

Australian Standard™

**Adjustable speed electrical power drive
systems**

**Part 3: EMC requirements and specific
test methods**

This Australian Standard was prepared by Committee EL-027, Power Electronics. It was approved on behalf of the Council of Standards Australia on 16 December 2004.
This Standard was published on 5 January 2005.

The following are represented on Committee EL-027:

Australian British Chamber of Commerce
Australian Electrical and Electronic Manufacturers Association
Energy Networks Association
Engineers Australia
Testing interests (Australia)

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 Standards may also be withdrawn.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 Web Shop 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.

Australian Standards™ and other products and services developed by Standards Australia are published and distributed under contract by SAI Global, which operates the Standards Web Shop.

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.org.au, or write to the Chief Executive, Standards Australia, GPO Box 5420, Sydney, NSW 2001.

This Standard was issued in draft form for comment as DR 04482.

Australian Standard™

**Adjustable speed electrical power drive
systems**

**Part 3: EMC requirements and specific
test methods**

Originated as AS 61800.3—2001.
Second edition 2005.

COPYRIGHT

© Standards Australia

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 GPO Box 5420, Sydney, NSW 2001, Australia

ISBN 0 7337 6434 7

PREFACE

This Standard was prepared by the Standards Australia Committee EL-027, Power Electronics to supersede AS 61800.3—2001.

The objective of this Standard is to provide manufacturers, regulators, test laboratories and users with electromagnetic compatibility (EMC) requirements for electrical power drives.

This Standard is identical with, and has been reproduced from, IEC 61800-3, Ed.2.0 (2004), *Adjustable speed electrical power drive systems Part 3: EMC requirements and specific test methods*.

Explanatory notes have been added to table 17 (in clause 6.4.2.2).

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.
- (d) Any French text on figures should be ignored.

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.

CONTENTS

	<i>Page</i>
1 Scope and object	1
2 Normative references	2
3 Terms and definitions	5
4 Common requirements	10
4.1 General conditions	10
4.2 Tests	11
4.3 Documentation for the user	11
5 Immunity requirements	12
5.1 General conditions	12
5.2 Basic immunity requirements – Low-frequency disturbances	14
5.3 Basic immunity requirements – High-frequency disturbances	20
5.4 Application of immunity requirements – statistical aspect	23
6 Emission	24
6.1 General emission requirements	24
6.2 Basic low-frequency emission limits	24
6.3 Conditions related to high-frequency emission measurement	27
6.4 Basic high-frequency emission limits	28
6.5 Engineering practice	31
6.6 Application of emission requirements – statistical aspects	35
 Annex A (informative) EMC techniques	 36
A.1 General overview of EMC phenomena	36
A.2 Load conditions regarding high-frequency phenomena	39
A.3 Some immunity aspects	40
A.4 High-frequency emission measurement techniques	41
 Annex B (informative) Low-frequency phenomena	 46
B.1 Commutation notches	46
B.2 Definitions related to harmonics and interharmonics	51
B.3 Application of harmonic emission standards	57
B.4 Installation rules/Assessment of harmonic compatibility	66
B.5 Voltage unbalance	71
B.6 Voltage dips – Voltage fluctuations	74
B.7 Verification of immunity to low frequency disturbances	76
 Annex C (informative) Reactive power compensation – filtering	 78
C.1 Installation	78
C.2 Reactive power and harmonics	87

	<i>Page</i>
Annex D (informative) Considerations on high-frequency emission	91
D.1 User guidelines	91
D.2 Safety and RFI-filtering in power supply systems	95
 Annex E (informative) EMC analysis and EMC plan	 97
E.1 General – System EMC analysis applied to PDSs	97
E.2 Example of EMC plan for general applications	100
E.3 Example of supplement to EMC plan for particular application	104
 Bibliography	 107
 Figure 1 – Definition of the installation and its content.....	 6
Figure 2 – Internal interfaces of the PDS and examples of ports.....	8
Figure 3 – Power interfaces of a PDS with common d.c. BUS.....	9
Figure 4 – Power interfaces with common input transformer	9
Figure 5 – Propagation of disturbances	33
Figure 6 – Propagation of disturbances in installation with a PDS rated > 1 000 V.....	33
Figure A.1 – Coordination between disturbance and immunity	38
Figure B.1 – Typical waveform of commutation notches – Distinction from non-repetitive transient.....	46
Figure B.2 – PCC, IPC, installation current ratio and R_{SI}	56
Figure B.3 – PCC, IPC, installation current ratio and R_{SC}	57
Figure B.4 – Assessment of the harmonic emission of a PDS	60
Figure B.5 – Load conditions for the measurement of harmonic emission of a PDS	61
Figure B.6 – Test set-up with mechanical load.....	62
Figure B.7 – Test set-up with electrical load replacing the loaded motor	62
Figure B.8 – Test set-up with resistive load	63
Figure B.9 – Assessment of harmonic emission where PDS are used (apparatus, systems or installations)	67
Figure C.1 – Reactive power compensation.....	81
Figure C.2 – Simplified diagram of an industrial network	83
Figure C.3 – Impedance versus frequency of the simplified network	84
Figure C.4 – Example of passive filter battery.....	86
Figure C.5 – Example of inadequate solution in reactive power compensation.....	88
Figure D.1 – Conducted emission of various unfiltered PDSs	92
Figure D.2 – Expected radiated emission of PDS up to rated voltage 400 V Peak values normalised at 10 m.....	93
Figure D.3 – Safety and filtering	96
Figure E.1 – Interaction between systems and EM environment	97
Figure E.2 – Zone concept	98
Figure E.3 – Example of drive	99

Table 1 – Criteria to prove the acceptance of a PDS against electromagnetic disturbances.....	13
Table 2 – Minimum immunity requirements for harmonics and commutation notches/voltage distortion on power ports of low voltage PDSs	15
Table 3 – Minimum immunity requirements for harmonics and commutation notches/voltage distortion on main power ports of PDSs of rated voltage above 1 000 V	16
Table 4 – Minimum immunity requirements for harmonics and commutation notches/voltage distortion on auxiliary low voltage power ports of PDSs.....	16
Table 5 – Minimum immunity requirements for voltage deviations, dips and short interruptions on power ports of low voltage PDSs.....	17
Table 6 – Minimum immunity requirements for voltage deviations, dips and short interruptions on main power ports of rated voltage above 1 000 V of PDSs	18
Table 7 – Minimum immunity requirements for voltage deviations, dips and short interruptions on auxiliary low voltage power ports of PDSs	18
Table 8 – Minimum immunity requirements for voltage unbalance and frequency variations on power ports of low voltage PDSs	19
Table 9 – Minimum immunity requirements for voltage unbalance and frequency variations on main power ports of rated voltage above 1 000 V of PDSs.....	19
Table 10 – Minimum immunity requirements for voltage unbalance and frequency variations on auxiliary low voltage power ports of PDSs	20
Table 11 – Minimum immunity requirements for PDSs intended for use in the first environment	21
Table 12 – Minimum immunity requirements for PDSs intended for use in the second environment	22
Table 13 – Summary of emission requirements	24
Table 14 – Limits for mains terminal disturbance voltage in the frequency band 150 kHz to 30 MHz.....	28
Table 15 – Limits for electromagnetic radiation disturbance in the frequency band 30 MHz to 1 000 MHz.....	29
Table 16 – Limits of disturbance voltage on the power interface	30
Table 17 – Limits for mains terminal disturbance voltage in the frequency band 150 kHz to 30 MHz PDS in the second environment – PDS of category C3	30
Table 18–Limits for electromagnetic radiation disturbance in the frequency band 30 MHz to 1 000 MHz PDS in the second environment – PDS of category C3.....	31
Table 19 – Limits for propagated disturbance voltage ("outside" in the first environment)	34
Table 20 – Limits for propagated disturbance voltage ("outside" in the second environment)	34
Table 21 – Limits for propagated electromagnetic disturbance above 30 MHz	34
Table 22 – Limits for electromagnetic disturbance below 30 MHz	35
Table A.1 – EMC overview	37
Table B.1 – Maximum allowable depth of commutation notches at the PC	50
Table B.2 – Harmonic current emission requirements relative to the total current of the agreed power at the PCC or IPC	69
Table B.3 – Verification plan for immunity to low frequency disturbances	77
Table E.1 – EM interaction between subsystems and environment	99
Table E.2 – Frequency analysis.....	106

STANDARDS AUSTRALIA

Australian Standard**Adjustable speed electrical power drive systems
Part 3: EMC requirements and specific test methods**

1 Scope and object

This part of IEC 61800 specifies electromagnetic compatibility (EMC) requirements for power drive systems (PDSs). A PDS is defined in 3.1. These are adjustable speed a.c. or d.c. motor drives. Requirements are stated for PDSs with converter input and/or output voltages (line-to-line voltage), up to 35 kV a.c. r.m.s.

PDSs covered by this standard are those installed in residential, commercial and industrial locations with the exception of traction applications, and electric vehicles. PDSs may be connected to either industrial or public power distribution networks. Industrial networks are supplied by a dedicated distribution transformer, which is usually adjacent to or inside the industrial location, and supplies only industrial customers. Industrial networks can also be supplied by their own electric generating equipment. On the other hand, PDSs can be directly connected to low-voltage public mains networks which also supply domestic premises, and in which the neutral is generally earthed (grounded).

The scope of this part of IEC 61800, related to EMC, includes a broad range of PDSs from a few hundred watts to hundreds of megawatts. PDSs are often included in a larger system. The system aspect is not covered by this standard but guidance is provided in the informative annexes.

The requirements have been selected so as to ensure EMC for PDSs at residential, commercial and industrial locations. The requirements cannot, however, cover extreme cases which may occur with an extremely low probability. Changes in the EMC behaviour of a PDS, as a result of fault conditions, are not taken into account.

The object of this standard is to define the limits and test methods for a PDS according to its intended use. This standard includes immunity requirements and requirements for electromagnetic emissions.

NOTE 1 Emission can cause interference in other electronic equipment (for example radio receivers, measuring and computing devices). Immunity is required to protect the equipment from continuous and transient conducted and radiated disturbances including electrostatic discharges. The emission and immunity requirements are balanced against each other and against the actual environment of the PDS.

This standard defines the minimum EMC requirements for a PDS.

Immunity requirements are given according to the environment classification. Low-frequency emission requirements are given according to the nature of the supply network. High-frequency emission requirements are given according to four categories of intended use, which cover both environment and bringing into operation.

As a product standard, this standard may be used for the assessment of PDS. It may also be used for the assessment of CDM or BDM (see 3.1), which can be marketed separately.