
Sistemi z neprekinjenim napajanjem (UPS) - 3. del: Metoda za določanje lastnosti in preskusnih zahtev

Uninterruptible power systems (UPS) - Part 3: Method of specifying the performance and test requirements

Unterbrechungsfreie Stromversorgungssysteme (USV) - Teil 3: Methoden zum Festlegen der Leistungs- und Prüfungsanforderungen

Alimentations sans interruption (ASI) - Partie 3: Méthode de spécification des performances et exigences d'essais

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Stabilizirano električno
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Rectifiers. Convertors.
Stabilized power supply

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22H/254/CDV

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IEC SC 22H : UNINTERRUPTIBLE POWER SYSTEMS (UPS)	
SECRETARIAT: France	SECRETARY: Mr Eric Brun
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☐ SAFETY	
☒ SUBMITTED FOR CENELEC PARALLEL VOTING ☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING	
Attention IEC-CENELEC parallel voting https://standards.iteh.ai/catalog/standards/sist/10370493-bdcf-49cc-be8e-88c3c8d63d8/o-sist-pr-en-iec-62040-3-2020 The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting. The CENELEC members are invited to vote through the CENELEC online voting system.	

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

TITLE:

Uninterruptible power systems (UPS) - Part 3: Method of specifying the performance and test requirements

PROPOSED STABILITY DATE: 2023

NOTE FROM TC/SC OFFICERS:

Due to the next MT 62040-3 meeting scheduled from 20-22 April 2020, NCs are requested to submit early comments by 2020-04-03. Thank you.

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CONTENTS

1			
2			
3			
4	FOREWORD.....		4
5	1 Scope.....		6
6	2 Normative references		7
7	3 Terms and definitions		8
8	3.1 General.....		8
9	3.2 Systems and components.....		10
10	3.3 Performance of systems and components		13
11	3.4 Equipment mobility		15
12	3.5 Specified values		16
13	4 Environmental conditions.....		22
14	4.1 Introduction - Test environment		22
15	4.2 Normal conditions		22
16	4.3 Unusual conditions		23
17	5 Electrical conditions, performance and declared values		24
18	5.1 General.....		24
19	5.2 UPS input specification		25
20	5.3 UPS output specification.....		27
21	5.4 Energy storage device specification		33
22	5.5 UPS switch specification.....		35
23	5.6 Signal, control and communication ports		35
24	6 UPS tests		35
25	6.1 Summary.....		35
26	6.2 Routine tests		38
27	6.3 Site tests		40
28	6.4 Type tests - Electrical.....		40
29	6.5 Type tests - Environmental		50
30	6.6 UPS functional unit tests (where not tested as a complete UPS)		53
31	Annex A (informative) Configurations - Uninterruptible power system (UPS)		55
32	A.1 General.....		55
33	A.2 Single output bus UPS		55
34	A.3 Parallel UPS.....		56
35	A.4 Dual bus UPS.....		59
36	Annex B (informative) Topologies – Uninterruptible power system (UPS).....		61
37	B.1 General.....		61
38	B.2 Double conversion topology		61
39	B.3 Line-interactive topology		62
40	B.4 Standby topology.....		62
41	Annex C (informative) Switch applications – Uninterruptible power systems (UPS)		64
42	C.1 General.....		64
43	C.2 Transfer switches, bypass transfer switches		64
44	C.3 Maintenance bypass switches		64
45	Annex D (informative) Purchaser specification guidelines		66
46	D.1 General.....		66
47	D.2 Load to be supplied by the UPS		66
48	D.3 Energy storage device (battery – where applicable).....		67

49	D.4	Physical and environmental requirements.....	67
50	D.5	UPS Technical data sheet – Manufacturer's declaration	68
51	Annex E (normative)	Reference non-linear load	73
52	E.1	General	73
53	E.2	Apparent power rating of the reference non-linear load	73
54	E.3	Circuit design	73
55	E.4	Adjustment	74
56	Annex F (informative)	Multiple normal mode UPS - Guidance for testing.....	75
57	F.1	General	75
58	F.2	UPS presenting automatic change of classification	75
59	Annex G (normative)	AC input power failure – Test method	76
60	G.1	General	76
61	G.2	Test G.1 – High impedance AC input power failure.....	76
62	G.3	Test G.2 – Low impedance AC input power failure.....	76
63	Annex H (informative)	Dynamic output performance – Measurement techniques	77
64	H.1	General	77
65	H.2	Validation method for RMS measurements	77
66	H.3	Validation method for instantaneous measurements	77
67	H.4	Example	78
68	Annex I (normative)	UPS Efficiency values	79
69	I.1	General	79
70	I.2	Equipment covered.....	79
71	I.3	Minimum weighted UPS efficiency	79
72	Annex J (normative)	UPS efficiency and no-load losses - Methods of measurement	81
73	J.1	General	81
74	J.2	Measurement conditions	81
75	J.3	Measurement method	82
76	J.4	Test report	83
77	Annex K (informative)	UPS availability	85
78	K.1	General	85
79	K.2	Downstream distribution failures in the AC output of UPS.....	85
80	K.3	Reliability integrity levels	85
81	K.4	Availability calculation	86
82	K.5	Industry practice.....	87
83	Bibliography		88
84			
85			
86			

INTERNATIONAL ELECTROTECHNICAL COMMISSION

UNINTERRUPTIBLE POWER SYSTEMS (UPS) –

Part 3: Method of specifying the performance and test requirements

FOREWORD

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International Standard IEC 62040-3 was prepared by subcommittee 22H: Uninterruptible power systems (UPS) of IEC technical committee 22: Power electronic systems and equipment.

This third edition cancels and replaces second edition published in 2011 and constitutes a technical revision. The significant technical changes are:

- Environmental conditions aligned with IEC 62040-1 Ed2:2017 (UPS safety requirements);
- Compliance requirements included in all sub-clauses referenced in Table 5 UPS test schedule;
- Non-linear step load removed from 6.4 **Type tests** in consistency with requirements for switch mode power supplies incorporating inrush current controls. This resulted in the performance classification coding being shortened from 8 to 7 characters. See 5.3.4;
- Free-fall test aligned with ISO 4180. See 6.5.1.3;
- Multiple normal mode UPS performance classification introduced;

- Non-linear load requirements relaxed in Annex E in consistency with requirements for switch mode power supplies complying with the applicable limits for harmonic current in IEC 61000-3-2 and IEC 61000-3-12; and
- Minimum UPS efficiency values referenced in Annex I became normative and based on active output power rating and utilisation of weighting factors rather than on allowances related to isolation transformers, input harmonic current filtering and to input voltages.

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

FDIS	Report on voting
XX/XX/FDIS	XX/XX/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.

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 stability 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
- amended.

UNINTERRUPTIBLE POWER SYSTEMS (UPS)

Part 3: Method of specifying the performance and test requirements

1 Scope

This part of IEC 62040 establishes the performance and test requirements applied to **movable**, **stationary** and **fixed** electronic **uninterruptible power systems (UPS)** that

- are supplied from AC voltage not exceeding 1 000 V;
- deliver AC **output voltage** not exceeding 1 000 V;
- incorporate an **energy storage device** not exceeding 1 500 V DC; and
- have a primary function to ensure **continuity of load power**.

This document specifies performance and test requirements of a complete **UPS** and, where applicable, of individual **UPS functional units**. Requirements for the individual **UPS functional units** found in IEC publications listed in the bibliography apply so far that they are not in contradiction with this document.

UPS are developed for a wide range of power, from less than hundred watts to several megawatts, to meet requirements for availability and quality of power to a variety of **loads**. Refer to Annexes A and B for information on typical **UPS** configurations and topologies.

This document also includes **UPS** performance and test requirements related to **UPS switches** that interact with other **functional units** of the **UPS** to maintain **continuity of load power**.

This standard does not cover

- conventional AC and DC distribution boards and their associated switches;
- stand-alone static transfer systems covered by IEC 62310-3;
- rotary UPS covered by IEC 88528-11; and;
- DC UPS covered by IEC 62040-5-3

NOTE 1 This standard recognises that **continuity of load power** to information technology (IT) equipment represents a major **UPS** application. The **UPS** output characteristics specified in this standard are therefore also aimed at ensuring compatibility with the requirements of IT equipment. This, subject any limitation stated in the manufacturer's declaration, includes requirements for **steady state** and **transient** voltage variation as well as for the supply of both **linear** and **non-linear load** characteristics of IT equipment.

NOTE 2 Test **loads** specified in this standard simulate both **linear** and **non-linear load** characteristics. Their use is prescribed with the objective of verifying the performance declared by the manufacturer, and of minimising any complexity and energy consumption during the tests.

NOTE 3 This standard is aimed at 50 Hz and 60 Hz applications but does not exclude other frequency applications within the domain of IEC 60196. This is subject to an agreement between manufacturer and purchaser with respect to any particular requirements arising.

210 2 Normative references

- 211 The following referenced documents are indispensable for the application of this document. For
 212 dated references, only the edition cited applies. For undated references, the latest edition of
 213 the referenced document (including any amendments) applies.
- 214 IEC 60038, *IEC standard voltages*
- 215 IEC 60068-2-1, *Environmental testing - Part 2-1: Tests - Test A: Cold*
- 216 IEC 60068-2-2, *Environmental testing - Part 2-2: Tests - Test B: Dry heat*
- 217 IEC 60068-2-27, *Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock*
- 218 IEC 60068-2-31:2008, *Environmental testing - Part 2-31: Tests - Test Ec: Rough handling*
 219 *shocks, primarily for equipment-type specimens*
- 220 IEC 60068-2-78, *Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state*
- 221 IEC 60146-1-1:2009, *Semiconductor converters - General requirements and line-commutated*
 222 *converters - Part 1-1: Specification of basic requirements*
- 223 IEC 60146-2:1999, *Semiconductor converters - Part 2: Self-commutated semiconductor*
 224 *converters including direct DC converters*
- 225 IEC 60364-1, *Low-voltage electrical installations - Part 1: Fundamental principles, assessment*
 226 *of general characteristics, definitions*
- 227 IEC 60364-5-52, *Low-voltage electrical installations - Part 5-52: Selection and erection of*
 228 *electrical equipment - Wiring systems*
- 229 IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems - Part 1:*
 230 *Principles, requirements and tests*
- 231 IEC TR 60721-4-3:2001+AMD1:2003, *Classification of environmental conditions - Part 4-3:*
 232 *Guidance for the correlation and transformation of environmental condition classes of IEC*
 233 *60721-3 to the environmental tests of IEC 60068 - Stationary use at weather protected locations*
- 234 IEC 61000-2-2:2002+AMD1:2017+AMD2:2018, *Electromagnetic compatibility (EMC) - Part 2-2:*
 235 *Environment - Compatibility levels for low-frequency conducted disturbances and signaling in*
 236 *public low-voltage power supply systems*
- 237 IEC 61000-3-2, *Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic*
 238 *current emissions (equipment input current ≤ 16 A per phase)*
- 239 IEC/TS 61000-3-4, *Electromagnetic compatibility (EMC) - Part 3-4: Limits - Limitation of*
 240 *emission of harmonic currents in low-voltage power supply systems for equipment with rated*
 241 *current greater than 16 A*
- 242 IEC 61000-3-12, *Electromagnetic compatibility (EMC) - Part 3-12: Limits - Limits for harmonic*
 243 *currents produced by equipment connected to public low-voltage systems with input current $>$*
 244 *16 A and ≤ 75 A per phase*
- 245 IEC 61000-4-30, *Electromagnetic compatibility (EMC) - Part 4-30: Testing and measurement*
 246 *techniques - Power quality measurement methods*
- 247 IEC 62040-1:2017, *Uninterruptible power systems (UPS) - Part 1: Safety requirements*

248 IEC 62040-2:2016, *Uninterruptible power systems (UPS) - Part 2: Electromagnetic compatibility*
 249 *(EMC) requirements*

250 ISO 3744:2010, *Acoustics - Determination of sound power levels and sound energy levels of*
 251 *noise sources using sound pressure - Engineering methods for an essentially free field over a*
 252 *reflecting plane*

253 ISO 3746:2010, *Acoustics - Determination of sound power levels and sound energy levels of*
 254 *noise sources using sound pressure - Survey method using an enveloping measurement*
 255 *surface over a reflecting plane*

256 ISO 4180, *Packaging - Complete, filled transport packages - General rules for the compilation*
 257 *of performance test schedules*

258 3 Terms and definitions

259 3.1 General

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

261 NOTE 1 to entry: In this standard, IEC 60050 definitions are referenced wherever possible, particularly those of
 262 IEC 60050(551). When an existing IEC 60050 definition needs amplification or additional information, this is indicated
 263 by adding the word "modified" after the IEC 60050 reference.

264 Table 1 provides an alphabetical cross-reference listing of terms.

265 **Table 1 – Alphabetical list of terms**

Term	Term number	Term	Term number	Term	Term number
AC input power	3.2.8	AC input power failure	3.3.1	active power	3.5.30
ambient temperature	3.5.56	apparent power	3.5.31	asynchronous transfer	3.3.14
automatic (control)	3.3.11	battery	3.2.19	battery ripple current	3.3.18
bidirectional converter	3.2.16	bypass	3.2.29	bypass mode (of UPS operation)	3.3.9
charger	3.2.21	charger current limit	3.5.29	continuity of load power	3.3.5
(electronic) (power) converter or convertor	3.2.12	current limit (control)	3.5.27	cut-off voltage	3.5.55
DC link	3.2.17	deviation	3.5.5	displacement power factor	3.5.41
electronic (power) switch	3.2.25	(UPS) efficiency	3.5.57	energy storage device	3.2.18
fixed UPS	3.4.3	flywheel energy storage system	3.2.22	frequency variation	3.5.46
(UPS) functional unit	3.2.13	harmonic components	3.5.51	harmonic content	3.5.52
high impedance failure	3.3.3	hybrid (power) switch	3.2.27	individual harmonic distortion	3.5.50
(UPS rated) input frequency tolerance band	3.5.47	(UPS rated) input power factor	3.5.42	(UPS rated) input voltage tolerance band	3.5.14
inrush current	3.5.25	instantaneous voltage variation	3.5.11	(UPS) inverter	3.2.15
inverter current limit	3.5.28	light load	3.2.38	linear load	3.2.33
load	3.2.31	load power factor	3.5.43	load sharing	3.5.37

Term	Term number	Term	Term number	Term	Term number
low impedance failure	3.3.4	mains (supply)	3.2.9	maintenance bypass switch	3.2.28
manual (control)	3.3.10	(UPS) maximum input current	3.5.24	mechanical (power) switch	3.2.26
movable UPS	3.4.1	multiple normal mode UPS	3.3.7	nominal (value)	3.5.3
non-linear load	3.2.34	non-sinusoidal output voltage	3.5.18	normal mode (of UPS operation)	3.3.6
output current	3.5.26	output frequency tolerance band	3.5.48	output voltage	3.5.15
output voltage tolerance band	3.5.16	overload capacity	3.5.38	parallel redundant UPS	3.2.7
parallel UPS	3.2.4	periodic output voltage variation (modulation)	3.5.22	phase angle	3.5.39
polyphase (circuit)	3.2.10	port	3.2.11	power factor	3.5.40
rated apparent power of the equipment Sequ	3.5.32	rated current	3.5.13	rated frequency	3.5.44
rated frequency range	3.5.45	(UPS) rated input current	3.5.23	rated load	3.2.32
rated output active power	3.5.36	rated output apparent power	3.5.35	rated value	3.5.1
rated voltage	3.5.12	rating	3.5.2	recovery time	3.5.10
(UPS) rectifier	3.2.14	redundant UPS	3.2.5	reference non-linear load	3.2.35
reference test load	3.2.36	reliability integrity level RIL	3.3.19	restored energy time	3.5.54
RMS (value)	3.5.7	RMS voltage variation	3.5.8	routine test	3.3.16
secondary battery	3.2.20	service life (of a battery)	3.3.17	short-circuit power Ssc	3.5.33
short-circuit ratio Rsce	3.5.34	single UPS	3.2.3	sinusoidal output voltage	3.5.17
standby redundant UPS	3.2.6	static bypass switch	3.2.30	stationary UPS	3.4.2
steady state	3.5.9	step load	3.2.37	stored energy mode (of UPS operation)	3.3.8
stored energy time	3.5.53	supply impedance	3.3.2	synchronization	3.3.12
synchronous transfer	3.3.13	tolerance band	3.5.4	total harmonic distortion (THD)	3.5.49
transfer switch	3.2.24	transient	3.5.6	type test	3.3.15
unbalance ratio	3.5.21	unbalanced load	3.5.20	uninterruptible power system UPS	3.2.1
UPS switch	3.2.23	UPS unit	3.2.2	voltage unbalance	3.5.19

267 3.2 Systems and components

268 3.2.1

269 uninterruptible power system UPS

270 combination of **converters**, switches and **energy storage devices** (such as **batteries**),
271 constituting a power system for maintaining **continuity of load power** in case of **AC input**
272 **power failure**

273 3.2.2

274 UPS unit

275 assembly consisting of at least one of each of the following **UPS functional units**:

- 276 - **UPS inverter**,
- 277 - **UPS rectifier** and/or a **charger**
- 278 - **energy storage device** (or means for connection to one)

279 3.2.3

280 single UPS

281 **UPS** comprising only one **UPS unit**

282 3.2.4

283 parallel UPS

284 **UPS** comprising two or more **UPS units** operating together for the purpose of sharing the **load**

285 3.2.5

286 redundant UPS

287 **UPS** that has additional **UPS units** and/or additional **functional units** for the purpose of
288 improving the **continuity of load power**

289 3.2.6

290 standby redundant UPS

291 **redundant UPS** in which one or more **UPS unit(s)** or **UPS functional units** are held in reserve
292 until one or more **UPS unit(s)** or **UPS functional unit(s)** fail

293 3.2.7

294 parallel redundant UPS

295 **parallel UPS** that is also a redundant UPS

296 3.2.8

297 AC input power

298 external electrical power supplied to the **UPS** and any **bypass** circuits, usually the **mains** or a
299 private low-voltage power supply system

300 3.2.9

301 mains (supply)

302 the public low-voltage power supply system with characteristics as detailed in IEC 61000-2-2,
303 or, for industrial applications, a non-public industrial low-voltage power supply system with class
304 3 characteristics as detailed in IEC 61000-2-4

305 3.2.10

306 polyphase (circuit)

307 circuit comprising more than one phase conductor

308 NOTE 1 to entry: typical **polyphase circuits** include three phase, bi-phase, split-phase circuits

309 3.2.11

310 port

311 access to a device or network where electromagnetic energy or signals may be supplied or
312 received or where the device or network variables may be observed or measured

313 NOTE 1 to entry: Examples of **ports** include sockets and a group of terminals

314 [IEC 60050-131:2002, 131-12-60 modified]

315 3.2.12

316 **(electronic) (power) converter or convertor**

317 an operative unit for electronic power conversion, comprising one or more electronic valve
318 devices, transformers and filters if necessary and auxiliaries if any

319 NOTE 1 to entry: In English, the two spellings "converter" and "convertor" are in use, and both are correct.

320 [IEC 60050-551:1998, 551-12-01]

321 3.2.13

322 **(UPS) functional unit**

323 A **UPS** sub-system, for example, a **UPS rectifier**, a **UPS inverter** or a **UPS switch**

324 3.2.14

325 **(UPS) rectifier**

326 **electronic converter** for rectification

327 [IEC 60050-551:1998, 551-12-07, modified]

328 3.2.15

329 **(UPS) inverter**

330 **electronic converter** for inversion

331 [IEC 60050-551:1998, 551-12-10, modified]

332 3.2.16

333 **bidirectional converter**

334 **electronic converter** which has functions of both **rectifier** and **inverter**, and which can reverse
335 the flow of power from AC to DC and vice-versa

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336 3.2.17

337 **DC link**

338 DC power interconnection between the **rectifier** and the **inverter functional units**

339 NOTE 1 to entry: The voltage of the **energy storage device** can differ from that of the **DC link**.

340 NOTE 2 to entry: The **DC link** can include **converters**.

341 3.2.18

342 **energy storage device**

343 system consisting of single or multiple devices designed to provide power to the **UPS inverter**
344 for the required **stored energy time**

345 NOTE 1 to entry: Notwithstanding challenges with respect to recharge, examples of **energy storage devices**
346 include but are not limited to **battery**, double-layer capacitor ("super" or "ultra" capacitor) and **flywheel energy**
347 **storage systems**.

348 3.2.19

349 **battery**

350 set of electrochemical cells of the same type so connected as to act together

351 [IEC 60050-151:2001, 151-12-11, modified]

352 3.2.20

353 **secondary battery**

354 a **battery** that is rechargeable by way of a reversible chemical reaction

355 [IEC 60050-482:2004, 482-01-03, modified]

356 **3.2.21**
 357 **charger**
 358 **converter** that provides DC power to an **energy storage device** for the purpose of increasing
 359 or maintaining the amount of stored energy

360 **3.2.22**
 361 **flywheel energy storage system**
 362 mechanical **energy storage device** wherein stored kinetic energy can be converted to electrical
 363 energy during **stored energy mode** of operation

364 **3.2.23**
 365 **UPS switch**
 366 controllable switch used to interconnect or isolate power **ports of UPS units, bypass or load**
 367 for **continuity of load power**

368 NOTE 1 to entry: Annex C details **UPS switch** applications.

369 **3.2.24**
 370 **transfer switch**
 371 **UPS switch** used to convey power from one of two or more sources

372 **3.2.25**
 373 **electronic (power) switch**
 374 **UPS switch** comprising at least one controllable valve device

375 [IEC 60050-551:1998, 551-13-01, modified]

376 NOTE 1 to entry: A **static bypass switch** is an example of an **electronic power switch**.

377 **3.2.26**
 378 **mechanical (power) switch**
 379 **UPS switch** with physical separation between contacts

380 **3.2.27**
 381 **hybrid (power) switch**
 382 **UPS switch** with physical separation between contacts in combination with at least one
 383 controllable electronic valve device

384 **3.2.28**
 385 **maintenance bypass switch**
 386 **UPS switch** designed to maintain **continuity of load power** via an alternative path during
 387 maintenance activities

388 **3.2.29**
 389 **bypass**
 390 alternative power path provided to maintain **continuity of load power** when the normal path
 391 cannot be used

392 **3.2.30**
 393 **static bypass switch**
 394 **electronic power switch**, typically internal to the **UPS**, used to enable the **bypass**

395 **3.2.31**
 396 **load**
 397 device or condition intended to absorb power supplied by the **UPS** and defined by the equations

398 $Z = U / I$
 399 $S = U^2 / Z = Z \cdot I^2$

400 Where

401 Z = **load impedance** [Ω]

402 S = **apparent power** [VA]

403 U = **UPS output voltage** [V]

404 I = current flowing through the **load** [A]

405 [IEC 60050-151:2001; 151-15-15 modified]

406 3.2.32

407 **rated load**

408 value of **load** used for specification purposes, generally established by a manufacturer for a
409 specified set of operating conditions of a component, device, equipment, or system.

410 The **rated load** is expressed in **apparent power** [VA] and **active power** [W] resulting in a **power**
411 **factor** of the **rated load** that includes the effect of any applicable combination of **linear** and of
412 **non-linear load**

413 3.2.33

414 **linear load**

415 **load** wherein the parameter Z (**load impedance**) is a constant

416 3.2.34

417 **non-linear load**

418 **load** wherein the parameter Z (**load impedance**) is a variable dependent on other parameters,
419 such as voltage or time

420 3.2.35

421 **reference non-linear load**

422 **non-linear load** constructed, rated and applied in accordance with annex E

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423 3.2.36

424 **reference test load**

425 **load** at which the **UPS** delivers its **rated output active power**

426 NOTE 1 to entry: This definition permits when in test-mode and subject to local regulations, the **UPS** output power
427 to be returned to the **AC input power port**.

428 3.2.37

429 **step load**

430 instantaneous addition or removal of electrical **loads** to a power source

431 3.2.38

432 **light load**

433 **load** that for practical and/or cost reasons is limited to a low value when the load level is not
434 relevant for performing a test, e.g. to 10% of the **reference test load** value

436 3.3 Performance of systems and components

437 3.3.1

438 **AC input power failure**

439 any variation in the **AC input power** which could cause the **UPS** to operate in **stored energy**
440 **mode**

441 3.3.2

442 **supply impedance**

443 Impedance of the power source supplying a **port** or a device.

444 Examples of **supply impedance** include that of the **AC input power source** supplying the input
445 **port** of a **UPS** and that of a **converter** supplying the output **port** of a **UPS**