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Adjustable speed electrical power drive systems - Part 5-3: Safety requirements - Functional, electrical and environmental requirements for encoders

Táto norma obsahuje anglickú verziu európskej normy.
This standard includes the English version of the European Standard.

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**Adjustable speed electrical power drive systems - Part 5-3:
Safety requirements - Functional, electrical and environmental
requirements for encoders
(IEC 61800-5-3:2021)**

Entraînements électriques de puissance à vitesse variable -
Partie 5-3: Exigences de sécurité - Exigences fonctionnelle,
électrique et environnementale pour codeurs
(IEC 61800-5-3:2021)

Elektrische Leistungsantriebssysteme mit einstellbarer
Drehzahl - Teil 5-3: Anforderungen an die Sicherheit von
Encodern (Gebern) - Funktional, elektrisch und
umwelttechnisch
(IEC 61800-5-3:2021)

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EN IEC 61800-5-3:2023 (E)**European foreword**

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ISO 12100:2010	NOTE	Approved as EN ISO 12100:2010 (not modified)
IEC 61508 (series)	NOTE	Approved as EN 61508 (series)
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Annex ZA (normative)

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<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60068-2-1	-	Environmental testing - Part 2-1: Tests - Test A: Cold	EN 60068-2-1	-
IEC 60068-2-47	-	Environmental testing - Part 2-47: Test - Mounting of specimens for vibration, impact and similar dynamic tests	EN 60068-2-47	-
IEC 60335-1	-	Household and similar electrical appliances - Safety - Part 1: General requirements	-	-
IEC 60947-5-2	2019	Low-voltage switchgear and controlgear - Part 5-2: Control circuit devices and switching elements - Proximity switches	EN IEC 60947-5-2	2020
-	-		+ A11	2022
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 61508-2	2010	Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems (see http://www.iec.ch/functionalsafety Functional Safety and IEC 61508)	EN 61508-2	2010
IEC 61800-1	1997	Adjustable speed electrical power drive systems - Part 1: General requirements - Rating specifications for low voltage adjustables speed d.c. power drive systems	EN 61800-1	1998
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
+ A1	2016		+ A1	2017
-	-		+ A11	2021

EN IEC 61800-5-3:2023 (E)

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61800-5-2	2016	Adjustable speed electrical power drive systems - Part 5-2: Safety requirements - Functional	EN 61800-5-2	2017
IEC 62368-1	2018	Audio/video, information and communication technology equipment - Part 1: Safety requirements	EN IEC 62368-1	2020
ISO 13849-1	2015	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



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**Entraînements électriques de puissance à vitesse variable –
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Partie 5-3: Exigences de sécurité – Exigences fonctionnelle, électrique et
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CONTENTS

FOREWORD.....	7
INTRODUCTION.....	9
1 Scope.....	10
2 Normative references	11
3 Terms and definitions	12
4 <i>Safety sub-functions</i>	20
4.1 General.....	20
4.2 Safe incremental position (SIP).....	20
4.3 Safe absolute position (SAP)	20
4.4 Safe speed value (SSV).....	20
4.5 Safe acceleration value (SAV)	20
4.6 <i>Safety sub-functions</i> for evaluation and signalling.....	21
5 Management of <i>functional safety</i>	21
6 Requirements for design and development	21
6.1 General requirements	21
6.2 Design standards.....	25
6.3 <i>Fault</i> detection	25
6.4 Design requirements for specific types of <i>Encoder(SR)</i>	26
6.4.1 Design requirements for <i>Encoder(SR)</i> with sine and cosine output signals.....	26
6.4.2 Design requirements for <i>Encoder(SR)</i> with incremental and absolute output signals	27
6.4.3 Design requirements for <i>Encoder(SR)</i> with square wave signal interface	28
6.4.4 Design requirements for Resolver	28
6.5 Design requirements regarding mechanics.....	29
6.5.1 General	29
6.5.2 Design requirements for <i>mechanical fastenings</i>	29
6.5.3 Design requirements for <i>mechanical connecting elements</i>	29
6.5.4 Bearings	29
6.6 Design requirements for signal generation	30
6.6.1 General	30
6.6.2 Design requirements for signal generation of optical <i>Encoder(SR)</i>	30
6.6.3 Design requirements for signal generation of magnetic <i>Encoder(SR)</i>	30
6.7 Design requirements for <i>signal processing</i>	31
6.8 Design requirements for internal evaluation and signaling.....	31
6.9 Design requirements for software.....	31
6.10 Pre-setting	31
6.11 Parameterization.....	31
6.12 Design requirements for thermal immunity	31
6.13 Design requirements for mechanical immunity	31
6.14 Design requirements for integrated connection cables	31
7 Information for use	32
7.1 General.....	32
7.2 Labels.....	32
7.3 Information and instructions for safe application of an <i>Encoder(SR)</i>	32
8 Verification and validation.....	32

8.1	General.....	32
8.2	Verification of <i>hardware fault tolerance</i>	32
8.3	Additional verification for <i>Encoder(SR)</i> with sine and cosine output signals.....	32
8.3.1	Verification of diagnostic measures for <i>Encoder(SR)</i> with sine and cosine output signals with $HFT = 0$	32
8.3.2	Suitability for <i>interpolation</i>	32
8.4	<i>Qualitative FMEDA</i>	33
8.5	Quantification.....	34
9	Test requirements.....	34
9.1	General.....	34
9.2	Planning of tests	34
9.3	Functional testing	34
9.4	Electromagnetic (EM) and electrical immunity testing.....	34
9.4.1	Electrical tests	34
9.4.2	Electromagnetic (EM) immunity testing	35
9.5	Thermal immunity testing	35
9.5.1	General	35
9.5.2	Dry cold.....	35
9.5.3	Dry heat	35
9.5.4	Damp heat.....	36
9.5.5	Temperature rise test	36
9.6	Mechanical immunity testing	36
9.6.1	Clearances and creepage distances	36
9.6.2	Short-circuit testing of printed wiring boards	36
9.6.3	<i>Mechanical fastenings</i>	36
9.6.4	<i>Mechanical connecting elements</i>	36
9.6.5	Vibration and shock test	37
9.6.6	Mechanical properties of integrated connecting cables	38
9.6.7	Testing the non-touchability	38
9.6.8	Deformation testing	38
9.7	Material tests	38
9.8	Suitability of the components and materials used.....	38
9.9	Contamination of <i>solid measure</i>	39
9.10	Labels.....	39
9.11	Instructions	39
9.12	Test documentation	39
10	Modification	39
Annex A (informative) Types of <i>Encoder(SR)</i>		40
Annex B (informative) Universal architecture of <i>Encoder(SR)</i>		43
B.1	General.....	43
B.2	The universal <i>Encoder(SR)</i> architecture.....	43
Annex C (informative) Examples of suitable mechanical tests for rotary <i>Encoder(SR)</i>		44
C.1	General.....	44
C.2	Mechanical fastening of the <i>Encoder(SR)</i>	44
C.2.1	Force-locked connection (e.g. by bolted joints)	44
C.2.2	Form-locked connection (e.g. by feather key)	44
C.3	<i>Mechanical connecting elements of the Encoder(SR) – Stator coupling (torque support) or shaft-rotor coupling</i>	45
C.3.1	General	45

C.3.2	Axial loads.....	45
C.3.3	Radial loads	45
Annex D (informative)	Extended shock testing for rotary <i>Encoder(SR)</i> mounted to motors	47
D.1	General.....	47
D.2	Pseudo-velocity shock-response spectrum (PVSRS).....	47
D.3	Verification of resilience	47
D.4	Testing machine	48
Annex E (informative)	Dimensioning of clearances and creepage distances on printed wiring boards – Example.....	50
E.1	General.....	50
E.2	Assumptions	50
E.3	Application of IEC 61800-5-1:2007, 5.2.2.1	50
Annex F (normative)	Information and instructions – Detailed list	51
F.1	Overview.....	51
F.2	Detailed list.....	51
Annex G (informative)	<i>Encoder(SR)</i> fault lists and fault exclusions	54
Annex H (informative)	Quantification.....	58
H.1	General.....	58
H.2	Safety architecture and safety-related block diagram	58
H.3	Failure rates	59
H.4	Failure rates at realistic working temperatures	60
H.5	<i>Quantitative FMEDA</i> and assessment of diagnostic measures	61
H.6	Estimation of the common cause factor β (only in case of redundancy).....	62
H.7	Estimation of the <i>PFH</i>	62
H.8	<i>Safe failure fraction (SFF)</i>	62
H.9	Determination of the quantitative <i>SIL capability</i>	63
H.9.1	General	63
H.9.2	<i>SIL</i> limit by architectural constraints	63
H.9.3	<i>SIL</i> limit by <i>PFH</i>	63
H.10	Additional considerations to comply with ISO 13849-1	64
H.10.1	General	64
H.10.2	<i>MTTF_D</i> of a channel.....	64
H.10.3	Determination of the quantitative category capability	64
H.10.4	Determination of the quantitative <i>PL-capability</i>	64
Annex I (informative)	Digital processing of sine/cosine signals.....	65
I.1	General.....	65
I.2	Sampling of sine and cosine signals	65
I.3	Consequences	66
I.4	Measures to improve <i>DC</i>	67
Annex J (informative)	Single channel architecture with <i>ideal fault detection</i>	68
J.1	General.....	68
J.2	<i>Ideal fault detection</i> for <i>Encoder(SR)</i> with sine and cosine output signals	68
Annex K (informative)	Specifics for single channel incremental <i>Encoder(SR)</i> with sine and cosine output signals	70
K.1	General.....	70
K.2	<i>Single-fault tolerance</i>	70
K.3	Undetectable faults.....	70

K.4	<i>Fault detection (DC)</i>	70
Annex L (normative) Static analysis of <i>signal evaluation</i> and <i>fault detection</i>		72
L.1	General.....	72
L.2	Motivation for the analysis of <i>signal evaluation</i> and <i>fault detection</i>	72
L.3	What does "static analysis of <i>signal processing</i> " mean?.....	72
L.4	Standard test signals	76
L.4.1	Make test signal available (step 1).....	76
L.4.2	Test signal 1.....	79
L.4.3	Test signal 2.....	79
L.4.4	Test signal 3.....	80
L.4.5	Test signal 4.....	80
L.4.6	Test signal 5.....	81
L.5	Simulation of <i>signal processing</i> to specification	81
L.5.1	General	81
L.5.2	Form differential signals (step 2).....	83
L.5.3	Form square-wave signals to specification (Schmitt trigger, step 3)	83
L.5.4	Perform specified diagnostics (step 4)	83
L.6	Assessment of the <i>signal processing</i> specification	84
L.6.1	General	84
L.6.2	Assessment concept for the <i>signal processing</i> specification	85
L.7	FMEDA <i>Encoder(SR)</i> for verification of the <i>diagnostic coverage</i>	88
L.7.1	General	88
L.7.2	Explanation of the problem	88
L.7.3	Procedure for FMEDA.....	90
L.8	List of variables used for performing static analysis	92
L.9	MS Excel tool for performance of static analysis	93
Annex M (informative) Aspects of diagnostic measures for obtaining incremental position values.....		94
M.1	General.....	94
M.2	Obtaining position values from incremental signals	94
M.3	Phase error of the sine and the cosine signals	96
M.3.1	General	96
M.3.2	Phase errors with absolute values < 90°	96
M.3.3	Phase errors with absolute values > 90°	99
M.4	Threshold errors of the square wave signal shapers	100
M.4.1	General	100
M.4.2	Asymmetric switching thresholds	101
M.4.3	Unequal switching hysteresis at the square wave shaping for sine and cosine.....	101
Bibliography.....		103
Figure 1 – Context of <i>Encoder(SR)</i>		11
Figure 2 – Example of hardware architecture of <i>Encoder(SR)</i> with incremental and absolute output signal.....		28
Figure B.1 – Universal <i>Encoder(SR)</i> architecture		43
Figure C.1 – Example of an additional ring for assembly with eccentricity x		46
Figure D.1 – Sample shock and corresponding PVSRS on 4CP		47
Figure D.2 – Testing machine		48

Figure I.1 – Digital sampling of sine and cosine signals – Hardware architecture, example	65
Figure I.2 – Lissajous figures of the sine and cosine signals A and B	66
Figure L.1 – Static analysis concept	73
Figure L.2 – Static analysis procedure (for one test signal) with variable denominations	76
Figure L.3 – Substitute circuit for <i>Encoder(SR)</i> 's outbound interface	77
Figure L.4 – Example of a circuit for evaluation of the output signals and diagnostics of <i>Encoder(SR) faults</i>	82
Figure L.5 – Lissajous diagrams (representation of signal B over signal A) in two <i>fault</i> cases	90
Figure L.6 – Examples of the dual effect of a single component <i>fault</i>	91
Figure M.1 – Obtaining position values from incremental signals	95
Figure M.2 – Counting pulse generation, faultless case	96
Figure M.3 – Counting pulse generation with a phase error of 20°	97
Figure M.4 – Lissajous diagram with a phase error $\Delta\varphi = 20^\circ$	98
Figure M.5 – Square-wave signal generation by means of a Schmitt trigger	100
Figure M.6 – Counting pulse generation with asymmetric switching thresholds	101
Figure M.7 – Counting pulse generation with unequal switching hysteresis	102
Table 1 – List of terms	13
Table 2 – Applicable subclauses of IEC 61800-5-2:2016 for <i>Encoder(SR)</i> and respective modifications	21
Table 3 – Applicable references of IEC 61800-5-1:2007 and IEC 61800-5-1:2007/AMD1:2016 for <i>Encoder(SR)</i> and respective modifications	23
Table A.1 – Types of <i>Encoder(SR)</i>	40
Table B.1 – Function blocks of the universal <i>Encoder(SR)</i> architecture	43
Table G.1 – <i>Encoder(SR)</i> – Mechanic <i>fault</i> list and <i>fault</i> exclusions	55
Table G.2 – <i>Faults</i> and <i>fault</i> exclusions for the selection, mounting and operation of rolling bearings	56
Table G.3 – Factors influencing the malfunctioning of rolling bearings – Considerations for selection, mounting and operation	56
Table H.1 – Components for <i>Encoder(SR)</i> and their inclusion in quantification	59

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Functional, electrical and environmental requirements for encoders**

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International Standard IEC 61800-5-3 has been prepared by subcommittee 22G: Adjustable speed electric power drive systems (PDS), of IEC technical committee 22: Power electronic systems and equipment.

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

FDIS	Report on voting
22G/431/FDIS	22G/434/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

Terms in *italics* are defined in Clause 3.

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 document will remain unchanged until the stability date indicated on the IEC website under "<http://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 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 *encoder* which are for example applied to measure angle and position of machine parts for use in safety-related applications (*Encoder(SR)*). Based on the *Encoder(SR)*'s output signals, *PDS(SR)* or other *evaluation units* calculate for example speed, acceleration, absolute position, etc., to perform their safety sub-functions SLS, SLA, SLP and others (see IEC 61800-5-2:2016, Clause 4). The *signal processing* necessary to perform some of these *safety sub-functions* may also be included in the *Encoder(SR)*.

Examples of industrial applications are:

- machine tools, robots, production test equipment, test benches;
- papermaking machines, textile production machines, calendars in the rubber industry;
- plastics processing lines, chemicals or metal production lines, 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 document can also be used as a reference for developers using *Encoder(SR)* for other applications, for example in wind power plants.

Users of this document should be aware that some type C standards for machinery currently refer to ISO 13849-1 for safety-related control systems. In this case, *Encoder(SR)* manufacturers may be requested to provide further information (e.g. category and *performance level PL*) to facilitate the integration of an *Encoder(SR)* into the safety-related control systems of such machinery. This has been considered during development of this document and corresponding indications are included where appropriate.

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.

There are many situations where control systems that incorporate *Encoder(SR)* are employed, for example as part of safety measures that have been provided to achieve risk reduction. A typical case is reducing the speed during start-up in order to protect personnel from hazards arising by unexpected fast movements of machine parts. This document gives a methodology to identify the contribution made by an *Encoder(SR)* to identified safety *sub-functions* and to enable the appropriate design of the *Encoder(SR)* and verification that it achieves the required performance.

Measures are given to co-ordinate the safety performance of the *Encoder(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 5-3: Safety requirements – Functional, electrical and environmental requirements for encoders

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 *encoder* (*Encoder(SR)*) in terms of their *functional safety* considerations, electrical safety and environmental conditions. It applies to *Encoder(SR)*, being sensors as part of a *PDS(SR)*.

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

This document can also be referred to and used for *Encoder(SR)* in any other safety-related application, for example safety-related position monitoring.

NOTE 2 This document specifies only complementary *functional safety*, electrical safety and environmental condition requirements that are not clearly provided by other parts of the IEC 61800 series.

This document is applicable where *functional safety* of an *encoder* is claimed and the *Encoder(SR)* is operating mainly in the high demand or continuous mode.

NOTE 3 While low demand mode operation is possible for an *Encoder(SR)*, this document concentrates on high demand and continuous mode. *Safety sub-functions* 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 (all parts) [2]. Some guidance for the estimation of average probability of *dangerous failure* on demand (PFD_{avg}) value is provided in IEC 61800-5-2:2016, Annex F.

The requirements of IEC 61800-5-2:2016 for *PDS(SR)* apply to *Encoder(SR)* as applicable. This document includes additional or different requirements for *Encoder(SR)*. It sets out safety-related considerations of *Encoder(SR)* in terms of the framework of IEC 61508 (all parts), and introduces requirements for *Encoder(SR)* as subsystems of a safety-related system. It is intended to facilitate the realisation of the electrical/electronic/programmable electronic (E/E/PE) and mechanical parts of an *Encoder(SR)* in relation to the safety performance of *safety sub-function(s)* of an *Encoder(SR)*.

Manufacturers and suppliers of *Encoder(SR)* will, by using the normative requirements of this document, indicate to users (system integrator, original equipment manufacturer) the safety performance of the *Encoder(SR)*. This will facilitate the incorporation of *Encoder(SR)* into safety-related control systems using the principles of IEC 61508 (all parts), and possibly its specific sector implementations (for example IEC 61511 (all parts) [3], IEC 61513 [4], IEC 62061 [5] or ISO 13849-1 and ISO 13849-2 (see Clause 2).

By applying the requirements from this document, the corresponding requirements of IEC 61508 (all parts) that are necessary for an *Encoder(SR)* are fulfilled.

This document does not specify requirements for:

- the functional properties of an *Encoder(SR)* without any safety relevance;
- the *hazard* and risk analysis of a particular application;
- the identification of *safety sub-functions* for that application;
- the initial allocation of *SILs* to those *safety sub-functions*;
- the driven equipment except for interface arrangements;

- secondary *hazards* (for example from failure in a production or manufacturing process);
- the *Encoder(SR)* manufacturing process;
- the validity of signals and commands to the *Encoder(SR)*; and
- security aspects (e.g. cyber security or *Encoder(SR)* security of access).

NOTE 4 The *functional safety* requirements of an *Encoder(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 *Encoder(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 *Encoder(SR)*.

This document applies to *Encoder(SR)* implementing *safety sub-functions* with a *SIL* not greater than *SIL* 3.

This document provides additional information for *Encoder(SR)* claiming conformity with ISO 13849-1:2015.

Figure 1 shows the installation and the functional parts of a *PDS(SR)* including the *Encoder(SR)* (sensor) which is considered in this document.

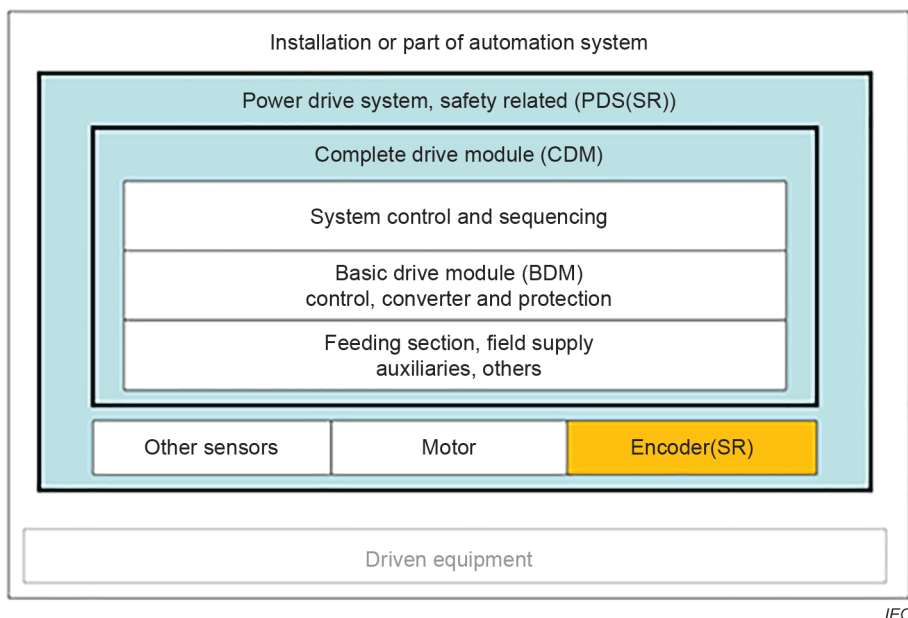


Figure 1 – Context of *Encoder(SR)*

Figure 1 shows a logical representation of a *PDS(SR)* rather than its physical description.

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 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-47, *Environmental testing – Part 2-47: Tests – Mounting of specimens for vibration, impact and similar dynamic tests*

IEC 60335-1, *Household and similar electrical appliances – Safety – Part 1: General requirements*

IEC 60947-5-2:2019, *Low-voltage switchgear and controlgear – Part 5-2: Control circuit devices and switching elements – Proximity switches*

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 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 61800-1:1997, *Adjustable speed electrical power drive systems – Part 1: General requirements – Rating specifications for low voltage adjustable speed d.c. power drive systems*

IEC 61800-5-1:2007, *Adjustable speed electrical power drive systems – Part 5-1: Safety requirements – Electrical, thermal and energy*
IEC 61800-5-1:2007/AMD1:2016

IEC 61800-5-2:2016, *Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional*

IEC 62368-1:2018, *Audio/video, information and communication technology equipment – Part 1: Safety requirements*

ISO 13849-1:2015, *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*

koniec náhľadu – text ďalej pokračuje v platenej verzii STN