Ethernet

IL ETH BK DI8 DO4 2TX-XC-PAC

**Modbus/TCP(UDP) bus coupler,
version for extreme conditions,
8 inputs, 24 V DC, 4 outputs, 24 V DC, 500 mA**

Data sheet
8501_en_01

1   Description

The bus coupler is the link between an Ethernet network and the Inline installation system.

Up to 61 Inline devices can be connected at any point to an existing Ethernet network using the bus coupler. The bus coupler and the Inline devices form one station with a maximum of 63 local bus devices. Here, the inputs and outputs of the bus coupler together form the first and second local bus devices.

Up to 16 PCP devices can be operated on the bus coupler.

Thanks to special engineering measures and tests, the terminal can be used under extreme ambient conditions.

Features

– 2 x Ethernet twisted pair according to 802.3 with auto negation and auto crossover connected via an integrated 3-port switch (2 external ports, 1 internal port)
– Transmission speeds of 10 Mbps and 100 Mbps
– Ethernet connection via 8-pos. RJ45 female connector
– Electrical isolation of Ethernet interface and logic

– Software interface: Modbus/TCP, Modbus/UDP, or DDI (Device Driver Interface)
– Process data access via XML
– Ethernet TCP/IP
    – Management via SNMP
    – Integrated web server
– IP address setting via BootP (can be switched off)
– Automatic baud rate detection on the local bus (500 kbps or 2 Mbps)
– Status and diagnostic LEDs
– Eight digital inputs
– Four digital outputs
– Can be used under extreme ambient conditions
– Painted PCBs
– Extended temperature range T2 (-40°C … +55°C)

i	This data sheet is only valid in association with the IL SYS INST UM E user manual.

i	Make sure you always use the latest documentation. It can be downloaded at www.phoenixcontact.net/catalog.

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INSPIRING INNOVATIONS

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# 2   Ordering data

Product

Description	Type	Order No.	Pcs. / Pkt.
Modbus/TCP(UDP) bus coupler, version for extreme conditions, 8 inputs, 24 V DC, 4 outputs, 24 V DC, 500 mA, complete with I/O connectors	IL ETH BK DI8 DO4 2TX-XC-PAC	2701388	1

Accessories	Type	Order No.	Pcs. / Pkt.
Snap-on end bracket, for 35 mm NS 35/7.5 or NS 35/15 DIN rail, can be fitted with Zack strip ZB 8 and ZB 8/27, terminal strip marker KLM 2 and KLM, width: 9.5 mm, color: gray (Assembly)	CLIPFIX 35	3022218	50
Insert strip, Sheet, white, Unlabeled, Can be labeled with: Office-Drucksysteme, Plotter: Laser printer, Mounting type: Insert, Lettering field: 62 x 46 mm (Marking)	ESL 62X46	0809502	5
Labeling field, width: 48.8 mm (Marking)	IB IL FIELD 8	2727515	10
Insert strip, Sheet, white, Unlabeled, Can be labeled with: Office-Drucksysteme, Plotter: Laser printer, Mounting type: Insert, Lettering field: 62 x 10 mm (Marking)	ESL 62X10	0809492	1
Labeling field, width: 12.2 mm (Marking)	IB IL FIELD 2	2727501	10
CD-ROM, with user documentation in PDF format, driver software and sample programs, IO configurator (Literature)	CD FL IL 24 BK	2832069	1
RJ45 connector, shielded, with bend protection sleeve, 2 pieces, gray for straight cables, for assembly on site. For connections that are not crossed, it is recommended that you use the connector set with gray bend protection sleeve. (Plug/Adapter)	FL PLUG RJ45 GR/2	2744856	1
RJ45 connector, shielded, with bend protection sleeve, 2 pieces, green for crossed cables, for assembly on site. For connections that are crossed, it is recommended that the connector set with green bend protection sleeves is used. (Plug/Adapter)	FL PLUG RJ45 GN/2	2744571	1
CAT5-SF/UTP cable (J-02YS(ST)C HP 2 x 2 x 24 AWG), heavy-duty installation cable, 2 x 2 x 0.22 mm², solid conductor, shielded, outer sheath: 7.8 mm diameter, inner sheath: 5.75 mm ± 0.15 mm diameter (Cable/conductor)	FL CAT5 HEAVY	2744814	1
CAT5-SF/UTP cable (J-LI02YS(ST)C H 2 x 2 x 26 AWG), light-duty, flexible installation cable 2 x 2 x 0.14 mm², stranded, shielded, outer sheath: 5.75 mm ± 0.15 mm diameter (Cable/conductor)	FL CAT5 FLEX	2744830	1
Crimping pliers, for assembling the RJ45 connectors FL PLUG RJ45..., for assembly on site (Tools)	FL CRIMPTOOL	2744869	1
End clamp, for assembly on NS 32 or NS 35/7.5 DIN rail (Assembly)	E/UK	1201442	50
Connector set, for Inline bus coupler with I/Os mounted in rows (Plug/Adapter)	IL BKDIO-PLSET	2878599	1

Documentation	Type	Order No.	Pcs. / Pkt.
User manual, English, Automation terminals of the Inline product range	IL SYS INST UM E	-	-
Application note, German/English, I/O modules at bus couplers	AH IL BK IO LIST	-	-
User manual, English, for drivers for G4-based controller boards, only available as a download.	IBS PC SC SWD UM E	2745172	1
User manual, English, for firmware messages of Generation 4 controller boards, only available as a download.	IBS SYS FW G4 UM E	2745185	1
User manual, English, for the Peripherals Communication Protocol (PCP), only available as a download.	IBS SYS PCP G4 UM E	2745169	1

3   Technical data

Dimensions (nominal sizes in mm)
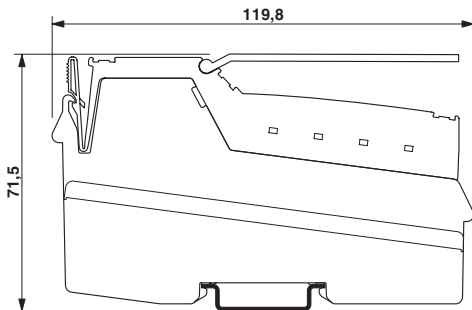
Width	80 mm
Height	119.8 mm
Depth	71.5 mm
Note on dimensions	Specfications with male connectors

General data

Color	green
Weight	375 g (with male connectors)
Ambient temperature (operation)	-40 °C ... 55 °C (See also the "Tested successfully: Use under extreme ambient conditions" section of the data sheet.)
Ambient temperature (operation)	-40 °C ... 60 °C (At U_S < 24.5 V; see also the "Tested successfully: Use under extreme ambient conditions" section of the data sheet.)
Ambient temperature (storage/transport)	-40 °C ... 85 °C
Temperature class	T2 (-40°C ... 55°C, EN 50155)
Permissible humidity (operation)	10 % ... 95 % (according to DIN EN 61131-2)
Permissible humidity (storage/transport)	10 % ... 95 % (according to DIN EN 61131-2)
Air pressure (operation)	70 kPa ... 106 kPa (up to 3000 m above sea level)
Air pressure (storage/transport)	70 kPa ... 106 kPa (up to 3000 m above sea level)
Degree of protection	IP20
Protection class	III, IEC 61140, EN 61140, VDE 0140-1

Connection data

Name	Inline connectors
Connection method	Spring-cage connection
Conductor cross section solid / stranded	0.08 mm² ... 1.5 mm²
Conductor cross section [AWG]	28 ... 16

Interface Inline local bus

Connection method	Inline data jumper
Transmission speed	500 kBit/s, 2 MBit/s (Automatic detection, no combined system)

Interface Modbus/TCP(UDP)

Number	2
Connection method	RJ45 female connector, auto negotiation
Transmission speed	10/100 MBit/s
Transmission physics	Ethernet in RJ45 twisted pair

System limits of the bus coupler

Number of supported devices	max. 63 (per station)
Number of local bus devices that can be connected	max. 61 (On board I/Os are two devices)
Number of devices with parameter channel (PCP)	max. 16
Support of branch termials with remote bus branch	No

> **i** Observe the logic current consumption of each device when configuring an Inline station. It is specified in every terminal-specific data sheet. The current consumption can differ depending on the individual terminal. The permissible number of devices that can be connected therefore depends on the specific station structure.

Power supply for module electronics

Connection method	Spring-cage connection
Name	Bus coupler supply U_{BC}; Communications power U_L (7.5 V) and the analog supply U_{ANA} (24 V) are generated from the bus coupler supply.
Supply voltage	24 V DC (via Inline connector)
Supply voltage range	19.2 V DC ... 30 V DC (including all tolerances, including ripple)
Supply current	70 mA
Current consumption	max. 0.98 A (from U_{BK})
Power loss	Typ. 3 W (Entire device)

Power consumption

> **!** **NOTE: Electronics may be damaged when overloaded**
> Provide external fuses for the 24 V areas U_{BK}, U_M, and U_S. The power supply unit must be able to supply four times the nominal current of the external fuse, to ensure that it trips in the event of an error.

Main circuit supply U_M	24 V DC
Supply voltage range U_M	19.2 V DC ... 30 V DC (including all tolerances, including ripple)
Power supply at U_M	max. 8 A DC (Sum of U_M + U_S)
Current consumption from U_M	max. 8 A DC
Segment supply voltage U_S	24 V DC
Supply voltage range U_S	19.2 V DC ... 30 V DC (including all tolerances, including ripple)
Power supply at U_S	max. 8 A DC (Sum of U_M + U_S)
Current consumption from U_S	max. 8 A DC
Communications power U_L	7.5 V DC ±5%
Power supply at U_L	max. 0.8 A DC
I/O supply voltage U_{ANA}	24 V DC
Supply voltage range U_{ANA}	19.2 V DC ... 30 V DC (including all tolerances, including ripple)
Power supply at U_{ANA}	max. 0.5 A DC

Digital inputs

Number of inputs	8
Connection method	Inline connectors
Connection method	2, 3-wire
Description of the input	EN 61131-2 type 1

Digital inputs

Nominal input voltage	24 V DC
Nominal input current	Typ. 3 mA
Current flow	Limited to 3 mA, maximum
Input voltage range "0" signal	-30 V DC ... 5 V DC
Input voltage range "1" signal	15 V DC ... 30 V DC
Delay at signal change from 0 to 1	1.2 ms
Delay at signal change from 1 to 0	1.2 ms
Permissible conductor length to the sensor	100 m
Protection against polarity reversal	Suppressor diode

Digital outputs

Number of outputs	4
Connection method	Inline connectors
Connection method	2, 3-wire
Nominal output voltage	24 V DC
Maximum output current per channel	500 mA
Maximum output current per device	2 A
Nominal load, ohmic	12 W
Nominal load, inductive	12 VA (1.2 H; 48 Ω)
Nominal load, lamp	12 W
Signal delay	Typ. 1.2 ms
Maximum operating frequency with inductive nominal load	0.5 Hz (1.2 H; 48 Ω)
Behavior at voltage switch-off	The output follows the power supply without delay
Limitation of the voltage induced on circuit interruption	Approx. -30 V
Output current when switched off	max. 10 µA (When not loaded, a voltage can be measured even at an output that is not set.)
Behavior with overload	Auto restart
Behavior with inductive overload	Output can be destroyed
Reverse voltage resistance to short pulses	Reverse voltage proof
Resistance to permanent reverse voltage	max. 2 A
Overcurrent shut-down	min. 0.7 A
Short-circuit and overload protection	Free running circuit In output driver

Error messages to the higher level control or computer system

Short-circuit / overload of the digital outputs	Yes
Sensor supply failure	Yes
Failure of the actuator supply	Yes

Mechanical tests

Vibration resistance in acc. with IEC 60068-2-6	5g
Shock test in acc. with IEC 60068-2-27	Operation: 25 g, 11 ms duration, semi-sinusoidal shock impulse

Conformance with EMC Directive 2004/108/EC

Noise immunity test in accordance with EN 61000-6-2

Electrostatic discharge (ESD) EN 61000–4–2/IEC 61000–4–2	Criterion B; 6 kV contact discharge, 8 kV air discharge
Electromagnetic fields EN 61000–4–3/IEC 61000–4–3	Criterion A; Field intensity: 10 V/m
Fast transients (burst) EN 61000–4–4/IEC 61000–4–4	Criterion A; all interfaces 1 kV Criterion B; all interfaces 2 kV

Conformance with EMC Directive 2004/108/EC

Transient surge voltage (surge) EN 61000−4−5/IEC 61000−4−5	Criterion B; supply lines DC: 0.5 kV/0.5 kV (symmetrical/asymmetrical); fieldbus cable shield 1 kV
Conducted interference EN 61000−4−6/IEC 61000−4−6	Criterion A; Test voltage 10 V
Noise emission test as per EN 61000-6-4	
EN 55011	Class A

Approvals

For the latest approvals, please visit www.phoenixcontact.net/catalog.

4 Tested successfully: Use under extreme ambient conditions

The terminal has been tested successfully over 250 temperature change cycles in accordance with IEC 61131-2 in the range from -40°C to +70°C.

The following conditions were observed:

–   The Inline devices for all connecting cables were connected with a minimum conductor cross section of 0.5 mm²

–   The Inline station was installed on a wall-mounted horizontal DIN rail

–   Fans were used to ensure continuous movement of air in the control cabinet

–   The Inline station was not exposed to vibration or shock

–   The Inline station was operated with a maximum of 24.5 V (ensured by using regulated power supply units)

⚠ **WARNING:**

The terminal is not approved for use in potentially explosive areas.

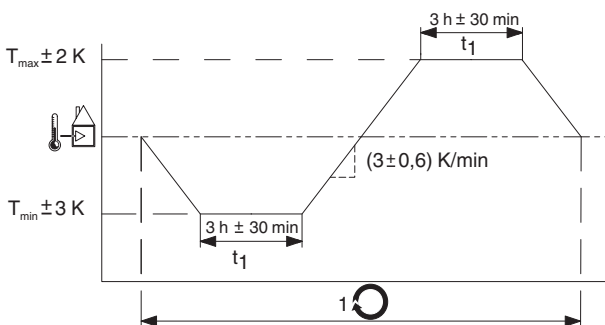The terminal is not approved for use in safety technology.
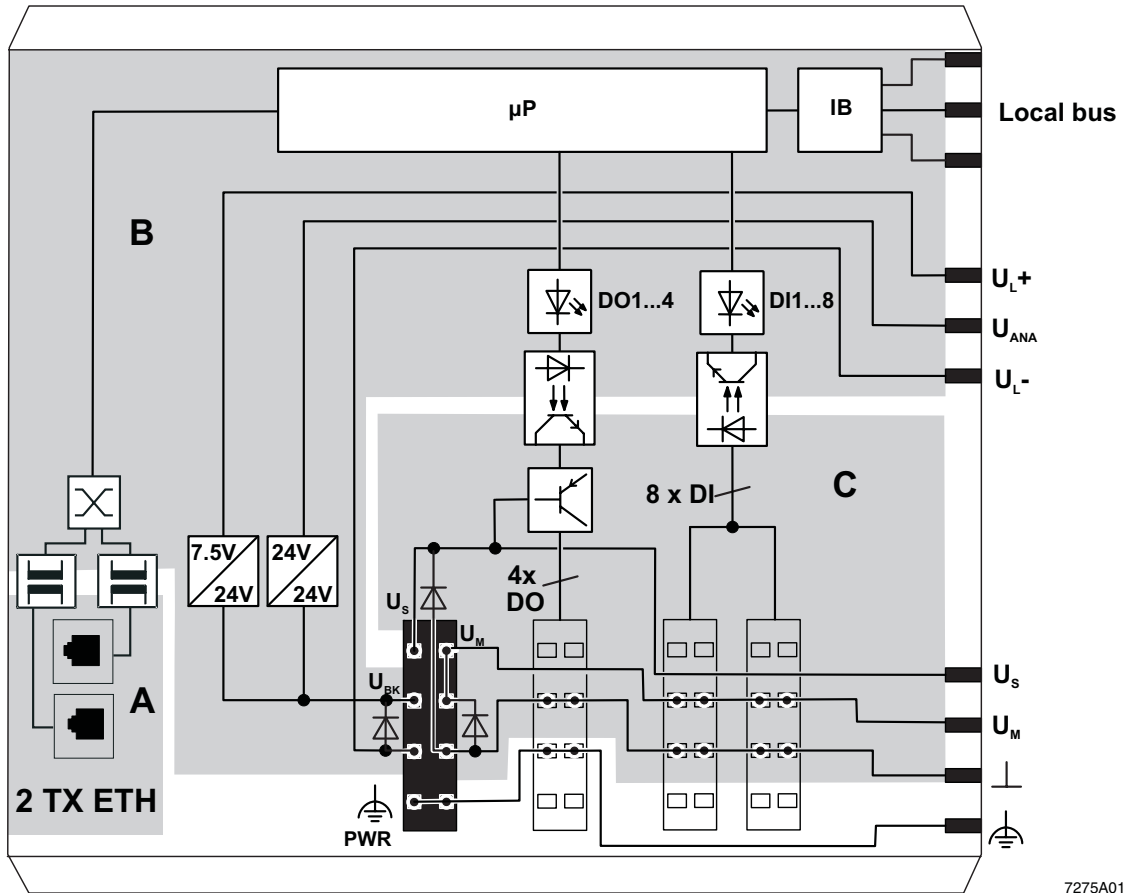

Figure 1   Temperature change cycle

Temperature in the control cabinet/ambient temperature

Cycle

5 Basic circuit diagram

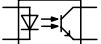Figure 2   Basic circuit diagram of the Ethernet bus coupler

Key:

µP	Microprocessor
IB	Protocol chip
(optocoupler symbol)	Optocoupler
(ethernet switch symbol)	Ethernet switch
(PNP transistor symbol)	PNP transistor
(transmitter symbol)	Transmitter with electrical isolation

The gray areas in the basic circuit diagram represent the electrically isolated areas:

A: Ethernet interface
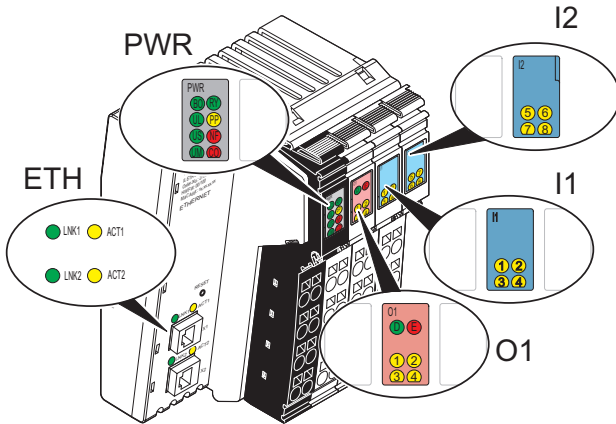B: Logic
C: I/O

6 Local diagnostic and status indicators

Figure 3   Indicators on the bus coupler

LED	Color	State	Meaning
ETH/PWR: Ethernet			
LNK 1/2	**Green**		Link port 1/2
		ON	Connection via Ethernet to a module via port 1/2 has been established.
		OFF	No connection established via port 1/2.
ACT 1/2	**Yellow**		Port 1 activity
		ON	Sending or receiving Ethernet telegrams at port 1/2
		OFF	Not sending or receiving Ethernet telegrams at port 1/2
BO	**Green**		Bootloader (**Bo**ot)
		ON	Boot loader active, firmware started
		Flashing	Waiting for BootP reply
		OFF	Firmware started successfully
RY	**Green**		**R**ead**y**
		ON	Connection to a process data client (Modbus/TCP (UDP) or DDI) established
		Flashing	Firmware ready to operate
		OFF	Firmware not active
PP	**Yellow**		**P**lug and **p**lay
		ON	Plug and play mode active
		OFF	Plug and play mode not active

LED	Color	State	Meaning
NF	**Red**		**N**etwork **f**ailure
		ON	A network error occurred. The monitoring function detected an error or the process data watchdog was activated.
		OFF	No network error, normal state
CO	**Red**		**Co**nfiguration
		ON	The active station configuration differs from the saved configuration
		OFF	The active station configuration matches the saved configuration.
PWR: Supply			
UL	**Green**		U_{Logic}
		ON	24 V bus coupler supply/ internal communications power present
		OFF	24 V bus coupler supply/ internal communications power not present
US	**Green**		$U_{Segment}$
		ON	24 V segment circuit supply/ internal communications power present
		OFF	24 V segment circuit supply/ internal communications power not present
UM	**Green**		U_{Main}
		ON	24 V main circuit supply/internal communications power present
		OFF	24 V I/O supply/internal communications power not present

LED	Color	State	Meaning
O1: Diagnostics of the Inline station/diagnostics and status of the outputs			
D	**Green**		Diagnostics
		ON	Data transmission within the station is active
		Flashing	Data transmission within the station is not active
E	**Red**		**E**rror
		ON	Short circuit/overload at one of the outputs
		OFF	No short circuit/overload of outputs
1-4	**Yellow**		**O1 ... O4**
		ON	Output active
		OFF	Output not active
I1: Status of the inputs			
1-8	**Yellow**		**I1 ... I8**
		ON	Input active
		OFF	Input not active

7 Reset button

The reset button is located on the front of the bus coupler.

It has two functions:

– Restarting the bus coupler
– Restoring the default settings

To restore the default settings (see page 12), hold down the reset button when applying the power supply.
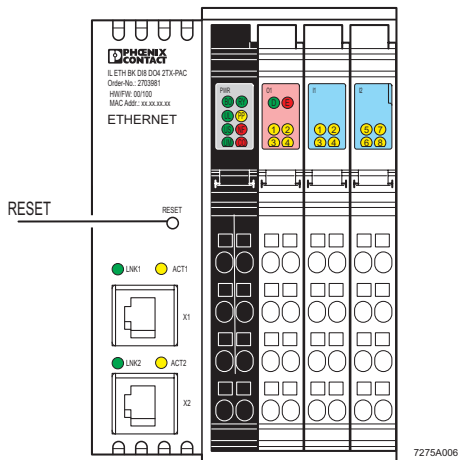

Figure 4   Reset button

8 Connecting Ethernet, supply, actuators, and sensors
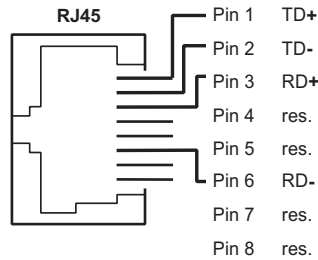
8.1 Connecting Ethernet

Figure 5   Pin assignment of the 8-pos. RJ45 female connector

Connect Ethernet to the bus coupler via an 8-pos. RJ45 connector. For the pin assignment, please refer to the following table:

Pin	Assignment
1	TxD + (transmit data +)
2	TxD - (transmit data -)
3	RxD+ (receive data +)
4	Reserved
5	Reserved
6	RxD - (receive data -)
7	Reserved
8	Reserved

ℹ	Both Ethernet interfaces are equipped with the auto crossover function.

ℹ	**Shielding** The shielding ground of the connected twisted pair cables is electrically connected with the female connector. When connecting network segments, avoid ground loops, potential transfers and voltage equalization currents via the braided shield.

Terminal point assignment of the power connector (1)

Terminal points	Assignment	Terminal points	Assignment
1.1	U_S	2.1	U_M
1.2	U_{BK}	2.2	U_M
1.3	U_{BK} GND	2.3	U_M, U_S GND
1.4	Functional earth ground (FE)	2.4	Functional earth ground (FE)

NOTE: Malfunction

The module is designed exclusively for operation with safety extra-low voltage (SELV) according to IEC 950/EN 60950/VDE 0805.

ℹ For information on the power supplies, please refer to the IL SYS INST UM E user manual.

ℹ Terminal points 1.3 and 2.3 on the connector can be jumpered if the same reference potential is to be used for the communications power and the segment voltage.

Terminal point assignment of the output connector (2)

Terminal points	Assignment	Terminal points	Assignment
1.1	OUT1	2.1	OUT2
1.2	GND	2.2	GND
1.3	FE	2.3	FE
1.4	OUT3	2.4	OUT4

Terminal point assignment of the input connector (3)

Terminal points	Assignment	Terminal points	Assignment
1.1	IN1	2.1	IN2
1.2	U_M	2.2	U_M
1.3	GND	2.3	GND
1.4	IN3	2.4	IN4

Terminal point assignment of the input connector (4)

Terminal points	Assignment	Terminal points	Assignment
3.1	IN5	4.1	IN6
3.2	U_M	4.2	U_M
3.3	GND	4.3	GND
3.4	IN7	4.4	IN8

ℹ **Observe bending radii**

The housing dimensions specified under "Documentation" on page 3 refer to the bus coupler with Inline connectors without Ethernet connection. When installing the bus coupler in a control box observe the bending radii of the Ethernet cables and the connectors used (e.g., FL CAT5 FLEX: 30 mm for permanent installation and FL CAT5 HEAVY: 30 mm without outer sheath and 45 mm with outer sheath; see also www.interbusclub.com/itc/eth/). If required, use angled RJ45 connectors to maintain these bending radii.

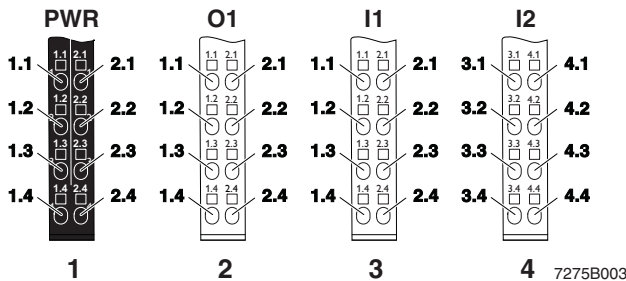## 8.2 Connecting the supply, actuators, and sensors

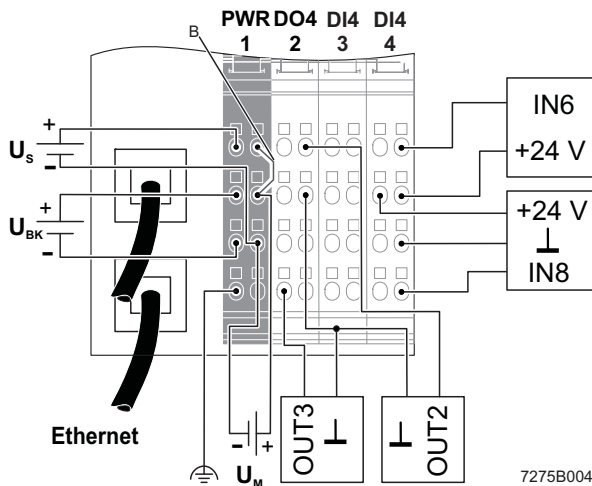Figure 6   Terminal point assignment of the Inline connectors

Figure 7   Connection example

B: Internal jumper

Connect the bus coupler according to Figure 7.

9 Startup

9.1 Delivery state/default settings

By default upon delivery, the following functions and features are available:

– IP Configuration

IP Address:	0.0.0.0
Subnet Mask:	0.0.0.0
Default Gateway:	0.0.0.0
BootP Requests:	Enable

– Software Update

Software Update on Next Reboot:	Disable
TFTP-Server IP Address:	0.0.0.0
Downloadable File Name:	c2703981.fw

– System Identification

Name of Device:	IL ETH BK DI8 DO4 2TX-PAC
Description:	Ethernet bus terminal
Physical Location:	Unknown
Contact:	Unknown

– Process Data Monitoring

Process Data Watchdog Timeout:	500 ms
Fault Response Mode:	Reset Fault Mode (Default)

– Plug and play mode	Enable
Expert mode	Disable

> **i** By default upon delivery, the bus coupler has no valid IP parameters.

9.2 Starting the firmware

The firmware is started after you have supplied power to the bus coupler. The following sequence appears on the LEDs:

Display	Meaning
BO flashing	Boot loader is started, BootP requests are being sent
BO ON	Extracting firmware
BO OFF	Starting the firmware
RY flashing	Firmware ready to operate

9.3 Sending BootP requests

Initial startup:

During initial startup, the bus coupler transmits BootP requests without interruption until it receives a valid IP address. The requests are transmitted at varying intervals (2 s, 4 s, 8 s, 2 s, 4 s, etc.) so that the network is not loaded unnecessarily.
If valid IP parameters are received, they are saved as configuration data by the bus coupler.

Further startups:

If the bus coupler already has valid configuration data and BootP is not disabled, it only transmits three more BootP requests on a restart. If it receives a BootP reply, the new parameters are saved. If the bus coupler does not receive a reply, it starts with the previous configuration. If BootP is disabled and a valid configuration is available, the bus coupler starts immediately.

> **i** For the definition of the IP address via BootP, you can use any BootP server available.

> **i** To check whether BootP is disabled, refer to the "IP Configuration" menu in WBM, see page 14.

10 Web-based management (WBM)

The bus coupler has a web server, which generates the required pages for web-based management and, depending on the requirements of the user, sends them to the "Factory Manager" or a standard web browser. Web-based management can be used to access static information (e.g., technical data, MAC address) or dynamic information (e.g., IP address, status information) or to change the configuration (password-protected).

10.1 Calling web-based management

The IL ETH BK DI8 DO4 2TX-XC-PAC web server can be addressed using the IP address if configured correspondingly. The bus coupler homepage is accessed by entering the URL "http://*ip address*".

Example: http://172.16.113.38

> ℹ If you cannot access the WBM pages, check the connection settings in your browser and deactivate the proxy, if set.
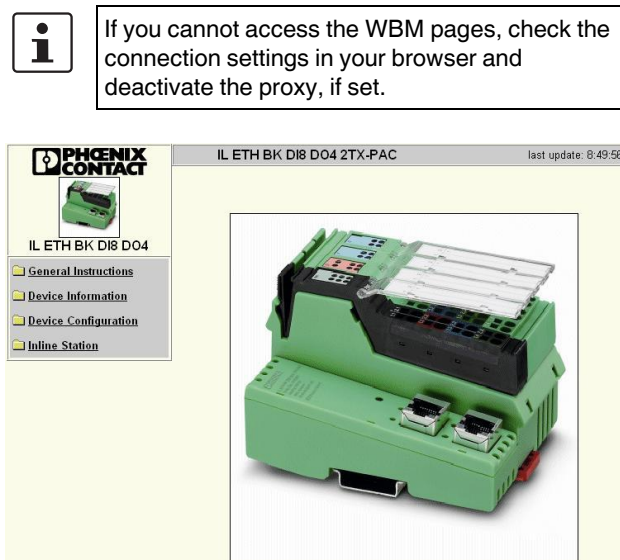
Figure 8   WBM homepage

10.2 Structure of the web pages

The web pages for the Ethernet bus coupler are divided into two sections. The left-hand side has the selection menu with the relevant submenus. The right-hand side displays the information related to the menu item. Static and dynamic information about the bus coupler can be found in the following menus.
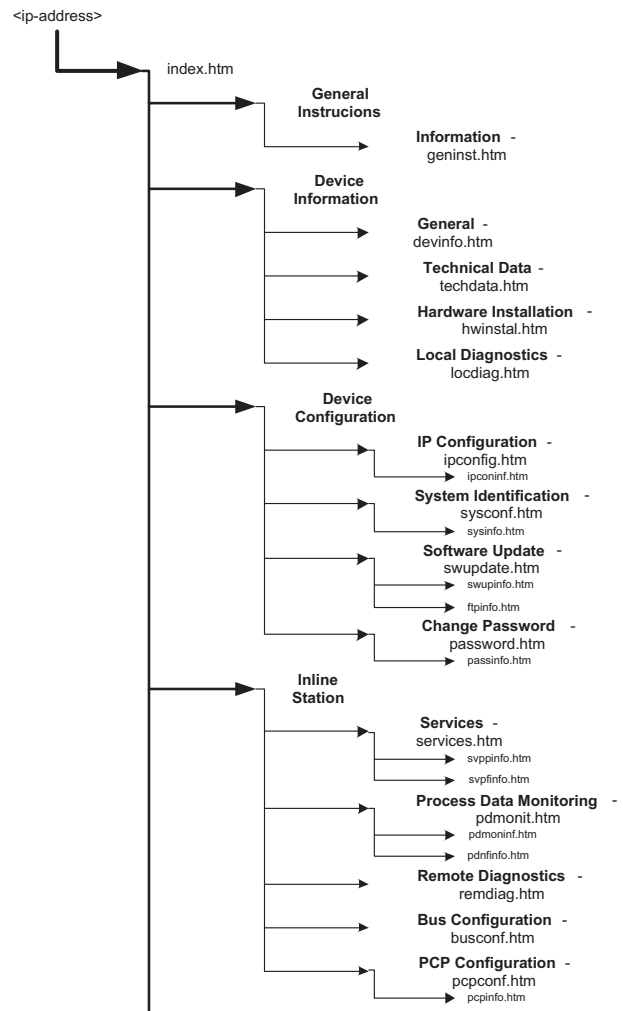
Figure 9   Structure of the web pages

10.3 "IP Configuration" menu

Figure 9 illustrates the set IP parameters and addressing mechanism. To change the IP parameters via WBM, "BootP Requests" must be set to "Disable" or BootP requests to the bus coupler must not be answered (no BootP server can be active in the network).

Figure 10   "IP Configuration" menu

10.4 Password protection

All status changes to the bus coupler require the entry of a password. The password can be changed at any time. Your unique password must be between four and twelve characters long (note that the password is case-sensitive). By default upon delivery, the password is "private".

> **i** If you forget the password, the only way to access the bus coupler again is to reset the entire configuration using the reset button.

10.5 Firmware update via WBM and TFTP

The following steps must be carried out when executing a firmware update using WBM:

– In WBM, click on "Device Configuration" and then "Software Update". Enter the IP address of the TFTP server in the "TFTP Server IP Address" field. Then enter the file name of the firmware and the path name, if necessary, in the "Downloadable File Name" field. In the "Software Update on Next Reboot" field, click "Enable".

– Enter your password. To wait until later to apply the update with a restart, click "Apply". To start the update immediately, click "Apply and Reboot".

– Check the execution of the update by checking the firmware version under "Device Information/General". In the event of an error during the download, a restart repeats the download. To abort the update, set "Disable" in the "Software Update on Next Reboot" field.

Figure 11   "Software Update" menu

ℹ️ If BootP is set to "Enable" and a reply with values for "TFTP Server IP Address" and "Downloadable File Name" is received on a restart, these values overwrite the entries made in WBM. After restart the values accepted are displayed in WBM.

ℹ️ In the event of an error during Flash programming (e.g., voltage interrupt), the bus coupler can only be restarted by repeating the update. The bus coupler starts the update automatically after a restart. Access to WBM is no longer possible.

10.6 Process data access via XML

The integrated web server of the IL ETH BK DI8 DO4 2TX-XC-PAC offers the option of accessing the process data of the connected Inline terminals via a web page in XML format.

You can access the web pages via a standard web browser. For calling the XML pages with the process data enter the address in the following format in the address line of the browser:

http:// <IP address>/procdata.xml

10.7 XML file structure

The XML file contains different data areas:

IL_STATION

Frame for the entire XML file. The mandatory elements of this frame are IL_BUS_TERMINAL and IL_BUS.

IL_BUS_TERMINAL

This data area contains information on the entire Inline station (bus coupler and all connected terminals). This data area includes: TERMINAL_TYPE, the module name NAME, the IP address IP_ADDRESS, the number of connected terminals MODULE_NUMBER, the local bus diagnostic status register DIAGNOSTIC_STATUS_REGISTER, and the local bus diagnostic parameter register DIAGNOSTIC_PARAMETER_REGISTER.

TERMINAL_TYPE

This area contains the designation of the bus coupler, which is always IL ETH BK DI8 DO4.

NAME

Contains the user-specific station name. The station name can be modified via WBM.

IP_ADDRESS

Contains the IP address of the station.

MODULE_NUMBER

Contains the number of connected Inline terminals, including local I/Os. In the event of a bus error, the number of the last known operable configuration is indicated.

DIAGNOSTIC_STATUS_REGISTER

Contains the INTERBUS status, represented by all bits of the diagnostic status register. A detailed description can be found in the diagnostic parameter register. Whenever an error bit is set, the diagnostic parameter register is rewritten.

IL_BUS

Frame for the connected Inline terminals.

IL_MODULE

Frame for the data of an individual Inline terminal. The terminals are numbered consecutively from one to a maximum of 63.

MODULE_TYPE

Contains the terminal type. Possible types are DI, DO, DIO, AI, AO, AIO, and PCP.

PD_CHANNELS

Number of process data channels in an Inline terminal. For digital terminals the number of channels is equal to the number of supported bits. For other terminals, the number of process data words is indicated. Example: An IB IL AO 2 has two process data channels and an IB IL 24 DO 8 has eight bits and eight process data channels.

PD_WORDS

Number of process data words in an Inline terminal. Please note that analog terminals always have the same number of output and input words. An IB IL AO 2 therefore also has two input channels and an IB IL AI 2 also has two output channels.

PD_IN

This area is used by all terminals that occupy input data. The number of process data words depends on the terminal type.

Examples:

a) Inline terminal with two active inputs

```
<IL_MODULE number="1">
<MODULE_TYPE>DI</MODULE_TYPE>
<PD_CHANNELS>2</PD_CHANNELS>
<PD_WORDS>1</PD_WORDS>
<PD_IN word="1">3</PD_IN>
</IL_MODULE>
```

b) Inline terminal with two digital inputs and only the second input is active

```
<IL_MODULE number="3">
<MODULE_TYPE>DI</MODULE_TYPE>
<PD_CHANNELS>2</PD_CHANNELS>
<PD_WORDS>1</PD_WORDS>
<PD_IN word="1">2</PD_IN>
</IL_MODULE>
```

c) Inline terminal with 16 digital inputs and the 13th and the 14th inputs are active

```
<IL_MODULE number="7">
<MODULE_TYPE>DI</MODULE_TYPE>
<PD_CHANNELS>16</PD_CHANNELS>
<PD_WORDS>1</PD_WORDS>
<PD_IN word="1">12288</PD_IN>
</IL_MODULE>
```

The input word returns the value 12288 ($2^{12} + 2^{13}$).

d) Inline terminal with two analog inputs, only the first channel being active (14970)

```
<IL_MODULE number="10">
<MODULE_TYPE>AI</MODULE_TYPE>
<PD_CHANNELS>2</PD_CHANNELS>
<PD_WORDS>2</PD_WORDS>
<PD_IN word="1">14970</PD_IN>
<PD_IN word="2">8</PD_IN>
<PD_OUT word="1">0</PD_OUT>
<PD_OUT word="2">0</PD_OUT>
</IL_MODULE>
```

PD_OUT

This area is used by all terminals with output data. The use of bits is identical with that in "PD_IN".

In the event of an error in the Inline station, this is indicated in the diagnostic registers. The D LED flashes on the bus coupler. The process data is invalid because only internal values are indicated, not the values on the local bus.

In order to make sure that only valid data is displayed, the diagnostic register must also always be requested. The same is true in the event of a faulty configuration. In this case, the local bus does not run and only internal values can be read in the XML file.

In the event of a peripheral fault, all data is valid, except for the data of the faulty terminal.

Figure 12   Screen for XML data

11 Startup behavior of the bus coupler

The startup behavior of the bus coupler is specified via two system parameters, plug and play mode (Var ID 2240_{hex}) and expert mode (Var ID 2275_{hex}). By default upon delivery, plug and play mode is activated and expert mode is deactivated.

11.1 Plug and play mode

i Please note that the following description is valid when expert mode is deactivated.

Plug and play mode active

The IL ETH BK DI8 DO4 2TX-XC-PAC supports plug and play mode (P&P). This mode enables Inline terminals connected in the field to be started up using the bus coupler without a higher-level computer. The P&P mode status (active or inactive) is stored retentively on the bus coupler. The current mode is displayed via the PP LED. In P&P mode, the connected Inline terminals are detected and their function checked. If this physical configuration is ready to operate, it is started, however writing outputs is not enabled.

To enable writing outputs, P&P mode must be deactivated. The deactivation of P&P mode is also the signal to save the active configuration as the reference configuration.

Plug and play mode inactive

When P&P mode is deactivated, the reference configuration is compared to the physical configuration. If they are the same, the bus coupler is set to the "RUN" state.

If the reference configuration and the physical configuration differ, the CO LED lights up and process data exchange is not possible for safety reasons.

In order to operate the bus despite this, you have the following two options:

1. Restore the original configuration so that the reference configuration and the physical configuration are the same again
2. Activate P&P mode and restart the bus coupler so that the active physical configuration is accepted as the reference configuration

11.2 Expert mode

Expert mode inactive

If expert mode is deactivated (default upon delivery), the bus coupler runs as described in 11.1.

Expert mode active

If expert mode is active, the bus is not started automatically. The user must set the station to the "RUN" state using the appropriate firmware commands such as CREATE_CONFIGURATION ,0710_{hex} and START_DATA_TRANSFER, 0701_{hex}. The PP and CO LEDs are not used.

11.3 Possible combinations of modes

P&P mode	Expert mode	Description/effect	Diagram
Inactive	Inactive	Normal case - the station sets valid configurations to the "RUN" state. Process data exchange is possible.	Figure 13 on page 19
Active	Inactive	The connected configuration is stored as the reference configuration and the station is set to the "RUN" state. Process data cannot be written.	Figure 14 on page 19
Any	Active	The bus is not started automatically, instead it waits for firmware commands from the user.	

11.4 Startup diagrams for the bus coupler
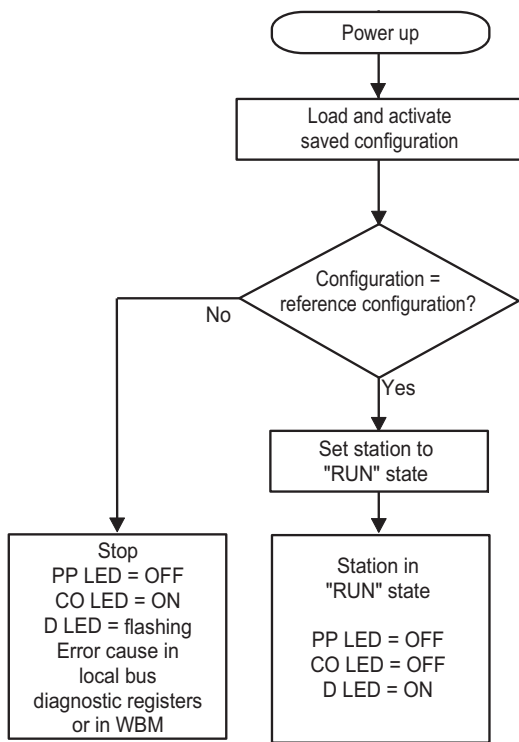
7275A010

Figure 13   "Standard" mode/
P&P and expert mode inactive
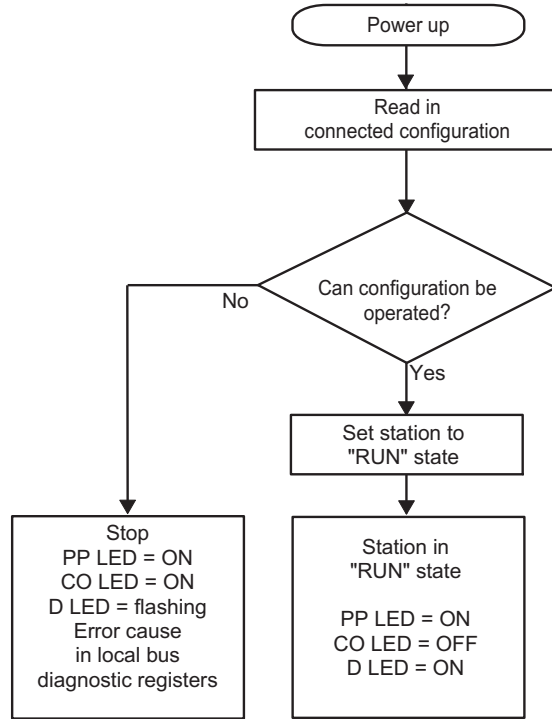
7275A011

Figure 14   P&P mode active and
expert mode inactive

ℹ️ When expert mode is deactivated, the bus coupler must be restarted for the change to take effect.

11.5 Changing and starting a configuration in P&P mode

ℹ️ Ensure that plug and play mode is activated and expert mode is deactivated.

The following steps must be carried out when **changing** an existing configuration:

Switch off the supply voltage.

Change the configuration.

Switch on the supply voltage.

A configuration is **started** as shown in the flowchart (see Figure 13 and Figure 14). During startup, please observe the following:

– Once the bus coupler has been switched on, the previously found configuration is read and started, as long as no errors are present.

– All connected Inline devices are integrated in the active configuration if the "DIAG" LEDs are continuously lit on all terminals.

– To prevent the accidental use of the wrong configuration, process data can only be accessed when P&P mode has been deactivated.

ℹ️ When P&P mode is active, access to process data is rejected with the error message 00A9$_{hex}$ (ERR_PLUG_PLAY). The outputs of the entire Inline station are reset in P&P mode.
P&P mode is activated either using WBM, the Modbus command register or the "Set_Value" command via Ethernet. Once P&P mode has been switched off, the bus is only started if the existing configuration and the reference configuration are the same.

12 Monitoring functions

Monitoring functions with different features are available for monitoring Ethernet communication.

– Process data watchdog (process data monitoring)

– Connection monitoring for Modbus (see "Modbus connection timeout" on page 29) and DTI

The monitoring functions differ according to the features/ functions that need to be monitored. Depending on the application requirements, the appropriate monitoring function can be activated. By default upon delivery, the process data watchdog is activated.

Monitoring mechanism	Monitoring...			
	... the client applica- tion	... the indi- vidual chan- nels	... the Ethernet connec- tion	... pro- cess data exchange
Process data watchdog (process data monitoring)	X	–	X	X
Connection monitoring for Modbus and DTI	X	X	X	–

In the event of an error the system responds with a fault response. The user determines the required fault response mode.

12.1 Setting the required fault response mode

The required fault response mode can be set via web-based management, by writing to Modbus register 2002 or using the "Set_Value" service for variable 2277$_{hex}$. The following fault response modes are available:

Fault response mode	Value	Function
Standard fault mode	0	All outputs are set to "0".
Reset fault mode (default)	1	The digital outputs are set to "0". The analog outputs are set to the default value for the terminal.
Hold last state mode	2	All outputs keep their last value.

12.2 Process data watchdog/process data monitoring

> ℹ️ By default upon delivery, the process data watchdog is activated with a 500 ms timeout.

Process Data Monitoring

Fault Response Mode
- ⦿ Reset Fault Mode (default)
- ○ Standard Fault Mode
- ○ Hold Last State Mode

Process Data Watchdog Timeout: 500 ms

The time is indicated in milliseconds and ranges from 200 ms to 65,000 ms. A value of 0 ms disables the Process OUT Data Monitoring.

Enter password [   ] [Apply]

Network Failure

Status: No network failure (nF) occurred.

Enter password [   ] [Confirm]

Figure 15   Process data monitoring configuration in WBM

Process data watchdog function

A process data watchdog is integrated into the IL ETH BK DI8 DO4 2TX-XC-PAC bus coupler to avoid uncontrolled setting/resetting of the I/O station outputs in the event of an error.

If station outputs are set, the controlling process must be able to access the station. In the event of an error, e.g., network line interrupted or function error in the controlling process, the bus terminal can respond appropriately via the process data watchdog. By default upon delivery, the watchdog is activated with a 500 ms timeout. The first write process activates the process data watchdog. The next write process is expected during the timeout period (default: 500 ms). During error-free operation, the write process is performed during the timeout period and the watchdog is restarted (triggered).

> ℹ️ Reading calls do not trigger the process data watchdog.

NET FAIL

If there is no triggering during the timeout period, an error occurred. Two responses follow:

– The selected fault response mode is executed.

– The Net Fail signal is set (the Net Fail LED is red).

The reason for setting the Net Fail signal is listed in the reason code.

For safety reasons, the user cannot stop the watchdog once it has been activated. If the user terminates the controlling application, there is no watchdog triggering; when the timeout period elapses, the Net Fail signal is set and the selected fault response mode is executed. After the watchdog has performed its task, the outputs are only enabled again after acknowledgment.

> ℹ️ By acknowledging the error, the watchdog is restarted. This means that it must be triggered during the timeout period, otherwise an error is detected again.

Configuration of the process data watchdog

> ℹ️ Timeout periods can only be changed if the watchdog is in the "INIT" state. The "INIT" state is present:
>
> – After power-up, as long as process data exchange has not taken place
>
> When a timeout has occurred and fault response has been activated, and Net Fail has not yet been acknowledged.

The process data watchdog timeout period can be configured from 200 ms to 65000 ms. Timeout periods can be set via web-based management, by writing to Modbus register 2000 or using the "Set_Value" service for variable 2233_{hex}.

Deactivating the process data watchdog

The process data watchdog can only be deactivated if it is in the "INIT" state. For deactivation, the timeout value is set to "zero".
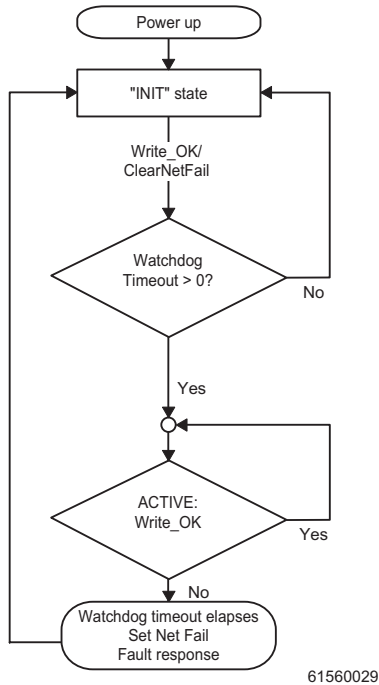
Figure 16   Status diagram of the process data watchdog

Fault response acknowledgment

The Net Fail signal can be acknowledged via web-based management via Modbus, by writing command 0002_{hex} to command register 2006 or using the "ETH_ClrNet FailStatus" function.

Reasons for fault response

The reasons for a fault response and a set Net Fail signal can be accessed via web-based management, Modbus register 2004 or the "ETH_GetNet FailStatus" service.

Possible reasons:

DDI_NF_TASK_CREAT_ERR	0001_{hex}
/* Error when starting a task */	
DDI_NF_LISTENER_ERR	0002_{hex}
/* Listener task error */	
DDI_NF_RECEIVER_ERR	0003_{hex}
/* Receiver task error */	
DDI_NF_ACCEPT_ERR	0004_{hex}
/* Accept function error */	
DDI_NF_ECHO_SERVER_ERR	0005_{hex}
/* Echo server task error */	
DDI_NF_HOST_CONTROLLER_ERR	0006_{hex}
/* Host controller task error */	
DDI_NF_DTI_TIMEOUT	0007_{hex}
/* DTI timeout occurred */	
DDI_NF_HOST_TIMEOUT	0008_{hex}
/* Host timeout occurred */	
DDI_NF_USER_TEST	0009_{hex}
/* NetFail set by user */	
DDI_NF_CONN_ABORT	$000A_{hex}$
/* Connection aborted */	
DDI_NF_INIT_ERR	$000B_{hex}$
/* Initialization error */	
DDI_NF_DTI_WATCHDOG	$000C_{hex}$
/* Process data watchdog triggered */	
DDI_NF_MBUS_TIMEOUT	$000D_{hex}$
/* Modbus timeout occurred */	

13 Modbus protocol

The bus coupler supports a Modbus/TCP server and a Modbus/UDP server with the following features:

13.1 Modbus connections

The bus coupler supports up to eight Modbus/TCP connections simultaneously.

The connection can access different addresses simultaneously (static or dynamic tables). If a connection over SDDI is used and simultaneously a connection to the static table is opened, the SDDI connection is aborted with the xxxx00AA$_{hex}$ error code. Only after a bus coupler reset can the SDDI connection be reestablished. Simultaneous connections over SDDI and Modbus dynamic tables are not write-protected. Writing to static and dynamic tables is protected with semaphores.

Since eight connections are supported, a connection can quickly be restored. This means that the client can successfully restore an interrupted Modbus connection. The UDP server is wireless.

13.2 Modbus interface

The Modbus interface according to standard port 502 supports Modbus communication via the bus coupler.

13.3 Modbus conformance classes

The bus coupler supports Modbus conformance class 0.

13.4 Modbus function codes

The following function codes are supported:

Code no.	Function code
fc3	Read multiple registers
fc4	Read input registers
fc6	Write single register
fc16	Write multiple registers
fc23	Read/write registers

13.5   Modbus tables

Special registers		
Modbus register table (16-bit word)	**Access**	**Function**
1280	Read/write	Modbus connection monitoring timeout
2000	Read/write	Process data watchdog timeout
2002	Read/write	Fault response mode
2004	Read/write	Net Fail reason
2006	Read/write	Command register

PCP		
Modbus register table (16-bit word)	**Access**	**Function**
6020 - 6173	Read/write	See Modbus PCP registers on page 30

Diagnostics		
Modbus register table (16-bit word)	**Access**	**Function**
7996	Read only	Status register
7997	Read only	Local bus diagnostic status register
7998	Read only	Local bus diagnostic parameter register 1
7999	Read only	Local bus diagnostic parameter register 2

Process data (dynamic table)		
Modbus register table (16-bit word)	**Access**	**Function**
8000	Read only	Local digital inputs
8001-(8000+x)	Read only	Bus inputs (x words)
(8001+x)	Read/write	Local digital outputs
(8002+x)-(8001+x+y)	Read/write	Bus outputs (y words)

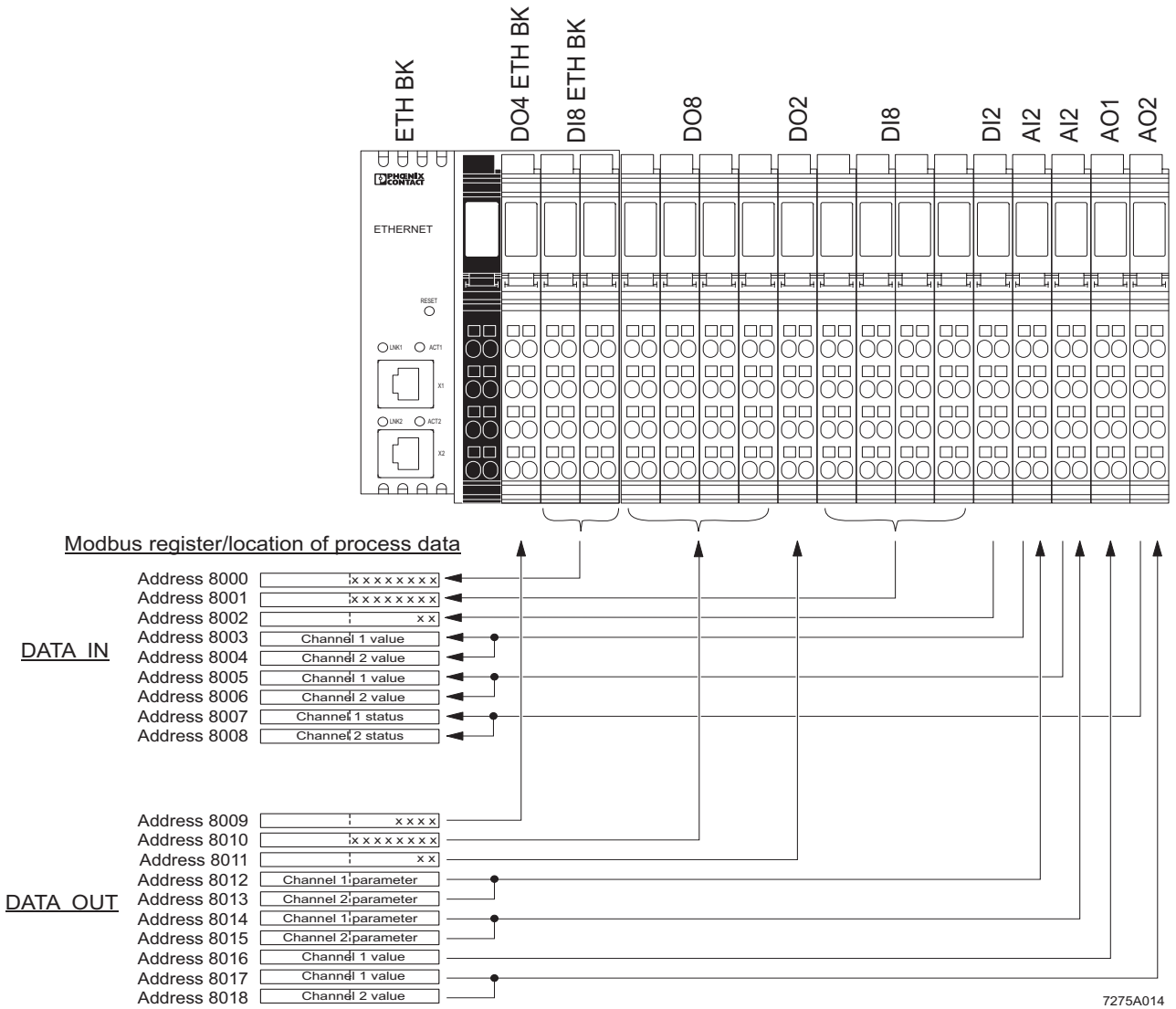| Process data (static table)			
Modbus register table (16-bit word)	**Internal IL ETH BK DI8 DO4 2 TX-XC-PAC tables (16-bit word)**	**Access**	**Function**
0 - 191	%I1 - 192	Read only	Digital inputs
192 - 383	%AI1 - 192	Read only	Analog inputs
384 - 575	%Q1 - 192	Read/write	Digital outputs
576 - 767	%AQ1 - 192	Read/write	Analog outputs

13.6 Assignment of process data

Figure 17   Example for the location of process data in dynamic tables
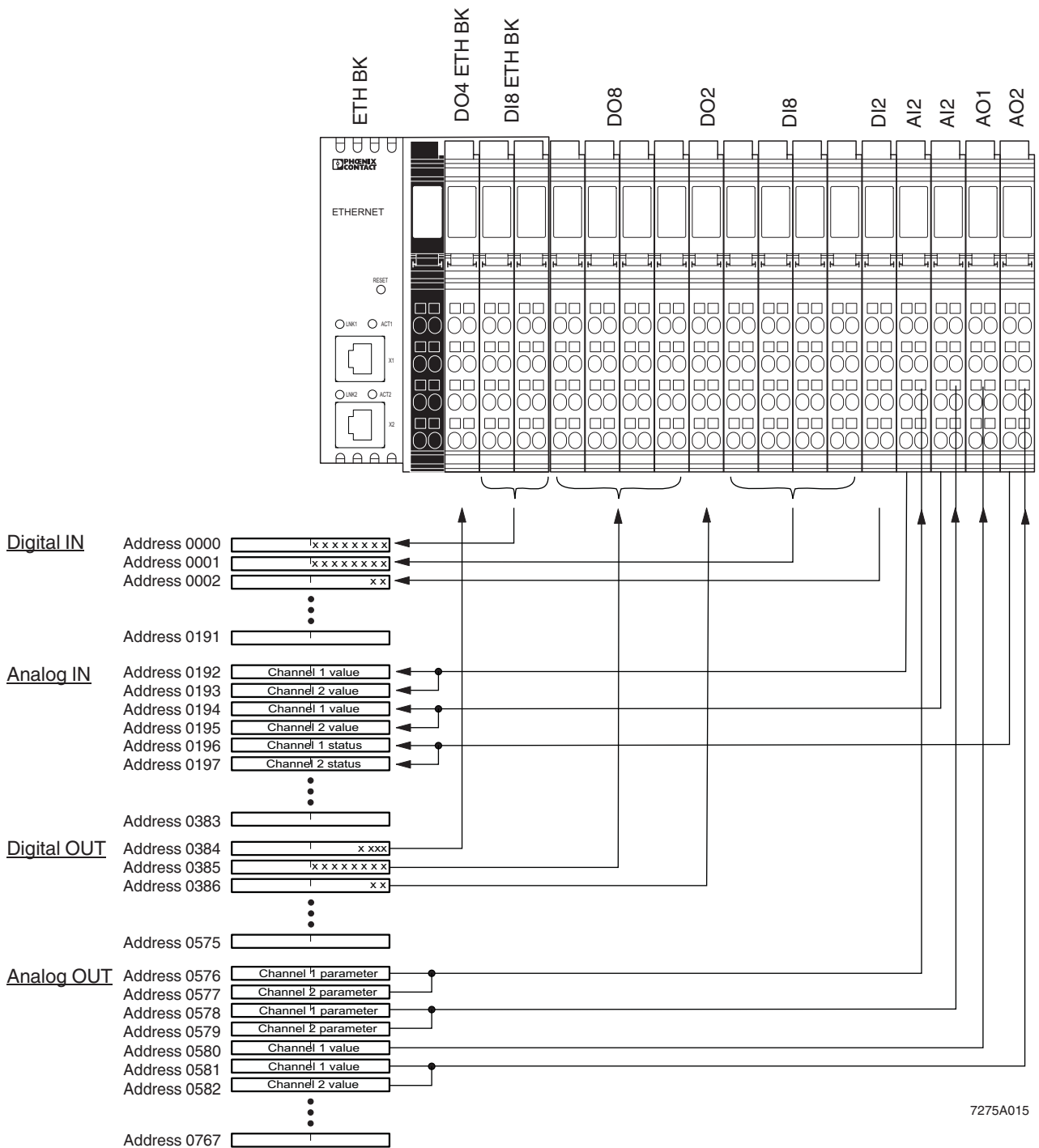
Figure 18   Example for the location of process data in static tables

13.7 Diagnostic registers

Status register

Address:

– Modbus: Register 7996

Using the Ethernet host controller, e.g., PLC, the user can read current diagnostic information from the network interface status word without the need for configuration software.

Only the two least significant bits (bit 0 and bit 1) have a function. The bits of bit 2 to bit 15 are reserved.

– Bit 0 = 0: An error occurred
  (e.g., a bit in the diagnostic register is set).
– Bit 0 = 1: No error
– Bit 1 = 0: No Net Fail
– Bit 1 = 1: Net Fail present

This results in the following values for the status word:

Register contents	State
0000_{hex}	An error occurred (e.g., a bit in the diagnostic register is set).
0001_{hex}	No errors have occurred.
0002_{hex}	A Net Fail occurred.

Local bus diagnostic status register

Address:

– Modbus: Register 7997

Each bit in the local bus diagnostic status register is assigned a state of the local bus master on the bus coupler. The states in the error bits (USER, PF, BUS, CTRL) are described in greater detail using the diagnostic parameter register. Whenever one of the error bits described above is set, the diagnostic parameter register is rewritten. Otherwise, the diagnostic parameter register has the value 0000_{hex}.

Bit	Constant	Meaning
0	USER_BIT	Application program error
1	PF_BIT	Local bus device detected a peripheral fault
2	BUS_BIT	Error on local bus
3	CTRL_BIT	Local bus master has an internal error
4	DETECT_BIT	Error localization ("LOOK FOR FAIL")

Bit	Constant	Meaning
5	RUN_BIT	Exchanging data cycles
6	ACTIVE_BIT	Local bus master ACTIVE
7	READY_BIT	Local bus master READY, selftest completed

Operating indicators: READY, ACTIVE, RUN

The READY, ACTIVE, and RUN operating indicators show the current state of the local bus system. The diagnostic parameter register is not used.

After the selftest, the local bus master is ready for operation. The READY indicator bit is set (READY = 1).

If the local bus master has been configured and the configuration frame activated without errors, the system indicates it is active. The READY and ACTIVE indicator bits are set (READY = 1, ACTIVE = 1).

In addition, the RUN indicator bit is set when data exchange is started (READY = 1, ACTIVE = 1 and RUN = 1).

i	Errors are indicated until they are acknowledged.

Error indicators: DETECT, CTRL, BUS, PF, USER

The DETECT error bit shows that an error is preventing further operation of the local bus (DETECT = 1). The outputs return to the set state, see page 20. The diagnostic routine searches for the error cause.

Once the error cause has been detected, the DETECT error bit will be reset (DETECT = 0) and the error indicated in the USER, PF, BUS and CTRL bits. The diagnostic parameter register and the extended diagnostic parameter register provide a detailed description of the error cause.

Error with local bus shutdown

Error bit/location	Contents of the diagnostic parameter register
CTRL = 1 Probably local bus master/ hardware error.	Error code
BUS = 1 Error on a local bus segment.	Error location

Error without local bus shutdown

Error bit/location	Contents of the diagnostic parameter register
PF = 1 Fault on the peripheral side of a local bus device: – Short circuit at the output – Sensor/actuator supply not present	Error location
USER = 1 User error, e.g., due to incorrect parameters	Error code

Local bus diagnostic parameter register 1

Address:

– Modbus: Register 7998

For detected local bus errors, the local bus diagnostic parameter register contains the error location:

Device number of device, e.g., "0.3" for bus segment 0; device 3,
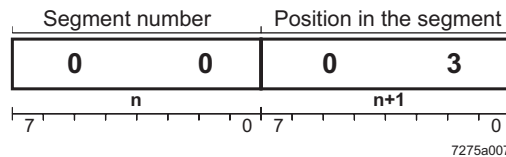
Error location, e.g., device number 0.3

Figure 19   Contents of the local bus diagnostic parameter register (example)

Local bus diagnostic parameter register 2

Address:

– Modbus: Register 7999

Local bus diagnostic parameter register 2 contains additional information about the error codes.

13.8 Special registers

Modbus connection timeout

Modbus: Register 1280

A monitoring mechanism can be activated for every Modbus/TCP connection in order for the bus coupler to detect an error on the network (e.g., faulty cable) or in the client (operating system crash or error in the TCP/IP protocol stack) and respond accordingly. The monitoring mechanism is activated via the relevant TCP connection upon the first read or write procedure.

To change the timeout value for the relevant TCP connection, write the new timeout value to the timeout table to the special address 1280 using functions "fc 6" or "fc 16". The value of this entry is the value of the timeout table. The time is specified in milliseconds in the range from 200 ms to 65000 ms.

A timeout value of "0" deactivates the monitoring function. Values between 1 ms and 199 ms, and values greater than 65000 ms generate exception response 3 (ILLEGAL DATA VALUE).

> ℹ️ Connection monitoring with the new timeout values is only activated after a Modbus/TCP function has been executed on the relevant TCP connection.

After the first access by a Modbus/TCP function, all other access must be carried out using the entered timeout value. Otherwise, fault response mode is activated and the Modbus/TCP connection is disabled.

Process data watchdog timeout

– Modbus: Register 2000

Setting or reading the timeout value for the process data watchdog. The time is specified in milliseconds in the range from 200 ms to 65000 ms. A timeout value of "0" deactivates the watchdog.

Fault response mode

– Modbus: Register 2002

Setting or reading the fault response mode. For information on fault response mode settings, please refer to Section "Setting the required fault response mode" on page 20.

Net Fail reason

Address:

– Modbus: Register 2004

This register can be used to read the reason after setting the Net Fail signal. If there is no Net Fail signal, the register is 0.

Command register

– Modbus: Register 2006

The network interface command register can be used to transmit commands with basic functions to the bus coupler using the Ethernet host controller, e.g., PLC.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Reserved bits													X	X	X

Clear peripheral fault ──┘ | |
Clear NetFail ──────┘ |
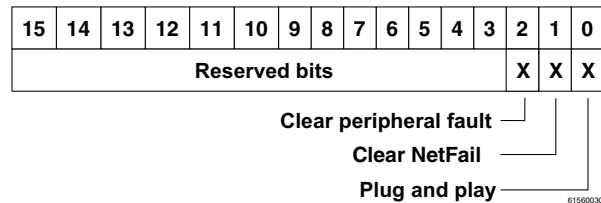Plug and play ────────────┘

61560030

Figure 20   Command word

14 Modbus/TCP PCP registers

14.1 Modbus/TCP PCP registers

The PCP registers are divided into two classes:

– Communication registers for exchanging data with the desired PCP device
– Configuration registers for selecting the invoke ID, index, and subindex of the PCP device

The IL ETH BK DI8 DO4 2TX-XC-PAC supports 16 PCP devices, therefore 16 communication registers and 24 configuration registers are supported.

Example: In order to read object $5FE0_{hex}$ of an IB IL RS 232 with communication reference 4, first set the configuration registers (6041 - 6043) to the desired values with the fc16 command (e.g., 6041 index: $5FE0_{hex}$, 6042 subindex: 0_{hex}, 6043 invoke ID: 0_{hex}). The fc3 command can then be used to read 29 words via communication register 6040.

A Modbus function is only ever used for read/write access to a PCP index. For example, the fc3 command cannot be used to read 20 words from registers 6020 to 6039.

The communication register contains a different value range due to the selected values of the register and the terminal used. Therefore, the IB IL RS 232 terminal, for example, has three different PCP objects: two objects are one word long, but the third is 29 words long. The three configuration registers can be read/written with a single Modbus command. An attempt to access a reserved register generates an exception response.

Communication reference	register	Configuration register	Note
CR 2	6020		
		6021	Index
		6022	Subindex
		6023	Invoke ID
		6024 - 6029	Reserved
CR 3	6030		
		6031	Index
		6032	Subindex
		6033	Invoke ID
		6034 - 6039	Reserved
CR 4	6040		
		6041	Index
		6042	Subindex
		6043	Invoke ID
		6044 - 6049	Reserved
...	...	...	...
CR 16	6160		
		6161	Index
		6162	Subindex
		6163	Invoke ID
		6164 - 6169	Reserved
CR 17	6170		
		6171	Index
		6172	Subindex
		6173	Invoke ID
		6174 - 6179	Reserved

14.2 Transmitting an odd number of data bytes via PCP (firmware version 1.30 or later)

The Modbus functions allow you to exchange data words with PCP devices.

Using bus couplers with firmware version <1.30, it was not possible to access odd-length communication objects.

Firmware version 1.30 includes the "Ignore last byte" option. This option enables odd-length communication objects to be transmitted.

To transmit an odd number of PCP bytes, set bit 0 in the high byte of the "Invoke-ID" PCP configuration register. This leads to the fact that the low byte of the last Modbus data word written or to be read is excluded from PCP transmission.

> **i** The PCP-Invoke-ID is an 8-bit date, thus allowing the high byte of this Modbus register to be used for this function.
> This change is backward compatible, since older firmware versions do not evaluate the bit.

Example 1: Writing 15 data bytes to the $5FE0_{hex}$ object of the PCP device with communication reference 2 (CR 2)

Initialize the configuration register of CR 2:

Modbus address	Register name	Value [hex]
6021	CR 2 index	5FE0
6022	CR 2 subindex	0
6023	CR 2 Invoke-ID	100

Eight data words will then be written to the CR 2 communication register (Modbus address 6020).

In this example, the low byte of the last data word written to the Modbus address 6020 will not be transmitted to the PCP device with CR 2.

Example 2: Reading 11 data bytes from the 5FE0(hex) object of the PCP device with communication reference 4 (CR 4)

Initialize the configuration register of CR 4:

Modbus address	Register name	Value [hex]
6041	CR 4 index	5FE0
6042	CR 4 subindex	0
6043	CR 4 Invoke-ID	100

Six data words will then be read from the CR 4 communication register (Modbus address 6040).

In this example, the last data byte read by the PCP device will be transmitted in the high byte of the last Modbus data word.

15 Device Driver Interface (DDI)

The IL ETH BK DI8 DO4 2TX-XC-PAC bus coupler supports access via the Device Driver Interface (DDI).

> **i** A driver for Windows NT, Windows 2000, and Windows XP can be downloaded at www.phoenixcontact.de/catalog under the name "Ethernet Driver 2.0. exe". Drivers for other operating systems are available from Phoenix Contact on request.

Using this interface requires the appropriate driver to be installed on the host. For a detailed description of the services, please refer to the "Driver reference manual for G4-based controller boards using PC bus and Ethernet", see "Documentation" on page 3.

The following services are supported:

15.1 Services for remote access to the DDI

– DDI_DevOpenNode ( )
– DDI_DevCloseNode ( )
– DDI_DTI_ReadData ( )
– DDI_DTI_WriteData ( )
– DDI_DTI_ReadWriteData ( )
– DDI_MXI_SndMessage ( )
– DDI_MXI_RcvMessage ( )
– GetIBSDiagnostic ( )

15.2 Connection and error monitoring

– ETH_SetDTITimeoutCtrl ( )
– ETH_ClearDTITimeoutCtrl ( )
– ETH_SetNet Fail ( )
– ETH_GetNet FailStatus ( )
– ETH_ClrNet FailStatus ( )
– ETH_SetNet FailMode ( )
– ETH_GetNet FailMode ( )

15.3 Services for process data monitoring

– ETH_ActivatePDinMonitoring ( )
– ETH_DeactivatePDinMonitoring ( )

16   Firmware services

As it is not necessary to use each firmware service in both operating modes (expert mode active/inactive), the following table indicates the assignment of the services to the operating modes. If the services are not used as specified in the table, this may cause the firmware to behave as follows:

1. The service is not permitted in this mode and is rejected with a negative acknowledgment

2. The service is executed and terminated with a positive acknowledgment. The effect of this service is removed by the firmware. Supported firmware services that can be used in every operating mode:

Code	Services	Function
0309_{hex}	Read_Configuration	Reads various entries of the configuration directory Used_Attributes: 0002_{hex} = Device code
$030B_{hex}$	Complete_Read_Configuration	Reads all device data for a configuration Used_Attributes: 0002_{hex} = Device code
0315_{hex}	Read_Device_State	Reads status of local bus devices Device_State_Mask: 0008_{hex} = Peripheral fault
0316_{hex}	Get_Error_Info	Requests additional error information
032Ahex	Get_Version_Info	Reads version information
$032B_{hex}$	Get_Diag_Info	Reads local bus counters Diag_Info_Attr: 0004_{hex} = Global_Count
0351_{hex}	Read_Value	Reads system parameters
0714_{hex}	Control_Device_Function	Sends control commands to local bus devices Device_Function: 0003_{hex} = Conf_Dev_Err 0004_{hex} = Conf_Dev_Err_All
0750_{hex}	Set_Value	Assigns new values to system parameters
0760_{hex}	Confirm_Diagnostics	Updates the diagnostic display and registers
0956_{hex}	Reset_Controller_Board	Resets the controller board

Supported firmware services that are only available in expert mode:

Code	Services	Function
0306_{hex}	Initiate_Load_Configuration	Loads a configuration frame (extension not supported)
0307_{hex}	Load_Configuration	Transmits the device data for a configuration Used_Attributes: 0002_{hex} = Device code
030Ahex	Complete_Load_Configuration	Transmits all device data for a configuration Used_Attributes: 0002_{hex} = Device code
0308_{hex}	Terminate_Load_Configuration	Terminates the transmission of configuration data only for automatic parameterization
$030C_{hex}$	Delete_Configuration	Deletes a configuration
$030E_{hex}$	Control_Parameterization	Starts or ends the parameterization phase
0701_{hex}	Start_Data_Transfer	Starts data transmission
0710_{hex}	Create_Configuration	Reads in the connected configuration
0711_{hex}	Activate_Configuration	Compares the saved and connected configuration
1303_{hex}	Alarm_Stop	Resets the local bus

> ℹ️ For additional information about firmware services, please refer to the IBS SYS FW G4 UM E user manual.

System parameters for the "Set_Value" (750$_{hex}$) and "Read_Value" (351$_{hex}$) services

Variable_ID	System parameter	Value/note
0104$_{hex}$	Diagnostic status register (16-bit word)	Read only
0105$_{hex}$	Diagnostic parameter register 1 (16-bit word)	Read only
010D$_{hex}$	Diagnostic parameter register 2 (16-bit word)	Read only
2216$_{hex}$	Current PD cycle time (32-bit word)	Read only
2240$_{hex}$	Plug and play mode (32-bit word)	0: Plug and play mode deactivated 1: Plug and play mode activated
2275$_{hex}$	Expert mode (32-bit word)	0: Expert mode deactivated 1: Expert mode activated
2277$_{hex}$	Fault response mode (32-bit word)	See page 20
2293$_{hex}$	Process data watchdog timeout (32-bit word)	See page 21

17 PCP communication

17.1 Transmission of parameter data

Intelligent devices such as frequency inverters or controllers exchange process data with each other and also exchange larger volumes of data with the control system. Such data can, for example, be used for the startup phase of a machine. This type of parameter data rarely changes and is transmitted when necessary.

The INTERBUS protocol can transmit process data and complex data records (parameter data) simultaneously. The comprehensive parameter data is divided into smaller units, transmitted and then recombined.

In the INTERBUS system, the Peripherals Communication Protocol (PCP) divides the parameter data into individual segments. After transmission it recombines the data. PCP refers to the protocol software. This software provides the necessary services for connection establishment and connection abort, etc.

	For detailed information on PCP communication, please refer to the IBS SYS PCP G4 UM E user manual.

	Please note that a maximum of 16 PCP terminals can be connected to a bus coupler.

17.2 Supported PCP commands

The MXI interface of the DDI can be used to send the following PCP commands.

Service	Service code
Initiate_Request	008B$_{hex}$
Abort_Request	088D$_{hex}$
Read_Request	0081$_{hex}$
Write_Request	0082$_{hex}$
Information_Report_Request	0885$_{hex}$
Status_Request	0083$_{hex}$
Identify_Request	0087$_{hex}$
Load_Kbl_Par_Loc_Request	0264$_{hex}$
Read_Kbl_Loc_Request	0203$_{hex}$

17.3 Configuration of the PCP PDU size

The standard PDU size for communication with all Phoenix Contact Inline devices is 64 bytes in the transmit and receive direction.

System couplers such as the ILC 200 UNI have configurable PDU sizes. If a different size will be configured and an IL ETH BK DI8 DO4 2TX-XC-PAC is used to communicate with the size, the bus coupler must also be configured to the new values.
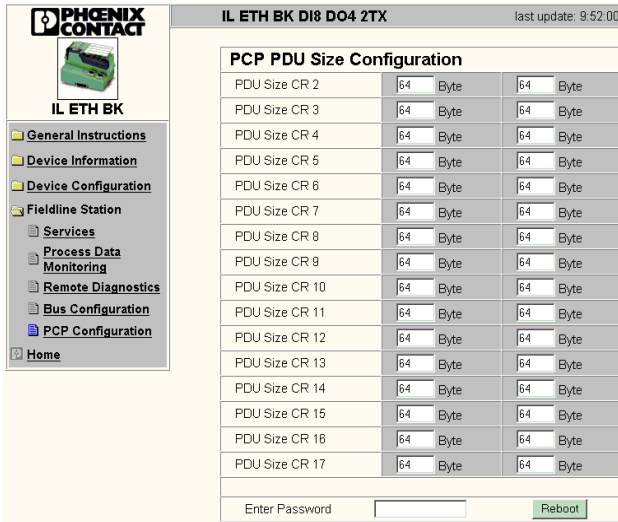

Figure 21   PCP configuration in web-based management

18 Simple Network Management Protocol (SNMP)

The bus coupler supports SNMP v1 and v2c.

Management Information Base - MIB

> ℹ️ The corresponding latest MIBs are available on the Internet at www.phoenixcontact.de/catalog.

For the object descriptions, please refer to the ASN1 descriptions of this product. These can be found on the Internet at www.phoenixcontact.net/catalog.

The password for read access is "public" and cannot be changed. By default upon delivery, the password for read/write access is "private" and can be modified at any time.