



# SLOVENSKI STANDARD

SIST EN 61800-5-2:2008

01-januar-2008

9`Y\_k] b]dc[ cbg\_l]g]ghYa ]n`bUghUj `]j c` \ ]fbcgthc `!) !&"XY. `JUfbcgthbY`nU hYj Y!  
: i b\_v]g\_Yf]97 `\*% \$\$!) !& &\$\$+L

Adjustable speed electrical power drive systems - Part 5-2: Safety requirements -  
Functional (IEC 61800-5-2:2007)

Elektrische Leistungsantriebssysteme mit einstellbarer Drehzahl - Teil 5-2:  
Anforderungen an die Sicherheit - Funktionale Sicherheit (IEC 61800-5-2:2007)

**ITeh STANDARD PREVIEW**

Entraînements électriques de puissance a vitesse variable - Partie 5-2: Exigences de  
sécurité - Fonctionnalité (IEC 61800-5-2:2007)

SIST EN 61800-5-2:2008

[https://standards.iteh.ai/catalog/standards/sist/4f70abf6-0f52-48bf-9bda-  
ca2e912e017/sist-en-61800-5-2-2008](https://standards.iteh.ai/catalog/standards/sist/4f70abf6-0f52-48bf-9bda-<br/>ca2e912e017/sist-en-61800-5-2-2008)

**Ta slovenski standard je istoveten z: EN 61800-5-2:2007**

### ICS:

13.110	Varnost strojev	Safety of machinery
29.200	W{ ^} ä äU! ^c[ !} ä ä Ucä ä ä ä [ Á   ^ d ä } [ } ä ä ä ä	Rectifiers. Convertors. Stabilized power supply

**SIST EN 61800-5-2:2008**

**en,de**

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

SIST EN 61800-5-2:2008

<https://standards.iteh.ai/catalog/standards/sist/4f70abf6-0f52-48bf-9bda-cad285f26017/sist-en-61800-5-2-2008>

EUROPEAN STANDARD

**EN 61800-5-2**

NORME EUROPÉENNE

EUROPÄISCHE NORM

October 2007

ICS 29.200; 13.110

English version

**Adjustable speed electrical power drive systems -  
Part 5-2: Safety requirements -  
Functional**  
(IEC 61800-5-2:2007)

Entraînements électriques de puissance  
à vitesse variable -  
Partie 5-2: Exigences de sécurité -  
Fonctionnalité  
(CEI 61800-5-2:2007)

Elektrische Leistungsantriebssysteme  
mit einstellbarer Drehzahl -  
Teil 5-2: Anforderungen an die Sicherheit -  
Funktionale Sicherheit  
(IEC 61800-5-2:2007)

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

This European Standard was approved by CENELEC on 2007-10-01. 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.

<https://standards.iteh.ai/catalog/standards/sist/4f70abf6-0f52-48bf-9bda-581e61800522008>

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

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

**CENELEC**

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

**Central Secretariat: rue de Stassart 35, B - 1050 Brussels**

## Foreword

The text of document 22G/179/FDIS, future edition 1 of IEC 61800-5-2, 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 was approved by CENELEC as EN 61800-5-2 on 2007-10-01.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2008-07-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2010-10-01

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and covers essential requirements of EC Directives 98/37/EC and 2006/42/EC. See Annex ZZ.

Annexes ZA and ZZ have been added by CENELEC.

---

## Endorsement notice

The text of the International Standard IEC 61800-5-2:2007 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:

<u>SIST EN 61800-5-2:2008</u>		
IEC 60300-3-1	NOTE	Harmonized as EN 60300-3-1:2004 (not modified).
IEC 60664-1	NOTE	Harmonized as EN 60664-1:2003 (not modified).
IEC 60664-3	NOTE	Harmonized as EN 60664-3:2003 (not modified).
IEC 61025	NOTE	Harmonized as EN 61025:2007 (not modified).
IEC 61078	NOTE	Harmonized as EN 61078:2006 (not modified).
IEC 61165	NOTE	Harmonized as EN 61165:2006 (not modified).
IEC 61508-4	NOTE	Harmonized as EN 61508-4:2001 (not modified).
IEC 61511	NOTE	Harmonized in EN 61511 series (not modified).
IEC 61511-1	NOTE	Harmonized as EN 61511-1:2004 (not modified).
IEC 61558	NOTE	Harmonized in EN 61558 series (partially modified).
IEC 61558-1	NOTE	Harmonized as EN 61558-1:2005 (not modified).
IEC 62061	NOTE	Harmonized as EN 62061:2005 (not modified).
ISO 13849-1	NOTE	Harmonized as EN ISO 13849-1:2006 (not modified).
ISO 13849-2	NOTE	Harmonized as EN ISO 13849-2:2003 (not modified).

---

**Annex ZA**  
(normative)

**Normative references to international publications  
with their corresponding European publications**

The following referenced documents are indispensable for the application 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 When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60204-1 (mod)	- <sup>1)</sup>	Safety of machinery - Electrical equipment of machines - Part 1: General requirements	EN 60204-1	2006 <sup>2)</sup>
IEC 61508	Series	Functional safety of electrical/electronic/programmable electronic safety-related systems	EN 61508	Series
IEC 61508-1 + corr. May	1998 1999	Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 1: General requirements	EN 61508-1	2001
IEC 61508-2	2000	Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems	EN 61508-2	2001
IEC 61508-3 + corr. April	1998 1999	Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 3: Software requirements	EN 61508-3	2001
IEC 61508-5	- <sup>1)</sup>	Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 5: Examples of methods for the determination of safety integrity levels	EN 61508-5	2001 <sup>2)</sup>
IEC 61508-6	2000	Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 6: Guidelines on the application of IEC 61508-2 and IEC 61508-3	EN 61508-6	2001

<sup>1)</sup> Undated reference.

<sup>2)</sup> Valid edition at date of issue.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61508-7	2000	Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 7: Overview of techniques and measures	EN 61508-7	2001
IEC 61800-1	- <sup>1)</sup>	Adjustable speed electrical power drive systems - Part 1: General requirements - Rating specifications for low voltage adjustable speed d.c. power drive systems	EN 61800-1	1998 <sup>2)</sup>
IEC 61800-2	- <sup>1)</sup>	Adjustable speed electrical power drive systems - Part 2: General requirements - Rating specifications for low voltage adjustable frequency a.c. power drive systems	EN 61800-2	1998 <sup>2)</sup>
IEC 61800-3	- <sup>1)</sup>	Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods	EN 61800-3	2004 <sup>2)</sup>
IEC 61800-4	- <sup>1)</sup>	Adjustable speed electrical power drive systems - Part 4: General requirements - Rating specifications for a.c. power drive systems above 1 000 V a.c. and not exceeding 35 kV	EN 61800-4	2003 <sup>2)</sup>
IEC 61800-5-1	2003	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy	EN 61800-5-1 <sup>3)</sup>	2003
IEC 62280	Series	Railway applications - Communication, signalling and processing systems	-	-

<sup>3)</sup> EN 61800-5-1 is superseded by EN 61800-5-1:2007, which is based on IEC 61800-5-1:2007.

**Annex ZZ**  
(informative)

**Coverage of Essential Requirements of EC Directives**

**Annex ZZA**  
(informative)

**Coverage of Essential Requirements of Directive 98/37/EC**

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and within its scope the standard covers the following essential requirements out of those given in Annex I of the EC Directive 98/37/EC:

- 1.2.1;
- 1.2.7.

Compliance with this standard provides one means of conformity with the specified essential requirements of the Directive concerned.

WARNING: Other requirements and other EC Directives may be applicable to the products falling within the scope of this standard.

**iTeh STANDARD PREVIEW**

**Annex ZZB**  
(informative)  
(standards.iteh.ai)

**Coverage of Essential Requirements of Directive 2006/42/EC**

<https://standards.iteh.ai/catalog/standards/sist/4f70abf6-0f52-48bf-9bda-cad285f26017/sist-en-61800-5-2-2008>

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and within its scope the standard covers the following essential requirements out of those given in Annex I of the EC Directive 2006/42/EC:

- 1.2.1.

Compliance with this standard provides one means of conformity with the specified essential requirements of the Directive concerned.

WARNING: Other requirements and other EC Directives may be applicable to the products falling within the scope of this standard.

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

SIST EN 61800-5-2:2008

<https://standards.iteh.ai/catalog/standards/sist/4f70abf6-0f52-48bf-9bda-cad285f26017/sist-en-61800-5-2-2008>



# INTERNATIONAL STANDARD

# IEC 61800-5-2

First edition  
2007-07

---

---

## Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

SIST EN 61800-5-2:2008

<https://standards.iteh.ai/catalog/standards/sist/4f70abf6-0f52-48bf-9bda-cad285f26017/sist-en-61800-5-2-2008>



Commission Electrotechnique Internationale  
International Electrotechnical Commission  
Международная Электротехническая Комиссия

PRICE CODE **XB**

*For price, see current catalogue*

## CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope and object.....	8
2 Normative references .....	9
3 Terms and definitions .....	10
4 Designated safety functions.....	15
4.1 General.....	15
4.2 Safety functions .....	16
4.2.1 Limit values .....	16
4.2.2 Stopping functions.....	16
4.2.3 Other safety functions.....	17
5 Management of functional safety .....	18
5.1 Objective.....	18
5.2 PDS(SR) development lifecycle .....	18
5.3 Functional safety planning.....	19
5.4 Safety requirements specification (SRS) for a PDS(SR) .....	21
5.4.1 General.....	21
5.4.2 Safety functionality requirements specification .....	21
5.4.3 Safety integrity requirements specification.....	22
6 Requirements for design and development of a PDS(SR) .....	22
6.1 General requirements.....	22
6.1.1 Change in operational status.....	22
6.1.2 Design standards.....	22
6.1.3 Realisation .....	23
6.1.4 Safety integrity and fault detection.....	23
6.1.5 Safety and non-safety functions.....	23
6.1.6 SIL to be used .....	23
6.1.7 Software requirements.....	23
6.1.8 Review of requirements .....	23
6.1.9 Design documentation .....	24
6.2 PDS(SR) design requirements.....	24
6.2.1 Requirements for probability of dangerous random hardware failures per hour (PFH) .....	24
6.2.2 Architectural constraints .....	26
6.2.3 Estimation of safe failure fraction (SFF).....	28
6.2.4 Requirements for systematic safety integrity of a PDS(SR) and PDS(SR) subsystems .....	28
6.2.5 Electromagnetic (EM) immunity requirement of a PDS(SR).....	31
6.3 Behaviour on detection of fault.....	31
6.3.1 Fault detection.....	31
6.3.2 Fault tolerance greater than zero.....	32
6.3.3 Fault tolerance zero.....	32
6.4 Additional requirements for data communications.....	32
6.5 PDS(SR) integration and testing requirements .....	33
6.5.1 Hardware integration .....	33

6.5.2	Software integration .....	33
6.5.3	Modifications during integration .....	33
6.5.4	Applicable integration tests.....	33
6.5.5	Test documentation .....	34
7	Information for use .....	34
7.1	Information and instructions for safe application of a PDS(SR).....	34
8	Verification and validation .....	35
8.1	General .....	35
8.2	Verification .....	36
8.3	Validation .....	36
8.4	Documentation .....	36
9	Test requirements .....	36
9.1	Planning of tests .....	36
9.2	Test documentation.....	36
10	Modification.....	37
10.1	Objective .....	37
10.2	Requirements.....	37
10.2.1	Modification request .....	37
10.2.2	Impact analysis.....	37
10.2.3	Authorization.....	37
10.2.4	Documentation .....	37
Annex A (informative)	Sequential task table.....	38
Annex B (informative)	Example for determination of PFH.....	41
Annex C (informative)	Available failure rate databases.....	52
Annex D (informative)	Fault lists and fault exclusions .....	54
Bibliography.....		64
Figure 1 – Functional elements of a PDS(SR).....		9
Figure 2 – PDS(SR) development lifecycle.....		19
Figure 3 – Architectures for data communication ( a) White channel; b) Black channel) .....		33
Figure B.1 – Example PDS(SR) .....		41
Figure B.2 – Subsystems of the PDS(SR) .....		42
Figure B.3 – Function blocks of subsystem A/B.....		43
Figure B.4 – Reliability model (Markov) of subsystem A/B.....		46
Figure B.5 – Function blocks of subsystem PS/VM.....		48
Figure B.6 – Reliability model (Markov) of subsystem PS/VM .....		50
Table 1 – Alphabetical list of definitions .....		11
Table 2 – Safety integrity levels: target failure measures for a PDS(SR) safety function .....		24
Table 3 – Hardware safety integrity: architectural constraints on type A safety-related subsystems.....		27
Table 4 – Hardware safety integrity: architectural constraints on type B safety-related subsystems.....		28

Table B.1 – Determination of DC factor of subsystem A/B.....	45
Table B.2 – PFH value calculation results for subsystem A/B.....	47
Table B.3 – Determination of DC factor of subsystem A/B.....	48
Table B.4 – PFH value calculation results for subsystem PS/VM.....	51
Table D.1 – Conductors/cables .....	55
Table D.2 – Printed wiring boards/assemblies.....	55
Table D.3 – Terminal block .....	56
Table D.4 – Multi-pin connector .....	56
Table D.5 – Electromechanical devices (for example relay, contactor relays).....	57
Table D.6 – Transformers .....	57
Table D.7 – Inductances .....	58
Table D.8 – Resistors .....	58
Table D.9 – Resistor networks .....	58
Table D.10 – Potentiometers.....	59
Table D.11 – Capacitors .....	59
Table D.12 – Discrete semiconductors (for example diodes, Zener diodes, transistors, triacs, GTO thyristors, IGBTs, voltage regulators, quartz crystal, phototransistors, light-emitting diodes [LEDs]).....	59
Table D.13 – Optocouplers .....	60
Table D.14 – Non-programmable integrated circuits.....	60
Table D.15 – Programmable and/or complex integrated circuits .....	61
Table D.16 – Motion and position feedback sensors .....	62

STANDARD PREVIEW  
(standards.iteh.ai)  
SIST EN 61800-5-2:2008  
<https://standards.iteh.ai/catalog/standards/sist/4f70abf6-0f52-48bf-9bda-cad285f26017/sist-en-61800-5-2-2008>

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

---

**ADJUSTABLE SPEED ELECTRICAL  
POWER DRIVE SYSTEMS –**
**Part 5-2: Safety requirements –  
Functional**

## 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 provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 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 61800-5-2 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 standard is based on the following documents:

FDIS	Report on voting
22G/179/FDIS	22G/182/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 of the IEC 61800 series, published under the general title *Adjustable speed electric drive systems*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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.

A bilingual version of this publication may be issued at a later date.

## **iTeh STANDARD PREVIEW** **(standards.iteh.ai)**

SIST EN 61800-5-2:2008

<https://standards.iteh.ai/catalog/standards/sist/4f70abf6-0f52-48bf-9bda-cad285f26017/sist-en-61800-5-2-2008>

## INTRODUCTION

As a result of automation, demand for increased production and reduced operator physical effort, control systems of machinery and plant items play an increasing role in the achievement of overall safety. These control systems increasingly employ complex electrical/electronic/programmable electronic devices and systems.

Prominent amongst these devices and systems are adjustable speed electrical power drive systems (PDS) that are suitable for use in safety-related applications (PDS(SR)).

Examples of industrial applications are:

- machine tools, robots, production test equipment, test benches;
- papermaking machines, textile production machines, calendars in the rubber industry;
- process lines in plastics, chemicals or metal production, rolling-mills;
- cement crushing machines, cement kilns, mixers, centrifuges, extrusion machines;
- drilling machines;
- conveyors, materials handling machines, hoisting equipment (cranes, gantries, etc);
- pumps, fans, etc.

This standard can also be used as a reference for developers using PDS(SR) for other applications.

Users of this standard should be aware that some type C standards for machinery currently refer to ISO 13849-1 for safety-related control systems. In this case, PDS(SR) manufacturers may be requested to provide further information (e.g. category and/or performance level) to facilitate the integration of a PDS(SR) into the safety-related control systems of such machinery.

NOTE "Type C standards" are defined in ISO 12100-1 as machine safety standards dealing with detailed safety requirements for a particular machine or group of machines.

Previously, in the absence of standards, there has been a reluctance to accept electronic, and in particular programmable electronic, devices and systems in safety-related functions because of uncertainty regarding the safety performance of such technology.

There are many situations where control systems that incorporate a PDS(SR) are employed, for example as part of safety measures that have been provided to achieve risk reduction. A typical case is guard interlocking in order to exclude personnel from hazards where access to the danger zone is only possible when rotating parts have attained a safe condition. This part of IEC 61800 gives a methodology to identify the contribution made by a PDS(SR) to identified safety functions and to enable the appropriate design of the PDS(SR) and verification that it meets the required performance.

Measures are given to co-ordinate the safety performance of the PDS(SR) with the intended risk reduction taking into account the probabilities and consequences of its random and systematic faults.