CiA® 850

CANopen®

Recommended practice

CiA® 413 based truck gateway for cranes, hookloaders, and areal working platforms

HISTORY

Date	Changes
2011-11-24	*Publication of version 1.0.0* as recommended practice
	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

This recommended practice specify the implementation of the CiA 413 gateway interface for truck-mounted cranes, multi-lifts, and aerial working platforms. Besides some general definitions, it specifies the Process Data Objects to be received and transmitted.

2 Normative references

/CiA301/ CiA 301, CANopen application layer and communication profile

/CiA302-2/ CiA 302-2, CANopen additional application layer functions – Part 2: Network management

/CiA413-1/ CiA 413-1, CANopen device profile for truck gateways – Part 1: General definitions and default communication objects

/CiA413-2/ CiA 413-2, CANopen device profile for truck gateways – Part 2: Application objects for brake and running gear equipment

/CiA413-3/ CiA 413-3, CANopen device profile for truck gateways – Part 3: Application objects for other than brake and running gear equipment

/CiA413-5/ CiA 413-5, CANopen device profile for truck gateways – Part 5: Application objects for superstructure

/CiA413-6/ CiA 413-6, CANopen device profile for truck gateways – Part 6: Framework for J1939-based networks

/CiA413-8/ CiA 413-8, CANopen device profile for truck gateways – Part 8: Framework for HMI control

/ISO11898-2/ ISO 11898-2, Road vehicles – Controller area network – Part 2: High-speed medium access unit

/ISO11898-5/ ISO 11898-5, Road vehicles – Controller area network – Part 5: High-speed medium access unit with low-power mode

3 Definitions, acronyms, and abbreviations

3.1 Definitions

3.1.1 cabin display
human machine interface, which is connected to the in-vehicle networks and optionally to the CANopen truck network

3.1.2 host controller
programmable CANopen device, which controls the body application (e.g. truck-mounted crane)

3.1.3 main host controller
programmable CANopen device, which controls one of several body applications (e.g. truck-mounted crane) and provides the NMT master functionality

The definitions given in /CiA301/ and /CiA413/ series apply to this specification, too.

3.2 Acronyms

CAN	Controller area network
CAN-ID	CAN identifier
EEC	Emergency error code
ECU	Electronic control unit
EMCY	Emergency

IVN	In-vehicle network
LSB	Least significant bit
MSB	Most significant bit
PDO	Process data object
RPDO	Receive PDO
SDO	Service data object
TPDO	Transmit PDO

3.3 Abbreviations

const	constant
M	mandatory
O	optional

4 Body network architectures

4.1 Single body controller applications

The CiA 413 gateway with optional local display functionality links the in-vehicle networks
(e.g. based on J1939 or ISO 11992) to the CANopen body network. Figure 1 shows two
options. The left example uses the CANopen network to link the truck gateway and the body
controller with NMT master function. Optionally the truck cabin display is connected to the
CANopen network. In the other example, the CANopen network is also used to interconnect
the body devices such as sensors and actuators as well as body displays and other human
machine interface devices.

BB = bodybuilder
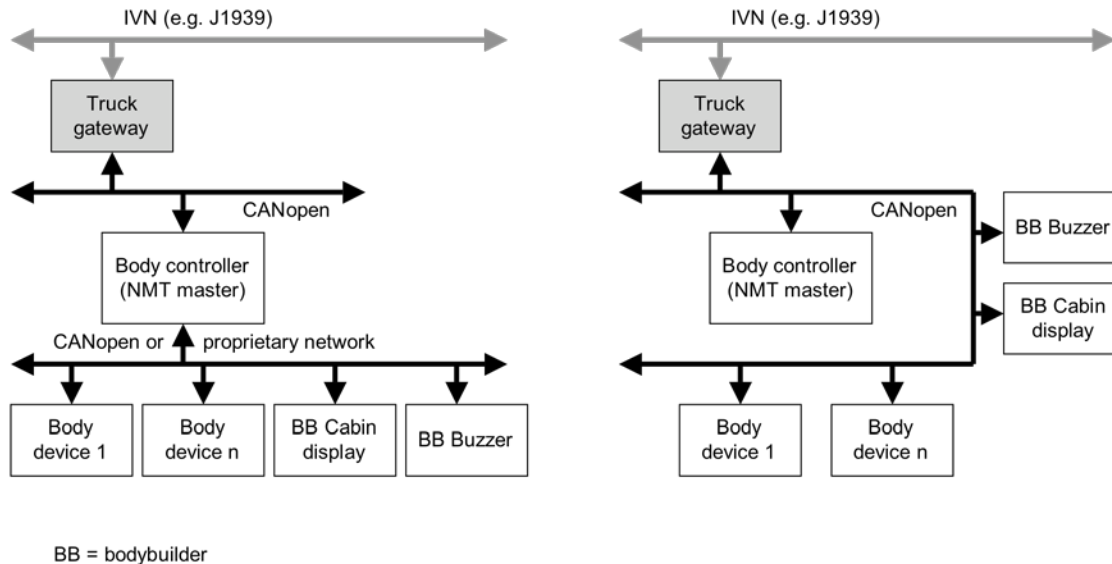
Figure 1 – CANopen network architecture options

4.2 Multiple body controller applications

If several body applications are mounted to the truck, the CANopen network is used as a
backbone network to interconnect multiple body controllers. Figure 2 shows an example. The
body controller may use NMT flying master functionality as defined in /CiA302-2/. For
integrating such a multiple body controller system, a body builder system integrator is
required. Among others the system integrator is responsible for establishing a proper
information interchange; especially with regard to requests to the IVN.
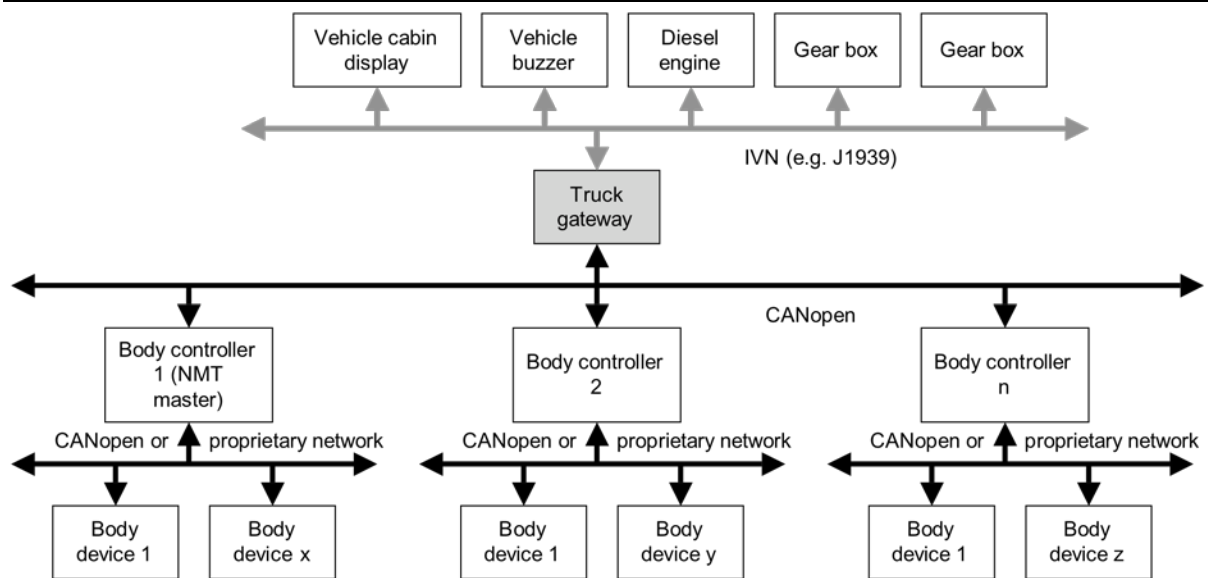
Figure 2 – Multiple body controller system (example)

5 Physical layer specification

5.1 General

The general physical layer specification given in /CiA301/ applies to devices compliant to this recommended practice, too. The transceiver chips shall be compliant to /ISO11898-2/ or /ISO11898-5/.

5.2 Transmission rates

The devices compliant to this recommended practice shall support by default the transmission rate of 250 kbit/s. In addition, the transmission rate of 125 kbit/s shall be supported; other bit rates as defined in /CiA301/ may be supported. The bit timing as defined in /CiA301/ shall be used.

The method to assign other transmission rates is manufacturer-specific. It is recommended to use automatic bit-rate detection or LSS services and protocols as defined in /CiA305/. It is not recommended to assign the bit-rate by means of SDO communication services.

5.3 Location of power plug and CANopen connector

The power plug and CANopen connector shall be located in a single connection box. The CANopen connector shall be compliant to /CiA413-1/ or a screw terminal type connector with a pin-assignment compliant to /CiA303-1/. The power supply connector and the optional truck discrete I/O lines connector shall also be located in this connection box. The connection box shall be mounted in the driver's cabin or at the backside of the driver's cabin. The power plugs and the optional discrete I/O lines plugs for cranes, multi-lifts, and aerial working platforms are described in the Annex A.

5.4 Node-ID assignment

The node-ID for the truck gateway device shall be 112 (70_h). It is recommended to use the node-ID 1 for the main body controller, which provides the NMT master functionality. The node-IDs 2 to 4 are recommended for additional body controllers.

The method to assign another node-ID is manufacturer-specific. It is recommended to use the LSS services and protocols as defined in /CiA305/. It is not recommended to assign the node-ID by means of SDO communication services.

6 Gateway interface specifications

6.1 General

The truck gateway device compliant to this recommended practice may implement all application objects specified in the CiA 413 series. It is recommended to implement one of the classes defined in this recommended practice. The classes specify the set of PDOs to be implemented and all mandatory application objects to be supported.

6.2 Gateway classes

6.2.1 Class A

This class is intended for single body (crane) controller applications with basic functionality.

Class A gateways shall provide the Default SDO server, in order to communicate with the host controller, which shall implement the corresponding SDO client.

Class A gateways shall support the PDO set 1 as specified in clause 6.4.2. It is not mandatory, that the mapping parameters of the default PDOs are configurable.

6.2.2 Class B

This class is intended for single body (crane) applications with normal functionality.

Class B gateways shall provide the Default SDO server, in order to communicate with the host controller, which implements the corresponding SDO client.

Class B gateways shall support the PDO set 2 as specified in clause 6.4. It is not mandatory, that the mapping parameters of the default PDOs are configurable.

The production of EMCY messages shall be supported. The EECs given in Table 1 shall be supported. Other EECs as defined in /CiA301/ may be supported, too.

Table 1 – Emergency error codes

EEC	Description	Reference
0000_h	Error reset or no error	/CiA301/
2000_h	Generic current error	/CiA301/
3000_h	Generic voltage error	/CiA301/
4000_h	Generic temperature error	/CiA301/
8110_h	CAN overrun (objects lost)	/CiA301/
8120_h	CAN in error passive mode	/CiA301/
8140_h	Recovered from bus-off	/CiA301/
8150_h	CAN-ID collision	/CiA301/
8240_h	Unexpected SYNC data length	/CiA301/
$FF01_h$	Time out of IVN ECU with Source Address 1_d	/CiA413-1/
::::	::::	::::
$FFFA_h$	Time out of IVN ECU with Source Address 251_d	/CiA413-1/
NOTE The gateway supports only those EECs in the range from $FF01_h$ to $FFFA_h$, which correspond to the installed ECU source addresses.		

6.2.3 Class C

This class is intended for multiple body applications with sophisticated functionality.

Class C gateways shall provide the Default SDO server and may provide additional SDO servers, in order to communicate with the main host controller (NMT master) as well as the other host controllers. The main host controller (NMT master) implements the SDO client corresponding to the default SDO server of the gateway. The other host controller may implement the SDO clients corresponding to the additional SDO servers of the truck gateway.

NOTE   The additional SDO servers and the corresponding clients need to be assigned with CAN-IDs by the system designer.

Class C gateways shall support the PDO set 3 as specified in clause 6.4. It is not mandatory, that the mapping parameters of the default PDOs are configurable.

The production of EMCY messages shall be supported. The Emergency Error Codes given in Table 1 shall be supported.

6.3   General communication parameter

6.3.1   General

Truck gateway devices compliant with this recommended practice shall be compliant to /CiA301/. The communication parameters are described by object description and entry description. Object description and entry description attributes are specified in /CiA301/.

Table 2 specifies, which general communication parameters are mandatory and which are optional but recommended to be implemented.

Table 2 — Mandatory general communication parameter

Index	Sub-index	Object name	Category	Reference
1000_h	00_h	Device type	M	/CiA301/
1001_h	00_h	Error register	M	/CiA301/
1010_h	00_h and 02_h	Store parameters	M	/CiA301/
1017_h	00_h	Producer heartbeat time	M	/CiA301/
1018_h	00_h to 04_h	Identity	M (NOTE 1)	/CiA301/
$1F80_h$	00_h	NMT start-up	M (NOTE 2)	/CiA302-2/
NOTE 1 Sub-index 02_h to 04_h are mandatory, if LSS is supported, otherwise they are recommended.				
NOTE 2 The truck gateway shall be a self-starting device.				

6.3.2   Object 1000_h: Device type

This object provides device type information as specified in /CiA301/ and /CiA413-1/. Figure 3 shows the object structure.

31	24	23	16	15	0
Specific functionality		*Gateway functionality*		*Device profile number: 413_d*	

MSB   LSB
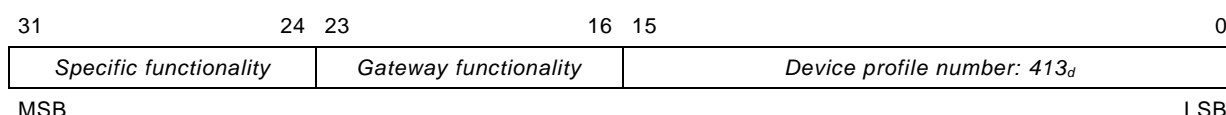
Figure 3 — Object structure

The gateway functionality and specific functionality values are specified in /CiA413-1/. Gateways compliant to this recommended practice shall set bit 31 to 28 to 2_h.

6.3.3   Object 1017_h: Producer heartbeat time

The producer heartbeat time shall be preset to 5000 ms.

6.4   PDO specifications

6.4.1   PDO set descriptions

For the truck gateway classes as defined in clause 6.2, there are three PDO sets specified. The PDO set A is used for class A, the PDO set B is used for class B, and the PDO set C is used for class C. An overview of the PDO sets is shown in Table 3. Manufacturer-specific PDOs to be transmitted or to be received may use the PDOs 5 to 8.

All TPDOs use the transmission type 255 by default. They shall be transmitted, if the gateway enters the NMT state Operational and if the event timer elapses. All RPDOs use the transmission type 255 by default. The received process data shall be implemented processed.

Table 3 – PDO sets overview

PDO set		Mapped application objects							
No.	PDO	Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
A	TPDO1	*not used*	6333_h 6334_h $610F_h$ 6124_h	6335_h $634D_h$ 6134_h 6316_h	6304_h		6117_h	6113_h	
	TPDO2	*not used*	*not used*	*not used*	*not used*	*not used*	*not used*	6132_h 6150_h $4 \times 6700_h$	$612E_h$ $612F_h$ 6130_h 6131_h
	RPDO1	*not used*	*not used*	*not used*	*not used*	$634E_h$ $634F_h$ $4 \times 0001_h$	$613E_h$ $613F_h$ 6313_h $634B_h$	$614A_h$	
B	TPDO1	Same as for PDO set A							
	TPDO2	Same as for PDO set A							
	TPDO3	reserved for future use by CiA							
	TPDO4	reserved for future use by CiA							
	RPDO1	Same as for PDO set A							
	RPDO2	reserved for future use by CiA							
	RPDO3	reserved for future use by CiA							
	RPDO4	reserved for future use by CiA							
C	TPDO1	Same as for PDO set A							
	TPDO2	Same as for PDO set A							
	TPDO3	reserved for future use by CiA							
	TPDO4	reserved for future use by CiA							
	RPDO1	Same as for PDO set A							
	RPDO2	reserved for future use by CiA							
	RPDO3	reserved for future use by CiA							
	RPDO4	reserved for future use by CiA							

6.4.2 PDO set A

6.4.2.1 TPDO 1 parameters

This TPDO is send to the host controller. Table 4 specifies the object description and Table 5 specifies the entry description of the TPDO communication parameter.

Table 4 — Object description

Attribute	Value
Index	1800_h
Name	TPDO 1 communication parameter
Object code	RECORD
Data type	PDO_COMMUNICATION_PARAMETER
Category	Mandatory

Table 5 — Entry description

Attribute	Value
Sub-Index	00_h
Description	Highest sub-index supported
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	05_h *to* 06_h
Default value	Manufacturer-specific
Sub-Index	01_h
Description	COB-ID used by PDO
Access	rw
Entry category	Mandatory
PDO mapping	No
Value range	{0000 0180$_h$, 4000 0180$_h$, 8000 0180$_h$, C000 0180$_h$} + node-ID
Default value	{0000 0180$_h$, 4000 0180$_h$} + node-ID
Sub-Index	02_h
Description	Transmission type
Access	rw
Entry category	Mandatory
PDO mapping	No
Value range	1_d *to* 240_d, 255_d
Default value	255_d
Sub-Index	03_h
Description	Inhibit time
Access	rw
Entry category	Optional
PDO mapping	No
Value range	See /CiA301/
Default value	0000_h
Sub-Index	05_h
Description	Event timer
Access	rw
Entry category	Mandatory
PDO mapping	No
Value range	See /CiA301/
Default value	50_d

Attribute	Value
Sub-Index	06$_h$
Description	SYNC start value
Access	rw
Entry category	Optional
PDO mapping	No
Value range	See /CiA301/
Default value	00$_h$

Table 6 specifies the object description and Table 7 specifies the entry description of the TPDO mapping parameter.

Table 6 — Object description

Attribute	Value
Index	1A00$_h$
Name	TPDO 1 mapping parameter
Object code	RECORD
Data type	PDO_MAPPING
Category	Mandatory

Table 7 — Entry description

Attribute	Value
Sub-Index	00$_h$
Description	Highest sub-index supported
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	0B$_h$
Default value	0B$_h$
Sub-Index	01$_h$
Description	Mapping parameter 1
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	6113 01 10$_h$
Default value	6113 01 10$_h$
Sub-Index	02$_h$
Description	Mapping parameter 2
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	6117 01 08$_h$
Default value	6117 01 08$_h$

Attribute	Value
Sub-Index	03$_h$
Description	Mapping parameter 3
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	6304 01 08$_h$
Default value	6304 01 08$_h$
Sub-Index	04$_h$
Description	Mapping parameter 4
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	6335 00 02$_h$
Default value	6335 00 02$_h$
Sub-Index	05$_h$
Description	Mapping parameter 5
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	634D 00 02$_h$
Default value	634D 00 02$_h$
Sub-Index	06$_h$
Description	Mapping parameter 6
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	6134 00 02$_h$
Default value	6134 00 02$_h$
Sub-Index	07$_h$
Description	Mapping parameter 7
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	6316 00 02$_h$
Default value	6316 00 02$_h$

Attribute	Value
Sub-Index	08$_h$
Description	Mapping parameter 8
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	6333 00 02$_h$
Default value	6333 00 02$_h$
Sub-Index	09$_h$
Description	Mapping parameter 9
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	6334 00 02$_h$
Default value	6334 00 02$_h$
Sub-Index	0A$_h$
Description	Mapping parameter 10
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	610F 00 02$_h$
Default value	610F 00 02$_h$
Sub-Index	0B$_h$
Description	Mapping parameter 11
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	6124 00 02$_h$
Default value	6124 00 02$_h$

6.4.2.2 TPDO 2 parameters

This TPDO is send to the host controller. Table 8 specifies the object description and Table 9 specifies the entry description of the TPDO communication parameter.

Table 8 — Object description

Attribute	Value
Index	1801$_h$
Name	TPDO 2 communication parameter
Object code	RECORD
Data type	PDO_COMMUNICATION_PARAMETER
Category	Mandatory

Table 9 — Entry description

Attribute	Value
Sub-Index	00_h
Description	Highest sub-index supported
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	05_h *to* 06_h
Default value	Manufacturer-specific
Sub-Index	01_h
Description	COB-ID used by PDO
Access	rw
Entry category	Mandatory
PDO mapping	No
Value range	{0000 0280_h, 4000 0280_h, 8000 0280_h, C000 0280_h} + node-ID
Default value	{0000 0280_h, 4000 0280_h} + node-ID
Sub-Index	02_h
Description	Transmission type
Access	rw
Entry category	Mandatory
PDO mapping	No
Value range	1_d *to* 240_d, 255_d
Default value	255_d
Sub-Index	03_h
Description	Inhibit time
Access	rw
Entry category	Optional
PDO mapping	No
Value range	See /CiA301/
Default value	0000_h
Sub-Index	05_h
Description	Event timer
Access	rw
Entry category	Mandatory
PDO mapping	No
Value range	See /CiA301/
Default value	50_d

Attribute	Value
Sub-Index	06$_h$
Description	SYNC start value
Access	rw
Entry category	Optional
PDO mapping	No
Value range	See /CiA301/
Default value	00$_h$

Table 10 specifies the object description and Table 11 specifies the entry description of the TPDO mapping parameter.

Table 10 — Object description

Attribute	Value
Index	1A01$_h$
Name	TPDO 2 mapping parameter
Object code	RECORD
Data type	PDO_MAPPING
Category	Mandatory

Table 11 — Entry description

Attribute	Value
Sub-Index	00$_h$
Description	Highest sub-index supported
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	0B$_h$
Default value	0B$_h$
Sub-Index	01$_h$
Description	Mapping parameter 1
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	612E 00 02$_h$
Default value	612E 00 02$_h$
Sub-Index	02$_h$
Description	Mapping parameter 2
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	612F 00 02$_h$
Default value	612F 00 02$_h$

Attribute	Value
Sub-Index	03$_h$
Description	Mapping parameter 3
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	6130 00 02$_h$
Default value	6130 00 02$_h$
Sub-Index	04$_h$
Description	Mapping parameter 4
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	6131 00 02$_h$
Default value	6131 00 02$_h$
Sub-Index	05$_h$
Description	Mapping parameter 5
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	6132 00 02$_h$
Default value	6132 00 02$_h$
Sub-Index	06$_h$
Description	Mapping parameter 6
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	6150 00 02$_h$
Default value	6150 00 02$_h$
Sub-Index	07$_h$ to 0A$_h$
Description	Mapping parameter 6 to 11
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	6700 00 01$_h$
Default value	6700 00 01$_h$

6.4.2.3 RPDO 1 parameters

This RPDO is received from the host controller. Table 12 specifies the object description and Table 13 specifies the entry description of the TPDO communication parameter.

Table 12 — Object description

Attribute	Value
Index	1400$_h$
Name	RPDO 1 communication parameter
Object code	RECORD
Data type	PDO_COMMUNICATION_PARAMETER
Category	Mandatory

Table 13 — Entry description

Attribute	Value
Sub-Index	00$_h$
Description	Highest sub-index supported
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	02$_h$ *to* 05$_h$
Default value	Manufacturer-specific
Sub-Index	01$_h$
Description	COB-ID used by PDO
Access	rw
Entry category	Mandatory
PDO mapping	No
Value range	{0000 0200$_h$, 8000 0200$_h$} + node-ID
Default value	{0000 0180$_h$} + node-ID
Sub-Index	02$_h$
Description	Transmission type
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	255$_d$
Default value	255$_d$
Sub-Index	03$_h$
Description	Inhibit time
Access	rw
Entry category	Optional
PDO mapping	No
Value range	See /CiA301/
Default value	0000$_h$

Attribute	Value
Sub-Index	05$_h$
Description	Event timer
Access	rw
Entry category	Optional
PDO mapping	No
Value range	See /CiA301/
Default value	0$_d$

Table 14 specifies the object description and Table 15 specifies the entry description of the TPDO mapping parameter.

Table 14 — Object description

Attribute	Value
Index	1600$_h$
Name	RPDO 1 mapping parameter
Object code	RECORD
Data type	PDO_MAPPING
Category	Mandatory

Table 15 — Entry description

Attribute	Value
Sub-Index	00$_h$
Description	Highest sub-index supported
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	0B$_h$
Default value	0B$_h$
Sub-Index	01$_h$
Description	Mapping parameter 1
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	614A 01 10$_h$
Default value	614A 01 10$_h$
Sub-Index	02$_h$
Description	Mapping parameter 2
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	613E 00 02$_h$
Default value	613E 00 02$_h$

Attribute	Value
Sub-Index	03$_h$
Description	Mapping parameter 3
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	613F 00 02$_h$
Default value	613F 00 02$_h$
Sub-Index	04$_h$
Description	Mapping parameter 4
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	6313 00 02$_h$
Default value	6313 00 02$_h$
Sub-Index	05$_h$
Description	Mapping parameter 5
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	634B 00 02$_h$
Default value	634B 00 02$_h$
Sub-Index	06$_h$
Description	Mapping parameter 6
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	634E 00 02$_h$
Default value	634E 00 02$_h$
Sub-Index	07$_h$
Description	Mapping parameter 7
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	634F 00 02$_h$
Default value	634F 00 02$_h$

Attribute	Value
Sub-Index	09_h to $0C_h$
Description	Mapping parameter 9 to 12
Access	const
Entry category	Mandatory
PDO mapping	No
Value range	6700 00 01$_h$
Default value	6700 00 01$_h$

6.4.3   PDO set B

The PDO set B is to be defined.

6.4.4   PDO set C

The PDO set C is to be defined.

6.5   Application object description

6.5.1   General

The application objects are specified in detail in /CiA413-2/, /CiA413-3/, and /CiA413-5/. In addition, the gateway may implement some manufacturer-specific application objects. If the application objects derive from J1939-based IVNs, it is recommended to use for those manufacturer-specific application objects the methods described in /CiA413-6/.

6.5.2   Support of application objects

Table 16 specifies the mandatory application objects for gateway class A, B, and C. Those application objects that are not mapped by default into PDOs are accessible by means of SDO services or they may be mapped into additional manufacturer-specific PDOs.

Table 16 — Mandatory application objects

Index	Application object name	Reference	Class A	Class B	Class C
603F$_h$	Level control request	/CiA413-2/	O	M	M
6040$_h$	Level control	/CiA413-2/	O	M	M
6041$_h$	Level change request front axle	/CiA413-2/	O	M	M
6042$_h$	Level change request rear axle	/CiA413-2/	O	M	M
6043$_h$	Level change front axle	/CiA413-2/	O	M	M
6044$_h$	Level change rear axle	/CiA413-2/	O	M	M
6045$_h$	Lift axle 1 position request	/CiA413-2/	O	M	M
6046$_h$	Lift axle 2 position request	/CiA413-2/	O	M	M
6047$_h$	Lift axle 1 position	/CiA413-2/	O	M	M
6048$_h$	Lift axle 2 position	/CiA413-2/	O	M	M
607D$_h$	Axle load – value	/CiA413-2/	O	M	M
6100$_h$	Rear obstacle distance – value	/CiA413-3/	O	O	M
6102$_h$	Thermal body temperature – value	/CiA413-3/	O	O	M
6104$_h$	Obstacle detection device request	/CiA413-3/	O	O	M
6106$_h$	Obstacle detection device active	/CiA413-3/	O	O	M
610A$_h$	Percent clutch slip – value	/CiA413-3/	O	M	M
610C$_h$	Current gear – value	/CiA413-3/	O	O	M
610E$_h$	Accelerator pedal low idle switch	/CiA413-3/	O	O	M

Index	Application object name	Reference	Class		
			A	B	C
610Fh	Engine control allowed	/CiA413-3/	M	M	M
6110h	PTO control allowed	/CiA413-3/	O	O	M
6111h	Vehicle speed – value	/CiA413-3/	O	M	M
6113h	Engine speed – value	/CiA413-3/	M	M	M
6117h	Actual engine percent torque – value	/CiA413-3/	M	M	M
6119h	Reference engine torque – value	/CiA413-3/	M	M	M
611Bh	Percent load at current speed – value	/CiA413-3/	O	O	M
611Dh	Maximum vehicle speed limit – value	/CiA413-3/	O	O	M
611Fh	Engine speed upper limit – value	/CiA413-3/	M	M	M
6121h	Engine speed lower limit – value	/CiA413-3/	M	M	M
6123h	Engine coolant temperature warning	/CiA413-3/	O	M	M
6124h	Engine oil pressure warning	/CiA413-3/	M	M	M
6125h	Engine oil temperature	/CiA413-3/	O	M	M
6127h	Engine coolant temperature – value	/CiA413-3/	O	O	M
6129h	Engine oil pressure	/CiA413-3/	O	O	M
612Bh	Torque converter oil temperature warning	/CiA413-3/	O	M	M
612Eh	First clutch dependent PTO feedback	/CiA413-3/	M	M	M
612Fh	Second clutch dependent PTO feedback	/CiA413-3/	M	M	M
6130h	Clutch independent PTO feedback	/CiA413-3/	M	M	M
6131h	First engine mounted PTO feedback	/CiA413-3/	M	M	M
6132h	Second engine mounted PTO feedback	/CiA413-3/	M	M	M
6133h	Starter active	/CiA413-3/	O	M	M
6134h	Engine running	/CiA413-3/	M	M	M
6135h	Engine torque mode	/CiA413-3/	O	M	M
6136h	First clutch dependent PTO switch	/CiA413-3/	O	M	M
6137h	Second clutch dependent switch	/CiA413-3/	O	M	M
6138h	Clutch independent switch	/CiA413-3/	O	M	M
6139h	First engine mounted PTO switch	/CiA413-3/	O	M	M
613Ah	Second engine mounted PTO switch	/CiA413-3/	O	M	M
613Bh	Requested percent clutch slip – value	/CiA413-3/	O	M	M
613Eh	Engine start switch	/CiA413-3/	M	M	M
613Fh	Engine stop switch	/CiA413-3/	M	M	M
6140h	Requested engine speed upper limit – value	/CiA413-3/	M	M	M
6142h	Requested engine speed lower limit – value	/CiA413-3/	M	M	M
6144h	Requested engine torque limit – value	/CiA413-3/	O	M	M
6146h	Requested vehicle speed limit – value	/CiA413-3/	O	M	M
614Ah	Requested engine speed	/CiA413-3/	M	M	M
614Eh	Ambient air temperature – value	/CiA413-3/	O	M	M
6150h	Fuel level warning	/CiA413-3/	M	M	M
6167h	Body fluid level – value	/CiA413-3/	O	O	M
6169h	Body pressure - value	/CiA413-3/	O	O	M
617Bh	Seconds – value	/CiA413-3/	O	O	M
617Dh	Minutes – value	/CiA413-3/	O	O	M

Index	Application object name	Reference	Class A	B	C
617F$_h$	Hours –value	/CiA413-3/	O	O	M
6181$_h$	Day – value	/CiA413-3/	O	O	M
6183$_h$	Month	/CiA413-3/	O	O	M
6184$_h$	Year - value	/CiA413-3/	O	O	M
6186$_h$	Local minute offset – value	/CiA413-3/	O	O	M
6188$_h$	Local hour offset – value	/CiA413-3/	O	O	M
619C$_h$	Trailer rear waning light(s) command	/CiA413-3/	O	O	M
61A0$_h$	Transmission output shaft PTO feedback	/CiA413-3/	O	M	M
61A1$_h$	Transfer case output shaft PTO switch	/CiA413-3/	O	M	M
61A2$_h$	At least one PTO engaged	/CiA413-3/	O	M	M
61A3$_h$	Transmission output shaft PTO switch	/CiA413-3/	O	M	M
61A4$_h$	Transfer case output shaft PTO switch	/CiA413-3/	O	M	M
61A5$_h$	First clutch dependent PTO engagement consent	/CiA413-3/	O	M	M
61A6$_h$	Second clutch dependent PTO engagement consent	/CiA413-3/	O	M	M
61A7$_h$	Clutch independent PTO engagement consent	/CiA413-3/	O	M	M
61A8$_h$	First engine mounted PTO engagement consent	/CiA413-3/	O	M	M
61A9$_h$	Second engine mounted PTO engagement consent	/CiA413-3/	O	M	M
61AA$_h$	Transmission output shaft PTO engagement consent	/CiA413-3/	O	M	M
61AB$_h$	Transfer case output shaft PTO engagement consent	/CiA413-3/	O	M	M
61AC$_h$	First clutch dependent PTO engagement consent - trailer	/CiA413-3/	O	O	M
61AD$_h$	Second clutch dependent PTO engagement consent - trailer	/CiA413-3/	O	O	M
61AE$_h$	Clutch independent PTO engagement consent - trailer	/CiA413-3/	O	O	M
61AF$_h$	First engine mounted PTO engagement consent - trailer	/CiA413-3/	O	O	M
61B0$_h$	Second engine mounted PTO engagement consent - trailer	/CiA413-3/	O	O	M
61B1$_h$	Transmission output shaft PTO engagement consent - trailer	/CiA413-3/	O	O	M
61B2$_h$	Transfer case output shaft PTO engagement consent - trailer	/CiA413-3/	O	O	M
61BF$_h$	Reefer unit battery voltage – value	/CiA413-3/	O	O	M
61C1$_h$	Reefer unit fuel tank level – value	/CiA413-3/	O	O	M
6304$_h$	Electrical potential – value	/CiA413-5/	M	M	M
6306$_h$	Rated engine power – value	/CiA413-5/	O	M	M
6308$_h$	Rated engine speed – value	/CiA413-5/	O	M	M
630A$_h$	Engine oil level – value	/CiA413-5/	O	O	M
630C$_h$	Power consumption (net torque) superstructure – value	/CiA413-5/	O	M	M
630E$_h$	Current consumption superstructure – value	/CiA413-5/	O	M	M
6310$_h$	Actual language	/CiA413-5/	O	O	M
6311$_h$	Starter lockout device active	/CiA413-5/	O	M	M
6312$_h$	Warning buzzer device active	/CiA413-5/	M	M	M
6313$_h$	Warning buzzer device request	/CiA413-5/	M	M	M
6316$_h$	Parking brake device active	/CiA413-5/	M	M	M
631A$_h$	Stopping brake device active	/CiA413-5/	O	M	M
631B$_h$	Stopping brake device request	/CiA413-5/	O	M	M
631C$_h$	Driver door open active	/CiA413-5/	O	M	M
631D$_h$	Co-driver door open active	/CiA413-5/	O	M	M

Index	Application object name	Reference	Class		
			A	B	C
631E$_h$	Central door lock device active	/CiA413-5/	O	M	M
6320$_h$	Fuel filter clocked active	/CiA413-5/	O	O	M
6321$_h$	Oil filter clocked active	/CiA413-5/	O	O	M
6322$_h$	Air filter clocked active	/CiA413-5/	O	O	M
632F$_h$	Transmission neutral switch active	/CiA413-5/	O	M	M
6330$_h$	Transmission reverse direction switch active	/CiA413-5/	O	M	M
6331$_h$	Clutch closed state active	/CiA413-5/	O	O	M
6332$_h$	Clutch open state active	/CiA413-5/	O	O	M
6333$_h$	Transmission low range sense switch active	/CiA413-5/	M	M	M
6334$_h$	Transmission high range sense switch active	/CiA413-5/	M	M	M
6335$_h$	Horn active	/CiA413-5/	M	M	M
6337$_h$	Engine speed control upper limit allowed	/CiA413-5/	O	M	M
6338$_h$	Engine speed control lower limit allowed	/CiA413-5/	O	M	M
6339$_h$	Engine speed control allowed	/CiA413-5/	O	M	M
633A$_h$	Engine torque limit control allowed	/CiA413-5/	O	M	M
633B$_h$	Engine stop allowed	/CiA413-5/	O	M	M
633C$_h$	Requested vehicle speed limit control allowed	/CiA413-5/	O	M	M
6343$_h$	Left parking light(s) active	/CiA413-5/	O	O	M
6344$_h$	Right parking light(s) active	/CiA413-5/	O	O	M
6345$_h$	Left front fog light(s) active	/CiA413-5/	O	O	M
6346$_h$	Right front fog light(s) active	/CiA413-5/	O	O	M
6347$_h$	Remote additional light request	/CiA413-5/	O	O	M
6348$_h$	Remote emergency light request	/CiA413-5/	O	M	M
634A$_h$	Ignition key (KL15) active	/CiA413-5/	O	O	M
634B$_h$	Horn activation request	/CiA413-5/	M	M	M
634C$_h$	Remote central door lock request	/CiA413-5/	O	M	M
634D$_h$	Warning acknowledge button	/CiA413-5/	M	M	M
634E$_h$	High boom light request	/CiA413-5/	M	M	M
634F$_h$	Leg locked warning request	/CiA413-5/	M	M	M
6350$_h$	Blackout truck status	/CiA413-5/	O	O	M
6351$_h$	Blackout truck remote request	/CiA413-5/	O	O	M
6352$_h$	Blackout body status	/CiA413-5/	O	O	M
6353$_h$	Blackout body remote request	/CiA413-5/	O	O	M
6601$_h$	Supported tell tale lights	/CiA413-8/	O	O	M
6602$_h$	Status tell tale lights	/CiA413-8/	O	O	M
6603$_h$	Command tell tale lights	/CiA413-8/	O	O	M
6604$_h$	Supported buzzer sounds	/CiA413-8/	O	O	M
6605$_h$	Status buzzer sounds	/CiA413-8/	O	O	M
6606$_h$	Command buzzer sounds	/CiA413-8/	O	O	M
6607$_h$	Popup configuration	/CiA413-8/	O	O	M
6608$_h$	Popup text	/CiA413-8/	O	O	M
6609$_h$	Status PBG	/CiA413-8/	O	O	M
660A$_h$	Command PBG	/CiA413-8/	O	O	M

Index	Application object name	Reference	Class		
			A	B	C
660B$_h$	Status popup	/CiA413-8/	O	O	M
660C$_h$	Command popup	/CiA413-8/	O	O	M
660D$_h$	Status drivers' acknowledge	/CiA413-8/	O	O	M
660E$_h$	Actual language	/CiA413-8/	O	O	M
6700$_h$	Bit dummy	/CiA413-1/	M	O	O

Annex A – Power plugs and optional truck discrete I/O lines

A.1 General

The truck shall provide power plugs and may provide some discrete I/O lines placed near the CANopen connector if it is present. The power plugs, the optional discrete I/O lines, and the CANopen connector shall be placed in the truck cabin or in a suitable environmental protected box at the back of the cabin or the framework. If placed in the cabin, there should be at least two empty conduits routed to the back of the cabin. Figure A.1 shows the location of the connectors.
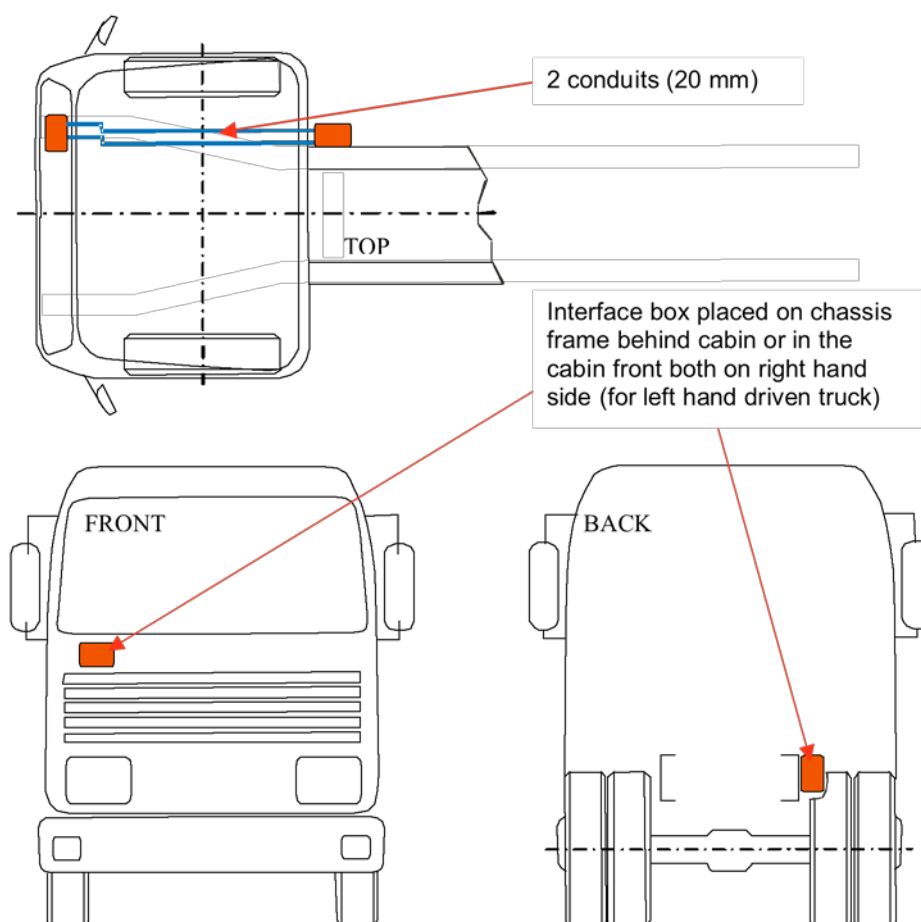

Figure A.1 — Location of connectors (truck top-, front-, and back-view)

A.2 Power plug

The power plug shall provide three power lines:

- Power line 1 shall be PTO engaged and fused with 40 A (optionally with 100 A)
- Power line 2 shall be ignition key engaged and fused with 40 A.
- Power line 3 shall have constant power and fused with 5 A fused.

The power plug pin-assignment is specified in Table A.1

Table A.1 — Electrical power plug pin assignment

Pin	Description
1 *and* 2	Power lines 3
3 *and* 4	Power lines 2
5 *and* 6	Power lines 1
7 *to* 12	Ground lines

A.3   Discrete I/O lines

The plug for discrete I/O lines shall provide high logic, which equals voltage level higher or equal 0,7 x supply voltage (12 V or 24 V) from power plugs. Table A.2 specifies the pin-assignment.

Table A.2 — Discrete I/O line assignment and description

| Pin	Description
1	Input 1: Start engine (same as object $613E_h$) When signal is high, engine is cranked (mandatory)
2	Input 2: Stop engine (same as object $613F_h$) When signal is high, engine is stopped (mandatory)
3 NOTE	Input 3: Engine speed 1 When signal is high, preset speed is set (mandatory)
4 NOTE	Input 4: Engine speed 2 When signal is high, preset speed is set (mandatory)
5	Input 5: Activate high boom warning light (same as object $634E_h$) When signal is high, warning light lamp in cabin is activated (mandatory)
6	Input 6: Active leg not locked warning lamp (same as object ($634F_h$) When signal is high, warning lamp in cabin is activated (mandatory)
7	Input 7: Activate high boom warning / leg not locked buzzer (same as object 6313_h) When signal is high, warning lamp in cabin is activated (mandatory)
8	Output 1: Warning acknowledge button (same as object $634D_h$) When signal is high, button in cabin is pressed (mandatory)
9	Output 2: Parking brake activated indication (same as object 6316_h) When signal is high, parking brake of the truck is engaged (mandatory)
10	Output 3: Engine running (D+) indication (same as object 6134_h) When signal is high, engine is running (mandatory)
11	reserved
12	Input 8: Increase engine speed (or use object $614A_h$) When signal is high, increasing of engine speed is requested (optional)
13	Input 9: Decrease engine speed (or use object $614A_h$) When signal is high, decreasing of engine speed is requested (optional)
NOTE Pin 3 and 4: The actual preset speed is setup by the truck manufacturer; engine speed 1 has the higher priority; when no engine speed commands are given (pin 3 and 4 signals are low), the engine speed equals idle.	

Figure A.2 shows an example of discrete I/O lines plug.
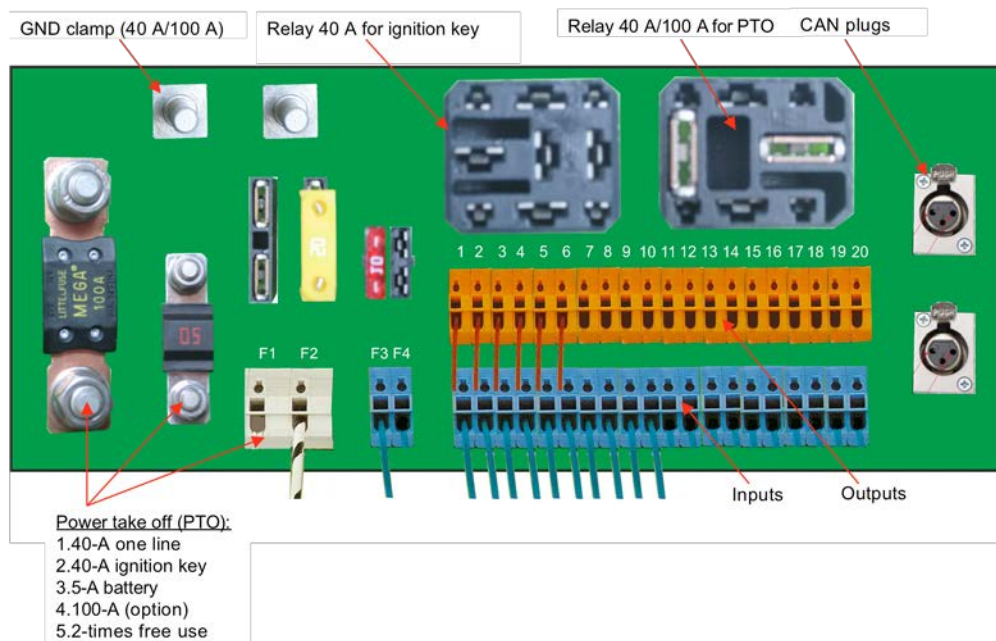
Figure A.2 – Discrete I/O lines plug (example)