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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

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Ethernet



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 negotiation 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)



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



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

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2 Ordering data

Product

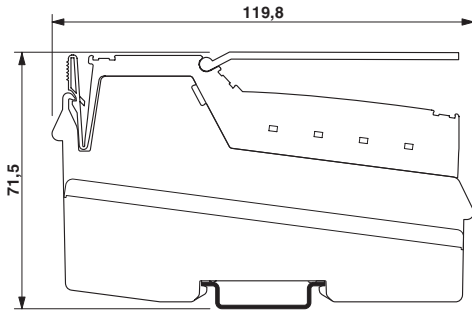
Description	Type	Order No.	Pcs. / Pkt.
Modbus/TCP(UDP) bus coupler, version for extreme conditions, 8 inputs, 24 V DC, 4 outputs, 24 V DC, 500 mA, complete with I/O connectors	IL ETH BK DI8 DO4 2TX-XC-PAC	2701388	1

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 mm ² , 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 mm ² , 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	Specifications 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 mm ² ... 1.5 mm ²
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 terminals with remote bus branch	No



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 $\pm 5\%$
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.

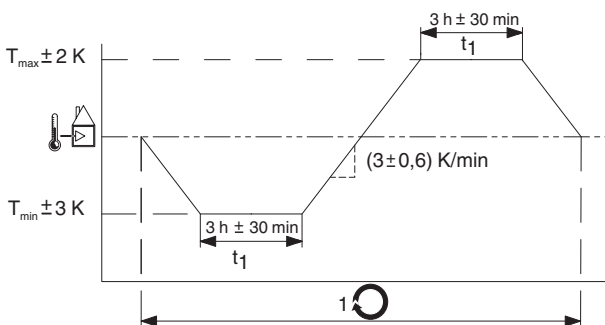


Figure 1 Temperature change cycle

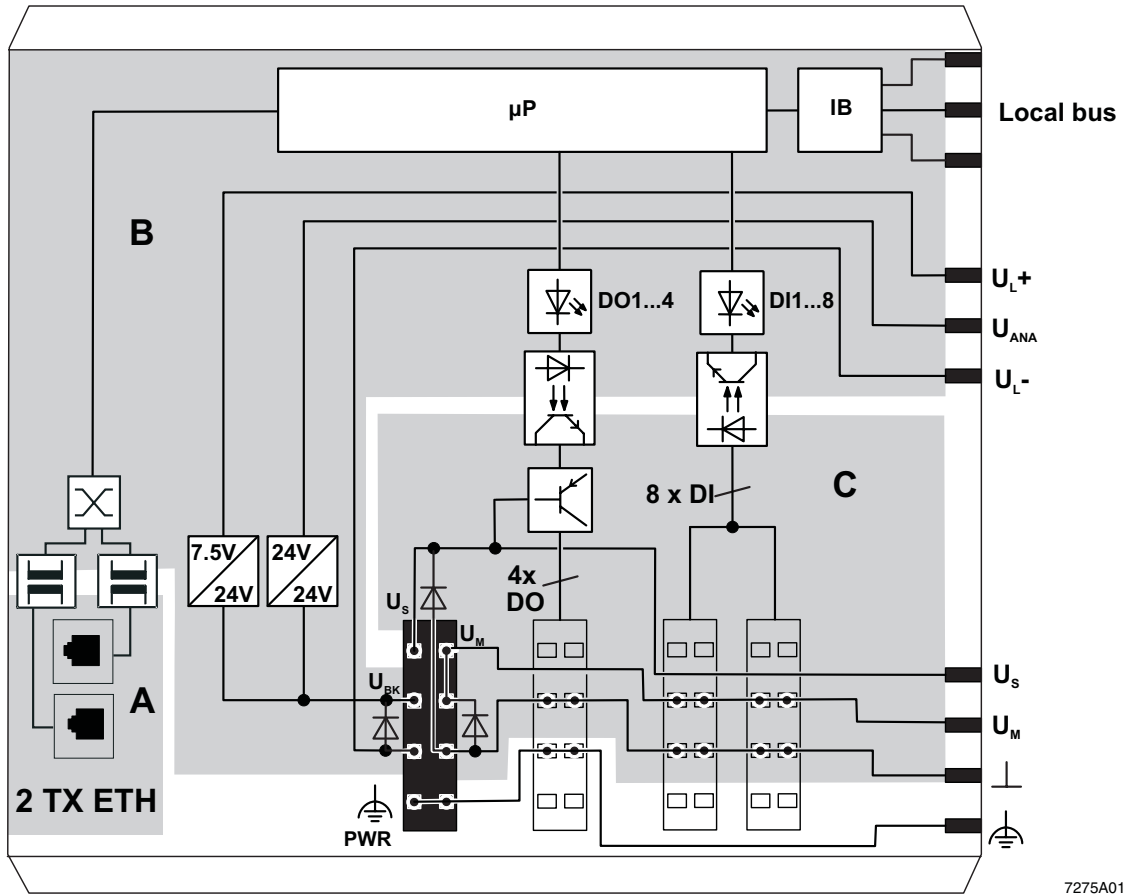


Temperature in the control cabinet/ambient temperature



Cycle



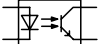



5 Basic circuit diagram



7275A016

Figure 2 Basic circuit diagram of the Ethernet bus coupler

Key:

	Microprocessor
	Protocol chip
	Optocoupler
	Ethernet switch
	PNP transistor
	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

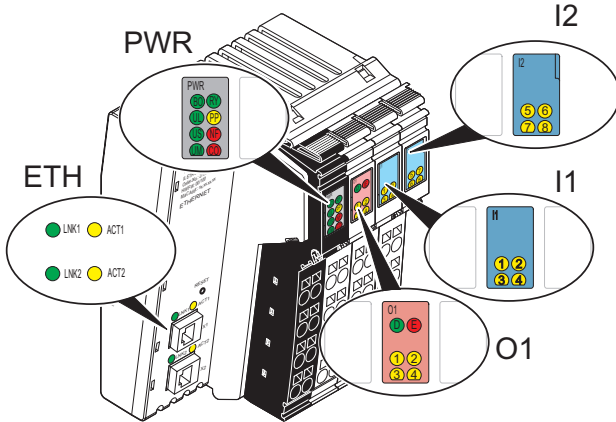


Figure 3 Indicators on the bus coupler

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 (Boot)
		ON	Boot loader active, firmware started
		Flashing	Waiting for BootP reply
		OFF	Firmware started successfully
RY	Green		Ready
		ON	Connection to a process data client (Modbus/TCP (UDP) or DDI) established
		Flashing	Firmware ready to operate
		OFF	Firmware not active
PP	Yellow		Plug and play
		ON	Plug and play mode active
		OFF	Plug and play mode not active

LED	Color	State	Meaning
NF	Red		Network failure
		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		Configuration
		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		Error
		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.

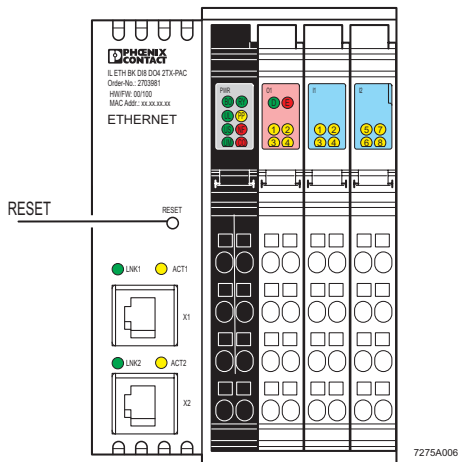


Figure 4 Reset button

8 Connecting Ethernet, supply, actuators, and sensors

8.1 Connecting Ethernet

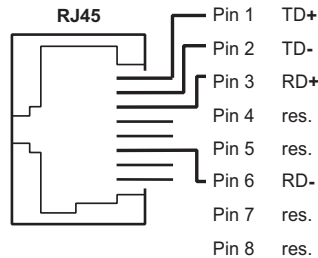


Figure 5 Pin assignment of the 8-pos. RJ45 female connector

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



Both Ethernet interfaces are equipped with the auto crossover function.



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.



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

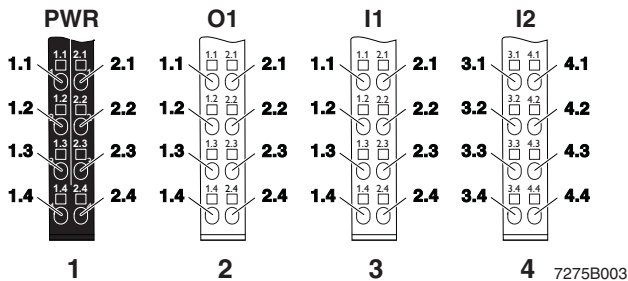


Figure 6 Terminal point assignment of the Inline connectors

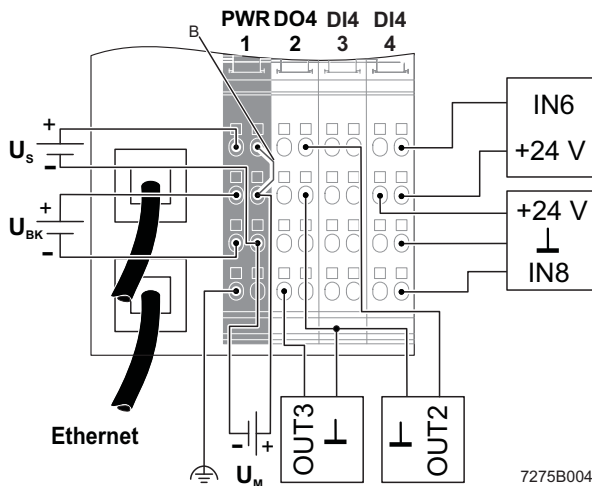


Figure 7 Connection example

B: Internal jumper

Connect the bus coupler according to Figure 7.

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.



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



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

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

Expert mode	Enable
	Disable



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.



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



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 D18 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

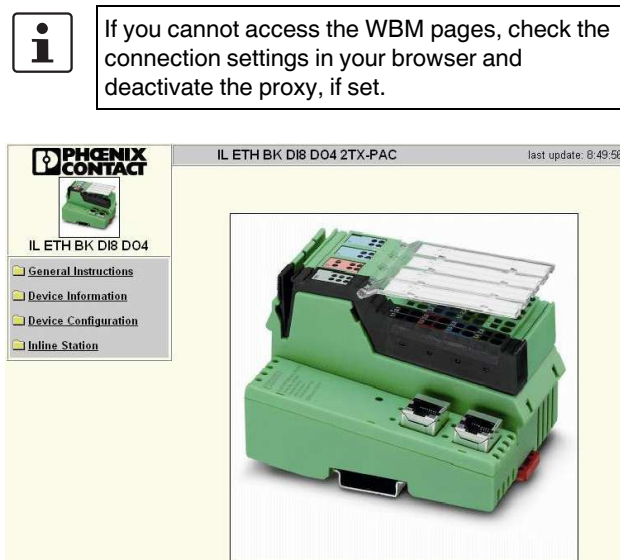


Figure 8 WBM homepage

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.

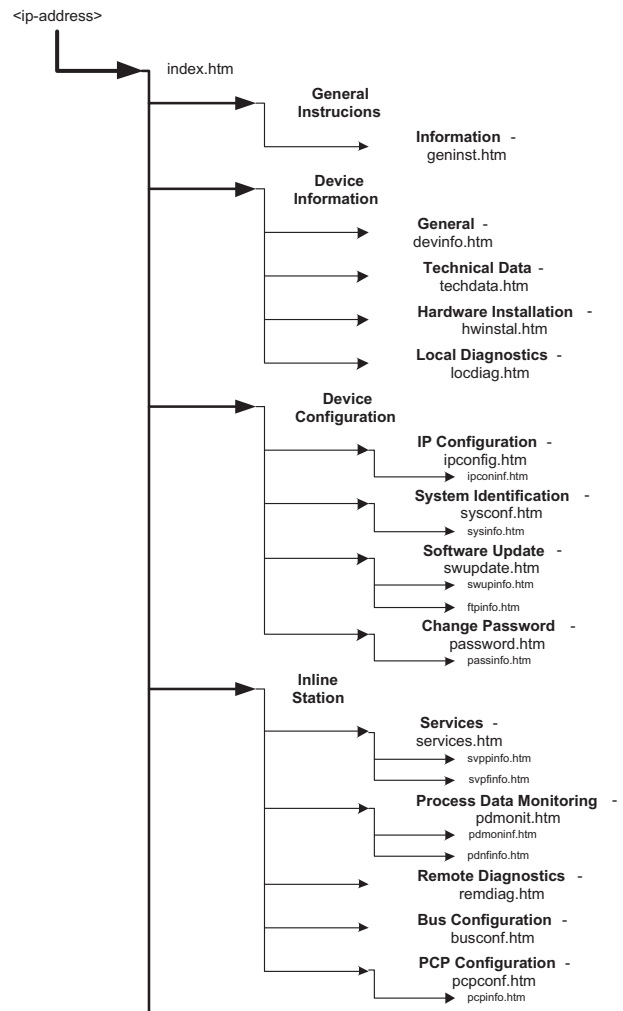


Figure 9 Structure of the web pages

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).

IP Configuration	
IP Address	<input type="text" value="172.16.113.38"/>
Subnet Mask	<input type="text" value="255.255.255.0"/>
Default-Gateway	<input type="text" value="0.0.0.0"/>
<i>Please enter IP Address, Subnet Mask and Gateway Address in dotted decimal notation (e.g., 172.16.16.230). The changes will take effect after the reboot of the IL ETH BK D18 DO4.</i>	
Enter Password	<input type="password"/> <input type="button" value="Reboot"/>
BootP Requests	<input type="radio"/> Enable <input checked="" type="radio"/> Disable
<i>Before disabling automatic BootP setting, be sure to record the current IP address. You will need the current IP address if you want to re-enable BootP setting of the IP address. If you forget the IP address, the only way is to delete the whole configuration over the Reconf-Button.</i>	
Enter Password	<input type="password"/> <input type="button" value="Apply"/>

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".



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.

Software Update	
TFTP Server IP Address	TFTP:// <input type="text" value="172.16.40.201"/>
Downloadable File Name	<input type="text" value="c2703981.fw"/>
Software Update on Next Reboot	<input type="radio"/> Enable <input checked="" type="radio"/> Disable
TFTP Update Status	A Firmware Update was not initiated before the last restart.
<i>If the software update status is set to enable the IL ETH BK D18 DO4 will try to load new software within the next reboot. Press the apply button to change the software update status. The settings will take effect after the next reboot of the IL ETH BK D18 DO4.</i>	
Enter password	<input type="password"/> <input type="button" value="Apply"/> <input type="button" value="Apply and Reboot"/>
Software Update via FTP on Next Reboot	<input type="radio"/> Enable <input checked="" type="radio"/> Disable
<i>If the software update status is set to enable, the IL ETH BK D18 DO4 will try to load new software after reboot. Press the apply and reboot button to change the software update status and start reboot of the IL ETH BK D18 DO4.</i>	
Enter password	<input type="password"/> <input type="button" value="Apply and Reboot"/>

Figure 11 "Software Update" menu



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.



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.

```

<?xml version="1.0" encoding="ISO-8859-1" ?>
<!DOCTYPE IL_STATION (View Source for full doctype...)>
- <IL_STATION>
- <IL_BUS_TERMINAL>
  <TERMINAL_TYPE>IL ETH BK DI8 DO4</TERMINAL_TYPE> ← Data of Inline Station
  <NAME>IL ETH BK DI8 DO4 2TX-PAC</NAME>
  <IP_ADDRESS>172.16.113.38</IP_ADDRESS>
  <MODULE_NUMBER>6</MODULE_NUMBER>
  <DIAGNOSTIC_STATUS_REGISTER>224</DIAGNOSTIC_STATUS_REGISTER> ← Diagnostic Register
  <DIAGNOSTIC_PARAMETER_REGISTER>0</DIAGNOSTIC_PARAMETER_REGISTER>
</IL_BUS_TERMINAL>
- <IL_BUS>
- <IL_MODULE number="1">
  <MODULE_TYPE>DO</MODULE_TYPE>
  <PD_CHANNELS>4</PD_CHANNELS>
  <PD_WORDS>1</PD_WORDS>
  <PD_OUT word="1">0</PD_OUT> ← Data of the first digital Output terminal
</IL_MODULE>
- <IL_MODULE number="2">
  <MODULE_TYPE>DI</MODULE_TYPE>
  <PD_CHANNELS>8</PD_CHANNELS>
  <PD_WORDS>1</PD_WORDS>
  <PD_IN word="1">0</PD_IN> ← Data of the first digital Input terminal
</IL_MODULE>
- <IL_MODULE number="3">
  <MODULE_TYPE>DO</MODULE_TYPE>
  <PD_CHANNELS>32</PD_CHANNELS>
  <PD_WORDS>2</PD_WORDS>
  <PD_OUT word="1">0</PD_OUT>
  <PD_OUT word="2">0</PD_OUT>
</IL_MODULE>
- <IL_MODULE number="4">
  <MODULE_TYPE>DI</MODULE_TYPE>
  <PD_CHANNELS>32</PD_CHANNELS>
  <PD_WORDS>2</PD_WORDS>
  <PD_IN word="1">0</PD_IN>
  <PD_IN word="2">0</PD_IN>
</IL_MODULE>
- <IL_MODULE number="5">
  <MODULE_TYPE>AIO</MODULE_TYPE>
  <PD_CHANNELS>2</PD_CHANNELS>
  <PD_WORDS>2</PD_WORDS>
  <PD_IN word="1">1</PD_IN>
  <PD_IN word="2">0</PD_IN>
  <PD_OUT word="1">0</PD_OUT>
  <PD_OUT word="2">0</PD_OUT>
</IL_MODULE>
- <IL_MODULE number="6">
  <MODULE_TYPE>AO</MODULE_TYPE>
  <PD_CHANNELS>1</PD_CHANNELS>
  <PD_WORDS>1</PD_WORDS>
  <PD_OUT word="1">0</PD_OUT>
</IL_MODULE>
</IL_BUS>
</IL_STATION>

```

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



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.

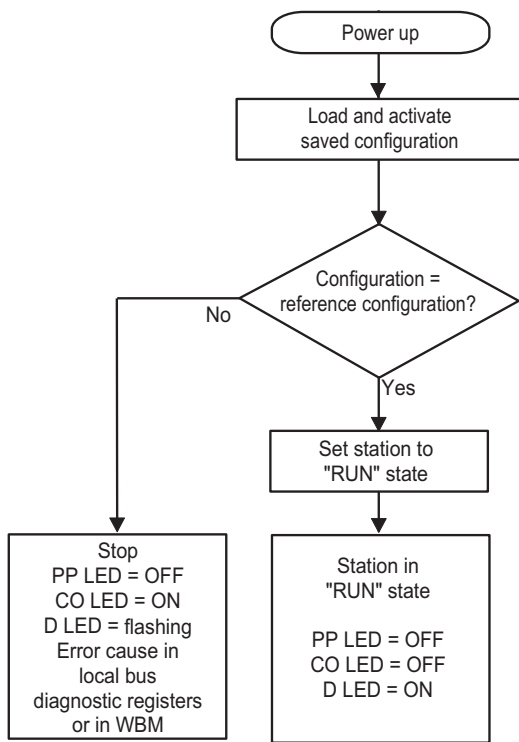
Expert mode active

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

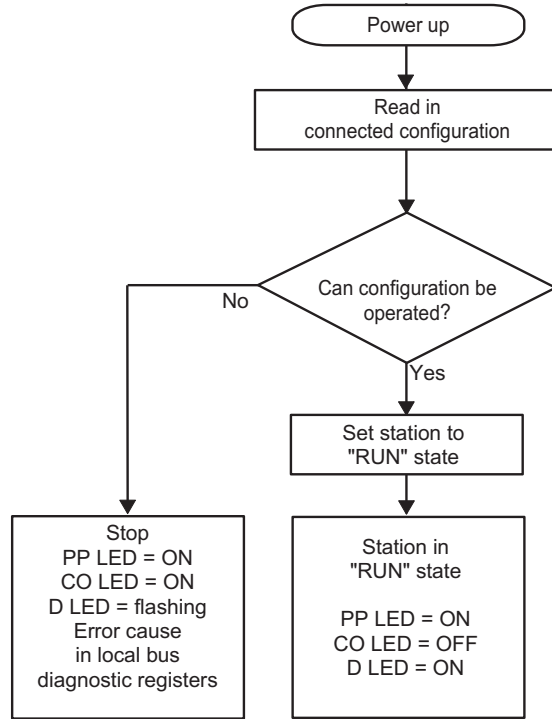
P&P mode	Expert mode	Description/effect	Diagram
Inactive	Inactive	Normal case - the station sets valid configurations to the "RUN" state. Process data exchange is possible.	Figure 13 on page 19
Active	Inactive	The connected configuration is stored as the reference configuration and the station is set 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



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



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.



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 application	... the individual channels	... the Ethernet connection	... process 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

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

Process Data Monitoring	
Fault Response Mode	<input checked="" type="radio"/> Reset Fault Mode (default) <input type="radio"/> Standard Fault Mode <input type="radio"/> Hold Last State Mode
Process Data Watchdog Timeout	500 ms
<i>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.</i>	
Enter password	<input type="text"/> <input type="button" value="Apply"/>
Network Failure Status: No network failure (nF) occurred.	
Enter password	<input type="text"/> <input type="button" value="Confirm"/>

Figure 15 Process data monitoring configuration in WBM

Process data watchdog function

A process data watchdog is integrated into the IL ETH BK D18 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).

i 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.

i 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

i 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".

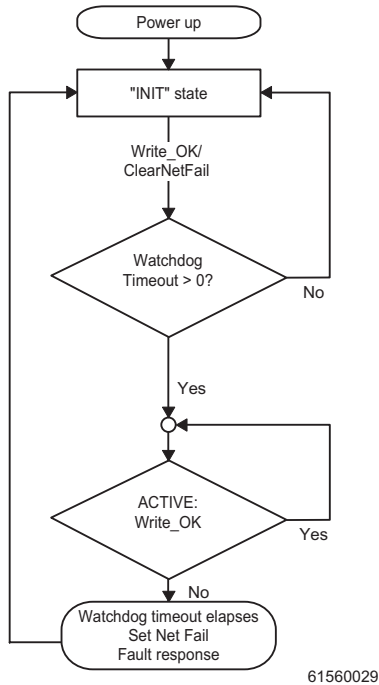


Figure 16 Status diagram of the process data watchdog

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 $\text{xxxx00AA}_{\text{hex}}$ 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

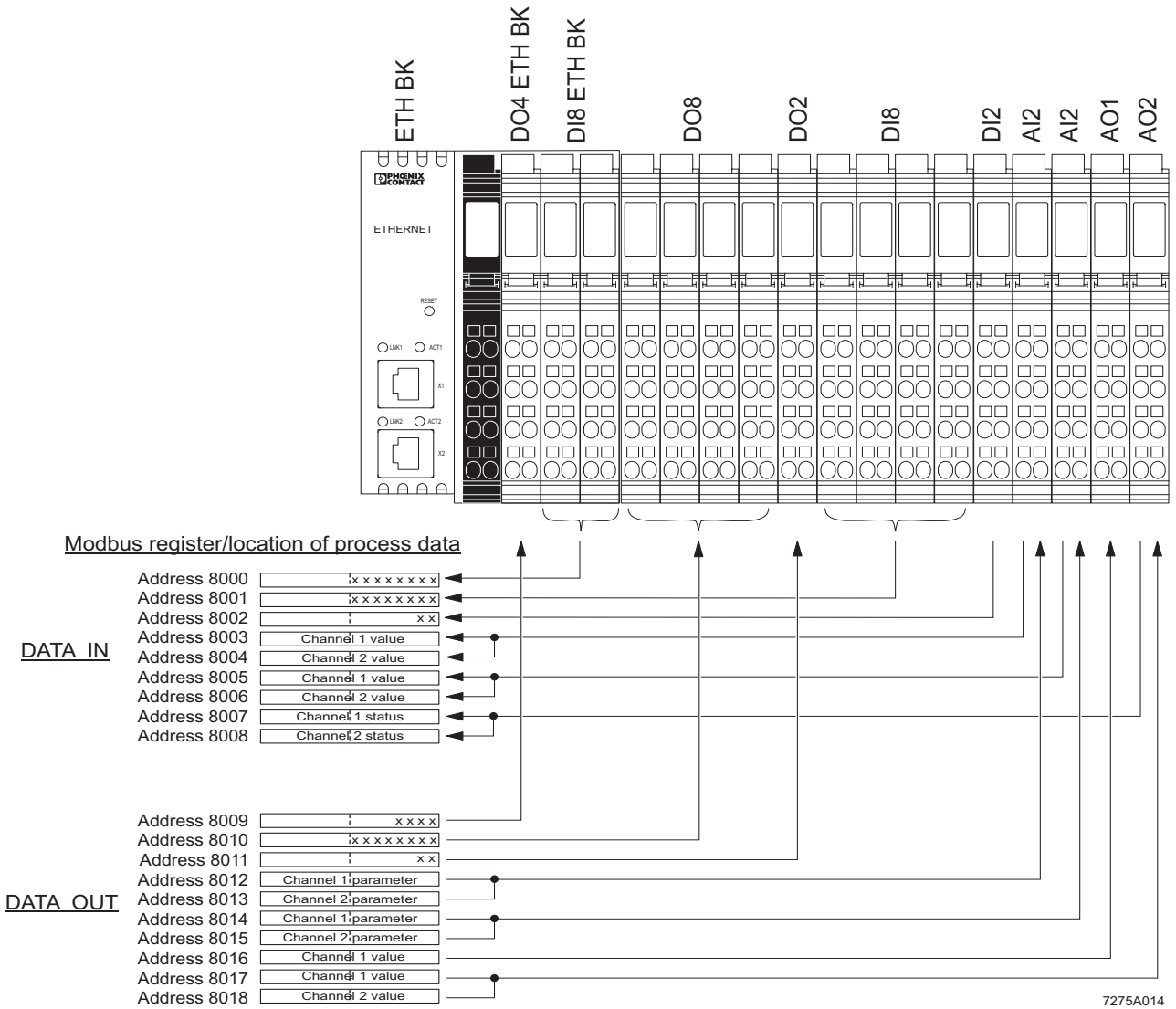


Figure 17 Example for the location of process data in dynamic tables