
Električni pogonski sistemi z nastavljivo hitrostjo - 9-2. del: Okoljsko primerno načrtovanje motornih pogonskih sistemov - Kazalniki energijske učinkovitosti ugotavljanje in razvrstitev

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

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

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

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TITLE:

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

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ADJUSTABLE SPEED ELECTRICAL POWER DRIVE SYSTEMS –**Part 9-2: Ecodesign for motor systems
Energy efficiency determination and classification**

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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- withdrawn,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.

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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.

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 d.c. power drive systems*
- *Part 2: General requirements – Rating specifications for low voltage adjustable speed a.c. 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 will be published with the part number followed by a dash and a second number identifying the subdivision (example: IEC 61800-9-2).

ADJUSTABLE SPEED ELECTRICAL POWER DRIVE SYSTEMS –

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 an Energy Efficiency Publication according to IEC Guide 118 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 as defined as RCDM or SDM are given and compared to the PDS 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 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 a.c./a.c. 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 a.c./d.c. or d.c./a.c. converters.

All provided reference data is derived from PDS with induction motors. It may be used for various types of PDS with other types of motors as well, for example but not limited to,

78 Electronically Commutated Motors (ECM), Permanent Magnet Motors (PM) or Synchronous
79 Reluctance Motors (SYN-RM), and Line-Start Permanent Magnet Motors (LSPM).

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

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

84 The following equipment is excluded from the scope:

- 85 • High voltage CDM, SDM and PDS with a rated voltage above 1,0 kV a.c. or 1,5 kV d.c.;
- 86 • Low voltage CDM, SDM and PDS with a rated voltage below 100 V a.c.;
- 87 • High power PDS above a rated power of 1 000 kW;
- 88 • High power CDM and SDM above a rated apparent output power of 1 209 kVA;
- 89 • Low power PDS below a rated power of 0,12 kW;
- 90 • Low power CDM and SDM below a rated apparent output power of 0,278 kVA;
- 91 • PDS with geared motors where motor and gearbox cannot be separated, for example
92 because of a common housing;
- 93 • Servo PDS (consisting of frequency converter, motor and position feedback sensor);
- 94 • CDM, BDM and SDM that are exclusively designed to drive servo motors;
- 95 • PDS, CDM, BDM and SDM specifically designed for d.c. motor applications according to
96 IEC 61800-1;
- 97 • PDS where several motors are connected in parallel to a single CDM with one three-phase
98 output.
- 99 • SDM with DC input and DC output

100 NOTE IEC 61800-9 (all parts) does not cover energy efficiency classification of driven equipment but provides input
101 for the assessment according to the extended product approach.

102

103 2 Normative references

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

108 IEC 60034-1:2017, *Rotating electrical machines – Part 1: Rating and performance*

109 IEC 60034-2-1:2014, *Rotating electrical machines – Part 2-1: Standard methods for determining*
110 *losses and efficiency from tests (excluding machines for traction vehicles)*

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

113 IEC 60034-30-1:2014, *Rotating electrical machines – Part 30-1: Efficiency classes of line*
114 *operated a.c. motors (IE Code)*

115 IEC TS 60034-30-2:2016, *Rotating electrical machines – Part 30-2: Efficiency classes of*
116 *variable speed a.c. motors (IE Code)*