BRITISH STANDARD

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Industrial communications subsystem based on ISO 11898 (CAN) for controller-device interfaces —

Part 1: General requirements

The European Standard EN 50325-1:2002 has the status of a British Standard

ICS 43.180

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British Standards

National foreword

This British Standard is the official English language version of EN 50325-1:2002. It supersedes BS EN 50325-1:2001 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee AMT/7, Industrial communications: Process measurement and control, including Fieldbus, which has the responsibility to:

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English version

Industrial communications subsystem based on ISO 11898 (CAN) for controller-device interfaces Part 1: General requirements

Sous-système de communications industriel basé sur l'ISO 11898 (CAN) pour les interfaces des dispositifs de commande
Partie 1: Prescriptions générales

Industrielles Kommunikationssubsystem basierend auf ISO 11898 (CAN)
Teil 1: Allgemeine Anforderungen

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

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Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 65CX, Fieldbus.

The text of the draft was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 50325-1 on 2002-07-01.

This European Standard replaces EN 50325-1:2000.

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) 2003-07-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2005-07-01

This European standard is divided into four parts:

Part 1	General requirements
Part 2	DeviceNet
Part 3	Smart Distributed System (SDS)
Part 4	CANopen

NOTE This European Standard exists only in English.

The specifications for DeviceNet, SDS and CANopen are based on ISO 11898 *Controller area network (CAN) for high-speed communication*, a broadcast-oriented communications protocol. However, ISO 11898 specifies only part of a complete communication system, and additional specifications are needed for other layers to ensure precise data exchange functionality and support of inter-operating devices. The DeviceNet and SDS specifications build on ISO 11898 to describe a complete industrial communication system.

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The license details may be obtained from

The Director
(Industrial Marketing and Applied Technology Sensing and Controls Europe)
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Further attention is drawn to the Standards EN 50325-2 (DeviceNet) and EN 50325-4 (CANopen) and the possibility that some of the elements of those European Standards may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights

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Contents

Introduction

The controller-device interfaces described in this standard utilise a common base protocol to provide solutions to users in industrial environments who have a need for simple communications and diagnostics. The application layer of each network has been created to meet specific performance and market requirements.

The objective of the interface user is a gain in productivity that may be realised through reduced wiring, reduced start up time, improved quality of output and reduced down time. The interfaces described provide low-cost connectivity between low-voltage switchgear, controlgear, control circuit devices, switching elements and controlling devices (e.g. programmable controllers, personal computers, etc.) and eliminate expensive hardwiring. The direct connectivity provides improved communication between devices as well as important device-level diagnostics not easily accessible or available through hardwired I/O interfaces.

The interfaces described are based on a broadcast-oriented communications protocol - Controller Area Network (CAN). The CAN protocol was originally developed by Robert Bosch GmbH for the European automotive market for replacing expensive, wire harnesses with low cost network cable on vehicles. As a result, the CAN protocol has fast response and high reliability and the protocol has been standardised as ISO 11898. Chips are available in a variety of packages with temperature and noise immunity ratings well suited to the industrial automation market. Demand for CAN is the key driver in the “low price with high performance” characteristic of CAN chips.

As a result of the common use of CAN, the interfaces described provide a common set of capabilities that are ideally targeted to applications which include simple devices, limited distance and limited amount of data per transmission.

1 Scope

This European Standard applies to controller-device interfaces that provide defined interfaces between low-voltage switchgear, controlgear, control circuit devices, switching elements and controlling devices (e.g. programmable controllers, personal computers, etc.). It may also be applied for the interfacing of other devices and elements to a controller-device interface.

This standard specifies requirements for controllers and devices utilising these interfaces, including not only the communication protocol specification, but also associated relevant electrical and mechanical characteristics. It also specifies the electrical and EMC tests required to verify the performance of each controller-device interface when connected to the appropriate controllers and devices.

This part 1 establishes a consistent terminology and format for the subsequent interfaces. It also harmonises requirements of a general nature in order to reduce the need for testing to different standards, increase understanding and facilitate comparisons of controller-device interface standards. Those requirements of the various controller-device interface standards which can be considered as general have therefore been gathered in this part 1.

In addition to meeting the specific requirements stated in this part 1, the controller-device interfaces included in this standard

- are documented in the English language in accordance with the requirements specified in this part 1,
- are already in use in commercial products and running in industrial plants,
- are available in quantity and at low price,
- are available from several sources and commercialised openly,
- to satisfy the tests specified, amongst others, in EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, and EN 61000-4-6 against the test levels specified in EN 50082-2,
- have appropriate mechanisms for transmission error detection,
- are open, widely accepted, well documented, stable and support inter-operability,
- are complete and describe the necessary interfaces in sufficient detail to enable error-free implementation,
- are free of any restriction related to testing the implementation.

For each controller-device interface only two documents are necessary to determine all requirements and tests:

- the general requirements of this standard, referred to as "part 1" in the relevant parts covering the various types of controller-device interfaces;
- the relevant controller-device interface standard hereinafter referred to as the "relevant controller-device interface standard" or "controller-device interface standard".

The solutions described in this standard have been used for many years by industry to solve application requirements involving low-voltage switchgear and controlgear. They are characterised by:

- their ability to power connected devices directly from the network;
- their ability to operate in harsh environments typified by those encountered at the machine level by controls in industrial applications;
- usage of the sophisticated medium access rules of CAN which allows both organisation of traffic based on user-assigned priorities and efficient resolution of occasional access conflict;
- a wide range of exchange services allowing precise tailoring of data exchange to the actual application needs as well as simultaneous distribution of data to a selected set of connected devices;
- their capability to simultaneously support data acquisition, diagnostics, messaging and programming/configuration as required, amongst others, for systems interfacing controllers to low-voltage switchgear and controlgear in industrial applications.

NOTE The controller-device interface standards currently part of this series are:

- EN 50325-2: DeviceNet
- EN 50325-3: Smart Distributed System (SDS)
- EN 50325-4: CANopen

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 50082-2	1995	Electromagnetic compatibility - Generic immunity standard -- Part 2: Industrial environment
EN 60529	1991	Degrees of protection provided by enclosures (IP code) (IEC 60529:1989)
EN 60947-1	1999	Low-voltage switchgear and controlgear -- Part 1: General rules (IEC 60947-1:1999, modified)
EN 60947-5-2	1998	Low-voltage switchgear and controlgear -- Part 5-2: Control circuit devices and switching elements - Proximity switches (IEC 60947-5-2:1997, modified)
EN 61000-4-2	1995	Electromagnetic compatibility (EMC) -- Part 4-2: Testing and measuring techniques - Electrostatic discharge immunity test (IEC 61000-4-2:1995)
EN 61000-4-3	1996	Electromagnetic compatibility (EMC) -- Part 4-3: Testing and measuring techniques - Radiated, radio-frequency, electromagnetic field immunity test (IEC 61000-4-3:1995, modified)
EN 61000-4-4	1995	Electromagnetic compatibility (EMC) -- Part 4-4: Testing and measuring techniques - Electrical fast transient / burst immunity test (IEC 61000-4-4:1995)
EN 61000-4-5	1995	Electromagnetic compatibility (EMC) -- Part 4-5: Testing and measuring techniques - Surge immunity test (IEC 61000-4-5:1995)
EN 61000-4-6	1996	Electromagnetic compatibility (EMC) -- Part 4-6: Testing and measuring techniques - Immunity to conducted disturbances, induced by radio-frequency fields (IEC 61000-4-6:1996)
ISO/IEC 7498-1	1994	Information technology - Open systems interconnection -- Part 1: Basic Reference Model : The Basic Model
ISO 11898	1993	Road vehicles - Interchange of digital information - Controller area network (CAN) for high-speed communication

3 Definitions

For the purposes of this part 1 of the European Standard, the following definitions apply.

NOTE The relevant controller-device interface standards include in their definitions clause those necessary terms and definitions that are not included in this part of the standard.

3.1
CAN (Controller Area Network)
definition of a generic physical layer and data link medium access procedure based on non-destructive bit-wise arbitration. See ISO 11898.

3.2
controller
network element such as a PLC, PC, or equivalent computing hardware in which the control application or process software runs

3.3
controller-device interface
arrangement of nodes and their interconnections that transport information in an industrial control system comprising a controller and field devices

3.4
cyclic
process of data exchange which occurs when devices or controllers produce data at a predetermined rate appropriate to the device and the application's need

3.5
electromechanics
physical components defined by a controller-device interface such as interconnecting wire, cable or media; and physical connectors

3.6
field device
physical unit containing application elements and may contain communication elements

EXAMPLES: Control circuit device (see 2.2.16 of EN 60947-1), presence sensing device, pressure sensing device, actuator, annunciator, operator terminal, motor controller, current sensor, valve control, data logger, bar-code scanner, push-button, pilot light, etc.

3.7
interface
boundary between two entities of a network defined by functional, signal, or other characteristics as appropriate

3.8
messaging
process of data exchange which occurs when a device or controller sends or requests information such as device I/O, device diagnostic and/or configuration information

3.9
multicast
process of data exchange which occurs when a device or controller produces one network message to multiple devices and controllers for their appropriate action

3.10
network power supply
power supply with characteristics and parameters suitable for the network's functionality and capability

3.11
polling
process of data exchange which occurs when a device, e.g. a controller, sends or requests data from a specific device

NOTE The receiving device responds to the polling by acting on the data it receives or returning its status data. When this network transaction is completed the device polls the next device in a predetermined sequence.

4 Classifications

This clause in the relevant controller-device interface parts of this standard lists the classifications below, where applicable, with appropriate details:

- components of the network;
- network interfaces;
- topology;

- information exchanges;
- network attributes.

The networks shall be based on ISO 11898 and shall support data acquisition, diagnostics, messaging, and programming/configuration.

The relationship between the network, CAN (ISO 11898) and the OSI reference model (ISO/IEC 7498-1) shall be described.

Networks shall provide a choice of data exchange options thus allowing optimisation of transmission time usage based on the requirements of the particular application.

The network shall be capable of providing data and power within the same cable – sufficient power shall be available for supplying network powered devices.

5 Characteristics

5.1 General

This clause in the relevant controller-device interface parts of this standard lists the applicable characteristics described below with appropriate details.

5.2 Components of the network

Controller-device interface parts of this standard specifies the components of the network that may be used.

5.3 Network interfaces

The networks shall utilise non-destructive arbitration for resolving conflicting transmission access to the media. Transmission on the media shall be regulated based on user assigned priority levels.

Media access rules shall simultaneously support the following exchange mechanisms:

- master-slave;
- multi-master;
- peer to peer.

The Controller-Device interface parts of this standard (EN 50325, parts 2 to 4) shall include information on the following:

- procedural, i.e. what needs to happen first, second, etc. when the interface system powers up and down, and establishes and terminates data exchange across the interface;
- rules, i.e. the procedure for communicating across the interface;
- services, i.e. what a device is requested to do across an interface;
- protocol, i.e. the message structure and content that crosses the interface;
- device behaviour as viewed from the network;
- mechanical, i.e. the shape, construction, pin size etc. of an industrial component interface connection system;
- electrical, i.e. the voltage, current and timing of the bit levels on the network;
- functional, i.e. what interface connections provide which functions.

5.4 Topology

The controller-device interface parts of this standard specifies the topologies that may be used.

5.5 Information exchanges

The controller-device interface parts of this standard specifies implementation details for all of the following types of information exchange:

- event driven triggering of data;
- multicast;
- cyclic;
- polled.

Networks shall be capable of supporting multiple independent update rates for different I/O data originating from a single device.

5.6 Network attributes

The network attributes parts of this standard specifies implementation details for all of the following:

- the data transmission rate (in bits per second) shall be specified and shall be a minimum of 125 kbit/s;
- the maximum network communication medium length or end to end distance shall be specified and shall be a minimum of 400 m at 125 kbit/s;
- the maximum network message length for a single transmission shall be specified and shall be a minimum of 6 bytes. Fragmentation shall be supported to transmit data exceeding this maximum network message length;
- the maximum network node count per system shall be specified and shall be a minimum of 64 nodes;
- the maximum power supported by the network cable for powering network connected devices shall be specified and shall be a minimum of 2 A at 24 V dc. The network configuration shall support multiple power supplies in order that the number of nodes and cable length are not limited by the power supply itself.

6 Product information

6.1 Instructions for installation, operation and maintenance

The manufacturer shall specify in the documents or catalogues the conditions for installation, operation and maintenance of the components of the network. The instructions shall specify the measures to be taken, if any, for achieving EMC compliance described in 8.2.

6.2 Marking

The controller, device or components of the network shall be marked with the following:

- manufacturer’s name or trademark;
- type designation or other marking which makes it possible to identify the product and to get the relevant information from the manufacturer or his catalogue.

For small devices that do not have the physical space to accommodate the required markings the information shall be provided on a label or other suitable means attached to the device.

7 Normal service, transport and mounting conditions

7.1 Normal service conditions

7.1.1 General

All components of the network shall be designed and used according to the relevant part of this standard, where applicable, or according to an agreement between the manufacturer and the user.

NOTE 1 Information given in the manufacturer's catalogue may take the place of such an agreement.

NOTE 2 If the conditions for operation differ from those given in this standard or by the manufacturer, the user should state the deviation from the standard conditions and consult the manufacturer on the suitability for use under such conditions.

7.1.2 Ambient air temperature

The operating characteristics of all components of the network shall be maintained at least over the ambient temperature range of -20 °C to +60 °C.

7.1.3 Altitude

Components of the network shall be capable of operating at altitudes of up to 2 000 m. Components intended to operate at a higher altitude shall be designed or used in accordance with an agreement between manufacturer and user.

7.1.4 Humidity

Components of the networks shall be capable of operating at 40 °C with the relative humidity of the air not exceeding 95 %.

7.1.5 Pollution degree

Devices and components of the network shall operate under environmental conditions of pollution degree 3 as defined in 6.1.3.2 of EN 60947-1.

7.1.6 Sealed connectors

Sealed connectors shall be specified and shall be protected to IP 67 (see EN 60529) and comply with annex D of EN 60947-5-2.

7.2 Conditions during transport and storage

A special agreement shall be made between the user and the manufacturer if the conditions during transport and storage differ from the following:

– humidity : relative humidity of the air not exceeding 95 % at 40 °C
– temperature : -40 °C to +85 °C

7.3 Mounting

Components of the network shall be mounted in accordance with the manufacturer’s instructions.

8 Constructional and performance requirements

8.1 General

The constructional and performance requirements shall be specified in the relevant parts of this standard. Requirements for the following shall be specified:

- power supply;
- network device (including network powered devices);
- controller;
- electromechanics;
- communication medium.

The requirements shall include but are not limited to

- general requirements,
- connections and ports,
- indicators / configuration switches,
- electromagnetic compatibility (EMC).

8.2 Electromagnetic compatibility (EMC)

Emission and immunity requirements shall be specified in the relevant parts of this standard. The following phenomena shall be considered as a minimum:

- radiated emissions;
- conducted emissions;
- radiated radio-frequency electromagnetic field immunity;
- conducted radio-frequency disturbance immunity;
- electro-static discharge (ESD) immunity;
- fast transient / burst immunity;
- surge immunity.

9 Tests

The relevant controller-device interface standards shall specify the type tests required to verify compliance of the design of a device to this standard. The equipment to be tested shall include

- power supply,
- network device,
- controller,
- communication medium,
- electromechanics.

These tests shall include

- electrical tests,
- electromagnetic compatibility tests,
- logical tests.

Note on Conformance Testing

Information on conformance testing services are offered by the following companies/institutions:

EN 50325-2:
DeviceNet Europe Technical Support Centre
International Manufacturing Centre
University of Warwick
Coventry CV4 7AL
ENGLAND
www.odvaeurope.com

EN 50325-3:
Underwriters Laboratories
333 Pfingsten Road
North Brook
IL 60062-2096
USA

EN 50325-4:
CAN in Automation (CiA) GmbH
Am Weichselgarten 26,
D-91058 Erlangen, Germany
www.can-cia.org.

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