CiA® 412

Profiles for medical devices

Part 1: General definitions

Version: 1.0.0
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HISTORY

Date	Changes
2003-05-25	*Publication of Version 1.0 as draft standard proposal*
2005-12-31	*Publication of Version 1.0.0 as draft standard (now publicly available)* NOTE: This document has been converted into "docx format". The conversion caused minor layout differences to the predecessor document in "doc format". The technical content word-by-word is the very same.

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CONTENTS

1 Scope

The CANopen profiles for medical devices includes several parts:

- Part 1 describes general definitions
- Part 2 defines the profile for automatic X-ray collimators
- Part 3 defines the profile for X-ray generators
- Part 4 defines the profile for patient tables
- Part 5 defines the profile for X-ray stands

Devices compliant to these profiles use communication techniques, which conforms to those described in the CANopen communication profile (CiA Draft Standard DS-301, /2/). In addition, medical devices and sub-systems may use communication techniques, which conform to those described in the framework for programmable CANopen Devices (CiA Draft Standard Proposal DSP-302). These specifications should be consulted in parallel to these device profile specifications.

2 Normative references

/1/: ISO 11898: Road vehicles – Interchange of digital information – Controller area network (CAN), November 1993.
Note: ISO 11898 is currently under review. A new version may arise as a result of the review procedure.

/2/: CiA DS-301 V4.02: CANopen application layer and communication profile, (February 2002).

/3/ CiA DSP-302 V3.2.1: Framework for programmable CANopen devices, (April 2003).

3 Acronyms and abbreviations

CAN
: Controller Area Network. Data link layer protocol for serial communication as specified in ISO 11898-1 (1999).

COB
: Communication Object, which is made of one or more CAN frames. Any information transmitted via CANopen has to be mapped into COBs.

COB-ID
: COB-Identifier. Identifies a COB uniquely in a CAN network. The identifier determines the priority of that COB in the data link layer, too.

SDO
: Service Data Object. Peer-to-peer communication with access to the Object Dictionary of a CANopen device.

RPDO
: Receive Process Data Object. Communication object of a device, which contains output data.

TPDO
: Transmit Process Data Object. Communication object of a device, which contains input data.

4 General operating principles

CANopen networks may not only be used for embedded communication in medical sub-systems but also to integrate medical sub-systems into medical device systems.

In medical devices, CANopen networks are used to integrate X-ray collimators, X-ray generators, patient tables, X-ray stands and other sub-systems. The sub-system communication interface is compliant to the CANopen application layer and communication profile /2/. The interface is specified in device profiles, which define the application objects as well as the default PDO communication and mapping parameter.

5 Physical layer definitions

The definitions given in /2/ shall apply to devices compliant to this profile. No additional specific physical layer definitions are specified.

6 Error handling

6.1 Principle

Emergency Messages shall be triggered by internal errors in the device (see /2/ for a description of emergency message handling). By default, the Emergency Messages shall contain the error field with pre-defined error numbers and additional information.

6.2 Error behavior

If a severe device failure is detected, the device shall automatically enter by default the pre-operational state (see /2/ CANopen NMT state machine).

If object 1029_h is implemented, the device can be alternatively configured in case of a device failure to automatically enter the stopped state or remain in the current state.

Device failures shall include the following communication errors:

- Bus-off conditions on the CAN interface
- Life guarding event with the state ‘occurred’
- Heartbeat event with state ‘occurred’

Severe device errors may also be caused by device internal failures.

Important note for X-ray collimators:

The X-ray collimator device profile interprets object 1029_h only in relation to the behavior of the device NMT communication state machine. The behavior of the collimator finite state automaton, described in the automatic X-ray collimator device profile remains unaffected by this object.

6.3 Additional error code meanings

See the CANopen medical device profiles, e.g. 412-2 for automatic X-ray collimators.

7 Predefinitions

7.1 General

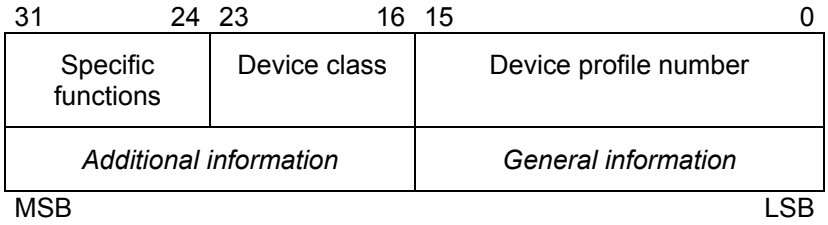
Either Heartbeat (recommended) or Node guarding functionality shall be supported (see /2/).

7.2 Predefined communication objects

7.2.1 1000_h: Device type

The object at index 1000_h describes the type of device and its functionality. For multiple device modules the Additional information parameter shall contain $FFFF_h$ (see /2/ section 9.6.3).

VALUE DEFINITION



General information:

Device profile number: 412_d

Additional information:

Device class:

Code	Function
0_h	reserved
1_h	X-ray collimator
2_h	X-ray generator
3_h	Patient table
4_h	X-ray stand
5_h	DMS
6_h to FE_h	reserved

Specific functions:

For X-ray collimator

Code	Function
0_h	reserved
1_h	Symmetric rectangular collimator with default PDOs
2_h.. FE_h	*<Reserved for future use>*

For X-ray-generator

Code	Function
0_h	reserved
1_h .. FE_h	*<Reserved for future use>*

For patient table

Code	Function
0_h	reserved
1_h .. FE_h	*<Reserved for future use>*

For X-ray stand

Code	Function
0_h	reserved
1_h .. FE_h	*<Reserved for future use>*

For DMS

Code	Function
0_h	reserved
1_h .. FE_h	*<Reserved for future use>*

7.2.2 1001_h: Error register

The device-specific bit in the error register object may be defined in other parts of this specification as it is reserved

7.2.3 1029_h: Error behavior

This object specifies to which state the device shall be set, when a communication error or a device-internal error is detected.

VALUE DEFINITION

0 = pre-operational (only if current state is operational)
1 = no state change
2 = stopped

OBJECT DESCRIPTION

INDEX	1029_h
Name	error_behavior
Object Code	Array
Data Type	Unsigned8
Category	Optional

ENTRY DESCRIPTION

Sub-Index	0_h
Description	number_of_error_classes
Access	ro
Entry Category	Mandatory
PDO Mapping	No
Value Range	1_h to 2_h
Default Value	No

Sub-Index	1_h
Description	communication_error
Access	rw
Entry Category	Mandatory
PDO Mapping	No
Value Range	0_h to 2_h
Default Value	1_h

Sub-Index	2_h
Description	internal_device_error
Access	rw
Entry Category	Mandatory
PDO Mapping	No
Value Range	0_h to 2_h
Default Value	1_h

7.2.4 $67FF_h$: Device type

See /2/ section 9.6.3.