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Vesoljska tehnika - Razširitveni protokol CANbus

Space engineering - CANbus extention protocol

Raumfahrttechnik - CANbus-Erweiterungsprotokoll

Ingénierie spatiale - Protocole d'extension du CANbus

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Space engineering - CANbus extention protocol

Ingénierie spatiale - Protocole d'extension du CANbus

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This European Standard was approved by CEN on 11 May 2017.

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European foreword

This document (EN 16603-50-15:2017) has been prepared by Technical Committee CEN-CENELEC/TC 5 "Space", the secretariat of which is held by DIN.

This standard (EN 16603-50-15:2017) originates from ECSS-E-ST-50-15C.

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of an identical text or by endorsement, at the latest by December 2017, and conflicting national standards shall be withdrawn at the latest by December 2017.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a standardization request given to CEN by the European Commission and the European Free Trade Association.

This document has been developed to cover specifically space systems and has therefore precedence over any EN covering the same scope but with a wider domain of applicability (e.g.: aerospace).

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

Introduction

This European Standard specifies requirements for the use of the CAN (Controller Area Network) data bus in spacecraft onboard applications. These requirements extend the CAN Network specification to cover the aspects required to satisfy the particular needs of spacecraft data handling systems. This standard is one of a series of ECSS standards relating to data link interfaces and communication protocols e.g. MIL-STD-1553 and ECSS-E-ST-50-5x Space Wire.

In order to provide a uniform set of communication services across these standards the CCSDS Spacecraft Onboard Interface Services (SOIS) Subnetwork Recommendations have been applied as driving requirements for protocol specification.

The CAN Network has been successfully used for three decades in automotive and critical control industry. In particular, its use in applications that have demanding safety and reliability requirements, or operate in hostile environments have similarities to spacecraft onboard applications.

The CAN Network is being adopted for a variety of space applications and care has therefore been taken during the drafting of this standard to include existing experience and feedback from European Space industry.

In addition to the CAN Network data link specifications, this standard also specifies the optional use of the CANopen standard as an application layer protocol operating over CANbus.

The set of CANopen specifications comprises the application layer and communication profile as well as application, device, and interface profiles. CANopen provides very flexible configuration capabilities.

1 Scope

This European Standard is applicable to spacecraft projects that opt to use the CAN Network for spacecraft on-board communications and control. It also defines the optional use of the CANopen standard as an application layer protocol operating in conjunction with the CAN Network data link layer.

This standard does not modify the basic CAN Network specification and complies with ISO 11898-1/-2:2003. This standard does define protocol extensions needed to meet spacecraft specific requirements.

This standard covers the vast majority of the on-board data bus requirements for a broad range of different mission types. However, there can be some cases where a mission has particularly constraining requirements that are not fully in line with those specified in this standard. In those cases this standard is still applicable as the basis for the use of CAN Network, especially for physical layer and redundancy management.

This standard may be tailored for the specific characteristic and constrains of a space project in conformance with ECSS-S-ST-00.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this ECSS Standard. For dated references, subsequent amendments to, or revision of any of these publications do not apply. However, parties to agreements based on this ECSS Standard are encouraged to investigate the possibility of applying the more recent editions of the normative documents indicated below. For undated references, the latest edition of the publication referred to applies.

EN reference	Reference in text	Title
EN 16601-00-01	ECSS-S-ST-00-01	ECSS system – Glossary of terms
EN 16603-20	ECSS-E-ST-20	Space engineering - Electrical and electronic
EN 16603-20-07	ECSS-E-ST-20-07	Space engineering - Electromagnetic compatibility
EN 16602-70-08	ECSS-Q-ST-70-08	Space product assurance - Manual soldering of high-reliability electrical connections
EN 16602-70-26	ECSS-Q-ST-70-26	Space product assurance - Crimping of high-reliability electrical connections
	ESCC 3401/029 Issue 1, October 2002	Connectors Electrical Rectangular Microminiature, based on type MDM
	ESCC 3401/01 Issue 2, March 2010	Connectors, Electrical, Rectangular, Microminiature, Solder Bucket Contacts, with EMI Backshell, based on Type MDM
	ANSI/TIA/EIA-485-A-1998 (reaffirmed 28 March 2003)	Electrical Characteristics of Balanced Voltage Digital Interface Circuits. NOTE: This standard referenced in this document as RS-485.
	DIN 41652-1 (1990-06)	Rack and panel connectors, trapezoidal, round contacts Ø 1 mm; common mounting features and dimensions; survey of types
	ISO 11898-1:2003	Road vehicles – Controller Area Network (CAN) - Part 1: Data link layer and physical signalling
	ISO 11898-2:2003	Road vehicles – Controller Area Network (CAN) - Part 2: High-speed medium access unit
	CiA 102 v. 2.0	CAN physical layer for industrial applications (available from www.can-cia.org)

	CiA 301 Version 4.2.0	CANopen Application Layer and Communication Profile, CAN in Automation (available from www.can-cia.org)
	CiA 306 Version 1.3.0	CANopen electronic data sheet specification (available from www.can-cia.org)
	iCC 2012	CAN in Automation - Computation of CAN Bit Timing Parameters Simplified - Meenanath Taralkar, OTIS ISRC PVT LTD, Pune, India (available from www.can-cia.org)
	MIL-DTL-38999 (formerly MIL-C D38999 Series 3)	Connectors, Electrical, Circular, Miniature, High Density, Quick Disconnect (Bayonet, Threaded, and Breech Coupling), Environment Resistant, Removable Crimp and Solder Contacts, General Specification for. U.S. Department of Defense. 30 May 2008.
	RS-485	The current reference of this standard is ANSI/TIA/EIA-485-A-1998 (reaffirmed 28 March 2003)

3 Terms, definitions and abbreviated terms

3.1 Terms from other standards

For the purpose of this Standard, the terms and definitions from ECSS-S-ST-00-01 shall apply.

3.2 Terms specific to the present standard

3.2.1 asynchronous data transmission

data transmission from an originating source that is not synchronized to any clock pulse or external common event

NOTE 1 The data frame is delimited with (e.g.) start and stop signals. Both communication terminals do not need to have local clocks synchronized.

NOTE 2 Data transmission systems that foresee asynchronous data transfer can allow senders to attempt to transfer data at any time. If two or more senders send data at the same time then there is a conflict and an arbitration scheme is used to determine the order in which the senders can put their data on the bus. Priority is then used to differentiate between information to be delivered urgently, and data whose delivery is less time critical. When there is a conflict between two or more senders the one with highest priority is allowed to send its data first.

3.2.2 CAN-ID

11- or 29-bit identifier used in the arbitration and control field of the CAN frame

[CANopen – CiA Standard 301 V4.2.0]

3.2.3 cold redundant bus

redundancy scheme whereby data is only transmitted on one of the available busses

[CANopen – CiA Standard 301 V4.2.0]

3.2.4 communication bus system latency

time from the source sending a packet to the time when it is received by the intended destination

3.2.5 cross-strapping

two identical units that are interconnected with the remaining system in such a way that either unit can provide the required functionality

NOTE In an avionics system, where each unit appears with its identical backup, cross-strapped units provide all possible interconnections between them. For bus-connected systems all bus connected subsystems, components, and instruments are cross-strapped to their respective data buses. The overall system reliability of a space avionics system is significantly enhanced by cross strapping, as if one unit fails a redundant unit can take over without implying a complete switch-over to a redundant chain.

3.2.6 cyclic data transmission

see "**isochronous data transmission**" 3.2.11.

3.2.7 dominant and recessive states of CANbus signals

CAN transmission based on differential signal transmission

NOTE In this case, the difference between the CAN (controller area network) high (CAN_H) and CAN low (CAN_L) signals are used. Bus operation is dependent on accurate interpretation of Dominant and Recessive data bits within a CAN frame. Signal levels are reported in Clause 5.3.2 of this standard.

3.2.8 dominant bit level

logical level that when applied to a bus forces the entire bus to the same logical level

[CANopen – CiA Standard 301 V4.2.0]

3.2.9 hard coded (or Hardcoded) data

embedding what can, perhaps only in retrospect, be regarded as input or configuration data directly into the source code/read only memory of a FPGA/device, or fixed formatting of the data, instead of obtaining that data from external sources

[CANopen – CiA Standard 301 V4.2.0]