

Australian Standard™

Uninterruptible power systems (UPS)

**Part 3: Method of specifying the
performance and test requirements**

This Australian Standard was prepared by Committee EL-027, Power Electronics. It was approved on behalf of the Council of Standards Australia on 15 November 2002 and published on 17 December 2002.

The following are represented on Committee EL-027:

Australian Communications Authority
Australian Electrical and Electronic Manufacturers Association
Bureau of Steel Manufacturers of Australia
Electricity Supply Association of Australia
Monash University
University of Wollongong

Keeping Standards up-to-date

Standards are living documents which reflect progress in science, technology and systems. To maintain their currency, all Standards are periodically reviewed, and new editions are published. Between editions, amendments may be issued. Standards may also be withdrawn. It is important that readers assure themselves they are using a current Standard, which should include any amendments which may have been published since the Standard was purchased.

Detailed information about Standards can be found by visiting the Standards Australia web site at www.standards.com.au and looking up the relevant Standard in the on-line catalogue.

Alternatively, the printed Catalogue provides information current at 1 January each year, and the monthly magazine, *The Global Standard*, has a full listing of revisions and amendments published each month.

We also welcome suggestions for improvement in our Standards, and especially encourage readers to notify us immediately of any apparent inaccuracies or ambiguities. Contact us via email at mail@standards.com.au, or write to the Chief Executive, Standards Australia International Ltd, GPO Box 5420, Sydney, NSW 1501.

Australian Standard™

Uninterruptible power systems (UPS)

**Part 3: Method of specifying the
performance and test requirements**

First published as AS 62040.3—2002.
Reissued incorporating Amendment No. 1 (August 2003).

COPYRIGHT

© Standards Australia International

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher.

Published by Standards Australia International Ltd
GPO Box 5420, Sydney, NSW 2001, Australia

ISBN 0 7337 4955 0

PREFACE

This Standard was prepared by the Standards Australia Committee EL-027, *Power Electronics*. This Standard incorporates Amendment No. 1 (August 2003). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

The objective of this Standard is to provide manufacturers, designers and users with a means of specifying uninterruptible power supply systems.

This Standard has been reproduced from, and is technically identical to, IEC 62040-3:1999, *Uninterruptible power systems (UPS) Part 3: Method of specifying the performance and test requirements*.

A1 IEC 62040-3:1999 contained errors in Figures 4 and F.3 and Annex E and, after consultation with the IEC Committee, these errors have been corrected. In addition, notes have been added to some clauses to assist users of this Standard.

Variations to IEC 62040-3:1999 are indicated at the appropriate places throughout this standard. Strikethrough (~~example~~) identifies IEC text, tables and figures which, for the purposes of this Australian Standard, are deleted. Where text, tables or figures are added, each is set in its proper place and identified by shading (**example**). Added figures are not themselves shaded, but are identified by a shaded border.

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.

In this Standard, the following print types are used:

- requirements proper: in arial type;
- explanatory matter: in smaller arial type.

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 international standard' should read 'this Australian Standard'.
- (c) A full point should be substituted for a comma when referring to a decimal marker.

CONTENTS

	<i>Page</i>
1 Scope and object.....	1
2 Normative references	2
3 Terms and definitions	4
3.1 Systems and components.....	4
3.2 Performance of systems and components	7
3.3 Specified values – General.....	13
3.4 Input values.....	16
3.5 Output values	17
4 General ambient service conditions	19
4.1 Normal environmental and climatic service conditions	19
4.1.1 Altitude.....	20
4.1.2 Ambient service temperature	20
4.1.3 Relative humidity	20
4.1.4 Ambient storage and transportation conditions	20
4.2 Unusual service conditions to be identified by the purchaser.....	21
4.2.1 Environmental conditions to be identified.....	21
4.2.2 Mechanical conditions to be identified	21
5 Electrical service conditions and performance	21
5.1 General - All UPS.....	21
5.1.1 UPS configurations.....	21
5.1.2 Equipment markings and instructions	22
5.1.3 Equipment safety.....	24
5.2 UPS input specifications.....	24
5.2.1 Normal service conditions.....	24
5.2.2 Rated values and characteristics	25
5.2.3 UPS input conditions to be identified by the purchaser	26
5.3 UPS output specifications.....	26
5.3.1 Steady state and dynamic output voltage characteristics	26
5.3.2 Rated output values and characteristics	29
5.3.3 Single UPS and parallel UPS with bypass.....	30
5.3.4 Performance requirements to be identified by the purchaser.....	30
5.4 UPS intermediate d.c. circuit and/or battery circuit specification	31
5.5 UPS switches, rated values and performance.....	31
5.5.1 General	31
5.5.2 UPS switches	32
5.6 Redundant and parallel UPS systems (refer to annex A)	32
5.6.1 Standby redundant UPS	32
5.6.2 Parallel redundant UPS	32
5.7 Electromagnetic compatibility	33
5.8 Signalling circuits	33

	<i>Page</i>
6 Electrical tests for UPS.....	33
6.1 General.....	33
6.1.1 Type tests.....	33
6.1.2 Routine tests.....	33
6.1.3 Test conditions.....	33
6.2 UPS functional unit tests (where applicable).....	34
6.2.1 UPS rectifier tests.....	34
6.2.2 UPS inverter tests.....	34
6.2.3 UPS switch tests.....	34
6.2.4 Monitoring and control equipment tests.....	35
6.2.5 Battery tests.....	35
6.3 Type tests of manufacturer's declared characteristics as a complete UPS.....	35
6.3.1 Control and monitoring signals.....	36
6.3.2 Input voltage and frequency tolerance test.....	37
6.3.3 Inrush current test.....	37
6.3.4 UPS output characteristics tests – Static conditions – Normal and stored energy mode of operation.....	38
6.3.5 UPS output characteristics – Overload and short circuit.....	39
6.3.6 UPS output dynamic characteristic tests.....	39
6.3.7 UPS output dynamic load characteristic tests.....	40
6.3.8 UPS output characteristics – Reference non-linear loads.....	40
6.3.9 Stored and restored energy time tests.....	42
6.3.10 Efficiency and input power factor.....	42
6.3.11 Backfeed test.....	42
6.3.12 Electromagnetic compatibility test.....	42
6.4 Reserved for future use.....	42
6.5 Reserved for future use.....	42
6.6 Factory witness tests/on-site tests.....	42
6.6.1 UPS tests.....	43
6.6.2 Test specifications.....	44
6.6.3 Light load test.....	44
6.6.4 UPS auxiliary device(s) test.....	44
6.6.5 Synchronization test.....	44
6.6.6 AC input failure test.....	44
6.6.7 AC output return test.....	44
6.6.8 Simulation of parallel redundant UPS fault test.....	45
6.6.9 Transfer test.....	45
6.6.10 Full load test.....	45
6.6.11 UPS efficiency test.....	45
6.6.12 Unbalanced load test.....	45
6.6.13 Balanced load test.....	45
6.6.14 Test of current division in parallel or parallel redundant UPS.....	46
6.6.15 Rated stored energy time test.....	46
6.6.16 Rated restored energy time.....	46
6.6.17 Battery ripple current measurement.....	46
6.6.18 Overload capability test.....	46

	<i>Page</i>
6.6.19 Short-circuit test	46
6.6.20 Short-circuit protection device test	46
6.6.21 Restart test	46
6.6.22 Output overvoltage test	47
6.6.23 Periodic output voltage variation test	47
6.6.24 Frequency variation test	47
6.6.25 Radiofrequency interference and conducted noise test	47
6.6.26 Harmonic components measurement	47
6.6.27 Earth fault test	47
6.6.28 On-site ventilation test	47
6.6.29 Standby generator compatibility test	47
6.7 UPS switches testing procedure	48
6.7.1 Testing schedule	48
6.7.2 Test specifications	48
6.7.3 Interconnection cable check	48
6.7.4 Light load test	48
6.7.5 Full load test	48
6.7.6 Transfer test	49
6.7.7 Overload capability test	49
6.7.8 Short-circuit current capability test	49
6.7.9 Overvoltage test (electronic power switches)	49
6.7.10 Radiofrequency interference and conducted noise	49
6.7.11 Audible noise	49
6.7.12 On-site ventilation test	49
6.7.13 Earth fault test	49
6.7.14 Additional tests	50
7 Non-electrical tests	50
7.1 Environmental and transportation test methods	50
7.1.1 Transportation	50
7.2 Environmental storage and operating test methods	51
7.2.1 Storage condition tests	51
7.2.2 Operating condition tests	51
7.3 Acoustic noise	52
Annex A (informative) Types of Uninterruptible Power Systems (UPS) configurations	53
A.1 Single UPS	53
A.2 Parallel UPS	55
A.3 Redundant UPS	56
Annex B (informative) Examples of Uninterruptible Power System (UPS) operation	59
B.1 UPS double conversion	59
B.2 UPS double conversion with bypass	59
B.3 UPS line interactive operation	61
B.4 UPS line interactive operation with bypass	61
B.5 UPS passive stand-by operation	63

	<i>Page</i>
Annex C (informative) Explanation of UPS switch definitions	64
C.1 UPS interrupters.....	64
C.2 Transfer switches	66
C.3 UPS isolation switches	69
C.4 UPS maintenance bypass switches	70
C.5 Tie switches	71
C.6 Multiple function UPS switches.....	71
Annex D (informative) Purchaser specification guidelines	73
D.1 Type of UPS, additional features and system requirements	73
D.2 UPS input.....	73
D.3 Load to be operated from UPS	74
D.4 UPS output.....	74
D.5 Battery (where applicable).....	75
D.6 General application requirements and special service conditions.....	75
D.7 Multi-module system configurations.....	75
D.8 Electromagnetic compatibility	75
D.9 Technical data sheets – Manufacturer's declaration.....	76
D.10 Classification of uninterruptible power systems by performance	78
Annex E (normative) Reference non-linear load	81
Annex F (normative) Backfeed protection test.....	83
F.1 Test for pluggable Type A or B UPS	83
F.2 Test for permanently connected UPS (only for UPS with backfeed protection).....	83
F.3 Measuring instrument for earth leakage current tests	84
Annex G (normative) Input mains failure – Test method	85
G.1 High impedance mains failure test	85
G.2 Low impedance mains failure test	85
Annex H (informative) Determination of output voltage transient deviation characteristics	86
H.1 General considerations	86
H.2 Test methods and instrumentation.....	87
H.3 Sinusoidal output voltage waveforms.....	87
H.4 Non-sinusoidal output voltage waveforms (trapezoidal/quasi-square/square).....	88
H.5 Resistive load test method – Change of operating mode/step load	88
H.6 Reference non-linear load test method – Change of operating mode/step load	89
Annex I (informative) Bibliography	90
Annex ZZ (normative) Variations to IEC 62040-3:1999 for application in Australia	91

STANDARDS AUSTRALIA

Australian Standard

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

Any IEC table, figure or passage of text that is struck-through is not part of this Standard. Any Australian table, figure or passage of text that is added (and identified by shading) is part of this Standard.

1 Scope and object

This standard applies to electronic indirect a.c. converter systems with electrical energy storage means in the d.c. link. The primary function of the uninterruptible power system (UPS) covered by this standard is to ensure continuity of an alternating power source. The uninterruptible power system may also serve to improve the quality of the power source by keeping it within specified characteristics.

A variety of uninterruptible power systems have been developed to meet consumers' requirements for continuity and quality of power for different types of loads over a wide range of power, from less than 100 W to several megawatts. Refer to annexes A and B for information on some of the types available.

This standard applies to electronic uninterruptible power systems (UPS):

- a) delivering single- or three-phase fixed frequency a.c. output voltage;
- b) with energy storage device in the d.c. link if not otherwise specified;
- c) with rated voltage not exceeding 1 000 V a.c.;
- d) movable, stationary and/or fixed equipment.

This standard also includes the method of specifying all power switches that form integral parts of a UPS and are associated with its output.

Included are interrupters, bypass switches, isolating switches, load transfer switches and tie switches. These switches interact with other functional units of the UPS to maintain continuity of load power.

This standard does not refer to conventional mains distribution boards, rectifier input switches or d.c. switches (for example for batteries, rectifier output or inverter input, etc.), or UPS based on rotating machines.

NOTE 1 – This standard recognizes that the major market usage with the UPS ratings within its scope is in conjunction with information technology equipment.

Under current technology, the majority of UPS load equipment employs power supplies which present a non-linear load to the UPS and can be tolerant of non-sinusoidal voltage waveforms for a limited time duration. UPS output ratings are specified to be compatible with non-linear loading and linear loading, subject to manufacturers' declaration if different.

References within this standard to linear loading are retained for test method reasons, or validation of manufacturers' additional declaration.

NOTE 2 – For use of UPS with a non-sinusoidal output voltage waveform, beyond the stored-energy time recommended in this standard, the agreement of the load equipment manufacturer should be sought.

NOTE 3 – For UPS output frequencies other than 50 Hz or 60 Hz, performance specification is subject to agreement between manufacturer and purchaser.