SVENSK STANDARD

SS-EN IEC 61800-9-2, utg 2:2025

Fastställd	Sida	Ansvarig kommitté
2025-10-22	1 (137)	SEK TK 22

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Varvtalsstyrda elektriska drivsystem – Del 9-2: Ekodesign för elektriska drivsystem – Bestämning av verkningsgrad och klassificering

Adjustable speed electrical power drive systems (PDS) – Part 9-2: Ecodesign for motor systems – Energy efficiency determination and classification

Som svensk standard gäller europastandarden EN IEC 61800-9-2:2025. Den svenska standarden innehåller den officiella engelska språkversionen av EN IEC 61800-9-2:2025.

Nationellt förord

Europastandarden EN IEC 61800-9-2:2025

består av:

– **europastandardens ikraftsättningsdokument,** utarbetat inom CENELEC
– **IEC 61800-9-2, Second edition, 2023 - Adjustable speed electrical power drive systems (PDS) - Part 9-2: Ecodesign for motor systems - Energy efficiency determination and classification**

utarbetad inom International Electrotechnical Commission, IEC.

Tidigare fastställd svensk standard SS-EN 61800-9-2, utg 1:2017 med eventuella tillägg, ändringar och rättelser gäller ej fr o m 2028-03-31.

ICS 29.130.01; 29.160.30; 29.200.00

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Entraînements électriques de puissance (PDS) à vitesse variable - Partie 9-2: Écoconception des systèmes moteurs - Détermination et classification de l'efficacité énergétique (IEC 61800-9-2:2023)

Drehzahlveränderbare elektrische Antriebe - Teil 9-2: Ökodesign für Antriebssysteme, Motorstarter, Leistungselektronik und deren angetriebene Einrichtungen - Indikatoren für die Energieeffizienz von Antriebssystemen und Motorstartern (IEC 61800-9-2:2023)

This European Standard was approved by CENELEC on 2023-11-24. 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.

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SS-EN IEC 61800-9-2, utg 2:2025

European foreword

The text of document 22G/475/FDIS, future edition 2 of IEC 61800-9-2, prepared by SC 22G "Adjustable speed electric power drive systems (PDS)" of IEC/TC 22 "Power electronic systems and equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 61800-9-2:2025.

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) 2026-03-31
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2028-03-31

This document supersedes EN 61800-9-2:2017 and all of its amendments and corrigenda (if any).

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This document has been prepared under a standardization request addressed to CENELEC by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

Any feedback and questions on this document should be directed to the users' national committee. A complete listing of these bodies can be found on the CENELEC website.

Endorsement notice

The text of the International Standard IEC 61800-9-2:2023 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 standard indicated:

IEC 60034 (series)	NOTE	Approved as EN IEC 60034 (series)
IEC/TS 60034-25	NOTE	Approved as CLC IEC/TS 60034-25
IEC 60146-1-1	NOTE	Approved as EN IEC 60146-1-1
IEC 60947-4-2	NOTE	Approved as EN IEC 60947-4-2
IEC 61800-1	NOTE	Approved as EN IEC 61800-1
IEC 61800-2	NOTE	Approved as EN IEC 61800-2
IEC 61800-3	NOTE	Approved as EN IEC 61800-3
IEC 61800-5-1	NOTE	Approved as EN IEC 61800-5-1
IEC 61800-9-1	NOTE	Approved as EN 61800-9-1

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 Where 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.cencenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 60034-1	2022	Rotating electrical machines - Part 1: Rating and performance	-	-
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 60034-2-3	2020	Rotating electrical machines - Part 2-3: Specific test methods for determining losses and efficiency of converter-fed AC motors	EN IEC 60034-2-3	2020
IEC 60034-30-1	2014	Rotating electrical machines - Part 30-1: Efficiency classes of line operated AC motors (IE code)	EN 60034-30-1	2014
IEC/TS 60034-30-2	2016	Rotating electrical machines - Part 30-2: Efficiency classes of variable speed AC motors (IE-code)	CLC IEC/TS 60034-30-2	2021
IEC/TS 60034-31	2021	Rotating electrical machines - Part 31: Selection of energy-efficient motors including variable speed applications - Application guidelines	CLC IEC/TS 60034-31	2024
IEC 60038 (mod)	2009	IEC standard voltages	EN 60038	2011
+ AMD1	-		-	-
IEC 60050-161	-	International Electrotechnical Vocabulary. Chapter 161: Electromagnetic compatibility	-	-
IEC 60947-4-1	2018	Low-voltage switchgear and controlgear - Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters	EN IEC 60947-4-1	2019

Publication	Year	Title	EN/HD	Year
IEC 61000-3-12	2011	Electromagnetic compatibility (EMC) - Part 3-12: Limits - Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and ≤ 75 A per phase	EN 61000-3-12	2011
IEC GUIDE 118	2017	Inclusion of energy efficiency aspects in electrotechnical publications	-	-

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PUBLICATION GROUPÉE SUR L'ÉFFICACITÉ ÉNERGÉTIQUE

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ADJUSTABLE SPEED ELECTRICAL POWER DRIVE SYSTEMS (PDS) –

Part 9-2: Ecodesign for motor systems – Energy efficiency determination and classification

FOREWORD

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IEC 61800-9-2 has been prepared by subcommittee 22G: Adjustable speed electric drive systems (PDS), of IEC technical committee 22: Power electronic systems and equipment. It is an International Standard.

It has the status of a group energy efficiency publication in accordance with IEC Guide 118.

This second edition cancels and replaces the first edition published in 2017. This edition constitutes a technical revision.

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

a) Additional IES Classes defined to IES5;
b) Removed reference motor loss data and now point to IEC 60034-30-2;

c) Expanded and modified factors in Clause 6 for CDMs;
d) Annex C is now the Mathematical Model for CDM Losses;
e) Moved the mathematical model for the CDM to Annex C;
f) Added Sub Drive Input Module and Sub Drive Output Modules to Annex B;
g) Annex D is now the Converter Topology (old Annex C);
h) Annex E is now the Interpolation of Motor Losses (Old Annex D);
i) Annex E expanded to include various motor connections and updated interpolation method;
j) New Annex E for determination of Interpolation Coefficients;
k) Annex F is the old Annex E;
l) New Annex J Explanation of Correction Factors for the Reference Losses in Table 8.

The text of this International Standard is based on the following documents:

Draft	Report on voting
22G/475/FDIS	22G/478/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The "colour inside" logo on the cover page of this document 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 SDMs (sub drive modules), 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, ISO/TC 115, ISO/TC 117, ISO/TC 118, CEN/TC 197) in order to provide a comprehensive standard for energy efficiency and ecodesign requirements.

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 IEC 61800 series does not deal with mechanical engineering components.

NOTE 1 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 adjustable speed AC power drive systems
– Part 3: EMC requirements and specific test methods
– 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 motor systems

Some parts are further subdivided into several subparts, published either as International Standards or as Technical Specifications or Technical Reports and will be published with the part number followed by a dash and a second number identifying the subdivision (example: IEC 61800-9-2).

NOTE 2 It is understood that Formula (13) is for Direct-on-Line motors. Formula (13) will be modified in the next amendment to account for Variable Frequency Drive motors.

NOTE 3 A new figure will be developed to demonstrate the use of a star point for measuring the converter phase voltages to determine the cosphi for each phase in 7.5.3.1.

ADJUSTABLE SPEED ELECTRICAL POWER DRIVE SYSTEMS (PDS) –

Part 9-2: Ecodesign for motor systems – Energy efficiency determination and classification

1 Scope

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

This document is a group energy efficiency publication according to IEC Guide 119 and specifies the methodology for the determination of losses of the complete drive module (CDM), the sub drive module (SDM), 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/torque profile and on the operating points over time of the driven load equipment. It provides a link for the energy efficiency evaluation and classification of the extended product.

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 PDS, 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. They are used for determining the efficiency class of a PDS if either the physical motor or physical CDM is unknown;
- the requirements for the determination of the losses of a physical PDS and a physical CDM including correction factors for other types of CDM, not defined as RCDM or SDM, are given and compared to the IES class limits and the 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 the RCDM and RM, limits for the PDS 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. A methodology is given in addition how this reference data can also be applied to other topologies like AC/DC or DC/AC converters.

All provided reference data is derived from PDS with induction motors. They can be used for various types of PDS with other types of motors as well, for example but not limited to, electronically commutated motors (ECM), permanent magnet motors (PM) or synchronous reluctance motors (SYN-RM), and line-start permanent magnet motors (LSPM).

PDS requirements in this document only apply to PDSs that are placed on the market as one single product, i.e. combination of motor and CDM that are not intended to be used separately.

CDM requirements only apply to a CDM where the included SDMs have not already been evaluated according to SDM requirements.

The following equipment is excluded from the scope:

- high voltage CDM, SDM and PDS with a rated voltage above 1,0 kV AC or 1,5 kV DC;
- low voltage CDM, SDM and PDS with a rated voltage below 100 V AC;
- high power PDS above a rated power of 1 000 kW;
- high power CDM and SDM above a rated apparent output power of 1 209 kVA;
- low power PDS below a rated power of 0,12 kW;
- low power CDM and SDM below a rated apparent output power of 0,278 kVA;
- PDS with geared motors where motor and gearbox cannot be separated, for example because of a common housing;
- servo PDS (consisting of frequency converter, motor and position feedback sensor);
- CDM, BDM and SDM that are exclusively designed to drive servo motors;
- PDS, CDM, BDM and SDM specifically designed for DC motor applications according to IEC 61800-1;
- PDS where several motors are connected in parallel to a single CDM with one three-phase output.
- SDM with DC input and DC output.

NOTE The IEC 61800-9 series does not cover energy efficiency classification of driven equipment but provides input for the assessment according to the extended product approach.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60034-1:2022, *Rotating electrical machines – Part 1: Rating and performance*

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)*

IEC 60034-2-3:2020, *Rotating electrical machines – Part 2-3: Specific test methods for determining losses and efficiency of converter-fed AC induction motors*

IEC 60034-30-1:2014, *Rotating electrical machines – Part 30-1: Efficiency classes of line operated AC motors (IE code)*

IEC TS 60034-30-2:2016, *Rotating electrical machines – Part 30-2: Efficiency classes of variable speed AC motors (IE-code)*

IEC TS 60034-31:2021, *Rotating electrical machines – Part 31: Selection of energy-efficient motors including variable speed applications – Application guidelines*

IEC 60038:2009, *IEC standard voltages*
IEC 60038:2009/AMD1:2021

IEC 60050-161, *International Electrotechnical Vocabulary (IEV) – Part 161: Electromagnetic compatibility*, available at www.electropedia.org

IEC 60947-4-1:2018, *Low voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters*

IEC 61000-3-12:2011, *Electromagnetic compatibility (EMC) – Part 3-12: Limits – Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and ≤ 75 A per phase*

IEC Guide 118:2017, *Inclusion of energy efficiency aspects in electrotechnical publications*