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Javni prevoz – Sistemi za časovno razporejanje in nadzor cestnih vozil – 5. del: Specifikacije za okablenje sistema CANopen

Public transport - Road vehicle scheduling and control systems - Part 5: CANopen cabling specifications

Öffentlicher Verkehr - Planungs- und Steuerungssysteme für Straßenfahrzeuge - Teil 5: Festlegungen für CANopen Verbindungen

Transports publics - Systemes d'ordonnancement et de contrôle des véhicules routiers - Partie 5: Spécifications de câblage CANopen

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Public transport - Road vehicle scheduling and control systems - Part 5: CANopen cabling specifications

Transports publics - Systèmes d'ordonnancement et de contrôle des véhicules routiers - Partie 5: Spécifications de câblage CanOpen

Öffentlicher Verkehr - Planungs- und Steuerungssysteme für Straßenfahrzeuge - Teil 5: Festlegungen für CANopen Verbindungen

This European Standard was approved by CEN on 21 June 2004.

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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 CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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Contents

Foreword

This document (EN 13149-5:2004) has been prepared by Technical Committee CEN/TC 278 "Road Transport and Traffic Telematics", the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2005, and conflicting national standards shall be withdrawn at the latest by March 2005.

This document supersedes ENV 13149-5:2002.

This document is part of the following series of standards related to road vehicle scheduling and control systems:

EN 13149-1, *Public transport - Road vehicle scheduling and control systems - Part 1: WORLDFIP definition and application rules for onboard data transmission*

EN 13149-2, *Public transport - Road vehicle scheduling and control systems - Part 2: WORLDFIP cabling specifications*

prENV 13149-3, *Public transport - Road vehicle scheduling and control systems - Part 3: WORLDFIP message content*

EN 13149-4, *Public transport - Road vehicle scheduling and control systems - Part 4: General application rules for CANopen transmission buses*

EN 13149-5, *Public transport - Road vehicle scheduling and control systems - Part 5: CANopen cabling specifications*

prCEN/TS 13149-6, *Public transport - Road vehicle scheduling and control systems - Part 6: CAN message content*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

This document is part 5 of EN 13149, which gives rules for on-board data transmission systems.

This part 5 together with part 4 and part 6 describes a complete solution independent from part 1, part 2 and part 3.

1 Scope

This document specifies the choice and the general application's rules of an onboard data transmission bus between the different equipment for service operations and monitoring of the fleet. This applies to equipment installed onboard buses, trolley buses and tramways only as part of a bus fleet operation. It excludes tramways when they are operated as part of a train, subway or metro operation. This equipment includes operation aid systems, automatic passenger information systems, fare collection systems, etc.

The equipment directly related to the safety-related functioning of the vehicle (propulsion management, brake systems, door opening systems, etc.) is excluded from the scope of the present document and are dealt with in other standardisation bodies.

For the described application two bus systems are standardised. Part 1 to part 3 describes the WORLDFIP bus system and part 4 to part 6 describes the CANopen bus system. There is no ranking between the two bus systems.

This document covers the link between equipment inside a single vehicle. Although it could be applied to multiple vehicles, this application is not explicitly covered by this document.

Part 4 of this document specifies the CANopen-based network. This specification describes the general architecture in terms of hierarchical layers according to the ISO reference model for Open Systems Interconnection (OSI) specified in ISO 7498.

Part 5 of this document specifies in detail the connectors and the connector pin assignment and the cabling.

Part 6 of this document specifies in detail the application profiles for the virtual devices in public transport.

2 Normative references

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.

EN 50325, *Industrial communications subsystem based on ISO 11898 (CAN) for controller-device interfaces*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
CAN
Controller Area Network. Data link layer protocol for serial communication as specified in EN 50325

3.2
CiA
CAN in Automation international manufacturer and user organisation:non profit association for CAN

3.3
ECU
Electronic Control Unit

3.4
EMC
Electromagnetic Compatibility

4 Requirements

4.1 General

All specific requirements for the applications, mentioned in the scope are described in the following chapters. The general requirements for the cabling and the physical layer are specified in EN 50325.

EN 50325 is the international document for in-vehicle high-speed communication using the Controller Area Network (CAN) bus protocol. The scope of this document essentially is to specify the so-called data link layer and physical layer of the communication link. The physical layer is subdivided into three sub layers. These are:

a) Physical Signalling

b) Physical Medium Attachment

c) Medium Dependent Interface

4.2 Cabling

4.2.1 General remarks

It is important to understand that electrical connections onto the bus have some impact upon the network performance, and that the practice is dependant upon the principles relevant to transmission lines rather than simple electrical power circuits.

4.2.2 Cable characteristics

The main trunk circuit shall be at least a single twisted pair of nominal characteristic impedance of 120 Ω at 1 MHz (tolerance 95 Ω to 140 Ω). A shielded cable with overall braided shield is highly recommended especially for vehicles with electric drives, e.g. trams and trolley-buses. It is also recommended to provide an additional twisted pair in the cable to support ECUs with galvanic isolation. The cable shall not be connected in the form of a ring.

4.2.3 Connections between devices

The topology of the CAN-network is "bus-shaped"[1], i.e. in contrast to a star-shaped or ring-shaped wiring the network has two "ends". At both ends, a nominal terminating impedance of 120 Ω[2] has to be connected between the signals CAN_H and CAN_L. Figure 1 shows a system with typical wiring.

4.2.4 Galvanic isolation

It is recommended that isolation is applied if there are remarkable ground potential differences in different parts of the vehicle, or the bus length exceeds 200 m. A galvanic isolation is highly recommended practice for vehicles with electric drives, e.g. trams and trolley-buses.

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1 If repeaters are used, the network may appear less “bus-shaped”. In this case the cable terminating and dead-end feeder requirements apply to each bus segment connected to the repeater.

2 Depending on the bus configuration, deviations from 120 Ω may be possible. It is, however, necessary to check the applicability of other resistor values in each case. EN 50325-4 gives guidelines to this.
NOTE The more nodes there are in the bus, the higher the termination resistor value should be.

However, it shall be ensured that all bus transceivers stay within their common mode voltage range at all times. It is therefore recommended to use only isolated ECUs (see Figure 2), or only non-isolated ones (see Figure 3) throughout the bus system. If the bus system consists of both non-isolated, and isolated ECUs, their grounding has to be designed carefully to prevent possible grounding problems. One approach to avoid ground loops is to supply power to non-isolated ECUs via DC/DC converters.

It is also recommended that the power supply voltage for the isolated transceiver of the ECU is generated locally inside the device by e.g. a DC/DC converter. Some isolated devices need external supply voltage for their transceivers. To support both kinds of isolated ECUs now and in the future, it is recommended that the cable also contain both GND and CAN_V+.

V+ and GND could be connected to the bus about in the middle of its length to minimise problems related to cable resistance – especially if there are many ECUs supplied by V+, which introduces more current to these lines.

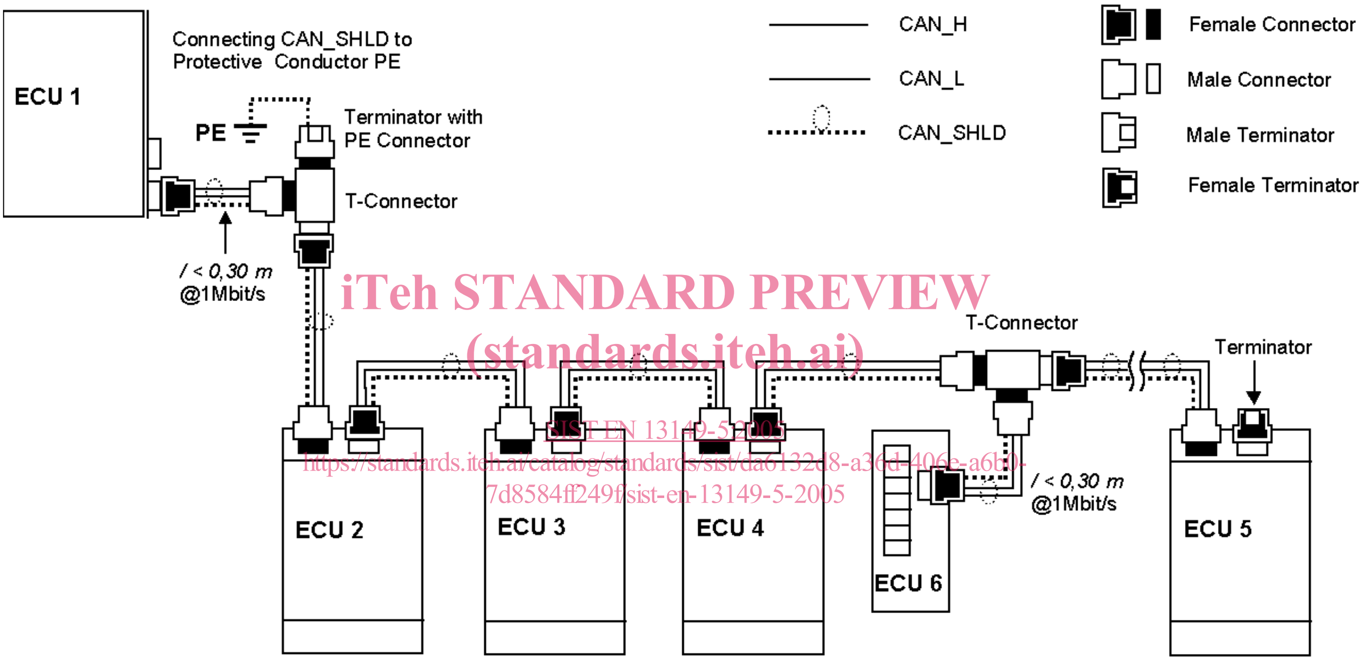

Figure 1 — Typical wiring of non-isolated devices using a shielded cable with one twisted pair