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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Industrial networks – Single-drop digital communication interface – Part 2: Functional safety extensions

Réseaux industriels – Interface de communication numérique point à point – Partie 2: Extensions de sécurité fonctionnelle

IEC 61139-2:2022-08 -II-

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INDUSTRIAL NETWORKS – SINGLE-DROP DIGITAL COMMUNICATION INTERFACE –

Part 2: Functional safety extensions

FOREWORD

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

Draft	Report on voting
65C/1168/FDIS	65C/1174/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/standardsdev/publications.

A list of all parts in the IEC 61139 series, published under the general title *Industrial networks – Single-drop digital communication interface*, 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

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- amended.

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INTRODUCTION

The base technology of IO-Link™ [1] is subject matter of the international standard IEC 61131-9 being part of a series of standards on programmable controllers and the associated peripherals such as remote I/O (RIO).

It specifies a single-drop digital communication interface technology – named SDCI, which extends the traditional switching input and output interfaces as defined in IEC 61131-2 towards a point-to-point communication link using coded switching. This technology enables the cyclic exchange of digital input and output process data between a Master and its associated Devices (sensors, actuators, I/O terminals, etc.). The Master can be part of a fieldbus communication system or any stand-alone processing unit. The technology also enables the acyclic transfer of parameters to Devices and the propagation of diagnosis information from the Devices to the upper-level automation system (controller, host) via the Master.

Physical topology is point-to-point from each Device to the Master using 3 wires over distances up to 20 m. The SDCI physical interface is backward compatible with the usual 24 V I/O signalling specified in IEC 61131-2 and supports three transmission rates of 4,8 kbit/s, 38,4 kbit/s and 230,4 kbit/s are supported.

The main advantages of the SDCI technology are:

- dual use of either switching signals (DI/DO) or coded switching communication respectively,
- traditional switching sensors and actuators now providing alternatively single drop digital communication within the same Device,
- one thin, robust, very flexible cable without shielding for power supply and signalling,
- lowest-cost digital communication down to the lowest end sensors and actuators.

The functional safety variant of SDCI is called SDCI-FS. Figure 1 shows an example positioning of SDCI-FS in functional safety automation.

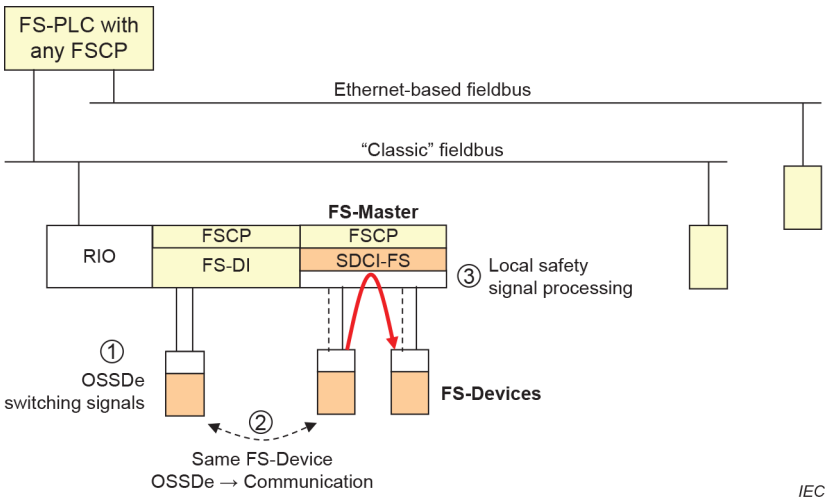

Figure 1 – Positioning of SDCI-FS in functional safety automation

[1] IO-Link™ is a trade name of the "IO-Link Community". This information is given for the convenience of users of this specification and does not constitute an endorsement by the IO-Link Community of the trade name holder or any of its products. Compliance to this document does not require use of the registered logos for IO-Link™. Use of the registered logos for IO-Link™ requires permission of the "IO-Link Community".

In this example, a remote I/O is connected to a functional safety programmable controller using one of the FSCPs of the IEC 61784-3 series [1][2] to communicate with an FS-DI module and a gateway to an SDCI-FS FS-Master. FS-Devices with OSSDe can be connected to FS-DIs or FS-Masters. All FS-Devices can communicate with any FS-Master using the SDCI-FS protocol regardless of the upper-level FSCP-system. The same is true for safety actuators (FS-Devices) such as drives with integrated safety. This means the largest component commonality ① for sensors and actuators similar to the DI and DO interfaces standardized within IEC 61131-2.

Safety sensors with OSSDe interfaces – equipped with SDCI-FS communication – can be parameterized via auxiliary tools such as "USB-Masters", then connected to an FS-DI and operated in OSSDe mode. They also can be operated in OSSDe mode on an FS-Master that supports OSSDe. In case these safety sensors are equipped with SDCI-FS communication in addition, they can be operated in both modes ②, either OSSDe or SDCI-FS. This corresponds to the SDCI SIO paradigm.

The concept of SDCI-FS allows for local safety signal processing if the gateway/FS-Master provides a local safety controller ③.

This document provides the necessary extensions to IEC 61131-9 for functional safety communication including standardization of OSSDe and parameterization within the domain of safety for machinery. Figure 2 shows its relationships to international fieldbus and safety standards as well as to relevant specifications (see Clause 2 and bibliography). Any functional safety starts with risk assessment and risk reduction (ISO 12100). One possibility of risk reduction is the usage of electrical or electronic control systems. For the design of those, standards such as IEC 61508, IEC 62061, and ISO 13849 can be used. Environmental conditions such as EMC are covered by for example IEC 61000-6-7. Further aspects are installations and security issues. A number of product standards such as IEC 60947-5-3 and ISO 14119 complement the generic or sector standards.

[2] Numbers in square brackets refer to the Bibliography.

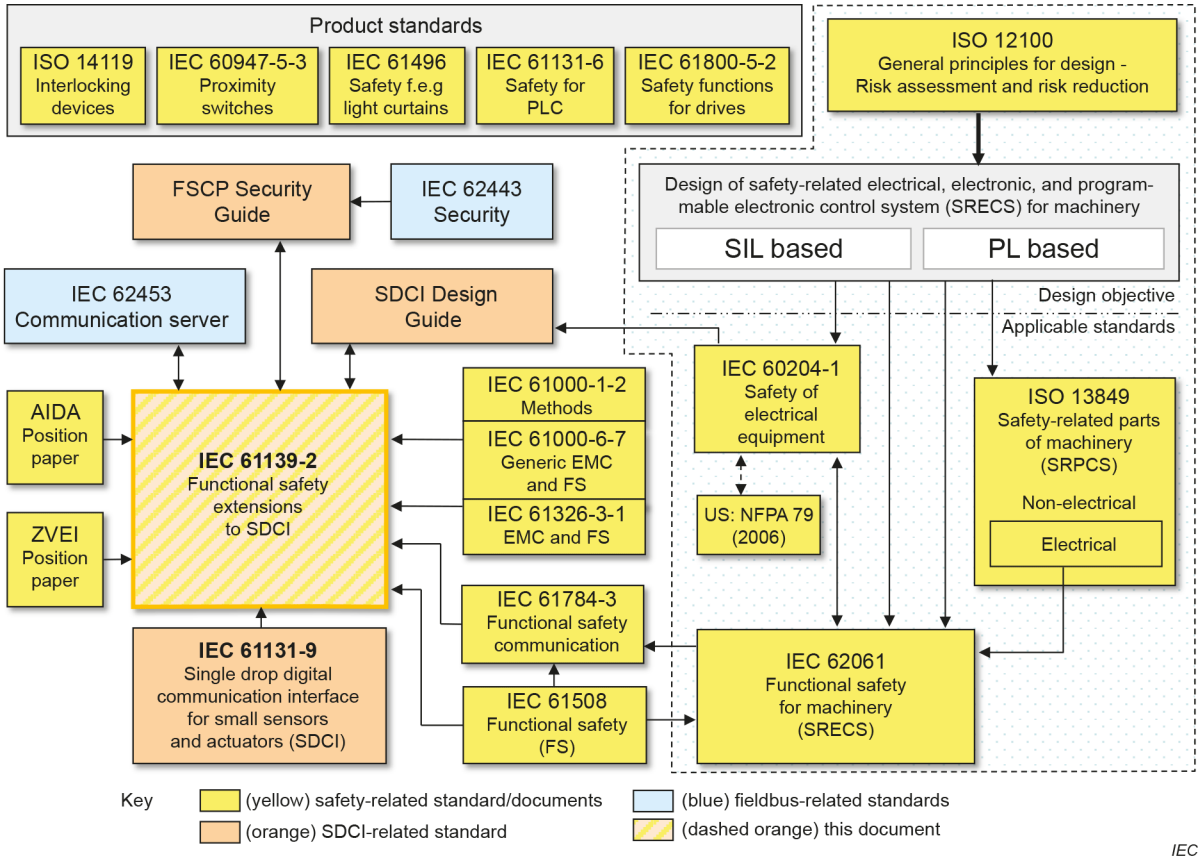

Figure 2 – Relationship of this document to standards

SDCI-FS can be used for functional safety applications according to IEC 62061 and IEC 61508 up to SIL3 and/or according to ISO 13849 up to PLe.

INDUSTRIAL NETWORKS – SINGLE-DROP DIGITAL COMMUNICATION INTERFACE –

Part 2: Functional safety extensions

1 Scope

This part of IEC 61139 specifies the extensions to SDCI in IEC 61131-9 for functional safety. This comprises:

- a standardized OSSDe interface for redundant switching signals based on IEC 61131-2,
- minor modifications/extensions to state machines of SDCI to support the safety operations,
- a lean functional safety communication protocol on top of the standard SDCI communication which is a black channel according to IEC 61784-3:2021,
- protocol management functions for configuration, parameterization, and commissioning,
- IODD extensions for functional safety,
- a Device tool interface to support Dedicated Tools according to functional safety standards.

This document does not cover:

- communication interfaces or systems including multi-point or multi-drop linkages,
- communication interfaces or systems including multi-channel or encrypted linkages,
- wireless communication interfaces or systems,
- integration of SDCI-FS into upper-level systems such as fieldbuses/FSCPs.

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

IEC 61010-2-201, *Safety requirements for electrical equipment for measurement, control and laboratory use – Part 2-201: Particular requirements for control equipment*

IEC 61131-2, *Industrial-process measurement and control – Programmable controllers – Part 2: Equipment requirements and tests*

IEC 61131-9:—[3], *Programmable controllers – Part 9: Single-drop digital communication interface for small sensors and actuators (SDCI)*

IEC 61496-1, *Safety of machinery – Electro-sensitive protective equipment – Part 1: General requirements and tests*

[3] Under preparation. Stage at the time of publication: IEC/CFDIS 61131-9:2022.