BS EN 61800-9-2:2017

BSI Standards Publication

Adjustable speed electrical power drive systems

Part 9-2: Ecodesign for power drive systems, motor starters, power electronics and their driven applications - Energy efficiency indicators for power drive systems and motor starters (IEC 61800-9-2:2017)

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National foreword

This British Standard is the UK implementation of EN 61800-9-2:2017. It is identical to IEC 61800-9-2:2017. It supersedes BS EN 50598-2:2014+A1:2016, which will be withdrawn on 7 April 2020.

The UK participation in its preparation was entrusted to Technical Committee PEL/22, Power electronics.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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EUROPEAN STANDARD

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English Version

Adjustable speed electrical power drive systems - Part 9-2: Ecodesign for power drive systems, motor starters, power electronics and their driven applications - Energy efficiency indicators for power drive systems and motor starters (IEC 61800-9-2:2017)

Entraînements électriques de puissance à vitesse variable - Partie 9-2: Ecoconception des entraînements électriques de puissance, des démarreurs de moteurs, de l'électronique de puissance et de leurs applications entraînées - Indicateurs d'efficacité énergétique pour les entraînements électriques de puissance et les démarreurs de moteurs (IEC 61800-9-2:2017)

Drehzahlveränderbare elektrische Antriebe - Teil 9-2: Ökodesign für Antriebssysteme, Motorstarter, Leistungselektronik und deren angetriebene Einrichtungen - Indikatoren für die Energieeffizienz von Antriebssystemen und Motorstartern (IEC 61800-9-2:2017)

This European Standard was approved by CENELEC on 2017-04-07. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

European foreword

The text of document 22G/349/FDIS, future edition 1 of IEC 61800-9-2, prepared by SC 22G "Adjustable speed electric drive systems incorporating semiconductor power converters", of IEC/TC 22 "Power electronic systems and equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61800-9-2:2017.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2018-01-07
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2020-04-07

This document supersedes EN 50598-2:2014.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For the relationship with EU Directive(s) see informative Annex ZZ, which is an integral part of this document.

Endorsement notice

The text of the International Standard IEC 61800-9-2:2017 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60034	NOTE	Harmonized in EN 60034 series.
IEC/TS 60034-25	NOTE	Harmonized as CLC/TS 60034-25.
IEC 60034-30	NOTE	Harmonized in EN 60034-30 series.
IEC/TS 60034-31	NOTE	Harmonized as CLC/TS 60034-31.
IEC 60146-1-1	NOTE	Harmonized as EN 60146-1-1.
IEC 60947-4-2	NOTE	Harmonized as EN 60947-4-2.
IEC 61000-3-12	NOTE	Harmonized as EN 61000-3-12.
IEC 61800-2	NOTE	Harmonized as EN 61800-2.

IEC 61800-3	NOTE	Harmonized as EN 61800-3.
IEC 61800-5-1	NOTE	Harmonized as EN 61800-5-1.
IEC 61800-9	NOTE	Harmonized in EN 61800-9 series.
IEC 61800-9-1	NOTE	Harmonized as EN 61800-9-1.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this Annex Is available here: www.cenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 60038 (mod)	2009	IEC standard voltages	EN 60038	2011
IEC 60050-161	-	International Electrotechnical Vocabulary (IEV) - Chapter 161: Electromagnetic compatibility	-	-
IEC 60034-1	-	Rotating electrical machines - Part 1: Rating and performance	EN 60034-1	2010
IEC 60034-2-1	2014	Rotating electrical machines - Part 2-1: Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles)	EN 60034-2-1	2014
IEC/TS 60034-2-3	-	Rotating electrical machines - Part 2-3: Specific test methods for determining losses and efficiency of converter-fed AC induction motors	-	-
IEC 60034-30-1	-	Rotating electrical machines - Part 30-1: Efficiency classes of line operated AC motors (IE code)	EN 60034-30-1	2014
IEC 60947-4-1	-	Low-voltage switchgear and controlgear - Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters	EN 60947-4-1 + A1	2010 2012
IEC/TS 61800-8	-	Adjustable speed electrical power drive systems - Part 8: Specification of voltage on the power interface	-	-
IEC/TS 62578	-	Power electronics systems and equipment - Operation conditions and characteristics of active infeed converter (AIC) applications including design recommendations for their emission values below 150 kHz	-	-

Annex ZZ
(informative)

Relationship between this European Standard and the ecodesign requirements of Commission Regulation (EC) No 640/2009 of 22 July 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for electric motors aimed to be covered

This standard has been prepared following the Commission's standardization request mandate to CEN, CENELEC and ETSI for Standardisation in the field of electrical motors with variable speed control and/or Power Drive System products, M/476 EN, to provide one voluntary means of conforming to ecodesign requirements of Commission Regulation (EC) No 640/2009 of 22 July 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for electric motors.

Once this standard is cited in the Official Journal of the European Union under that Regulation, compliance with the normative clauses of this standard given in Table ZZ.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding ecodesign requirements of that Regulation, and associated EFTA regulations.

Table ZZ.1 – Correspondence between this European Standard and Commission Regulation (EC) No 640/2009 of 22 July 2009, Articles 2.2, 3.2 and 3.3 and Annex I, implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for electric motors and Mandate to CEN, CENELEC and ETSI for Standardisation in the field of variable speed drives and/or Power Drive System products M/476, relating to Directive 2009/125/EC establishing a framework for the setting of ecodesign requirements for energy-related products (recast)

Ecodesign requirements of Regulation (EC) No 640/2009	Clause(s) / sub-clause(s) of this EN 61800-9-2	Remarks / Notes
Article 2.2: Definition of variable speed control	Clause 3 sets the international confirmed definitions to comprehensively understand the correct terms needed to purchase and to apply the VSD technology and auxiliaries, as VSD is not the standardized term.	The comprehensive definitions are necessary to clarify possible misunderstandings and to set the link for fulfilling this regulation with necessary equipment in terms of: VSD, ASD, VFD, BDM, CDM, PDS.
Article 3.2: From 1. January 2015: motors with a rated output of 7,5-375 kW shall not be less efficient than the IE3 efficiency level, as defined in Annex I, point 1, or meet the IE2 efficiency level, as defined in Annex I, point 1, and be equipped with a variable speed drive. Article 3.3: From 1 January 2017: motors with a rated output of 0,75-375 kW shall not be less efficient than the IE3 efficiency level, as defined in Annex I, point 1, or meet the IE2 efficiency level, as defined in Annex I, point 1, and be equipped with a variable speed drive.	Subclauses 4.1 and 4.2 set the definitions for the concept of reference losses and for the optional relevant "torque versus speed operating points (including part load conditions)". Subclause 4.3 sets the workflow requirements to analyse the variable speed drive in combination with driven equipment. Subclauses 4.4 - 4.8 set the IE and the IES classification system for converters and variable speed drives. Clause 7 sets the requirements for losses determination and type testing to verify the efficiency classes.	The option to use an IE2 motor in a variable speed application instead of an IE3 motor depends mainly on the torque versus speed characteristic of the driven equipment and how it is applied. In order to do the right optional decision for maximum energy savings, EN 61800-9-2 gives the fundamental requirements, the workflows and the classification system for variable speed drives to do the fundamental assessment in the power range of 0,12 kW up to 1000 kW.

Ecodesign requirements of Regulation (EC) No 640/2009	Clause(s) / sub-clause(s) of this EN 61800-9-2	Remarks / Notes
Annex I, point 2: Information on the mandatory requirement to equip motors, which do not meet the IE3 efficiency level with a variable speed drive, shall be visibly displayed on the rating plate, technical documentation of the motor.	Clause 8 sets the requirements for the documentation that shall be provided by the manufacturers of the electronic frequency converters and the variable speed drives.	All energy efficiency related equipment labels (IE as well as IES classes) are addressed, in order to ensure a classification of the CDM, PDS. Also the provisions of sufficient information are fixed, to recognize this classification for the final application and/or system, where the converters or variable speed drives are used as components.
Annex I, point 2: Manufacturers shall provide information in the technical documentation on any specific precautions that must be taken when motors are assembled, installed, maintained or used with variable speed drives, including information on how to minimize electrical and magnetic fields from variable speed drives.	Subclause 8.4 sets requirements for the determination of additional energy losses and part load conditions depending on the BDM/CDM/PDS architecture and the possible use of options for compliance to other performance or environmental requirements. Clause 2 sets the relevant information on how to minimize electrical and magnetic fields from variable speed drives and the specific information by requesting reference to EN 61800-3 “Electromagnetic compatibility requirements and specific test methods”. Subclauses B.3.1 and B.3.2 are describing the use of high frequency electromagnetic interference filters and low frequency line harmonics filters to minimize electrical and magnetic fields from variable speed drive systems.	Electromagnetic compatibility (EMC) requirements are specific items for variable speed drives and are handled in the dedicated product standard EN 61800-3. Following those requirements leads to a fully compliant operation of variable speed drives since decades.

WARNING 1: Presumption of conformity stays valid only as long as a reference to this European Standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2: Other Union legislation may be applicable to the motor systems falling within the scope of this standard.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ADJUSTABLE SPEED ELECTRICAL POWER DRIVE SYSTEMS –

Part 9-2: Ecodesign for power drive systems, motor starters, power electronics and their driven applications – Energy efficiency indicators for power drive systems and motor starters

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.
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International Standard IEC 61800-9-2 has been prepared by subcommittee 22G: Adjustable speed electric drive systems incorporating semiconductor power converters, of IEC technical committee 22: Power electronic systems and equipment.

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

FDIS	Report on voting
22G/349/FDIS	22G/352/RVD

Full information on the voting for the approval of this document 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.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website 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.

INTRODUCTION

This part of IEC 61800 has been developed to allow evaluation of power losses of CDMs (complete drive modules) and PDSs (power drive systems).

The requirements for measuring energy efficiency of motors with non-sinusoidal supply are under the responsibility of IEC/TC 2 and will be published under the IEC 60034 series.

IEC SC 22G includes the standardization task force for dealing with this topic. It has close collaboration with several other technical committees (for example, IEC TC 2, IEC SC 121A).

IEC SC 22G maintains responsibility for all relevant aspects in the field of energy efficiency and ecodesign requirements for power electronics, switchgear, control gear and power drive systems and their industrial applications.

The core requirements of energy efficiency standardization are illustrated in Figure 1. The work has been agreed to provide the reasonable target as a best compromise.

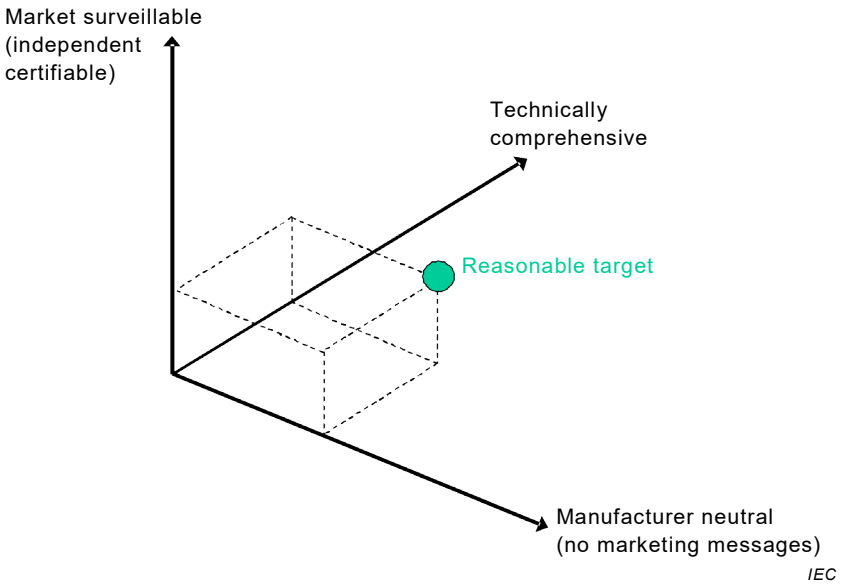

Figure 1 – Illustration of core requirements of energy efficiency standardization

IEC 61800 (all parts) does not deal with mechanical engineering components.

NOTE Geared motors (motors with directly adapted gearboxes) are treated like power drive systems (converter plus motor). See IEC 60034-30-1 for classification of the losses of a geared motor. The efficiency classes of gearboxes as individual components are under consideration.

IEC 61800-9-2 is a subpart of the IEC 61800 series, which has the following structure:

– *Part 1: General requirements – Rating specifications for low voltage adjustable speed DC power drive systems*
– *Part 2: General requirements – Rating specifications for low voltage adjustable speed AC power drive systems*
– *Part 3: EMC requirements and specific test methods*
– *Part 4: General requirements – Rating specifications for AC power drive systems above 1 000 V AC and not exceeding 35 kV*
– *Part 5: Safety requirements*

– *Part 6: Guide for determination of types of load duty and corresponding current ratings*

– *Part 7: Generic interface and use of profiles for power drive systems*

– *Part 8: Specification of voltage on the power interface*

– *Part 9: Ecodesign for power drive systems, motor starters, power electronics and their driven applications*

Each part is further subdivided into several subparts, published either as International Standards or as Technical Specifications or Technical Reports, some of which have already been published. Other will be published with the part number followed by a dash and a second number identifying the subdivision (example: IEC 61800-9-2).

It considers basic requirements from the EN 50598-2 CENELEC standard published on 2014-12-19 and considers also the following key points in cooperation with relevant technical committees.

It has been developed in close collaboration with other technical committees (IEC TC 2, IEC SC 121A) and with a customer's stakeholder committee CEN/TC 197 in order to provide a comprehensive standard for energy efficiency and ecodesign requirements.

Key points:

- Requirements for energy-efficient design of electric drive systems in accordance with the driven load
- Requirements and IE-classification of complete drive modules (CDM)
- Requirements and IES-classification of power drive systems (PDS)
- Determination of PDS losses and requirements for the link to the driven equipment for the determination of energy efficiency classification/evaluation of the extended product
- Requirements for an environmentally conscious system design and environmental declaration of a motor system

ADJUSTABLE SPEED ELECTRICAL POWER DRIVE SYSTEMS –

Part 9-2: Ecodesign for power drive systems, motor starters, power electronics and their driven applications – Energy efficiency indicators for power drive systems and motor starters

1 Scope

This part of IEC 61800 specifies energy efficiency indicators of power electronics (complete drive modules, CDM), power drive systems (PDS) and motor starters, all used for motor driven equipment.

It specifies the methodology for the determination of losses of the complete drive module (CDM), the power drive system (PDS) and the motor system.

It defines IE and IES-classes, their limit values and provides test procedures for the classification of the overall losses of the motor system.

Furthermore, this document proposes a methodology for the implementation of the best energy efficiency solution of drive systems. This depends on the architecture of the motor driven system, on the speed/load profile and on the operating points over time of the driven equipment.

The methodology of the extended product approach and the semi analytical models are defined in IEC 61800-9-1.

The structure of this document is as follows:

- the losses of standardized reference PDS (RPDS), standardized reference CDM (RCDM) and the mathematical model for their calculation are given and classified;
- the reference motor (RM) and the reference CDM (RCDM) are defined and can be used to determine the efficiency class of a motor system when one of its constituents is unknown;
- the requirements for the determination of the losses of a real PDS and a real CDM are given and compared to the reference RPDS and RCDM;
- the requirements for type testing and user documentation are given;
- some exemplary losses of an overall system are illustrated in annexes;
- information about system and drive topologies are given in annexes.

Specific data for power losses of RCDM, RM, RPDS and IE/IES-classes are given for low voltage (100 V up to and equal to 1 000 V), single axis AC/AC power drive systems with three-phase motors. Geared motors are treated as standard motors when motor and gearbox can be separated.

All provided reference data is derived from PDS with induction motors. It may be used for all types of PDS with other types of motors as well.

The application of this document to the following equipment may be technically possible but is not mandatory:

- High voltage CDM and PDS with a rated voltage above 1 000 V AC;
- Low voltage CDM and PDS with a rated voltage below 100 V AC;