 ^b	56	46	73	60
5 to 30	60	50	73	60
^a The limit decreases linearly with the logarithm of the frequency.				
^b The lower limit shall apply at the transition frequency.				

b) UPS of category C3

Table 2 – Limits of mains terminal interference voltage frequency range 0,15 MHz to 30 MHz for Category C3 UPS equipment

UPS rated output current A	Frequency range MHz	Limits dB (µV)	
		Quasi-peak	Average
>16 – 100	0,15 to 0,50 ^b	100	90
	0,50 to 5,0 ^b	86	76
	5,0 to 30,0	90 to 70 ^a	80 to 60 ^a
>100	0,15 to 0,50 ^b	130	120
	0,50 to 5,0 ^b	125	115
	5,0 to 30,0	115	105
^a The limits decrease linearly with the logarithm of the frequency.			
^b The lower limit shall apply at the transition frequency.			

6.4.2 Limits of a.c. output interference voltage

The limits in Tables 1 and 2 apply.

An allowance of +14 dB is permitted for conducted disturbances at the output of the UPS as specified in Tables 1 and 2, except for C3 greater than 100 A where no increase is allowed.

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

The values shall be measured using a voltage probe in accordance with A.2.3.

6.4.3 Limits of signal and telecommunication ports

For ports intended for connection to the public switched telecommunication network (PSTN), the test methods and limits of CISPR 22 apply (see also Annex C).

6.4.4 Limits of d.c. ports

The d.c. port is deemed an internal part of the UPS and, as such, is not subject to limits of conducted interference. The effect of conducted interference on the d.c. port may, however, cause radiated interference, but no further tests are required, provided that the UPS, in both normal and in stored energy modes of operation and when set-up as described in this clause, complies with the radiated requirements according to 6.5.

Where a UPS is provided with terminals for the connection of an external d.c. source, this port shall be included in the test set-up and tested as shown below.

For table-top UPS, the battery and its enclosure shall be installed in a position permitted by the manufacturer's instructions. For floor-standing UPS, the external d.c. source and its enclosure shall be positioned 0,8 m from the UPS and wired in accordance with the manufacturer's instructions. For large UPS, where the d.c. source 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 shall be fitted to the d.c. source end of the cables to enable measurement in stored energy mode.

6.4.5 Low-frequency emissions – Input current harmonics

If the rated input current and voltage are within the scope of IEC 61000-3-2, the limits and test methodology therein shall apply.

6.5 Radiated emissions

6.5.1 Electromagnetic field

The UPS 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.

No limits apply for radiated emission below 30 MHz.

Measurements methods and informative limits for study are given in Annex B.

Table 3 – Limits of radiated emission in the frequency range 30 MHz to 1 000 MHz

Frequency range MHz	Quasi-peak limits dB(μV/m)		
	Category C1 UPS	Category C2 UPS	Category C3 UPS
30 to 230	30	40	50
230 to 1 000	37	47	60

The lower limit shall apply at the transition frequency.

NOTE 1 The test distance is 10 m. 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 a closer distance, for example, 3 m (see CISPR 22, 10.3.1, note).

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

6.5.2 Magnetic field

No limits apply for magnetic emissions. Refer to Annex B for measurement methods and informative limits.

7 Immunity

7.1 General

Immunity requirements in the frequency range 0 Hz to 1 GHz only 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 extreme cases, which may occur in any location but with an extremely low probability of occurrence. 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 part of IEC 62040, for example, where a hand-held transmitter is used in proximity of a UPS. In these instances, special mitigation measures may have to be employed.