

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Adjustable speed electrical power drive systems –
Part 2: General requirements – Rating specifications for adjustable speed
AC power drive systems**

**Entraînements électriques de puissance à vitesse variable –
Partie 2: Exigences générales – Spécifications de dimensionnement pour
entraînements électriques de puissance à vitesse variable en courant alternatif**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2021 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 l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
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 corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

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 It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC online collection - oc.iec.ch

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 18 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) 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 IEC

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

Recherche de publications IEC -

webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, ...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

IEC online collection - oc.iec.ch

Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Adjustable speed electrical power drive systems –
Part 2: General requirements – Rating specifications for adjustable speed
AC power drive systems**

**Entraînements électriques de puissance à vitesse variable –
Partie 2: Exigences générales – Spécifications de dimensionnement pour
entraînements électriques de puissance à vitesse variable en courant alternatif**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 29.160.30; 29.200

ISBN 978-2-8322-9450-5

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	6
INTRODUCTION.....	9
1 Scope.....	11
2 Normative references	12
3 Terms and definitions	14
4 Guidance for specification of BDM/CDM/PDS and methodologies for compliance	32
4.1 General.....	32
4.2 Methodology for compliance	32
4.2.1 Agreement between <i>customer</i> and <i>manufacturer</i>	32
4.2.2 Methodology to state compliance without <i>customer</i> input.....	33
4.3 Applicable standards.....	38
5 Performance and functionality criteria.....	38
5.1 General.....	38
5.2 <i>BDM/CDM/PDS</i> characteristics and topology	39
5.2.1 General	39
5.2.2 <i>BDM/CDM/PDS</i> characteristics	39
5.2.3 Basic topology for <i>BDM/CDM/PDS</i> s.....	40
5.2.4 Cooling topology.....	42
5.2.5 Bypass and redundant configurations	43
5.3 Ratings	44
5.3.1 General	44
5.3.2 Input ratings	45
5.3.3 Output ratings.....	46
5.3.4 Operating <i>quadrants</i>	48
5.3.5 Ratings and functionality of the control equipment	49
5.3.6 Special ratings related to <i>BDM/CDM/PDS</i> or <i>motor</i>	49
5.4 Performance	59
5.4.1 Operational.....	59
5.4.2 Fault supervision	68
5.4.3 Minimum status indication required.....	70
5.4.4 I/O devices	70
5.5 General safety	72
5.6 Functional safety	72
5.7 EMC	72
5.8 Ecodesign.....	72
5.8.1 General	72
5.8.2 Energy <i>efficiency</i> and power losses	73
5.8.3 Environmental impact	73
5.9 Environmental condition for service, transport and storage	73
5.9.1 General	73
5.9.2 Operation	73
5.9.3 Storage and transport of equipment.....	78
5.9.4 Mechanical conditions	78
5.9.5 Specific storage hazards	79
5.9.6 Environmental service tests (<i>type test</i>)	80
5.10 Types of load duty profiles	80

5.11	Generic interface and use of profiles for <i>PDS</i>	81
5.12	Voltage on <i>power interface</i>	82
5.13	Driven equipment interface	83
5.13.1	Critical speeds.....	83
5.13.2	Torsion analysis	83
5.14	Explosive environment.....	84
5.15	Earthing requirements.....	84
6	Test.....	85
6.1	General.....	85
6.2	Items of individual <i>PDS</i> component tests	85
6.3	Overview of standards and tests for <i>PDS</i> components	85
6.4	Performance of tests.....	85
6.5	Standard tests for <i>BDM/CDM/PDS</i>	86
6.5.1	General	86
6.5.2	Current source <i>converter zero power factor test</i>	86
6.6	Test specifications	86
6.6.1	Visual inspections (<i>type test, sample test and routine test</i>).....	86
6.6.2	Supply system earthing conditions	86
6.6.3	Static performance and rating test	87
6.6.4	Electrical safety	94
6.6.5	Functional safety	94
6.6.6	EMC	94
6.6.7	Ecodesign.....	95
6.6.8	Environmental condition tests	95
6.6.9	Communication profiles	97
6.6.10	Explosive atmosphere environment	97
7	Information and marking requirements.....	97
7.1	General.....	97
7.2	Marking on product	97
7.3	Information to be supplied with the <i>PDS</i> or <i>BDM/CDM</i>	98
7.4	Information to be supplied or made available	98
7.5	Safety and warning	98
7.5.1	Safety and warning labels.....	98
7.5.2	Additional safety considerations of a <i>PDS</i>	99
Annex A (informative) Classification of <i>PDS</i> into low-voltage system and high-voltage system.....		100
A.1	General.....	100
A.2	Classification of <i>PDS</i> by voltage	100
A.3	Examples.....	101
A.3.1	<i>PDS</i> with a supply transformer.....	101
A.3.2	<i>PDS</i> with an <i>active infeed converter</i>	101
A.3.3	<i>PDS</i> with an output transformer	102
A.3.4	<i>PDS</i> with a common <i>DC link</i>	103
A.3.5	<i>PDS</i> with a step-up chopper	104
A.3.6	<i>PDS</i> with parallel-connected line-side <i>converters</i>	104
A.3.7	<i>PDS</i> with series-connected line-side <i>converters</i>	105
A.3.8	<i>PDS</i> with star-connected <i>inverters</i>	106
A.3.9	<i>PDS</i> with a multilevel <i>inverter</i>	107
A.3.10	Multiple <i>PDS</i> s with a common supply transformer.....	109

Annex B (informative) Determination of the <i>input current</i> of <i>BDM/CDM/PDS</i>	111
Bibliography.....	113
Figure 1 – <i>BDM/CDM/PDS manufacturer/customer</i> relationship	18
Figure 2 – Operating quadrants	20
Figure 3 – Example of a <i>power drive system</i>	26
Figure 4 – Typical <i>BDM/CDM/PDS</i>	40
Figure 5 – Common <i>DC link</i> <i>BDM/CDM/PDS</i>	41
Figure 6 – <i>BDM/CDM/PDS</i> with brake	42
Figure 7 – <i>BDM/CDM/PDS</i> with AIC	42
Figure 8 – Bypass configuration for system with indirect <i>converter</i>	44
Figure 9 – Load commutation <i>inverters</i> LCI-synchronous <i>motor</i> in a partly redundant configuration.....	44
Figure 10 – Example of operating region of a PDS.....	47
Figure 11 – Overload cycle example	48
Figure 12 – Insulation stressing types.....	56
Figure 13 – Definition of the transient voltage at the terminals of the <i>motor</i>	57
Figure 14 – Admissible pulse voltage (including voltage reflection and damping) at the <i>motor</i> terminals as a function of the peak rise time t_a	57
Figure 15 – Deviation band.....	60
Figure 16 – Time response following a step change of reference input – No change in operating variables	63
Figure 17 – Time response following a change in an operating variable – No reference change.....	64
Figure 18 – Time response following a reference change at specified rate.....	64
Figure 19 – Frequency response of the control – Reference value as <i>stimulus</i>	66
Figure 20 – Example of relationship of IEC 61800-7 (all parts) to control system software and the <i>BDM/CDM/PDS</i>	82
Figure 21 – Example of protective earthing and interconnection of main components	84
Figure 22 – Measuring circuit of <i>PDS</i>	88
Figure A.1 – Basic configuration of <i>PDS</i>	100
Figure A.2 – Example of <i>low-voltage PDS</i> with a supply transformer.....	101
Figure A.3 – Example of <i>low-voltage PDS</i> with an <i>active infeed converter</i>	102
Figure A.4 – Example of <i>high-voltage PDS</i> with an <i>active infeed converter</i>	102
Figure A.5 – Example of <i>high-voltage PDS</i> with an output transformer.....	102
Figure A.6 – Example of <i>low-voltage PDS</i> with a common <i>DC link</i>	103
Figure A.7 – Example of <i>high-voltage PDS</i> with a common <i>DC link</i>	104
Figure A.8 – Example of <i>high-voltage PDS</i> with a step-up chopper	104
Figure A.9 – Example of <i>low-voltage PDS</i> with parallel-connected <i>rectifiers</i>	105
Figure A.10 – Example of <i>high-voltage PDS</i> with parallel-connected line-side <i>converters</i>	105
Figure A.11 – Example of <i>high-voltage PDS</i> with series-connected <i>rectifiers</i>	106
Figure A.12 – Example of <i>high-voltage PDS</i> with series-connected <i>rectifiers</i>	106
Figure A.13 – Example of <i>high-voltage PDS</i> with star-connected <i>inverters</i>	107
Figure A.14 – Example of <i>high-voltage PDS</i> with a multilevel <i>inverter</i>	108

Figure A.15 – Example of a power module	108
Figure A.16 – Example of multiple <i>low-voltage/high-voltage PDSs</i> with a common supply transformer	110
Figure B.1 – Example of distortion effect of the <i>input current</i> affected by a three-phase <i>converter</i> with capacitive load	111
Table 1 – List of general terms.....	14
Table 2 – List of input ratings of <i>BDM/CDM/PDS</i>	15
Table 3 – List of output ratings of <i>BDM/CDM/PDS</i>	15
Table 4 – List of <i>motor speed</i> and <i>torque</i> ratings	16
Table 5 – Basic classification of PDS by voltage	21
Table 6 – Selection of equipment rating, performance, functionality by responsible parties with corresponding test specification	34
Table 7 – Overview of input and output ratings of the <i>BDM/CDM/PDS</i>	45
Table 8 – Example of reduced maximum continuous load as a function of an overload	48
Table 9 – Limiting parts and typical voltage stress capability of the <i>motor</i> insulation system.....	58
Table 10 – Maximum deviation bands (percent)	61
Table 11 – PDS protection functions	69
Table 12 – Environmental service conditions	74
Table 13 – Definitions of pollution degree	75
Table 14 – Environmental vibration limits for fixed <i>installation</i>	75
Table 15 – <i>Installation</i> vibration limits	76
Table 16 – Environmental shock limits for fixed <i>installation</i>	76
Table 17 – Storage and transport limits.....	78
Table 18 – Transportation vibration limits.....	79
Table 19 – Transportation limits of free fall	79
Table 20 – Environmental service tests.....	80
Table 21 – Shock test	96
Table A.1 – Basic classification of PDS by voltage.....	101

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ADJUSTABLE SPEED ELECTRICAL POWER DRIVE SYSTEMS –**Part 2: General requirements –
Rating specifications for adjustable
speed AC power drive systems**

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 itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 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 61800-2 has been prepared by subcommittee 22G: Adjustable speed electric power drive systems (PDS), of IEC technical committee 22: Power electronic systems and equipment.

This third edition cancels and replaces the second edition published in 2015. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) the requirements from IEC 61800-4 for high-voltage PDS are now merged with requirements from IEC 61800-2:2015, and IEC 61800-4:2002 will be withdrawn upon release of this document;
- b) Clause 1 has been updated to introduce the new concept of Clause 4;

- c) terms and definitions in Table 1 to Table 4 have been classified in logical order; classification in low voltage and high voltage has been considered in Table 5, and Figure 3 clarifies boundaries within *BDM/CDM/PDS*.
- d) Clause 4 is new and creates the methods for evaluating a product to this document;
- e) Clause 5 has been updated with respect to:
- 1) specific content for high-voltage *BDM/CDM/PDS*;
 - 2) description of the basic topology for *BDM/CDM/PDS* (5.2);
 - 3) ratings and performance (5.3 and 5.4);
 - 4) reference to applicable standards within the IEC 61800 series with respect to EMC (IEC 61800-3), electrical safety (IEC 61800-5-1), functional safety (IEC 61800-5-2), load duty aspects (IEC TR 61800-6), communication profiles (IEC 61800-7 series), *power interface* voltage (IEC TS 61800-8), and ecodesign (IEC 61800-9 series) to avoid conflicting requirements (5.5, 5.6, 5.7, 5.10, 5.11, 5.12);
 - 5) update of requirement for ecodesign (5.8);
 - 6) update of requirement for environmental evaluation (5.9);
 - 7) implementation of requirement for explosive atmosphere (5.14);
- f) Clause 6 has been updated with test requirement in order to provide a clear link between design requirement and test requirement;
- g) Clause 7 has been updated to harmonize the marking and documentation requirement within IEC 61800 (all parts);
- h) existing Annex A and Annex B have been updated to include specific detail pertaining to *high voltage BDM/CDM/PDS*.

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

FDIS	Report on voting
22G/432/FDIS	22G/435/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.

A list of all parts in the IEC 61800 series, published under the general title *Adjustable speed electrical power drive systems*, can be found on the IEC website.

In this document, the terms in *italics* are defined in Clause 3.

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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.