SVENSK STANDARD SS-EN 61800-5-2

Fastställd	Utgåva	Sida	Ansvarig kommitté
2017-06-14	2	1 (1+87)	SEK Elektro-tekniska rådet

Varvtalsstyrda elektriska drivsystem – Del 5-2: Funktionssäkerhet

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

Som svensk standard gäller europastandarden EN 61800-5-2:2017. Den svenska standarden innehåller den officiella engelska språkversionen av EN 61800-5-2:2017.

Nationellt förord

Europastandarden EN 61800-5-2:2017

består av:

– **europastandardens ikraftsättningsdokument,** utarbetat inom CENELEC
– **IEC 61800-5-2, Second edition, 2016 - Adjustable speed electrical power drive systems - Part 5-2: Safety requirements - Functional**

utarbetad inom International Electrotechnical Commission, IEC.

Tidigare fastställd svensk standard SS-EN 61800-5-2, utgåva 1, 2007, gäller ej fr o m 2020-04-28.

ICS 13.110.00; 29.200.00

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Box 1284
164 29 Kista
Tel 08-444 14 00
www.elstandard.se

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 61800-5-2

April 2017

ICS 13.110; 29.200

Supersedes EN 61800-5-2:2007

English Version

Adjustable speed electrical power drive systems - Part 5-2: Safety requirements - Functional (IEC 61800-5-2:2016)

Entraînements électriques de puissance à vitesse variable - Partie 5-2: Exigences de sécurité - Fonctionnelle (IEC 61800-5-2:2016)

Elektrische Leistungsantriebssysteme mit einstellbarer Drehzahl - Teil 5-2: Anforderungen an die Sicherheit - Funktionale Sicherheit (IEC 61800-5-2:2016)

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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

Ref. No. EN 61800-5-2:2017 E

SEK Svensk Elstandard

European foreword

The text of document 22G/332/FDIS, future edition 2 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 approved by CENELEC as EN 61800-5-2:2017.

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)	2017-10-28
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2020-04-28

This document supersedes EN 61800-5-2:2007.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] 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.

Endorsement notice

The text of the International Standard IEC 61800-5-2:2016 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 60300-3-1:2003	NOTE	Harmonized as 60300-3-1:2003.
IEC 60664-1:2007	NOTE	Harmonized as EN 60664-1:2007.
IEC 606643	NOTE	Harmonized as EN 60664-3.
IEC 61025	NOTE	Harmonized as EN 61025.
IEC 61078	NOTE	Harmonized as EN 61078.
IEC 61165	NOTE	Harmonized as EN 61165.
IEC 61508-4:2010	NOTE	Harmonized as EN 61508-4:2010.
IEC 61508-5:2010	NOTE	Harmonized as EN 61508-5:2010.
IEC 61511 (series)	NOTE	Harmonized as EN 61511 (series).
IEC 61511-1	NOTE	Harmonized as EN 61511-1.
IEC 61513	NOTE	Harmonized as EN 61513.
IEC 61558 (series)	NOTE	Harmonized as EN 61558 (series).
IEC 61558-1:2005	NOTE	Harmonized as EN 61558-1:2005.
IEC 61558-1:2005/AMD1:2009	NOTE	Harmonized as EN 61558-1:2005/A1:2009.

IEC 61784-3	NOTE	Harmonized as EN 61784-3.
IEC 62061	NOTE	Harmonized as EN 62061.
ISO 13849-2	NOTE	Harmonized as EN ISO 13849-2.

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 60204-1	-	Safety of machinery - Electrical equipment of machines -- Part 1: General requirements	EN 60204-1	-
IEC 61000-2-4	2002	Electromagnetic compatibility (EMC) -- Part 2-4: Environment - Compatibility levels in industrial plants for low-frequency conducted disturbances	EN 61000-2-4	2002
IEC 61000-4-2	2008	Electromagnetic compatibility (EMC) -- Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test	EN 61000-4-2	2009
IEC 61000-4-3	2006	Electromagnetic compatibility (EMC) -- Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	EN 61000-4-3	2006
+ A1	2007		+ A1	2008
+ A2	2010		+ A2	2010
IEC 61000-4-4	2012	Electromagnetic compatibility (EMC) -- Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test	EN 61000-4-4	2012
IEC 61000-4-5	2014	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test	EN 61000-4-5	2014
IEC 61000-4-6	2013	Electromagnetic compatibility (EMC) -- Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields	EN 61000-4-6	2014
IEC 61000-4-29	2000	Electromagnetic compatibility (EMC) -- Part 4-29: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests	EN 61000-4-29	2000
IEC 61000-4-34	2005	Electromagnetic compatibility (EMC) -- Part 4-34: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current more than 16 A per phase	EN 61000-4-34	2007
IEC 61000-6-7	2014	Electromagnetic compatibility (EMC) - Part 6-7: Generic standards - Immunity requirements for equipment intended to perform functions in a safety-related system (functional safety) in industrial locations	EN 61000-6-7	2015

IEC 61400-21	2008	Wind turbines -- Part 21: Measurement and assessment of power quality characteristics of grid connected wind turbines	EN 61400-21	2008
IEC 61508-1	2010	Functional safety of electrical/electronic/programmable electronic safety-related systems -- Part 1: General requirements	EN 61508-1	2010
IEC 61508-2	2010	Functional safety of electrical/electronic/programmable electronic safety-related systems -- Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems	EN 61508-2	2010
IEC 61508-3	2010	Functional safety of electrical/electronic/programmable electronic safety-related systems -- Part 3: Software requirements	EN 61508-3	2010
IEC 61508-6	2010	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	2010
IEC 61508-7	2010	Functional safety of electrical/electronic/programmable electronic safety-related systems -- Part 7: Overview of techniques and measures	EN 61508-7	2010
IEC 61800-1	-	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	-
IEC 61800-2	2015	Adjustable speed electrical power drive systems -- Part 2: General requirements - Rating specifications for low voltage adjustable speed a.c. power drive systems	EN 61800-2	2015
IEC 61800-3	2004	Adjustable speed electrical power drive systems -- Part 3: EMC requirements and specific test methods	EN 61800-3	2004
IEC 61800-4	-	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	-
IEC 61800-5-1	2007	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy	EN 61800-5-1	2007
ISO 13849-1	2006	Safety of machinery - Safety-related parts of control systems -- Part 1: General principles for design	-	-
ISO 13849-2	2012	Safety of machinery - Safety-related parts of control systems_- Part_2: Validation	EN ISO 13849-2	2012

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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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.
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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.

This second edition cancels and replaces the first edition published in 2007. This edition constitutes a technical revision.

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

a) rational added in the scope why low demand mode is not covered by this standard
b) definition added for: "*category*" and "*safety function*"
c) "Other sub-functions" sorted into "Monitoring sub-functions" and "Output functions"
d) deleted "proof test" throughout the document because for *PDS(SR)* a proof test is not applicable

e) replaced the term “safety function” by “*safety sub-function*” throughout the document

f) Updated references to IEC 61508 series Ed.2010

g) Added the principle rules of ISO 13849-1 and reference to tables of ISO 13849-2

h) 6.1.6 Text replaced by Table 2

i) 6.1.7 Integrated circuits with on-chip redundancy matched to changed requirement in IEC 61508-2: 2010, Annex E

j) 6.2.8 Design requirements for thermal immunity of a *PDS(SR)*

k) 6.2.9 Design requirements for mechanical immunity of a *PDS(SR)*

l) 6.1.6 *SIL* for multiple *safety sub-functions* within one *PDS(SR)*

m) 6.1.7 Integrated circuits with on-chip redundancy

n) 6.2.1 Basic and well-tried safety principles

o) 6.2.2.1.4 *Diagnostic test* interval when the hardware fault tolerance is greater than zero

p) 6.2.5.2.7 *PDS(SR)* parameterization

q) 9 Test requirements

r) 9.3 Electromagnetic (EM) immunity testing

s) 9.4 Thermal immunity testing

t) 9.5 Mechanical immunity testing

u) Annex A Sequential task table

v) Annex D, D.3.16, Motion and position feedback sensors updated

w) Annex E Electromagnetic immunity (EM) requirement for *PDS(SR)*

x) Annex F Estimation of PFD_{avg} value for low demand with given PFH value

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

FDIS	Report on voting
22G/332/FDIS	22G/335/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 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

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 performance level PL) 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 as machine safety standards dealing with detailed safety requirements for a particular machine or group of machines.

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 *hazard*s where access to the dangerous area is only possible when rotating parts have stopped. This part of IEC 61800 gives a methodology to identify the contribution made by a *PDS(SR)* to identified *safety sub-function*s 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.

ADJUSTABLE SPEED ELECTRICAL POWER DRIVE SYSTEMS –

Part 5-2: Safety requirements – Functional

1 Scope

This part of IEC 61800, which is a product standard, specifies requirements and makes recommendations for the design and development, integration and validation of safety related power drive systems (*PDS(SR))* in terms of their functional safety considerations. It applies to adjustable speed electrical power drive systems covered by the other parts of the IEC 61800 series of standards as referred in IEC 61800-2.

NOTE 1 The term “integration” refers to the *PDS(SR)* itself, not to its incorporation into the safety-related application.

NOTE 2 Other parts of IEC 61800 cover rating specifications, EMC, electrical safety, etc.

This International Standard is applicable where functional safety of a *PDS(SR)* is claimed and the *PDS(SR)* is operating mainly in the high demand or continuous mode (see 3.15)

While low demand mode operation is possible for a *PDS(SR)*, this standard concentrates on high demand and continuous mode. *Safety sub-function*s implemented for high demand or continuous mode can also be used in low demand mode. Requirements for low demand mode are given in IEC 61508 series. Some guidance for the estimation of average probability of dangerous failure on demand (PFD_{avg}) value is provided in Annex F.

This part of IEC 61800 sets out safety-related considerations of *PDS(SR)*s in terms of the framework of IEC 61508, and introduces requirements for *PDS(SR)*s as *subsystem*s of a safety-related system. It is intended to facilitate the realisation of the electrical/ electronic/ programmable electronic (E/E/PE) parts of a *PDS(SR)* in relation to the safety performance of *safety sub-function*(s) of a PDS.

Manufacturers and suppliers of *PDS(SR)*s by using the normative requirements of this part of IEC 61800 will indicate to users (system integrator, original equipment manufacturer) the safety performance for their equipment. This will facilitate the incorporation of a *PDS(SR)* into a safety-related control system using the principles of IEC 61508, and possibly its specific sector implementations (for example IEC 61511, IEC 61513, IEC 62061 or ISO 13849).

By applying the requirements from this part of the IEC 61800 series, the corresponding requirements of IEC 61508 that are necessary for a *PDS(SR)* are fulfilled.

This part of IEC 61800 does not specify requirements for:

- the *hazard* and risk analysis of a particular application;
- the identification of *safety sub-function*s for that application;
- the initial allocation of *SIL*s to those *safety sub-function*s;
- the driven equipment except for interface arrangements;
- secondary *hazard*s (for example from failure in a production or manufacturing process);
- the electrical, thermal and energy safety considerations, which are covered in +IEC 61800-5-1;
- the *PDS(SR)* manufacturing process;
- the validity of signals and commands to the *PDS(SR)*.

- security aspects (e.g. cyber security or *PDS(SR)* security of access)

NOTE 3 The functional safety requirements of a *PDS(SR)* are dependent on the application, and can be considered as a part of the overall risk assessment of the *installation*. Where the supplier of the *PDS(SR)* is not responsible for the driven equipment, the *installation* designer is responsible for the risk assessment, and for specifying the functional and safety integrity requirements of the *PDS(SR)*.

This part of IEC 61800 only applies to *PDS(SR)*s implementing *safety sub-function*s with a *SIL* not greater than *SIL* 3.

Figure 1 shows the installation and the functional parts of a *PDS(SR)* that are considered in this part of IEC 61800 and shows a logical representation of a *PDS(SR)* rather than its physical description.

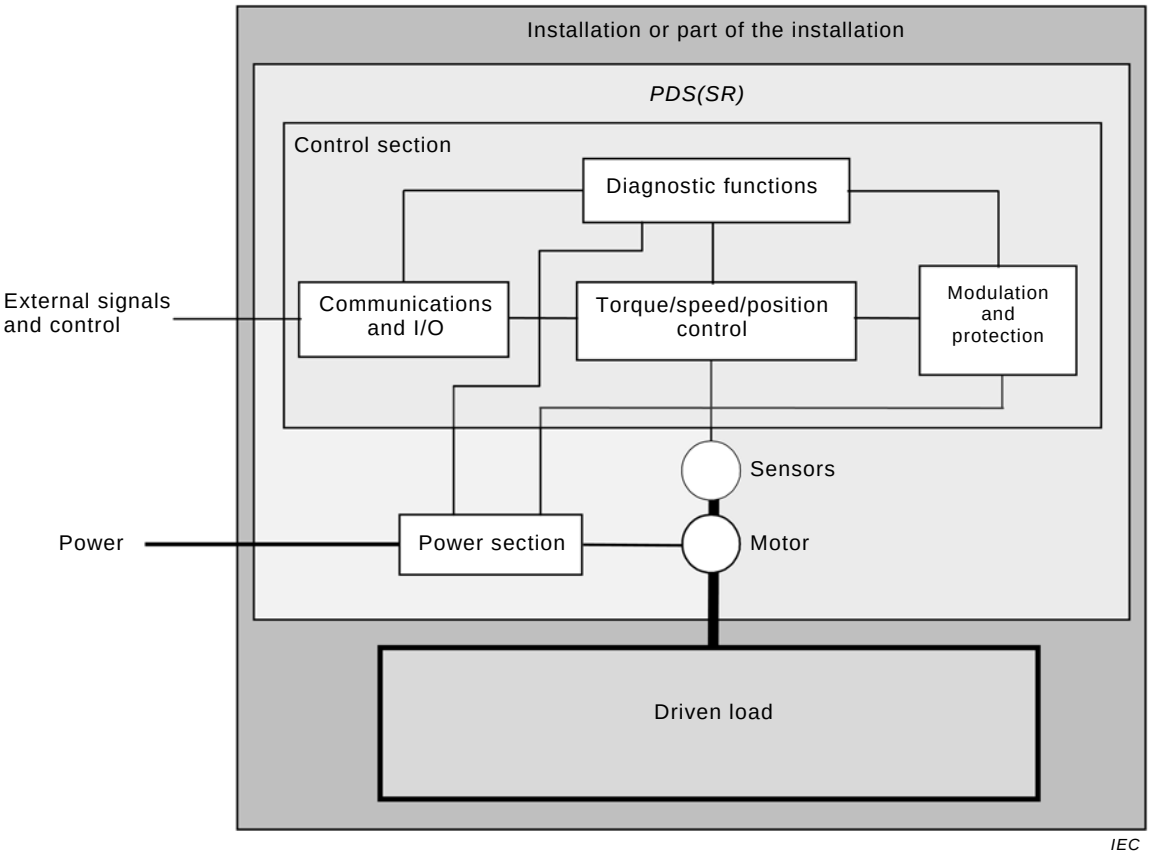

Figure 1 – Installation and functional parts of a *PDS(SR)*

2 Normative references

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.

IEC 60204-1, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

IEC 61000-2-4:2002, *Electromagnetic compatibility (EMC) – Part 2-4: Environment – Compatibility levels in industrial plants for low-frequency conducted disturbances*

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*
IEC 61000-4-3:2006/AMD1:2007
IEC 61000-4-3:2006/AMD2:2010

IEC 61000-4-4:2012, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5:2014, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-6:2013, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-29:2000, *Electromagnetic compatibility (EMC) – Part 4-29: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests*

IEC 61000-4-34:2005, *Electromagnetic compatibility (EMC) – Part 4-34: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current more than 16 A per phase*

IEC 61000-6-7:2014, *Electromagnetic compatibility (EMC) – Part 6-7: Generic standards – Immunity requirements for equipment intended to perform functions in a safety-related system (functional safety) in industrial locations*

IEC 61400-21:2008, *Wind turbines – Part 21: Measurement and assessment of power quality characteristics of grid connected wind turbines*

IEC 61508-1:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1: General requirements*

IEC 61508-2:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems*

IEC 61508-3:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 3: Software requirements*

IEC 61508-6:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 6: Guidelines on the application of IEC 61508-2 and IEC 61508-3*

IEC 61508-7:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 7: Overview of techniques and measures*

IEC 61800-1, *Adjustable speed electrical power drive systems – Part 1: General requirements – Rating specifications for low voltage adjustable speed d.c. power drive systems*

IEC 61800-2:2015, *Adjustable speed electrical power drive systems – Part 2: General requirements – Rating specifications for low voltage adjustable speed a.c. power drive systems*

IEC 61800-3:2004, *Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods*
IEC 61800-3:2004/AMD1:2011

IEC 61800-4, *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*

IEC 61800-5-1:2007, *Adjustable speed electrical power drive systems – Part 5-1: Safety requirements – Electrical, thermal and energy*

ISO 13849-1:2006, *Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*

ISO 13849-2:2012*, Safety of machinery – Safety-related parts of control systems – Part 2: Validation*