

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Uninterruptible power systems (UPS) –
Part 1: General and safety requirements for UPS**

**Alimentations sans interruption (ASI) –
Partie 1: Exigences générales et règles de sécurité pour les ASI**

[IEC 62040-1:2008](https://standards.iteh.ai/iec/62040-1:2008)

<https://standards.iteh.ai/catalog/standards/iec/62040-1:2008>



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2008 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester.

If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de la CEI ou du Comité national de la CEI du pays du demandeur.

Si vous avez des questions sur le copyright de la CEI ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de la CEI de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

- Catalogue of IEC publications: www.iec.ch/searchpub

The IEC on-line Catalogue enables you to search by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: www.iec.ch/online_news/justpub

Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.

- Electropedia: www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.

- Customer Service Centre: www.iec.ch/webstore/custserv

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:

Email: csc@iec.ch
Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00

A propos de la CEI

La Commission Electrotechnique Internationale (CEI) est la première organisation mondiale qui élabore et publie des normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications CEI

Le contenu technique des publications de la CEI est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

- Catalogue des publications de la CEI: www.iec.ch/searchpub/cur_fut-f.htm

Le Catalogue en-ligne de la CEI vous permet d'effectuer des recherches en utilisant différents critères (numéro de référence, texte, comité d'études,...). Il donne aussi des informations sur les projets et les publications retirées ou remplacées.

- Just Published CEI: www.iec.ch/online_news/justpub

Restez informé sur les nouvelles publications de la CEI. Just Published détaille deux fois par mois les nouvelles publications parues. Disponible en-ligne et aussi par email.

- Electropedia: www.electropedia.org

Le premier dictionnaire en ligne au monde de termes électroniques et électriques. Il contient plus de 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International en ligne.

- Service Clients: www.iec.ch/webstore/custserv/custserv_entry-f.htm

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions, visitez le FAQ du Service clients ou contactez-nous:

Email: csc@iec.ch
Tél.: +41 22 919 02 11
Fax: +41 22 919 03 00

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Uninterruptible power systems (UPS) –
Part 1: General and safety requirements for UPS**

**Alimentations sans interruption (ASI) –
Partie 1: Exigences générales et règles de sécurité pour les ASI**

[IEC 62040-1:2008](https://standards.iteh.ai/standards/iec/62040-1:2008)

<https://standards.iteh.ai/catalog/standards/iec/62040-1:2008>

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX

XB

CONTENTS

FOREWORD.....	6
1 Scope and specific applications.....	8
1.1 Scope.....	8
1.2 Specific applications.....	8
2 Normative references.....	9
3 Terms and definitions.....	10
3.1 General definitions.....	10
3.2 UPS electrical ratings.....	11
3.3 Load types.....	11
3.4 Connection to the supply.....	12
3.5 Circuits and circuit characteristics.....	12
3.6 Insulation.....	12
3.7 Equipment mobility.....	12
3.8 Insulation classes of UPS.....	12
3.9 Earth fault.....	12
3.10 Enclosures.....	12
3.11 Accessibility.....	12
3.12 Components.....	12
3.13 Power distribution.....	12
3.14 Flammability.....	12
3.15 Miscellaneous.....	12
3.16 Clearances and creepage distances.....	12
3.17 Telecommunication networks.....	13
4 General conditions for tests.....	13
4.1 Introduction.....	13
4.2 Type test.....	13
4.3 Operating parameters for tests.....	13
4.4 UPS loading during tests.....	14
4.5 Components.....	14
4.6 Power interfaces.....	14
4.7 Markings and instructions.....	15
4.7.1 General.....	15
4.7.2 Power rating.....	15
4.7.3 Safety instructions.....	15
4.7.4 Main voltage adjustment.....	17
4.7.5 Power outlets.....	17
4.7.6 Fuses.....	17
4.7.7 Wiring terminals.....	17
4.7.8 Battery terminals.....	17
4.7.9 Controls and indicators.....	18
4.7.10 Isolation of multiple power sources.....	18
4.7.11 IT power systems.....	18
4.7.12 Protection in building installation.....	18
4.7.13 High leakage current.....	18
4.7.14 Thermostats and other regulating devices.....	18
4.7.15 Language.....	18

4.7.16	Durability of markings	18
4.7.17	Removable parts	18
4.7.18	Replaceable batteries	19
4.7.19	Operator access with a tool	19
4.7.20	Battery	19
4.7.21	Installation instructions	20
5	Fundamental design requirements	20
5.1	Protection against electric shock and energy hazards	20
5.1.1	Protection for UPS intended to be used in operator access areas	20
5.1.2	Protection for UPS intended to be used in service access areas	21
5.1.3	Protection for UPS intended to be used in restricted access areas	21
5.1.4	Backfeed protection	21
5.1.5	Emergency switching (disconnect) device	22
5.2	Requirements for auxiliary circuits	22
5.2.1	Safety extra low voltage circuits – SELV	22
5.2.2	Telephone network voltage circuits – TNV	22
5.2.3	Limited current circuits	22
5.2.4	External signalling circuits	22
5.2.5	Limited power source	22
5.3	Protective earthing and bonding	22
5.3.1	General	22
5.3.2	Protective earthing	23
5.3.3	Protective bonding	23
5.4	AC and d.c. power isolation	24
5.4.1	General	24
5.4.2	Disconnect devices	24
5.5	Overcurrent and earth fault protection	24
5.5.1	General	24
5.5.2	Basic requirements	24
5.5.3	Battery circuit protection	25
5.6	Protection of personnel – Safety interlocks	25
5.6.1	Operator protection	25
5.6.2	Service person protection	26
5.7	Clearances, creepage distances and distances through insulation	27
6	Wiring, connections and supply	27
6.1	General	27
6.1.1	Introduction	27
6.1.2	Dimensions and ratings of busbars and insulated conductors	28
6.2	Connection to power	28
6.2.1	General provisions for connection to power	28
6.2.2	Means of connection	28
6.3	Wiring terminals for external power conductors	28
7	Physical requirements	29
7.1	Enclosure	29
7.2	Stability	29
7.3	Mechanical strength	29
7.4	Construction details	29
7.4.1	Introduction	29
7.4.2	Openings	30

7.4.3	Gas concentration	30
7.4.4	Equipment movement	30
7.5	Resistance to fire	30
7.6	Battery location	30
7.6.1	Battery location and installation	30
7.6.2	Accessibility and maintainability	31
7.6.3	Distance	31
7.6.4	Case insulation	31
7.6.5	Wiring	31
7.6.6	Electrolyte spillage	31
7.6.7	Ventilation	31
7.6.8	Charging voltages	32
7.7	Temperature rise	32
8	Electrical requirements and simulated abnormal conditions	33
8.1	General provisions for earth leakage	33
8.2	Electric strength	33
8.3	Abnormal operating and fault conditions	33
8.3.1	General	33
8.3.2	Simulation of faults	34
8.3.3	Conditions for tests	34
9	Connection to telecommunication networks	35
Annex A (normative)	Tests for resistance to heat and fire	36
Annex B (normative)	Motor tests under abnormal conditions	37
Annex C (normative)	Transformers	38
Annex D (normative)	Measuring instruments for touch current tests	39
Annex E (normative)	Temperature rise of a winding	40
Annex F (normative)	Measurements of clearances and creepage distances	41
Annex G (normative)	Alternative method for determining minimum clearances	42
Annex H (informative)	Guidance on protection against ingress of water and foreign objects	43
Annex I (normative)	Backfeed protection test	45
Annex J (informative)	Table of electrochemical potentials	48
Annex K (normative)	Thermal controls	49
Annex L (normative)	Reference loads	50
Annex M (normative)	Ventilation of battery compartments	54
Annex N (normative)	Minimum and maximum cross-sections of copper conductors suitable for connection (see 6.3)	57
Annex O (informative)	Guidance for disconnection of batteries during shipment	58
	Bibliography	60
	Figure I.1 – Test circuit for load-induced change of reference potential – single-phase output	46
	Figure I.2 – Test circuit for load-induced change of reference potential – three-phase output	46
	Figure O.1 – Precautionary label for products shipped with the battery disconnected	58
	Figure O.2 – Precautionary label for products shipped with the battery connected	59

Table 1 – Temperature limits	32
Table 2 – Permitted temperature limits for magnetic windings at the end of stored energy mode of operation	33
Table H.1 – Degrees of protection against foreign objects indicated by the first characteristic numeral	43
Table H.2 – Degrees of protection against water indicated by the second characteristic numeral	44
Table N.1 – Conductor cross-sections (extract from IEC 60439-1)	57

iTeh Standards
(<https://standards.itih.ai>)
Document Preview

[IEC 62040-1:2008](https://standards.itih.ai/catalog/standards/iec/62040-1-2008)

<https://standards.itih.ai/catalog/standards/iec/62040-1-2008>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

UNINTERRUPTIBLE POWER SYSTEMS (UPS) –

Part 1: General and safety requirements for UPS

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 62040-1 has been prepared by subcommittee 22H: Uninterruptible power systems (UPS), of IEC technical committee 22: Power electronic systems and equipment.

This standard cancels and replaces the first edition of IEC 62040-1-1, published in 2004 and IEC 62040-1-2, published in 2004 and constitutes a technical revision. This standard merges all requirements of previous IEC 62040-1-1 and IEC 62040-1-2, with the addition of the following:

- update of normative references including IEC 60950-1 as Reference Document (RD);
- harmonization and alignment with current world recognized best practices;
- enhancement of backfeed protection, definition of ground-fault, revision of temperature rise tables and of hydrogen concentration in battery compartments.

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

FDIS	Report on voting
22H/104/FDIS	22H/106/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

It is to be used with IEC 60950-1, Edition 2.0, which is referred to in this standard as "RD".

In this standard, the following print types are used:

- requirements proper and normative annexes: in roman type;
- compliance statements and test specifications: *in italic type*;
- notes and other informative matter: in smaller roman type;
- normative conditions within tables: in smaller roman type;
- terms that are defined in Clause 3: **bold**.

A list of all parts of the IEC 62040 series, under the general title: *Uninterruptible power systems (UPS)*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or [IEC 62040-1:2008](#)
- amended.

The contents of the corrigendum of September 2008 have been included in this copy.

UNINTERRUPTIBLE POWER SYSTEMS (UPS) –

Part 1: General and safety requirements for UPS

1 Scope and specific applications

1.1 Scope

This part of IEC 62040 applies to **uninterruptible power systems (UPS)** with an electrical energy storage device in the d.c. link. It is used with IEC 60950-1, which is referred to in this standard as "RD" (reference document).

NOTE **UPS** applications generally make use of a chemical battery as the energy storage device. Alternative devices may be suitable, and as such, where "battery" appears in the text of this standard, where applicable, this may be understood as "energy storage device".

When a clause is referred to by the phrase "The definitions or the provisions of item/RD apply", this phrase is intended to mean that the definitions or provisions in that clause of IEC 60950-1 apply, except any which are clearly inapplicable to **uninterruptible power systems**. National requirements additional to those in IEC 60950-1 apply and are found as notes under relevant clauses of the RD.

The primary function of the **UPS** covered by this standard is to ensure continuity of an alternating power source. The **UPS** may also serve to improve the quality of the power source by keeping it within specified characteristics.

This standard is applicable to **UPS** which are movable, stationary, fixed or for building-in, for use in low-voltage distribution systems and intended to be installed in any **operator** accessible area or in **restricted access locations** as applicable. It specifies requirements to ensure safety for the **operator** and layman who may come into contact with the equipment and, where specifically stated, for the **service person**.

This standard is intended to ensure the safety of installed **UPS**, both as a single **UPS** unit or as a system of interconnected **UPS** units, subject to installing, operating and maintaining the **UPS** in the manner prescribed by the manufacturer.

This standard does not cover **UPS** based on rotating machines.

Electromagnetic compatibility (EMC) requirements and definitions are given in IEC 62040-2.

1.2 Specific applications

Even if this standard does not cover all types of **UPS**, it may be taken as a guide for such equipment. Requirements additional to those specified in this standard may be necessary for specific applications, e.g. related to **UPS** that operate:

- while exposed to extremes of temperature; to excessive dust, moisture, or vibration; to flammable gases; to corrosive or to explosive atmospheres;
- where ingress of water and foreign objects are possible;

NOTE 1 Annex H provides guidance on such requirements and on relevant testing.

- in vehicles, on board ships or aircraft, in tropical countries, or at elevations greater than 1 000 m;

NOTE 2 Guidance for performance of **UPS** operating at elevations greater than 1 000 m is provided in 4.1.1 of IEC 62040-3.

- with trapezoidal output waveforms and long run times (greater than 30 min);
NOTE 3 In addition to complying with 5.3.1.2 of IEC 62040-3, voltage distortion tests for the purpose of load compatibility should also be performed.
 - subject to transient overvoltages exceeding those of overvoltage category II according to IEC 60664;
NOTE 4 Subclause G.2.1/RD provides guidance for additional protection against transient overvoltages at the mains supply to the **UPS**. Where such additional protection is an integral part of the equipment insulation requirements, creepage distances and clearance distances from the mains through to the load side of the additional protection may be judged as category III or IV as required. All further downstream insulation requirements, creepage distances, and clearance distances on the load side of the additional protection may be judged as category I or II as required.
 - in electromedical applications with the **UPS** located within 1,5 m of the patient contact area;
 - in systems classified as emergency power systems by an authority having jurisdiction.
- NOTE 5 Additional requirements may also apply in accordance with local regulations.

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.

IEC 60364-4-42, *Electrical installations of buildings – Part 4-42: Protection for safety – Protection against thermal effects*

IEC 60417, *Graphical symbols for use on equipment*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60664 (all parts), *Insulation coordination for equipment within low-voltage systems*

IEC 60755, *General requirements for residual current operated protective devices*

IEC 60950-1:2005, *Information technology equipment – Safety – Part 1: General requirements*

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

IEC 61008-1, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – Part 1: General rules*

IEC 61009-1, *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) – Part 1: General rules*

IEC 62040-2:2005, *Uninterruptible power systems (UPS) – Part 2: Electromagnetic compatibility (EMC) requirements*

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 General definitions

NOTE 1 Where the terms "voltage" and "current" are used, they imply the r.m.s. values, unless otherwise specified.

NOTE 2 Care should be taken that measuring instruments give a true r.m.s. reading in the presence of non-sinusoidal signals.

3.1.1

uninterruptible power system UPS

combination of convertors, switches and energy storage devices (such as batteries), constituting a power system for maintaining continuity of load power in case of input power failure

NOTE Continuity of load power occurs when voltage and frequency are within rated steady-state and transient tolerance bands and with distortion and interruptions within the limits specified for the load. Input power failure occurs when voltage and frequency are outside rated steady-state and transient tolerance bands or with distortion or interruptions outside the limits specified for the **UPS**.

3.1.2

bypass

alternative power path, either internal or external to the **UPS**

3.1.3

primary power

power supplied by an electrical utility company or by a **user's** generator

3.1.4

active power

under periodic conditions, mean value, taken over one period T , of the instantaneous power p :

$$P = \frac{1}{T} \int_0^T p \, dt$$

NOTE 1 Under sinusoidal conditions, the **active power** is the real part of the complex power.

NOTE 2 The SI unit for **active power** is the watt.

[IEV 131-11-42]

NOTE 3 DC, fundamental and harmonic voltages contribute directly to the magnitude of the **active power**. Where applicable, instruments used to measure **active power** should therefore present sufficient bandwidth and be capable of measuring any significant non-symmetrical and harmonic power components.

3.1.5

apparent power

product of the r.m.s. voltage and r.m.s. current

3.1.6

backfeed

condition in which a voltage or energy available within the **UPS** is fed back to any of the input terminals, either directly or by a leakage path while operating in the **stored energy mode** and with **primary power** not available

3.1.7

backfeed protection

control scheme that reduces the risk of electric shock due to **backfeed**

3.1.8

stored energy mode

operation of the **UPS** when supplied by the following conditions:

- **primary power** is disconnected or is out of a given tolerance;
- battery is being discharged;
- load is within the given range;
- output voltage is within the given tolerance

3.2 UPS electrical ratings

3.2.1

rated voltage

input or output voltage (for three-phase supply, the phase-to-phase voltage) as declared by the manufacturer

3.2.2

rated voltage range

input or output voltage range as declared by the manufacturer, expressed by its lower and upper **rated voltages**

3.2.3

rated current

input or output current of the **UPS** as declared by the manufacturer

NOTE See 4.7.2.

3.3 Load types

3.3.1

normal load

mode of operation which approximates as closely as possible the most severe conditions of normal use in accordance with the manufacturer's operating instructions

NOTE 1 However, when the conditions of actual use can obviously be more severe than the maximum load conditions recommended by the manufacturer, a load should be used that is representative of the maximum that can be applied

NOTE 2 For examples of reference **normal load** conditions for **UPS**, see Annex L.

3.3.2

linear load

load where the current drawn from the supply is defined by the relationship:

$$I = U/Z$$

where

I is the load current;

U is the supply voltage;

Z is the load impedance

3.3.3

non-linear load

load where the parameter Z (load impedance) is no longer a constant but is a variable dependent on other parameters, such as voltage or time (see Annex L)

3.4 Connection to the supply

The definitions of 1.2.5/RD apply together with the following.

3.4.1

power cord

flexible cord or cable for interconnection purposes

3.5 Circuits and circuit characteristics

The definitions of 1.2.8/RD (e.g. hazardous voltage 1.2.8.6/RD) apply.

3.6 Insulation

The definitions of 1.2.9/RD apply.

3.7 Equipment mobility

The definitions of 1.2.3/RD apply.

3.8 Insulation classes of UPS

The definitions of 1.2.4/RD apply.

3.9 Earth fault

Occurrence of an accidental conductive path between a live conductor and the earth

[IEV 195-04-14]

3.10 Enclosures

The definitions of 1.2.6/RD apply.

3.11 Accessibility

The definitions of 1.2.7/RD apply.

3.12 Components

The definitions of 1.2.11/RD apply.

3.13 Power distribution

The definitions of 1.2.8.1/RD and 1.2.8.2/RD apply.

3.14 Flammability

The definitions of 1.2.12/RD apply.

3.15 Miscellaneous

The definitions of 1.2.13/RD (e.g. type test definition 1.2.13.1/RD) apply.

3.16 Clearances and creepage distances

The definitions of 1.2.10/RD apply.