Professional Fieldbus Connections

ESEPRO
Profibus gateway for CANopen genset controls
User manual

Edition 1

UMESEPRO-1401

ESEPRO

Profibus gateway for CANopen genset controls: User manual

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Important user information

This manual explains how to install, operate and configure the ESEPRO. This device may only be used for the applications described in this document.

This manual is to be used with ESEPRO firmware version 1.1.

These instructions are intended for use by trained specialists in electrical installation and control and automation engineering, who are familiar with the applicable national standards and safety procedures.

Safety Precautions

ELECTRICAL HAZARD

- This equipment must be installed and serviced only by qualified personnel. Such work should be performed only after reading this entire set of instructions.
- Before performing visual inspections, tests, or maintenance on this equipment, disconnect all sources of electric power. Assume that all circuits are live until they have been completely de-energized, tested, and tagged. Pay particular attention to the design of the power system. Consider all sources of power, including the possibility of backfeeding.
- Apply appropriate personal protective equipment and follow safe electrical practices.
- Turn off all power supplying the equipment in which the ESEPRO is to be installed before installing, wiring or removing the ESEPRO.
- Always use a properly rated voltage sensing device to confirm that power is off.
- The successful operation of this equipment depends upon proper handling, installation, and operation. Neglecting fundamental installation requirements may lead to personal injury as well as damage to electrical equipment or other property.

Failure to follow these instructions could result in death or serious injury!

Document conventions

Throughout this manual we use the following symbols and typefaces to make you aware of safety or other important considerations:

	Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.
	Indicates a potentially hazardous situation that, if not avoided, could result in damage to equipment.
	Indicates information that is critical for successful application and understanding of the product.
	Provides other helpful user information that does not fall in above categories.
	Provides supplemental user information.
Acronym	This typeface is used to introduce acronyms or product names.
`Command`	This typeface is used to represent commands, prompts, input fields and filenames. In the context of programming it is used for functions, variable names, constants or class names.
`Placeholder`	This typeface is used to represent replacable text. Replaceable text is a placeholder for data you have to provide, like filenames or command line arguments.
`User input`	This typeface is used to represent data entered by the user or buttons.
`Screen output`	Screen output or program listing

Chapter 1. Introduction

ESEPRO is a Profibus gateway specifically designed to interface Woodward's Easygen series genset controls with Profibus-DP networks. It interfaces via the CAN bus with the Woodward controls and is easy to configure using standard Profibus configuration tools like Simatic Manager.

A single ESEPRO added to the CAN network will make all Visualisation Data of connected Woodward CANopen controls available without adding additional load to the CAN bus communication. The Visualisation Data is buffered in the ESEPRO gateway which decouples Profibus' cyclic process I/O from the CANopen cyclic TPDO transfers.

The ESEPRO appears as a modular I/O module in the Profibus configuration tool.

The ESEPRO offers three different methods to map data into the PLC's process I/O image to suit different application requirements and programming styles. Visualisation Data of connected Easygen and LS-5 devices can be mapped directly into the PLC's process image. For larger data tables which exceed the Profibus I/O space, an indexed mapping similar to the Profidrive standard can be used. Alternatively access to larger data blocks via acyclic DP-V1 transfers is also possible. In addition, read and write access to the Easygen's device Parameter IDs is possible which are internally translated to CANopen SDO transfers.

Common applications include:

- PLC connection
- Operator panel interfacing
- HMIs

- SCADA integration
- Power station automation
- Gen set control
- Remote control & monitoring
- Data logging

Features

The ESEPRO gateway provides the following key features:

- Supports Easygen-3000 Series (3500, 3400, 3200, 3100)
- Supports Easygen-2000 Series
- Supports Easygen-1000 Series
- Supports LS-5
- Supports DTSC-200
- Addresses up to 8 Woodward controls
- Easy configuration using Simatic Manager
- Direct mapping of data into process I/O
- Fast indexed access to Basic Visualisation Data table
- Acyclic DP-V1 functions to read and write Remote Control words
- Acyclic DP-V1 access to larger data blocks
- Reading and Writing of device parameters
- Internal buffer for Visualisation Data
- Transparent handling of data guarantees future compatibility
- Firmware upgradable via Ethernet bootloader

Quick start checklist

- Read this set of instructions properly and in its entirety.
- Mount the unit.
- Wire Profibus plug.
- Wire CAN bus plug.
- Connect the power.
- Configure the device with a Profibus configuration tool.

Chapter 2. Description

The power terminals and CAN bus connector are placed on the top side of the unit. The Profibus connector and Ethernet jack are placed on the bottom side of the unit as shown in the following illustration:

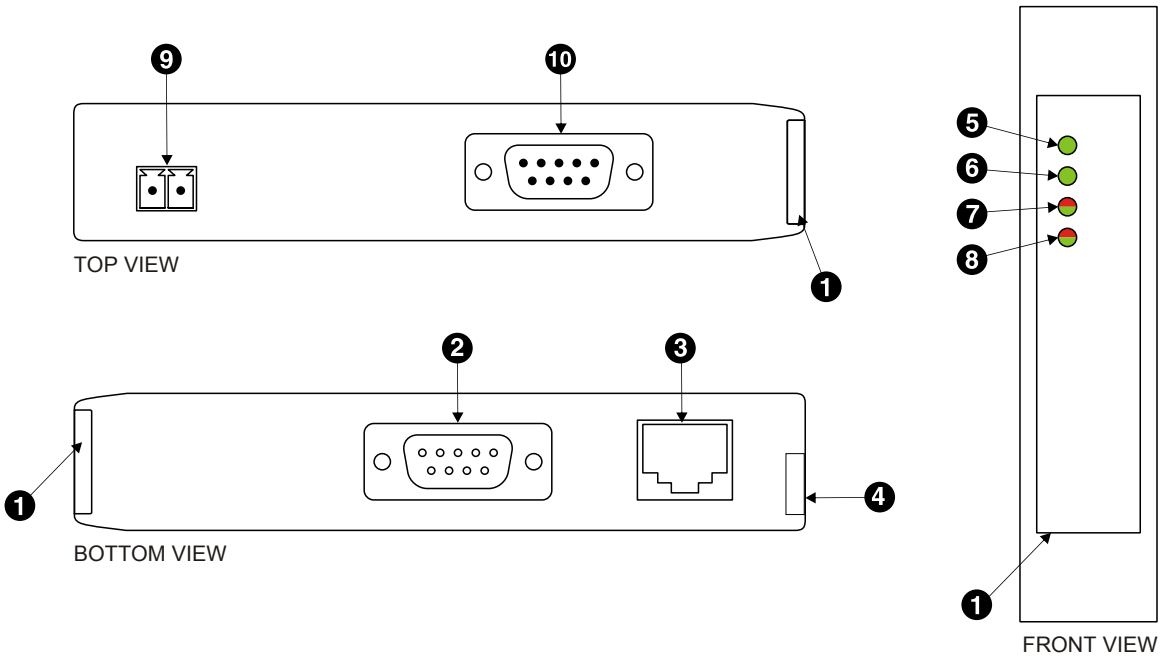


Figure 2.1: Location of connectors

1. Clear front cover
2. Profibus connector
3. Ethernet jack
4. DIN rail clip
5. Power LED
6. Ethernet link LED
7. Device status LED
8. Communication status LED
9. Power terminals
10. CAN bus connector

LED indicators

Four LEDs located at the front panel indicate the status of the ESEPRO. The LEDs assist maintenance personnel in quickly identifying wiring or communication errors.

A LED test is exercised at power-up, cycling each LED off, green and then red for approximately 0.25 seconds. At the same time the power-on self test of the device is performed.

The following table outlines the indicator condition and the corresponding status after the power-on self-test has been completed:

LED	Function	Condition	Indication
Power	Power	Off	No power applied to the device.
		Green	Power supply OK
Link	Ethernet link	Off	No Ethernet link
		Green	Ethernet link OK
Status1	Device status	Off	The device has an unrecoverable fault; may need replacing.
		Flashing green at 1 s rate	Device operational but needs commissioning due to configuration missing, incomplete or incorrect.
		Green	The device is operating in normal condition.
		Flashing red at 1 s rate	Device operational but has a fault listed which requires acknowledgment.
		Red	The device has an unrecoverable fault; may need replacing. Flashing sequence and rate of Status2 LED indicates fault class.
Status2	Network status	Flashing red at 1 s rate	No CAN comms and not in DP Data_Exch state
		Off	CAN comms OK, but not in DP Data_Exch state
		Flashing red/green at 1 s rate	No CAN comms but in DP Data_Exch state
		Green	CAN comms OK and in DP Data_Exch state

Table 2.1: LED diagnostic codes

Chapter 3. Installation

Regulatory notes

1. The ESEPRO is suitable for use in non-hazardous locations only.
2. The ESEPRO is not authorized for use in life support devices or systems.
3. Wiring and installation must be in accordance with applicable electrical codes in accordance with the authority having jurisdiction.
4. This is a Class A device and intended for commercial or industrial use. This equipment may cause radio interference if used in a residential area; in this case it is the operator's responsibility to take appropriate measures.
5. The precondition for compliance with EMC limit values is strict adherence to the guidelines specified in this set of instructions. This applies in particular to the area of grounding and shielding of cables.

FCC Notice (USA only)

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Industry Canada Notice (Canada only)

This Class A digital apparatus complies with Canadian ICES-003.

Unpacking, handling and storage

1. Please read this set of instructions. carefully before fitting it into your system.
2. Keep all original packaging material for future storage or warranty shipments of the unit.
3. Do not exceed the specified temperatures.

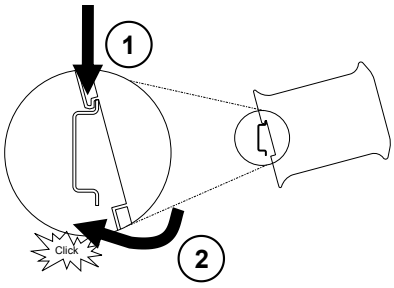
Before connecting anything

1. Before installing or removing the unit or any connector, ensure that the system power and external supplies have been turned off.

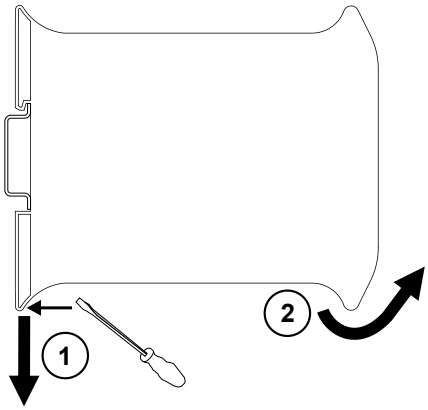
2. Check the system supply voltage with a multimeter for correct voltage range and polarity.
3. Connect the power supply cable and switch on the system power. Check if the Power LED is lit.
4. Turn off system power.
5. Connect all I/O cables.
6. Once you are certain that all connections have been made properly, restore the power.

DIN rail mounting and removal

The ESEPRO gateway is designed to be mounted on a 35 mm DIN rail according to DIN/EN 50022. The enclosure features a 35 mm profile at the back which snaps into the DIN rail. No tools are required for mounting. Please observe the rules outlined in the section called “Mounting rules”.



To mount the unit on a DIN rail, slot the top part of the ESEPRO into the upper guide of the rail and lower the enclosure until the bottom of the red hook clicks into place.



To remove the ESEPRO from the DIN rail, use a screw driver as a lever by inserting it in the small slot of the red hook and push the red hook downwards. Then remove the unit from the rail by raising the bottom front edge of the enclosure.

Mounting rules

The enclosure provides protection against solid objects according to IP 20 / NEMA Type 1 protection rating. When mounting the unit observe the following rules:

- No water splash and water drops

- No aggressive gas, steam or liquids
- Avoid dusty environments.
- Avoid shock or vibration
- Do not exceed the specified operational temperatures and humidity range.
- Mount inside an electrical switchboard or control cabinet.
- Make sure there is sufficient air ventilation and clearance to other devices mounted next to the unit.
- Observe applicable local regulations like EN60204 / VDE0113.

Powering the ESEPRO

Before connecting power please follow the rules in the section called “Safety Precautions” and the section called “Before connecting anything”.

Power is supplied via a 3.81 mm 2-pin pluggable terminal block located at the top side of the mounted unit (refer to Figure 2.1, “Location of connectors”). The following table and picture shows the power terminal socket pinout:

Pin	Signal	Function
1	V+	Positive voltage supply (10 - 30 V DC)
2	V-	Negative voltage supply, DC power return

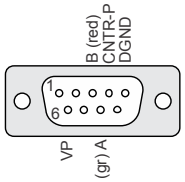
Table 3.1: Power supply connector pinout

Make sure that the polarity of the supply voltage is correct before connecting any device to the CAN port! A wrong polarity can cause high currents on the ground plane between the V- power supply pin and the ground pins of the non-isolated CAN port, which can cause damage to the device.

Wiring the Profibus interface

The Profibus interface connects the ESEPRO to a Profibus-DP master station.

The Profibus connector is a female 9-pin D-sub type, located at the bottom side of the mounted unit. It has Profibus standard IEC 61158-2 pinout as shown in the following table and picture:



Pin	Signal	Function
1	NC	
2	NC	
3	RxD/TxD-P	Non-inverting transceiver terminal, line B (red)
4	CNTR-P	Control of repeater direction
5	DGND	Signal ground (isolated)
6	VP	Power supply +5 V (for bus termination)
7	NC	
8	RxD/TxD-N	Inverting transceiver terminal, line A (green)
9	NC	
	SHIELD	Shield

Table 3.2: Profibus connector pinout

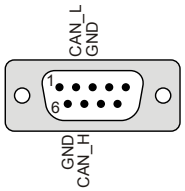
Wiring and installation must be carried out as specified in "Installation Guideline for PROFIBUS-DP/FMS", Order No 2.112 published by PROFIBUS & PROFINET International (PI) [PIG98].

- Use an appropriate shielded twisted pair cable which conforms with Profibus Type A classification as per EN 50170.
- Use a Profibus connector plug to connect to the RS-485 segment.
- Line termination at both ends of the RS-485 bus segment is required and is best accomplished using a Profibus connector plug with activated integrated termination.
- Maximum number of RS-485 nodes in one bus segment is 32. Bus segments can be interconnected using RS-485 repeaters.
- In order for the cable shield to be effective at high frequencies the shield must be connected to chassis ground at both ends low inductively. In cases were there is a concern of ground currents passing along the cable shield, capacative grounding at one of the ends may be an option or an additional potential equalisation cable may be required.

Wiring the CAN interface

The CAN interface connects the ESEPRO to the Woodward CANopen based controls.

The CAN bus connector is a male 9-pin D-sub type located at the top side of the mounted unit (refer to Figure 2.1, "Location of connectors"). It has industry standard CiA DS-102 pinout as shown in the following table and picture:



Pin	Signal	Function
1	NC	
2	CAN_L	CAN_L bus line
3	CAN_GND	CAN ground
4	NC	
5	NC	
6	CAN_GND	CAN ground
7	CAN_H	CAN_H bus line
8	NC	
9	NC	

Table 3.3: CAN bus connector pinout

- The network must be terminated at both ends with its characteristic impedance, typically a 120 Ohm 1/4 W resistor.
- Maximum number of electrically connected CAN nodes is 64 [1].
- Maximum CAN bus cable length is 250 m (820 ft) and is derated depending on bit rates and cable type.
- Stub connections off the main line should be avoided if possible or at least be kept as short as possible. Stub connections must not have terminating resistors.
- To ensure a high degree of electromagnetic compatibility and surge protection the cable should be twisted pairs and shielded. An additional cable conductor or pair may be used for the CAN_GND reference.

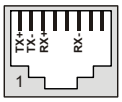
Do *not* connect the cable shield to the CAN_GND pins or the connector shell! Use an external *chassis ground* connection to terminate the shield.

Connecting Ethernet

The ESEPRO is equipped with an Ethernet interface for diagnostic and maintenance purposes. The Ethernet interface is not used in normal operation. The default IP address is `169.254.0.10`.

[1] The number of logically adressable units may be less.

The following table describes the 10BASE-T Ethernet RJ-45 connector pinout:



Pin	Signal	Function
1	TX+	Non-inverting transmit signal
2	TX-	Inverting transmit signal
3	RX+	Non-inverting receive signal
4		Internal termination network
5		Internal termination network
6	RX-	Inverting receive signal
7		Internal termination network
8		Internal termination network

Table 3.4: Ethernet connector pinout

- We recommend to use Category 5 UTP network cable.
- Maximum cable length is 100 m (3000 ft).

Chapter 4. Profibus configuration

The ESEPRO gateway is configured using a Profibus configuration tool like Simatic Step 7's *HW Config*. The required GSD file PR0X0EAB.GSD can be downloaded from http://www.proconx.com/esepro/gsd

Install the GSD file according to the requirements of your Profibus configuration tool. After successful installation the ESEPRO is listed under the device family *Gateway/CANopen* and can be added as a node into the master's Profibus network as shown below:

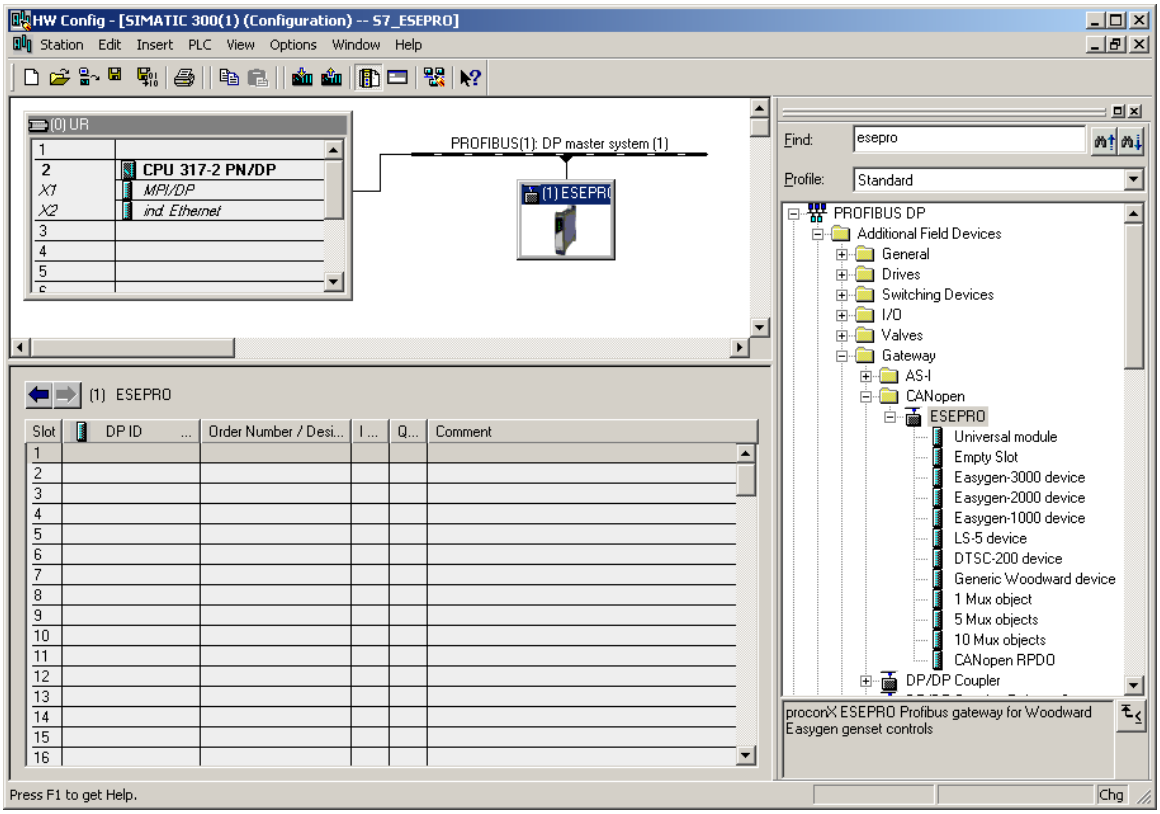


Figure 4.1: Commissioning the ESEPRO using Simatic Step 7's HW Config tool

The Profibus station address of the ESEPRO is configured via Profibus using your Profibus configuration tool. For example in Simatic Step 7 it is assigned from the menu **PLC→PROFIBUS→Assign PROFIBUS Address...** using the following dialog:

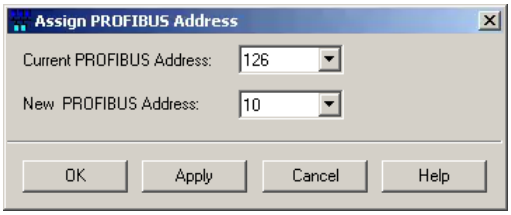


Figure 4.2: Assigning station address using Step 7's HW Config tool

The default Profibus station address of an uncommissioned ESEPRO device is 126. Once configured, the Profibus station address is stored in non-volatile memory. The station address can be checked using the Ethernet diagnostic interface.

There is no baud rate setting, the baud rate is detected automatically and matched to the baud rate of the master station.

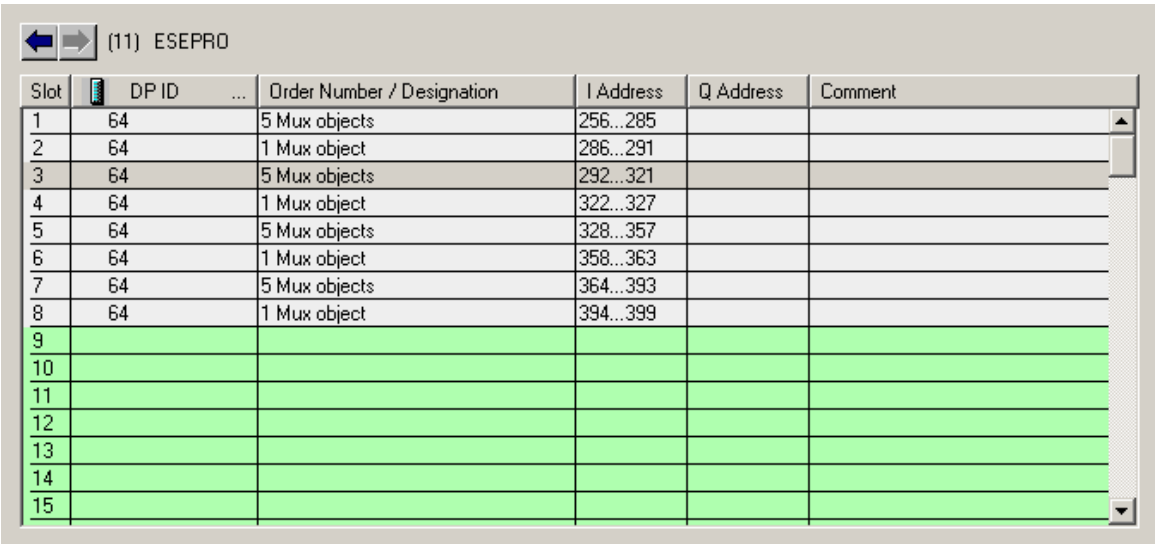
Mapping of Woodward devices into the process I/O

The ESEPRO gateway is a modular Profibus slave device which is organised into virtual modules. Different type of virtual modules can be configured. Each of the types facilitate different methods of data transport.

Direct mapping

The ESEPRO does support direct mapping of Data Protocol Mux objects into the process I/O. Mux objects in a Woodward device are organised in word triplets (3 × 16-bit) which are identified by a Mux number (refer to chapter *Interfaces And Protocols*, section *CANopen Protocols* of your Woodward device manual). All Woodward CANopen devices do list the available Mux numbers in the *Data Protocols* section of their respective manual.

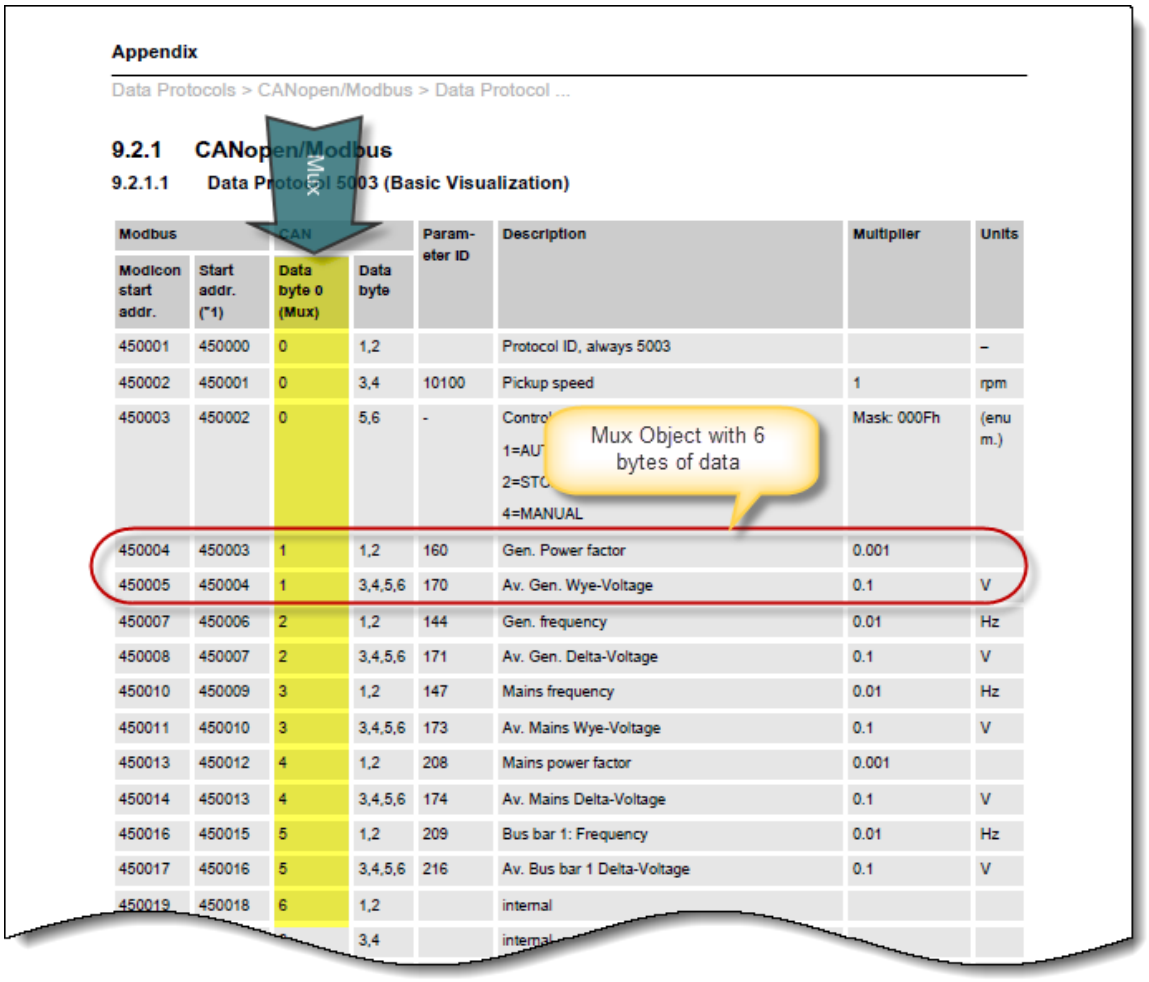
To map data directly into the process I/O space of the Profibus master, a Mux Object module has to be inserted into a slot. The GSD file defines a selection of Mux object modules with different data lengths to allow insertion of a single Mux object or multiple consequtive Mux objects. A Mux object consumes 6 input bytes.



Slot	DP ID ...	Order Number / Designation	I Address	Q Address	Comment
1	64	5 Mux objects	256...285		
2	64	1 Mux object	286...291		
3	64	5 Mux objects	292...321		
4	64	1 Mux object	322...327		
5	64	5 Mux objects	328...357		
6	64	1 Mux object	358...363		
7	64	5 Mux objects	364...393		
8	64	1 Mux object	394...399		
9					
10					
11					
12					
13					
14					
15					

Figure 4.3: Example configuration of direct mapping with 4 Easygens using 6 Mux objects each

The following example shows how to identify the object with Mux number 1 which contains the 16-bit value "Gen. Power Factor" and the 32-bit value "Av. Gen. Wye-Voltage".



Appendix

Data Protocols > CANopen/Modbus > Data Protocol ...

9.2.1 CANopen/Modbus

9.2.1.1 Data Protocol 5003 (Basic Visualization)

Mux

Modbus		CAN		Param-eter ID	Description	Multiplier	Units
Modicon start addr.	Start addr. (*1)	Data byte 0 (Mux)	Data byte				
450001	450000	0	1,2		Protocol ID, always 5003		–
450002	450001	0	3,4	10100	Pickup speed	1	rpm
450003	450002	0	5,6	-	Control 1=AU 2=STO 4=MANUAL	Mask: 000Fh	(enum.)
450004	450003	1	1,2	160	Gen. Power factor	0.001	
450005	450004	1	3,4,5,6	170	Av. Gen. Wye-Voltage	0.1	V
450007	450006	2	1,2	144	Gen. frequency	0.01	Hz
450008	450007	2	3,4,5,6	171	Av. Gen. Delta-Voltage	0.1	V
450010	450009	3	1,2	147	Mains frequency	0.01	Hz
450011	450010	3	3,4,5,6	173	Av. Mains Wye-Voltage	0.1	V
450013	450012	4	1,2	208	Mains power factor	0.001	
450014	450013	4	3,4,5,6	174	Av. Mains Delta-Voltage	0.1	V
450016	450015	5	1,2	209	Bus bar 1: Frequency	0.01	Hz
450017	450016	5	3,4,5,6	216	Av. Bus bar 1 Delta-Voltage	0.1	V
450019	450018	6	1,2		internal		
			3,4		internal		

Mux Object with 6 bytes of data

Figure 4.4: Data Protocols from Easygen-3500 manual

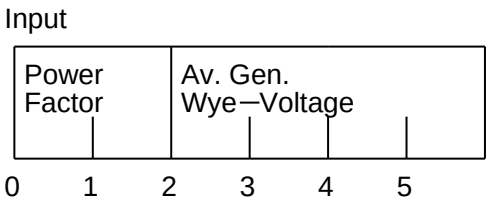


Figure 4.5: Example how the Easygen-3000 Mux object 1 maps into the PLC iput area

Once a Mux object module is inserted, it has to be parametrized with a *COB-ID* and the *Mux* number. The COB-ID links the Mux object to a Woodward device's TPDO channel. The *Mux* value defines the which entry of the Data Protocol is to be mapped. In case of multiple Mux objects it defines the start entry of the array of Mux objects to be mapped.

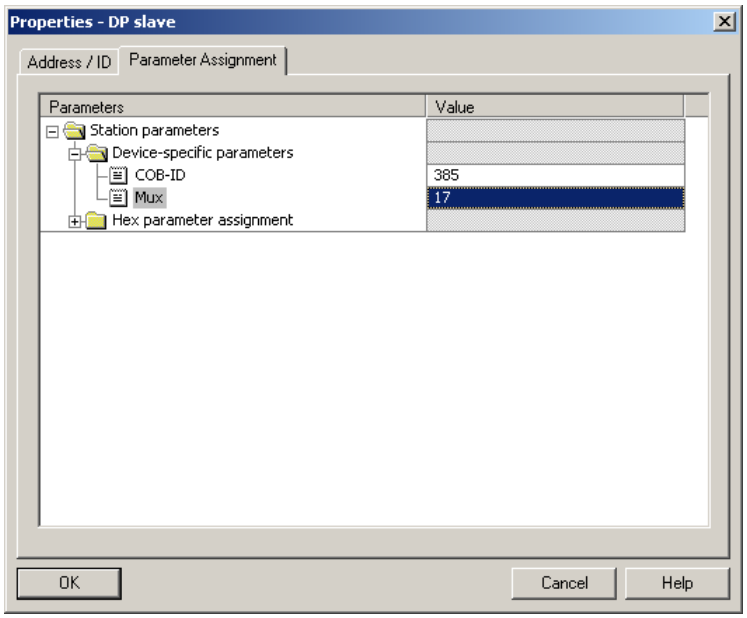


Figure 4.6: Parameter assignment of a Mux object module

The following module parameters can be configured:

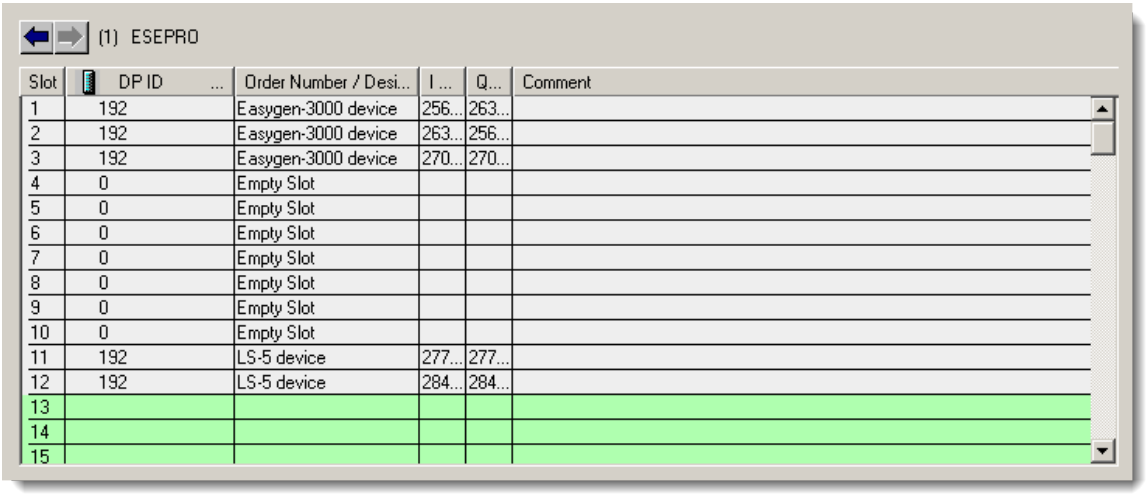
COB-ID	COB-ID of the TPDO which transmits the Data Protocol
Mux	Data Protocol Mux number (Data byte 0) of object to be mapped

The I/O space of Profibus-DP is limited to 244 bytes and compared to the large amount of data available in a Woodward control only a relativley small number of data values can be mapped directly into the I/O space. Larger amount of data can be accessed via DP-V1 transfers or using indexed access which is described in the next section.

Indexed mapping

In a typical installation for each connected Woodward control a device module is added to the process I/O. A device module consumes 7 bytes in the process I/O space and facilitates CANopen TPDO and SDO communciation between the Woodward control and the Profibus master station. A device module allows access to data via cyclic DP-V0 communication and also via acyclic DP-V1 communication. Access to data is performed in an indexed manner.

Once a device module is inserted into a slot it is automatically linked to the Woodward device with the Node-ID matching the slot number. It is therefore recommended to insert Easygen #1 into slot 1, Easygen #2 into slot 2 and so forth. Automatic linking makes configuration much faster and your module layout matches the structure of your CANopen network.


(1) ESEPRO

Slot	DP ID	...	Order Number / Desi...	I ...	Q...	Comment
1	192		Easygen-3000 device	256...	263...	
2	192		Easygen-3000 device	263...	256...	
3	192		Easygen-3000 device	270...	270...	
4	0		Empty Slot			
5	0		Empty Slot			
6	0		Empty Slot			
7	0		Empty Slot			
8	0		Empty Slot			
9	0		Empty Slot			
10	0		Empty Slot			
11	192		LS-5 device	277...	277...	
12	192		LS-5 device	284...	284...	
13						
14						
15						

Figure 4.7: Example configuration with 3 Easygens (Node-ID 1, 2 and 3) and 2 LS-5 (Node-ID 11 and 12)

There are however applications where automatic linking is not practical and the link to a particluar Woodward device can be set using the following module parameters:

`Node-ID`	CANopen Node-ID of the Woodward device. Leave at 0 for automatic linking based on slot number.
`COB-ID`	COB-ID of the TPDO which transmits the Data Protocol. Leave at 0 for automatic linking based on slot number.

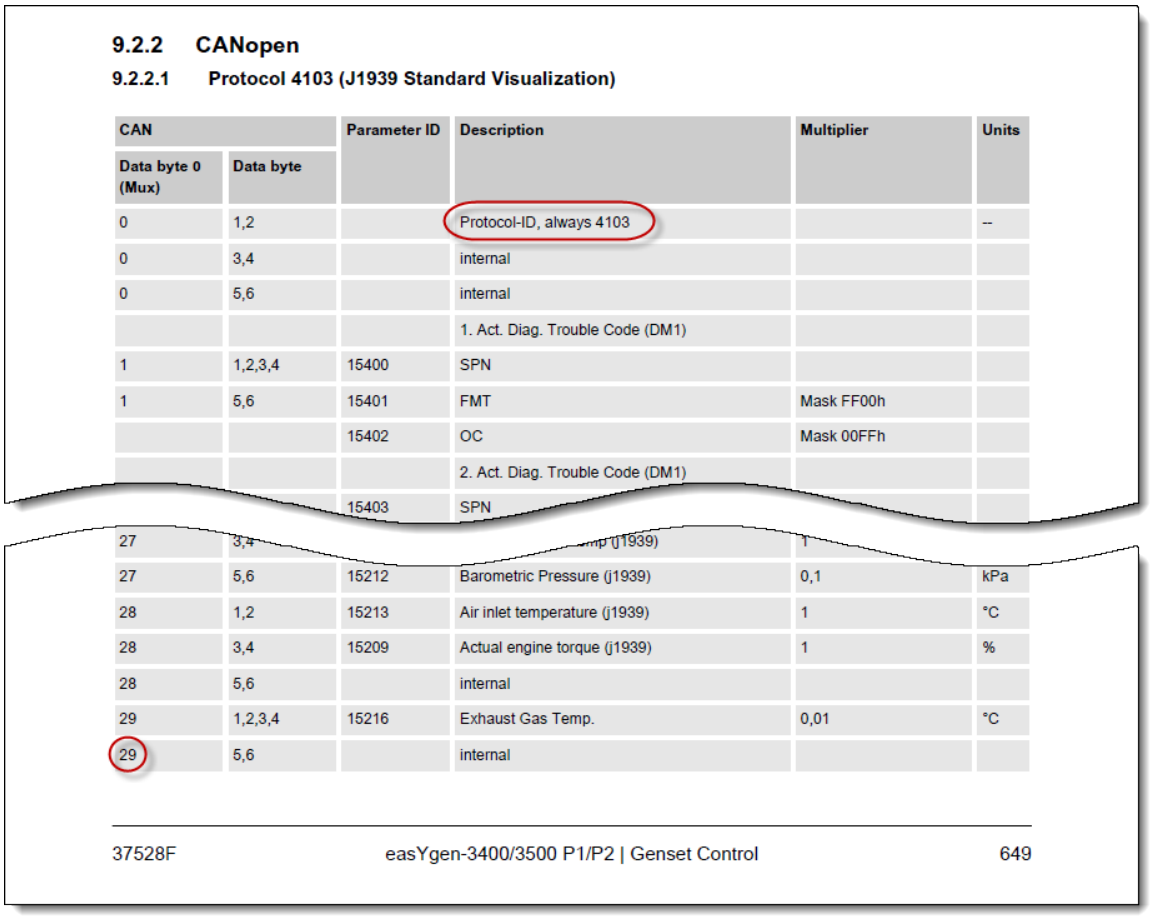
Generic Woodward device module

In addition to the standard device modules for Easygens, LS-5 and DTSC-200, the GSD file defines a generic device module which can be used to add non-standard Data Protocols or other Woodward devices for which no specific module exists. The following module parameters have to be configured:

`Node-ID`	CANopen Node-ID of the Woodward device.
`COB-ID`	COB-ID of the TPDO which transmits the Data Protocol.
`Number of Mux objects`	Configure the number of Mux objects this device is publishing. The Easygen-3000 for example publishes 90 Mux objects for Data Protocol 5003 and 30 Mux objects for Data Protocol 4103.
`Protocol ID`	Protocol ID of the transmitted Data Protocol

Example for Data Protocol 4103 (J1939 Standard Visualization)

To access Data Protocol 4103 (*J1939 Standard Visualization*), first look up its documentation in the Easygen-3000 Series manual and extract the *Protocol ID* and the *Number of Mux objects* this protocol is publishing from the table:



9.2.2 CANopen

9.2.2.1 Protocol 4103 (J1939 Standard Visualization)

CAN		Parameter ID	Description	Multiplier	Units
Data byte 0 (Mux)	Data byte				
0	1,2		Protocol-ID, always 4103		--
0	3,4		internal		
0	5,6		internal		
			1. Act. Diag. Trouble Code (DM1)		
1	1,2,3,4	15400	SPN		
1	5,6	15401	FMT	Mask FF00h	
		15402	OC	Mask 00FFh	
			2. Act. Diag. Trouble Code (DM1)		
		15403	SPN		
27	3,4		mp (j1939)	1	
27	5,6	15212	Barometric Pressure (j1939)	0,1	kPa
28	1,2	15213	Air inlet temperature (j1939)	1	°C
28	3,4	15209	Actual engine torque (j1939)	1	%
28	5,6		internal		
29	1,2,3,4	15216	Exhaust Gas Temp.	0,01	°C
29	5,6		internal		

37528F easYgen-3400/3500 P1/P2 | Genset Control 649

Figure 4.8: Extract from Easygen manual with Data Protocol 4103 J1939 Standard Visualization

Use Woodward's ToolKit to configure a second TPDO in the Easygen with protocol 4103 and set it to a unique COB-ID within the range 432 - 511 as shown below:

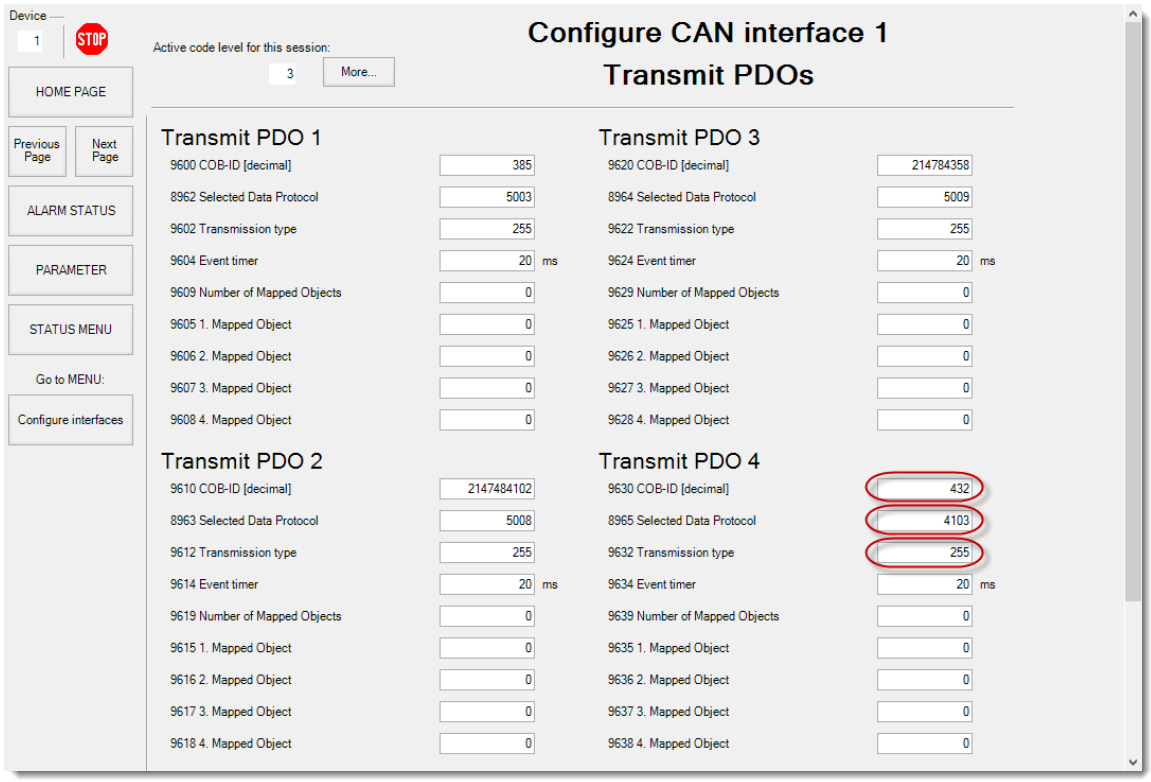


Figure 4.9: J1939 Data Protocol TPDO configuration with Woodward ToolKit

Then add a *Generic Woodward device* module with the following parameter assignment to your Profibus configuration:

`Node-ID` = Parameter *8950 Node-ID* of the Easygen
`COB-ID` = 432
`Protocol ID` = 4103
`Number of Mux objects` = 30 (add 1 to the highest Mux ID of this Data Protocol)

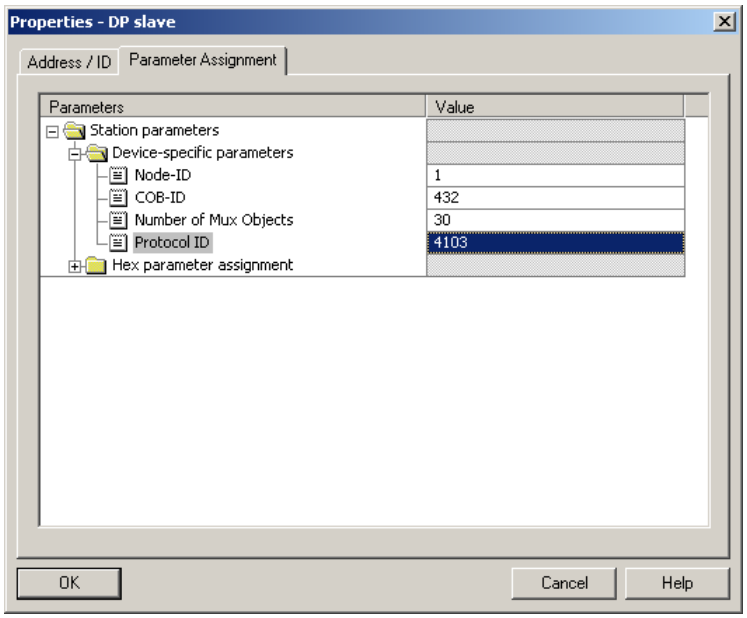


Figure 4.10: Parameter assignment for a Generic Woodward device module to access Easygen's J1939 Standard Visualization data protocol

RPDO Profile

In addition to Data Protocols it is also possible for a Woodward device to publish individual parameter IDs using TPDOs. All Woodward CANopen devices offer multiple TPDO (Transmit PDO) channels. While the first TPDO channel is typically used for the Mux based visualisation data, the remaining TPDO channels can be configured application specific. The ESEPRO gateway supports reading application specific PDO messages using the *RPDO* module.

Configuration of Woodward device

The following parameters have to be set at the Woodward control:

COB-ID	Set to unique COB-ID within the range of 432 ($1B0_{hex}$) to 511 ($1FF_{hex}$).
Transmission type	Set to 255 for *cyclic*
Event timer	Set to desired update rate, for example 1000 ms
Selected data protocol	Must be 0
Number of Mapped Objects	1 - 4
1. Mapped Object	Parameter ID of data item
2. Mapped Object	Parameter ID of data item
3. Mapped Object	Parameter ID of data item
4. Mapped Object	Parameter ID of data item

Configuration of ESEPRO device

The RPDO module parameters must be set to match the settings made on the Woodward device.

`COB-ID`	Configure the COB-ID to match the TPDO. Must be in the range of 432 ($1B0_{hex}$) to 511 ($1FF_{hex}$).

Chapter 5. Profibus operation

Organisation of the data in Woodward CANopen devices

Data in Woodward CANopen devices is accessible to external devices either as single parameter value or as block data part of a Data Protocol.

The technical method how these two classes of data is transported is quite different.

Retrieving single parameter values involves acyclic CANopen SDO transfers. Accessing Data Protocol values is based on cyclic CANopen TPDO publishing.

The SDO transfer method is used mainly for Configuration and Remote Control. The TPDO message method is used to publish a selected list of Visualisation Data Protocols identified by a Protocol ID.

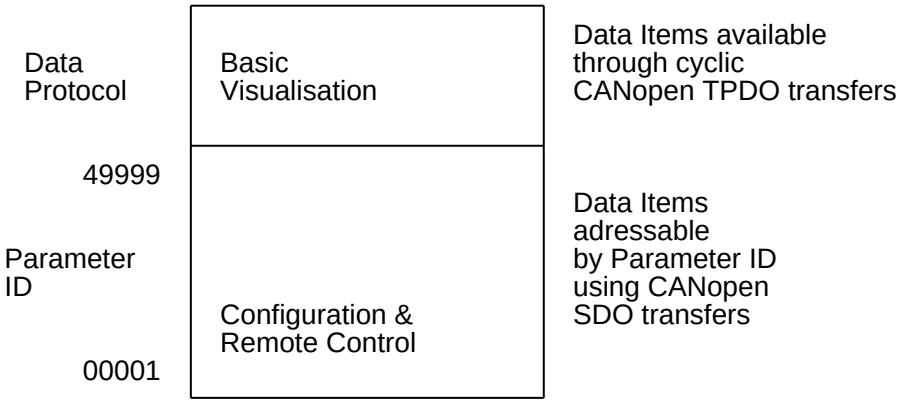


Figure 5.1: Organisation of data in Woodward controls

Processing Data Protocol data through the ESEPRO gateway is more efficient and faster than using single parameter values because Data Protocol data is internally buffered and instantly available.

All Woodward CANopen devices offer several Data Protocols which can be published via CANopen. The Basic Visualisation data protocol is usually configured as default data protocol.

The following table lists the most commonly used Data Protocols:

Woodward CAN device	Data protocol	Topic
Easygen-3000 series	5003 [a]	Basic Visualisation
Easygen-3000 series	4103	J1939 Standard Visualization
Easygen-3000 series	4104	J1939 Scania S6 Visualization
Easygen-3000 series	4105	J1939 Deutz EMR2 Visualization
Easygen-3000 series	4110	J1939 MTU ADEC Visualization
Easygen-3000 series	5004	Generator Values Visualization
Easygen-3000 series	5005	Mains Values Visualization
Easygen-3000 series	5011	Alarm Values Visualization
LS-5	5103	Basic Visualisation
LS-5	6003	LS-5 Communication
Easygen-1000 series	4000 or 4003	
Easygen-2000 series	5100 or 5101	
DTSC-200	4700 or 4701	
	65000	IKD 1 - external DIs/DOs 1 through 8
	65001	IKD 1 - external DIs/DOs 9 through 16
	65002	IKD 1 - external DIs/DOs 17 through 24
	65003	IKD 1 - external DIs/DOs 25 through 32

[a] Enabled by default

Table 5.1: CANopen Data Protocols

For a Data Protocol to be available through the ESEPRO gateway, it must be enabled in the TPDO configuration of the Woodward CANopen device.

Addressing of Woodward CANopen devices

The individual Woodward devices on the CAN bus are identified by two different means. Firstly each Woodward CANopen device is identified by a CANopen Node-ID. The Node-ID is used for single parameter value SDO transfers. The Data Protocol values are associated to a particular Woodward CANopen device using a TPDO COB-ID rather the CANopen Node-ID. So it is important to have both a unique Node-ID and a unique TPDO COB-ID configured for each device.

Methods of data transfer

The Profibus-DP standard offers two different methods of data transfer. Cyclic Data Transfer of up to 244 bytes per Profibus-DP Slave device and Acyclic Data Transfer for bulk data which are transferred in blocks of up to 240 bytes.

The Easygen and LS-5 devices offer a large catalogue of process data which exceeds the cyclic transfer limit of 244 bytes.

To overcome this limitation the ESEPRO offers two distinct data transfer methods:

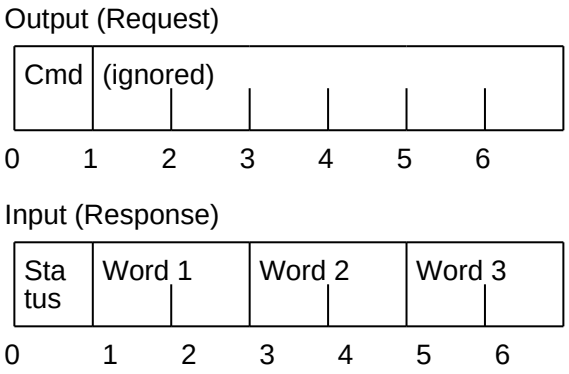
- Profile style transfers using a small 7 byte request/reply buffer in the process I/O area and
- DP-V1 transfers using acyclic communication services.

DP-V0 indexed data mapping

The method of using indexed data mapping is similar to the method used by the Profidrive standard. A small 7-byte buffer area is defined in the process I/O area. The PLC then selects a data item to be transferred by putting a command and an ID number into the output buffer and then polls an input buffer until the queried data item has been received.

This method has the advantage that it can be used with DP-V0 masters as no DP-V1 capabilities are required. The programming effort is also quite minimal.

Read Mux object



`Cmd`	Set to the identifier of the Mux object to be read
`Status`	If in range from 0 to 99 indicates the Mux identifier corresponding to the three input words. 255 indicates a PDO communication time-out.
`Word 1`	Data byte 1,2 of Mux values
`Word 2`	Data byte 3,4 of Mux values
`Word 3`	Data byte 5,6 of Mux values

Example

We like to read the three generator currents of the Easygen-3500. The generator currents are contained in Mux objects 11, 12 and 13 of data protocol 5003 as shown below:

450029	450028				...rent		
450031	450030	10			Analog input 3	changeable	
450032	450031	10	3,4,5,6	159	Calculated ground current	0.001	A
450034	450033	11	1,2	10117	Analog input 4, P2	changeable	
450035	450034	11	3,4,5,6	111	Gen. current 1	0.001	A
450037	450036	12	1,2	10151	Analog input 5, P2	changeable	
450038	450037	12	3,4,5,6	112	Gen. current 2	0.001	A
450040	450039	13	1,2	10152	Analog input 6, P2	changeable	

Modbus		CAN		Param-eter ID	Description	Multiplier	Units
Modicon start addr.	Start addr. (*1)	Data byte 0 (Mux)	Data byte				
450041	450040	13	3,4,5,6	113	Gen. current 3	0.001	A
450043	450042	14	1,2	10153	Analog input 7, P2	changeable	
450044	450043	14	3,4,5,6	134	Mains current L1	0.001	A
450046	450045	15	1,2	10154	Analog input 8, P2	changeable	
			3,4		inter...		

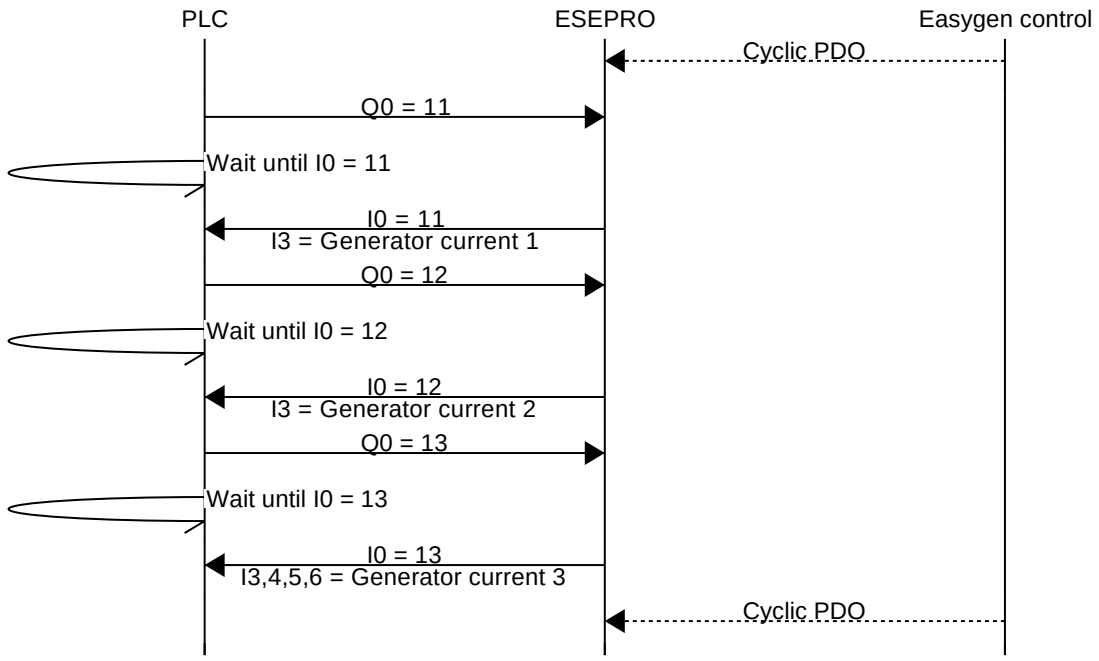
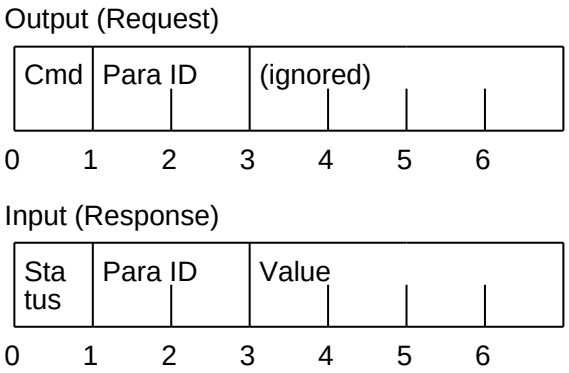


Figure 5.2: Message sequence chart for reading the three generator currents

Read parameter



`Cmd`	240
`Para ID`	Parameter ID
`Status`	241 = 8-bit parameter value received 242 = 16-bit parameter value received 244 = 32-bit parameter value received 245 = SDO transfer in progress 248 = Woodward device returned an SDO error code 249 = SDO response time-out error 255 = PDO communication time-out error
`Value`	Parameter value if `Status` is 241, 242 or 244. Length is `Status` minus 240.

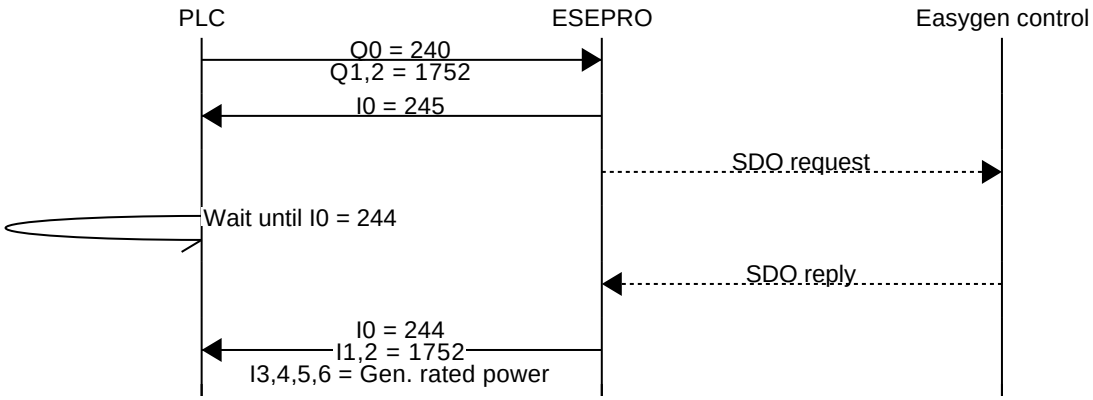


Figure 5.3: Message sequence chart for reading parameter ID 1752 "Gen. rated active power"

Write parameter

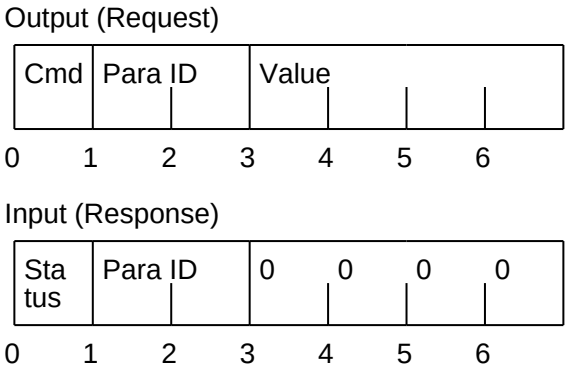


Figure 5.4: Layout of process I/O image for writing Parameters

`Cmd`	241 = Write 8-bit parmater value 242 = Write 16-bit parmater value 244 = Write 32-bit parmater value
`Para ID`	Parameter ID
`Value`	Parameter value to be transferred. Length is determined by `Cmd` byte.
`Status`	240 = Parameter value transmitted successfully 245 = SDO transfer in progress 248 = Woodward device returned an SDO error code 249 = SDO response time-out error 255 = PDO communication time-out error

Unless the Parameter ID is in the remote control range from 500 to 599 a CAN Interface password with the appropriate code level must be set before the parameter change is accepted by the Woodward control.

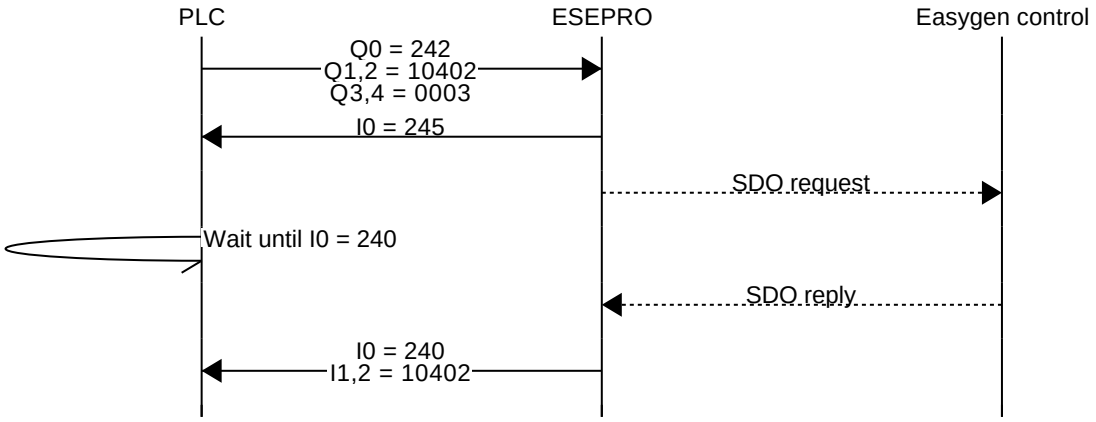


Figure 5.5: Message sequence chart for writing parameter ID 10402 "Password for CAN Interface 1"

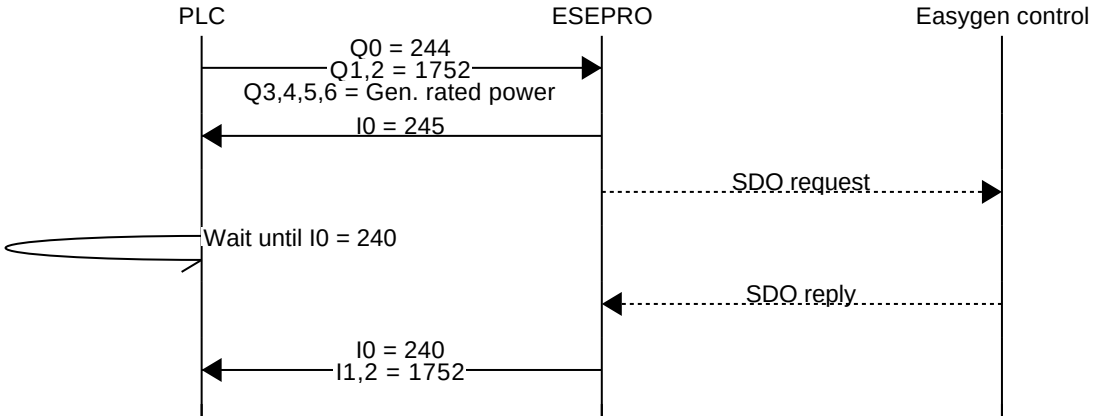


Figure 5.6: Message sequence chart for writing parameter ID 1752 "Gen. rated active power"

DP-V1 functions

The ESEPRO supports the following services for acyclic communication in the Profibus DP network:

- Communication between class 1 master and slave (MS1):
  - Data acyclic reading (DS_Read)
  - Data acyclic writing (DS_Write)

- Communication between class 2 master and slave (MS2):
  - Initiates the connection (Initiate)
  - Data acyclic reading (DS_Read)
  - Data acyclic writing (DS_Write)
  - Aborts the connection (Abort)

The Profibus DP-V1 DP_READ function can be used to read larger blocks of data. In addition Remote Control words can be written and read using DP_WRITE and DP_READ.

Writing/reading data with STEP 7

You can access the ESEPRO data sets via the user program.

- Reading Visualisation data, Remote Control words and Parameter:
  - S7 master: By calling up SFC 59 "RD_REC"
  - S7-DPV1 master: By calling up SFB 52 "RDREC" or SFC 59 "RD_REC"

- Writing Remote Control words:
  - S7 master: By calling up SFC 58 "WR_REC"
  - S7-DPV1 master: By calling up SFB 53 "WRREC" or SFC 58 "WR_REC"

Read MUX objects

DP-V1 Service	$5F_{hex}$ DP_Read
In	
Slot	1-127, slot number of a device module
Index	0-99, set to MUX Byte of first MUX object to read
Length	6-240, set to number of MUX ojects expected to be read x 6
Out	
Length	6-240, length of MUX array actually read in bytes
Data	Variable size record holding the read MUX objects

Read Remote Control word

DP-V1 Service	$5F_{hex}$ DP_Read
In	
Slot	1-127, slot number of a device module
Index	100-199, set index to Remote Control Word ID minus 400
Length	2 or 4, set to size of Remote Control Word which can be either 2 or 4 bytes
Out	
Length	2 or 4, length of the read result in bytes
Data	Variable size field holding the read result

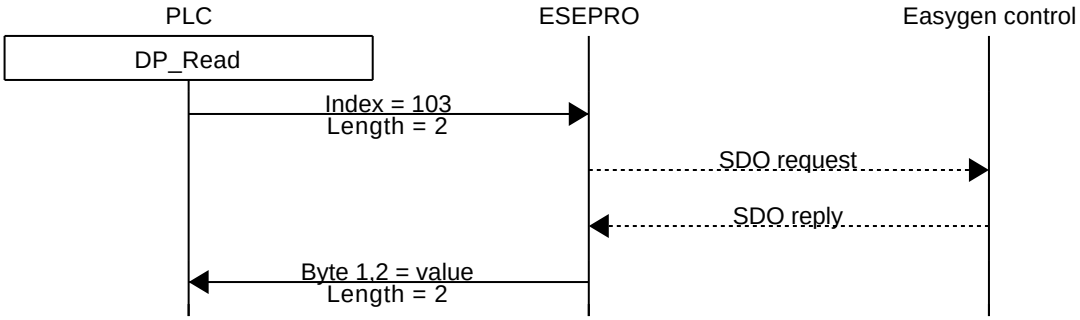


Figure 5.7: Message sequence chart for reading Remote Control Word 1 (Parameter ID 503)

Write Remote Control word

DP-V1 Service	$5E_{hex}$ DP_Write
In	
Slot	1-127, slot number of a device module
Index	100-199, set index to Remote Control Word ID minus 400
Length	2 or 4, set to size of Remote Control Word which can be either 2 or 4 bytes
Data	Variable size field holding the remote control word content

No interface password is required for writing to Remote Control Words.

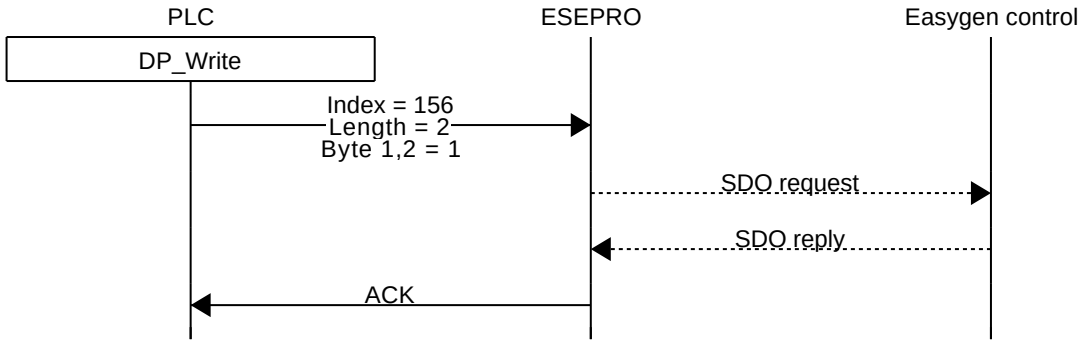


Figure 5.8: Message sequence chart for setting Remote Control Bit 1 (Parameter ID 556)

Remote Control Word IDs

Name	Parameter ID	Index	Length	Encoding	Used for
Remote Control Word 1	503	103	2	Bit 0: Remote start Bit 1: Remote stop Bit 2: write always 0 Bit 3: write always 0 Bit 4: Alarm acknowledgment Bit 5-15: internal use	Easygen remote start/stop/alarm acknowledge
Remote Control Word 2	504	104	2	Bit 0-3: internal use Bit 4: Remote V setpoint [04.37] Bit 5: Remote F setpoint [04.38] Bit 6: Remote PF setpoint [04.39] Bit 7: Remote P setpoint [04.40] Bit 8-15: internal use	Easygen activate remote setpoints 2
Remote Control Word 3	505	105	2		LS-5 or Easygen, freely configurable in Logics Manager [a]
Remote Active Power Setpoint	507	107	4	kW × 10	Easygen Analog Manager data source [05.06]
Remote Power Factor Setpoint	508	108	2	cos φ × 1000	Easygen Analog Manager data source [05.12]

Remote Frequency Set-point	509	109	2	Hz × 100	Easygen Analog Manager data source [05.03]
Remote Voltage Set-point	510	110	4	V × 1	Easygen Analog Manager data source [05.09]
Remote Reset Alarm	522	122	2	Parameter ID of alarm	Resetting specific alarms
Remote Control Bit 16	541	141	2	0=off, 1=on	LS-5 or Easygen Logics Manager command variable [04.59]
Remote Control Bit 15	542	142	2	0=off, 1=on	LS-5 or Easygen Logics Manager command variable [04.58]
Remote Control Bit 14	543	143	2	0=off, 1=on	LS-5 or Easygen Logics Manager command variable [04.57]
Remote Control Bit 13	544	144	2	0=off, 1=on	LS-5 or Easygen Logics Manager command variable [04.56]
Remote Control Bit 12	545	145	2	0=off, 1=on	LS-5 or Easygen Logics Manager command variable [04.55]
Remote Control Bit 11	546	146	2	0=off, 1=on	LS-5 or Easygen Logics Manager command variable [04.54]
Remote Control Bit 10	547	147	2	0=off, 1=on	LS-5 or Easygen Logics Manager command variable [04.53]
Remote Control Bit 9	548	148	2	0=off, 1=on	LS-5 or Easygen Logics Manager command variable [04.52]
Remote Control Bit 8	549	149	2	0=off, 1=on	LS-5 or Easygen Logics Manager command variable [04.51]
Remote Control Bit 7	550	150	2	0=off, 1=on	LS-5 or Easygen Logics Manager command variable [04.50]
Remote Control Bit 6	551	151	2	0=off, 1=on	LS-5 or Easygen Logics Manager command variable [04.49]
Remote Control Bit 5	552	152	2	0=off, 1=on	LS-5 or Easygen Logics Manager command variable [04.48]
Remote Control Bit 4	553	153	2	0=off, 1=on	LS-5 or Easygen Logics Manager command variable [04.47]
Remote Control Bit 3	554	154	2	0=off, 1=on	LS-5 or Easygen Logics Manager command variable [04.46]
Remote Control Bit 2	555	155	2	0=off, 1=on	LS-5 or Easygen Logics Manager command variable [04.45]
Remote Control Bit 1	556	156	2	0=off, 1=on	LS-5 or Easygen Logics Manager command variable [04.44]

[a]The bits of this control word can alternatively be written individually using Paremeter ID 541 - 556

Table 5.2: Relationship between Remote Control Word ID and DP-V1 Index

Remote Control Examples

Send start command to Easygen

```
Index = 103
Length = 2
Request Data = 0001hex
```

Send stop command to Easygen

```
Index = 103
Length = 2
```

Request Data = 0002_{hex}

Alarm reset Easygen

1. Set signal
   Index = 103
   Length = 2
   Request Data = 0010_{hex}
2. Reset signal
   Index = 103
   Length = 2
   Request Data = 0000_{hex}

Alarm reset requires generation of two rising edges which is achieved by first setting the command bit, clearing it again and then repeating this sequence. The first set/ clear sequence disables the horn, the second finally resets the alarm.

Acknowledge "Mains undervoltage 1" alarm (Parameter ID 3012) on Easygen
Index = 122
Length = 2
Request Data = 3012_{dec}

Set active power setpoint of 100 kW for Easygen
Index = 107
Length = 4
Request Data = 1000_{dec}

Set power factor setpoint to c0.71 (capacitive) for Easygen
Index = 108
Length = 2
Request Data = -710_{dec} or $FD3A_{hex}$

Set power factor setpoint to i0.99 (inductive) for Easygen
Index = 108
Length = 2
Request Data = 990_{dec} or $03DE_{hex}$

Write Remote Control Word 3 on LS-5 to set Remote Control Bit 1
Index = 105
Length = 2
Request Data = 0001_{hex}

Set Remote Control Bit 1 on LS-5
Index = 156
Length = 2
Request Data = 1

Clear Remote Control Bit 1 on LS-5
Index = 156
Length = 2
Request Data = 0

Chapter 6. Configuration of connected Woodward controls

The ESEPRO has been designed to keep the configuration effort required to connect the gateway with Woodward CANopen devices to a minimum. In most situations no additional configuration is necessary to get the ESEPRO communicating with an Easygen-3000 series control. Other Woodward controls like the DTSC-200 may require some configuration changes for settings like CAN baudrate and the TPDO COB-IDs.

The following list of Woodward CAN device parameters affect the operation of the ESEPRO gateway and their setting should be checked during installation and commissioning:

- CAN baudrate
- CANopen Node-ID
- COB-ID of Transmit PDOs (TPDO)
- Data Protocol of the Transmit PDOs (TPDO)

CAN baudrate

For all CAN devices the CAN baudrate must be set to 250 kBit/s.

CANopen Node-ID and TPDO COB-ID

To minimise the configuration effort, there is a fixed relationship between the CANopen Node-ID and the TPDO COB-ID which is documented in the table below. The relationship follows the rules of the CANopen Predefined Connection Set PDO assignments. Easygen-3000 and LS-5 controls use the COB-ID range from 385 to 432 by default. For the DTSC-200 the preconfigured range must be changed to be in the range of 385 to 432.

CANopen Node-ID	TPDO COB-ID dec	TPDO COB-ID hex
1	385	181
2	386	182
3	387	183
4	388	184
5	389	185
6	390	186
7	391	187
8	392	188
9	393	189
10	394	18A
11	395	18B
12	396	18C
13	397	18D
14	398	18E
15	399	18F
16	400	190
17	401	191

CANopen Node-ID	TPDO COB-ID dec	TPDO COB-ID hex
18	402	192
19	403	193
20	404	194
21	405	195
22	406	196
23	407	197
24	408	198
25	409	199
26	410	19A
27	411	19B
28	412	19C
29	413	19D
30	414	19E
31	415	19F
32	416	1A0
33	417	1A1
34	418	1A2
35	419	1A3
36	420	1A4
37	421	1A5
38	422	1A6
39	423	1A7
40	424	1A8
41	425	1A9
42	426	1AA
43	427	1AB
44	428	1AC
45	429	1AD
46	430	1AE
47	431	1AF
48	432	1B0

Table 6.1: CANopen Node-ID & COB-ID relationship

Data Protocol of the Transmit PDOs

The Data Protocol of the Transmit PDOs must be set according to the Woodward CANopen device used. The following tables shows the supported Data Protocols.

Woodward CAN device	Data protocol	Mapped Object ID	TPDO COB-ID range dec (hex)
Easygen-3000 series	5003	n/a	385 (0x181) - 400 (0x190)
LS-5	5103	n/a	385 (0x181) - 400 (0x190)
Easygen-1000 series	4000 or 4003	n/a	385 (0x181) - 400 (0x190)
Easygen-2000 series	5100 or 5101	n/a	385 (0x181) - 400 (0x190)
DTSC-200	4700 or 4701	03190	385 (0x181) - 400 (0x190)

Table 6.2: Supported Data Protocols

Specific information for Easygen-3000 series controls

The most convenient way to configure the Easygen is using Woodward's Toolkit software. Below are Toolkit screenshots of the relevant menus.

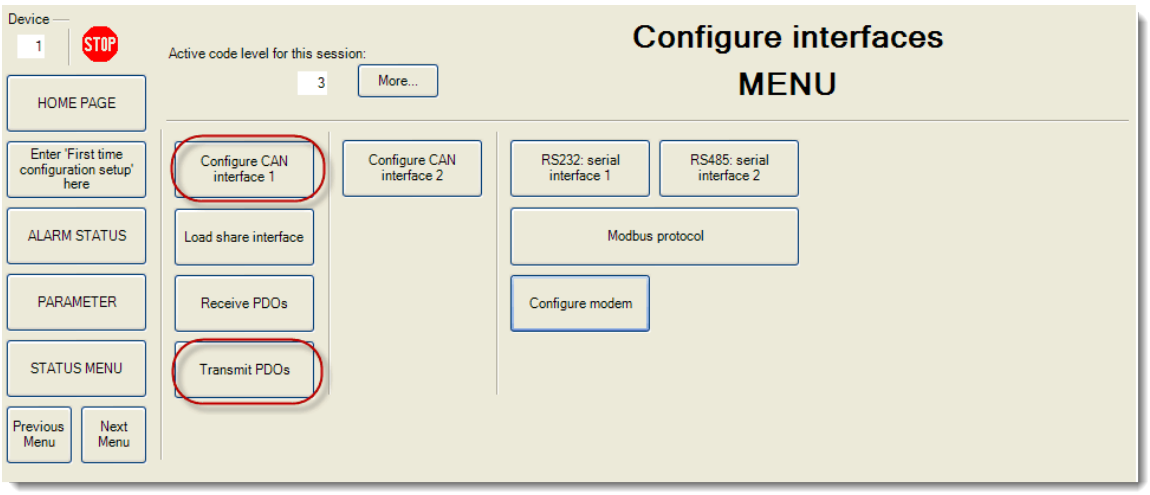


Figure 6.1: "Configure interfaces" menu in Woodward Toolkit

CAN interface

From Woodward's Toolkit software select the **`Configure CAN interface 1`** page as shown below:

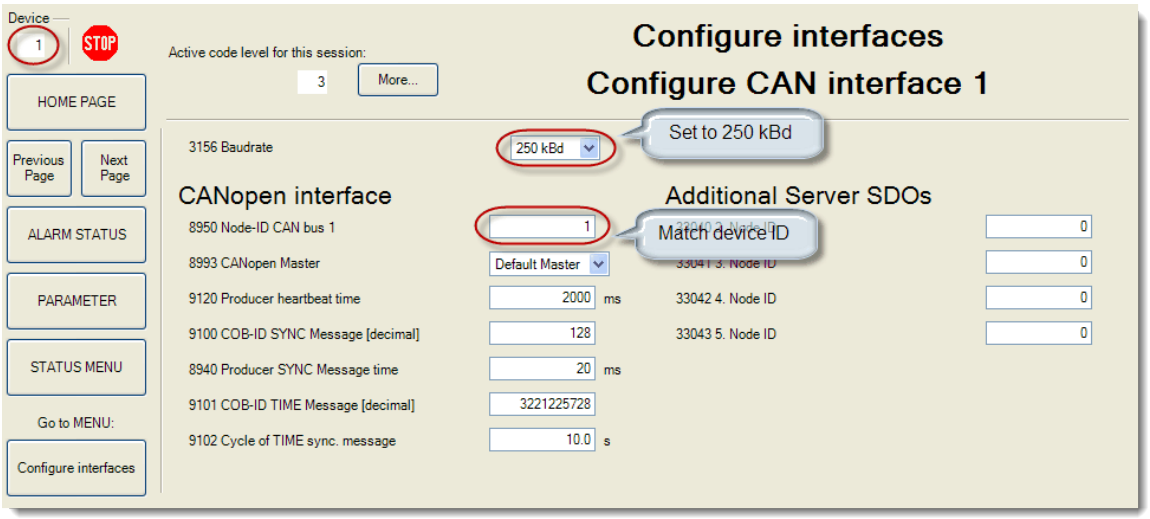


Figure 6.2: "Configure CAN interface 1" menu in Woodward Toolkit

- Parameter *3156 Baudrate* must be set to `250` kBd.
- Parameter *8950 Node-ID* should match the device ID. It must be in the range of 1 to 127 and a unique number in the network.

Transmit PDOs

In order for the ESEPRO gateway to receive cyclic data updates from the Easygen, one of the five available Transmit PDOs (TPDO) must be configured. Typically Tranmsit PDO 1 is already pre-configured for that purpose, but any of the five TPDOs could be used for that purpose.

If for example Transmit PDO 1 is used, then:

- parameter *9600 COB-ID* must be set to `384 + Node-ID`,
- parameter *8962 Selected Data Protocol* to `5003` and
- parameter *9602 Tramsission type* to `255`.

In the following example for an Easygen with device ID of 1 and Node-ID of 1, the Transmit PDO 1 is used to send data updates every 20 ms:

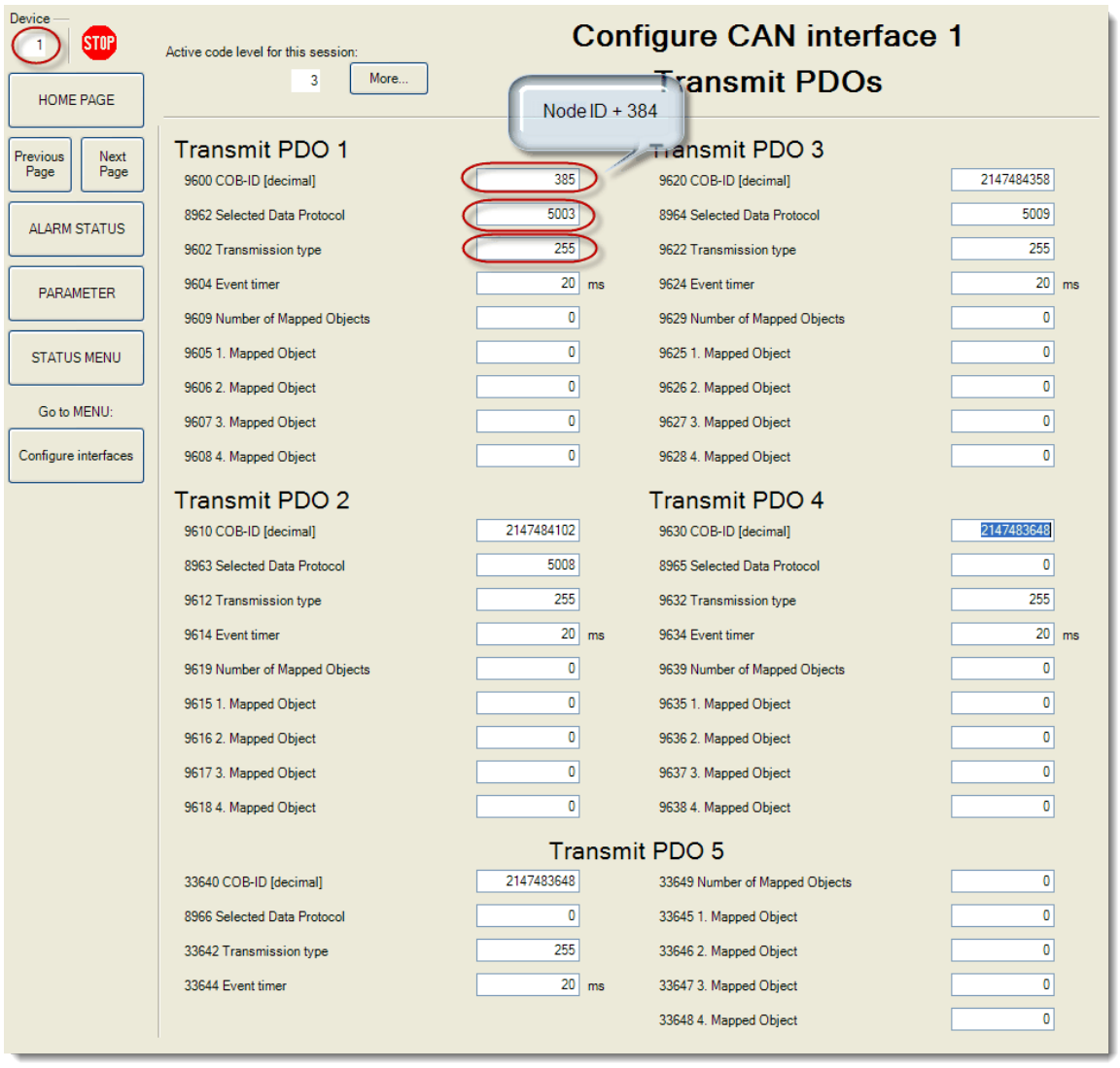


Figure 6.3: "Transmit PDOs" menu in Woodward Toolkit

All COB-IDs used in the CAN network must be unique. Please make sure that a COB-ID is only configured once. If TPDO or RPDO COB-ID entries are referring to an already used COB-ID, either disable that PDO or change its COB-ID.

Specific information for LS-5 controls

The LS-5 CANopen parameters are configured using Woodward's Toolkit software. Below are Toolkit screenshots of the relevant menus.

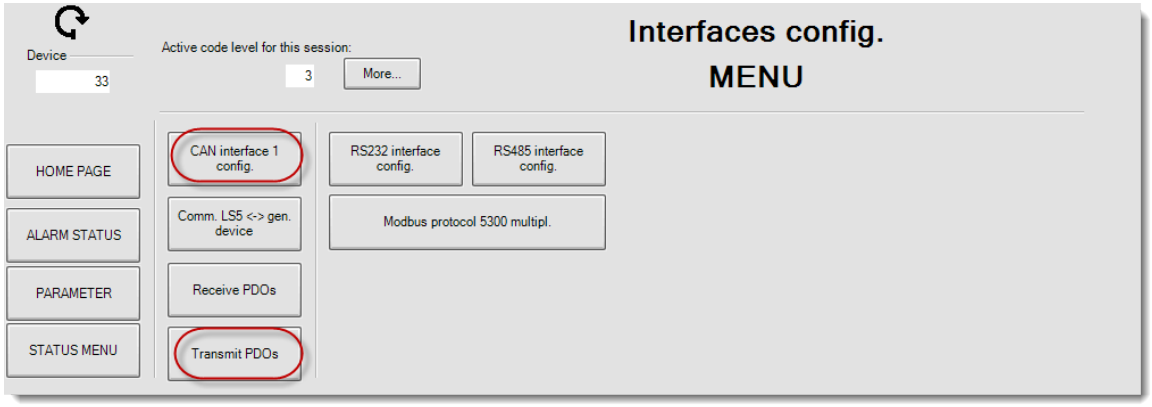


Figure 6.4: "Interfaces config" menu in Woodward Toolkit

CAN interface

From Woodward's Toolkit software select the **`CAN interface 1 config`** page as shown below:

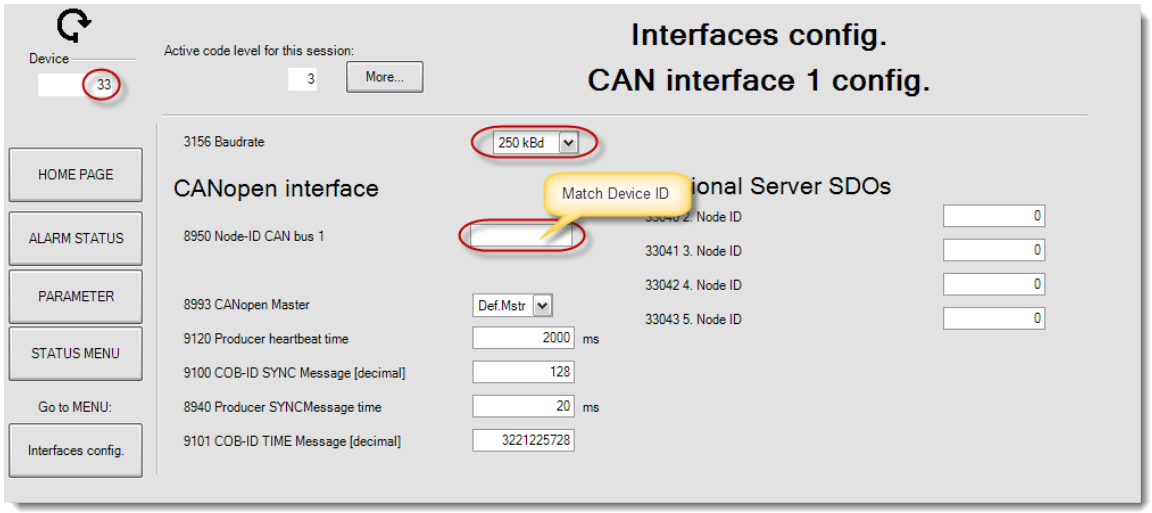


Figure 6.5: "CAN interface 1 config" menu in Woodward Toolkit

- Parameter *3156 Baudrate* must be set to `250` kBd.

- Parameter *8950 Node-ID* should match the device ID. It must be in the range of 1 to 127 and a unique number in the network.

Transmit PDOs

In order for the ESEPRO gateway to receive cyclic data updates from the LS-5, one of the five available Transmit PDOs (TPDO) must be configured. Typically Tranmsit PDO 1 is already pre-configured for that purpose, but any of the five TPDOs could be used for that purpose.

Figure 6.6: "Transmit PDOs" menu in Woodward Toolkit

If Transmit PDO 1 is used, then:

- parameter *9600 COB-ID* must be set to `384 + Node-ID`,
- parameter *8962 Selected Data Protocol* to `5301` and
- parameter *9602 Tramsission type* to `255`.

All COB-IDs used in the CAN network must be unique. Please make sure that a COB-ID is only configured once. If TPDO or RPDO COB-ID entries are referring to an already used COB-ID, either disable that PDO or change its COB-ID.

Chapter 7. Decommissioning

Before disconnecting the ESEPRO unit please follow the rules in the section called “Safety Precautions”.

Disconnecting

1. Ensure that the system power and external supplies have been turned off.
2. Disconnect power supply plug.
3. Disconnect all I/O cables.
4. Remove the ESEPRO from the DIN rail following the procedure described in the section called “DIN rail mounting and removal”.

Disposal

This product must be disposed of at a specialized electronic waste recycling facility. Do not dispose of in domestic waste.

Appendix A.Specifications

Product name	**ESEPRO**
Interfaces	
Profibus	1 DP-Slave
CAN	1
Ethernet	1 (diagnostics and firmware upgrade)
User interface	
LED indicators	Power (green), Ethernet link (green), 2 status (bi-color red/green)
Monitoring	Web browser based
Diagnostic	
High availability features	Watchdog supervision, brown-out detection
Profibus interface	
Connector	female 9-pin D-sub, Profibus standard (IEC 61158-2) pin-out
Physical layer	EIA-485-A (RS-485)
Isolation	500 V galvanic
Speed	9.6 kBit/s - 12 MBit/s
Protocols	Profibus DP-V0 and DP-V1 Slave
Max. nodes on a single bus segment	32
CAN interface	
Connector	male 9-pin D-sub, industry standard CiA DS-102 pin-out
Physical layer	ISO 11898
Isolation	non-isolated
Speed	250 kBit/s
Protocols	CANopen consumer & client
Max. nodes on a single bus segment	64
Number of adressable nodes	8
Ethernet port	
Connector	8-pin RJ-45 socket for Cat 5 UTP
Physical & Data Link Layer Layer	IEEE 802.3i 10BASE-T
Isolation	1.5 kV galvanic
Speed	10 Mbit/s
Max. cable length	100 m (328 ft)
Ethernet frame types	802.3
Protocols	Toolkit, HTTP, IP, TCP, ARP
Concurrent connections	2 HTTP
Power supply	
Connector	3.81 mm 2-pin pluggable terminal block header
Voltage	10-30 V DC
Current	30 mA typical @ 24 V DC
Intrinsic consumption	750 mW
Electromagnetic compatibility	
Emissions (radiated and conducted)	AS/NZS CISPR 22 / EN 55022 (Class A)
Immunity	EN 55024

Electrostatic discharge	EN 61000-4-2
Radiated RF	EN 61000-4-3
Fast transients	EN 61000-4-4
Conducted RF	EN 61000-4-6
Enclosure	
Material	Self-extinguishing PC/ABS blend (UL 94-V0)
Mounting	35 mm DIN rail (EN 60715)
Classification / Type rating	IP 20 / NEMA Type 1
Cooling	Convection
Environmental	
Operating temperature	0 to 60 °C / 32 to 140 °F
Storage temperature	-25 to 85 °C / -13 to 185 °F
Humidity	10 to 95% non condensing
Operating ambience	Free from corrosive gas, minimal dust
Physical	
Dimensions	101 x 22.5 x 120 mm / 3.98 x 0.886 x 4.72 in
Weight	0.15 kg / 0.33lb
Compliance	
Australia	C-Tick
Europe	CE, RoHS
USA	FCC Part 15 (Class A)
Canada	ICES-003 (Class A)

Dimensions

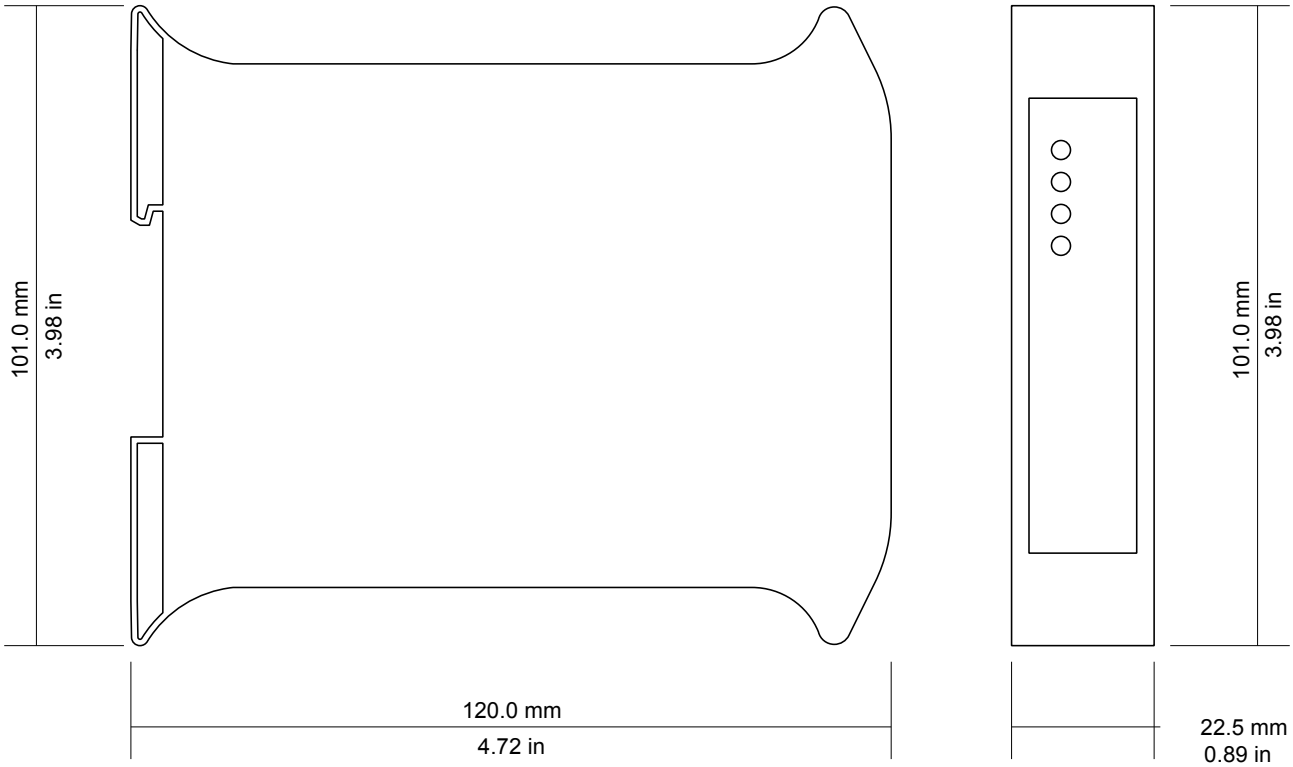


Figure A.1: Enclosure dimensions

References

[PIG98] PROFIBUS Nutzerorganisation e.V., "Installation Guideline for PROFIBUS-DP/FMS", Order No 2.112, Version 1.0, September 1998

Glossary

10BASE-T
: 10 Mbit/s twisted pair Ethernet standard. Standardized in IEEE 802.3i

APIPA
: Automatic Private IP Addressing

CAN
: Controller area network. Standardized in ISO 11898.

CANopen
: Internationally standardized (EN 50325-4) CAN-based higher-layer protocol for embedded control systems.

CiA DS-102
: Standard for the pinout of CAN connectors

Class A
: Class A equipment is that used in commercial or light industrial environments.

COB-ID
: Unique CANopen Communication Object Identifier.

DIN rail
: 35 mm wide mounting bracket standardized in DIN/EN 50022.

DP
: Decentralised periphery. A Profibus protocol for the simple, fast, cyclic and deterministic I/O data exchange between a bus master and its assigned slave devices.

DP-V0
: DP-V0 is the basic stage of the Profibus DP communication protocol providing cyclic data exchange.

DP-V1
: Extension to Profibus DP protocol providing acyclic data transfer and alarms.

EMC
: Electromagnetic compatibility

EMI
: Electromagnetic interference

ESD
: Electrostatic discharge. ESD can damage electronic equipment.

IEEE
: Institute of Electrical and Electronics Engineers

IP
: Ingress Protection Rating standardized in IEC 60529. Standard for various grades of electrical enclosures.

ISO
: International Standards Organisation

MAC address
: Every piece of Ethernet hardware has a unique number assigned to it called it's MAC address. MAC addresses are administered and assigned by the IEEE organization.

MS1
: Acyclic communication between a class 1 master and a slave device

MS2
: Acyclic communication between a class 2 master and a slave device

Mux
: Multiplexed process data object. Proprietary extension by Woodward to the CANopen protocol.

NEMA
: National Electrical Manufacturers Association. NEMA defines standards for various grades of electrical enclosures.

Node
: A communications device on the network

PC/ABS
: Polycarbonate-ABS. Widely used thermoplastic material.

PDO
: CANopen Process Data Object. Process data the device is either producing or consuming.

PLC
: Programmable Logic Controller

Predefined Connection Set
: The CANopen Predefined Connection Set defines standard COB-IDs for PDOs and SDOs.

Profibus
: Fieldbus protocol used in the process automation industry. It uses a multiple master and slave structure with predictable cyclic communications. Originally developed by Siemens.

RPDO
: CANopen Receive Process Data Object. Process data the device is consuming.

SDO
: CANopen Service Data Object.

TPDO
: CANopen Transmit Process Data Object. Process data the device is producing.

UL 94
: Plastics flammability standard released by Underwriters Laboratories of the USA.

Notes