

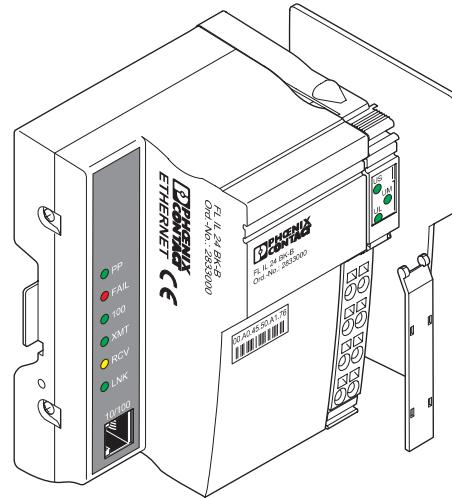
# FL IL 24 BK-B-PAC

## Inline bus coupler for Ethernet

### AUTOMATION

Data sheet  
7580\_en\_01

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### 1 Description

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

With the help of a bus coupler, 63 Inline terminals can be connected at any position within an existing Ethernet system.

### Features

- Ethernet TCP/IP; 10/100 Base-T(X)
- Transmission speeds of 10 Mbps and 100 Mbps
- Ethernet connection via 8-pos. RJ45 female connector
- Up to 63 other Inline terminals can be connected (process data channel)
- DDI (Device Driver Interface) software interface and Modbus/TCP
- Process data access via XML
- Management via WEB
- IP parameter setting via BootP
- Diagnostic and status LEDs
- Driver software for Sun Solaris/ Windows NT/2000
- Software interface kit for other Unix systems
- Approved for the use in potentially explosive areas (observe the notes on page 10)



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

For further information on the bus coupler, please refer to the FL IL 24 BK-B UM E user manual.



Make sure you always use the latest documentation.

It can be downloaded at [www.download.phoenixcontact.com](http://www.download.phoenixcontact.com).

A conversion table is available on the Internet at [www.download.phoenixcontact.com/general/7000\\_en\\_00.pdf](http://www.download.phoenixcontact.com/general/7000_en_00.pdf).



This data sheet is valid for the products listed on the following page:

FL IL 24 BK-B-PAC

## 2 Ordering data

### Products

Description	Type	Order No.	Pcs./Pkt.
Inline bus coupler for Ethernet; complete with accessories (connectors, labeling fields and end plate)	FL IL 24 BK-B-PAC	2862327	1

### Accessories: Ethernet

Description	Type	Order No.	Pcs./Pkt.
Gray RJ45 connector set for linear cable	FL PLUG RJ45 GR/2	2744856	2
Green RJ45 connector set for crossed cable	FL PLUG RJ45 GN/2	2744571	2
Double sheathed Ethernet cable	FL CAT5 HEAVY	2744814	
Stranded Ethernet cable	FL CAT5 FLEX	2744830	
Assembly tool for RJ45 connector	FL CRIMPTOOL	2744869	
Media converter 660 nm	FL MC 10BASE T/FO POF	2744513	
Media converter 850 nm	FL MC 10BASE T/FO G850	2744788	

### Accessories: Software

Description	Type	Order No.	Pcs./Pkt.
Factory Manager, network management software	FL SWT	2831044	1
FL SNMP OPC gateway, software for information exchange between SNMP and OPC	FL SNMP OPC SERVER	2832166	1
INTERBUS OPC server	FL OPC SNMP AGENT	2832179	1
CD-ROM with German and English product version 2.1x and online documentation. Additional language versions are available on request.	IBS OPC SERVER	2729127	1
IO configurator; CD-ROM with driver software, example program, OPC configurator and user documentation in pdf format	CD FL 24 24 BK	2832069	1

### Accessories: Connector as replacement item

Description	Type	Order No.	Pcs./Pkt.
Inline connector, with color print	IB IL SCN-8-CP	2727608	1

### Accessories: Other

Description	Type	Order No.	Pcs./Pkt.
Recommended end clamp; placed both to the right and left of the module to secure it on the DIN rail	CLIPFIX 35-5	3022276	50
Power supplies	QUINT-PS ... see INTERFACE catalog		

### Documentation

Description	Type	Order No.	Pcs./Pkt.
"Hardware and Firmware Manual for the Inline/Ethernet BusCoupler" user manual	FL IL 24 BK-B UM E	2698766	1
"Automation Terminals of the Inline Product Range" user manual	IL SYS INST UM E	2698737	1
"I/O modules at bus couplers" application note	AH IL BK IO LIST	9015358	1
"Inline Terminals for Use in Zone 2 Potentially Explosive Areas" application note	AH EN IL EX ZONE 2	-	-

### 3 Technical data

#### General data

Housing dimensions (width x height x depth)	90 mm x 120 mm x 72 mm
Weight	270 g, typical
Ambient temperatures (operation)	0°C ... +55°C
Ambient temperature (storage/transport)	-25°C ... +85°C
Permissible humidity (operation/storage/transport)	10% ... 95% according to EN 61131-2
Permissible air pressure (operation/storage/transport)	70 kPa ... 106 kPa (up to 3000 m above sea level)
Degree of protection	IP20 according to IEC 60529
Class of protection	Class 3 according to EN 61131-2, IEC 61131-2
Connection to protective earth ground	Functional earth ground must be connected through the 24 V DC power/FE connector. The contacts are directly connected to the potential jumper and FE springs on the bottom of the housing. The terminal is grounded when it is snapped onto a grounded DIN rail. Functional earth ground is only used to discharge interference.
Ambient compatibility	Free from substances that would hinder coating with paint or varnish (according to VW specification)
Resistance to solvents	Standard solvents
Connection data for Inline connectors	
Connection method	Spring-cage terminals
Conductor cross-section	0.08 mm <sup>2</sup> to 1.5 mm <sup>2</sup> (solid or stranded), 28 - 16 AWG

#### Interfaces

##### Ethernet interface

Number	One
Connection format	8-pos. RJ45 female connector
Connection medium	Twisted pair cable with a conductor cross section of 0.14 mm <sup>2</sup> to 0.22 mm <sup>2</sup>
Cable impedance	100 Ω
Transmission speed	10/100 Mbps
Maximum network segment expansion	100 m
<b>Inline local bus</b>	
Connection	Through data routing
Transmission speed	500 kbps
Electrical isolation	No
Number of Inline terminals that can be connected	
Limitation through software	63, maximum
Limitation through power supply unit	Maximum logic current consumption of the connected local bus modules: $I_{max} \leq 2 \text{ A DC}$



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.

#### Protocols/MIBs

Supported protocols	TCP/UDP BootP
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### Common data for 24 V main supply, segment supply, and bus coupler supply

Connection	Through Inline connector; terminal point assignment see page 9
Recommended cable lengths	30 m, maximum; routing cables through outdoor areas is not permitted
Continuation	Via potential routing
Special demands on the voltage supply	The $U_M/U_S$ supplies are electrically isolated from the bus coupler supply $U_{BK}$ if they are supplied separately. This is only ensured if two separate power supply units are used.
Nominal value	24 V DC
Tolerance	-15%/+20% (according to EN 61131-2)
Ripple	± 5%
Permissible range	19.2 V to 30 V



#### NOTE: Module damage in the event of overload

Each 24 V area must be protected externally. The power supply unit must be able to supply 4 times (400%) the nominal current of the external fuse, to ensure that the fuse blows safely in the event of an error.

### 24 V main supply ( $U_M$ )/24 V segment supply ( $U_S$ )

Behavior in the event of voltage fluctuations	Voltages (main and segment supply) that are transferred from the bus coupler to the potential jumpers follow the supply voltages without delay.
Current carrying capacity	8 A, maximum (total current of $U_S$ and $U_M$ )

### 24 V bus coupler supply $U_{BK}$

Minimum current consumption at nominal voltage	92 mA (At no-load operation, i.e., Ethernet connected, no local bus devices are connected, bus inactive)
Maximum current consumption at nominal voltage	1.5 A (Load of the 7.5 V communications power with 2 A, the 24 V analog voltage with 0.5 A)



Communications power  $U_L$  (7.5 V) and the analog supply  $U_{ANA}$  (24 V) are generated from the bus coupler supply  $U_{BK}$ .

### Communications power ( $U_L$ ) and analog supply ( $U_{ANA}$ )

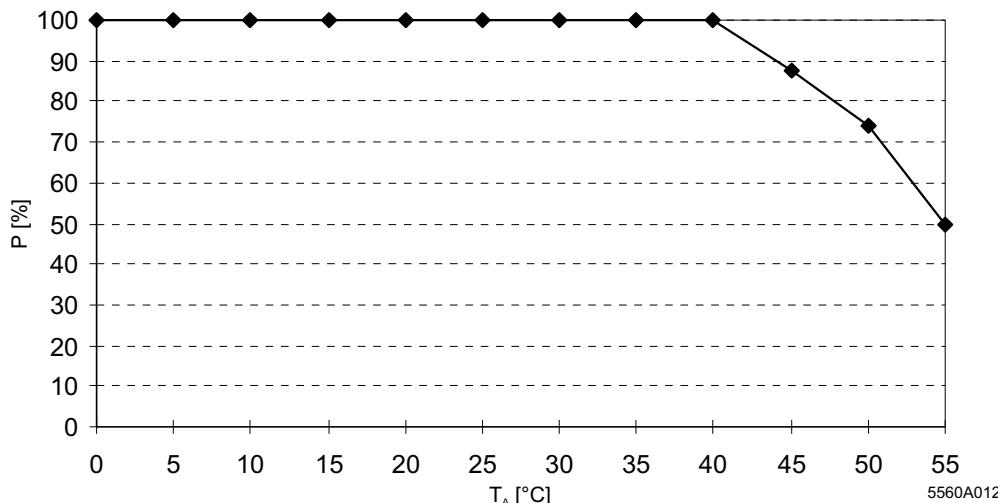
#### Communications power (potential jumpers)

Nominal value	7.5 V DC
Maximum output current	2 A DC (observe derating)
Safety equipment	Electronic short-circuit protection

#### Analog supply (potential jumpers)

Nominal value	24 V DC
Maximum output current	0.5 A DC (observe derating)
Safety equipment	Electric short-circuit protection

### Derating of the communications power and the analog terminal supply



P [%] Current carrying capacity of the power supply unit for communications power and analog supply in %  
T<sub>A</sub> [°C] Ambient temperature in °C

### Power dissipation

#### Formula to calculate the power dissipation of the electronics

$$P_{ET} = P_{BUS} + P_{PERI}$$

$$P_{EL} = 2.6 \text{ W} + (1.1 \frac{\text{W}}{\text{A}} \times \sum_{n=1}^a I_{Ln}) + (0.7 \frac{\text{W}}{\text{A}} \times \sum_{m=1}^b I_{Lm})$$

Where

P<sub>EL</sub> Total power dissipation in the terminal  
P<sub>BUS</sub> Power dissipation for bus operation without I/O load (constant)  
P<sub>PERI</sub> Power dissipation with I/O connected

I<sub>Ln</sub> Current consumption of device *n* from the communications power  
n Index of the number of connected devices (n = 1 to a)  
a Number of connected devices (supplied with communications power)

$\sum_{n=1}^a I_{Ln}$  Total current consumption of the devices from the 7.5 V communications power (2 A, maximum)

I<sub>Lm</sub> Current consumption of the device *m* from the analog supply  
m Index of the number of connected analog devices (m = 1 to b)  
b Number of the connected analog devices (supplied with analog voltage)

$\sum_{m=1}^b I_{Lm}$  Total current consumption of the devices from the 24 V analog supply (0.5 A, maximum)

## Power dissipation/derating

Using the maximum currents 2 A (logic current) and 0.5 A (current for analog terminals) in the formula to calculate the power dissipation when the I/Os are connected results in the following:

$$P_{PERI} = 2.2 \text{ W} + 0.35 \text{ W} = 2.55 \text{ W}$$

2.55 W correspond to 100% current carrying capacity of the power supply unit in the derating curves on page 5.

Make sure that the indicated nominal current carrying capacity in the derating curves is not exceeded when the ambient temperature is above 40°C. Corresponding to the formula, the total current carrying capacity of the connected I/Os ( $P_{PERI}$ ) is relevant. If, for example, no current is drawn from the analog supply, the percentage of current coming from the communications power may be increased.

Example: Ambient temperature: 55°C

Nominal current carrying capacity of communications power and analog supply: 50% according to the diagram

$$I_{LLogic} = 1 \text{ A}, I_{Analog} = 0.25 \text{ A}$$

$$P_{PERI} = 1.1 \text{ W} + 0.175 \text{ W}$$

$$P_{PERI} = 1.275 \text{ W} \text{ (corresponds to 50% of 2.55 W)}$$

Possible logic current if the analog supply is not loaded:

$$P_{PERI} = 1.1 \text{ W/A} \times I_{LLogic} + 0 \text{ W}$$

$$P_{PERI} / 1.1 \text{ W/A} = I_{LLogic}$$

$$I_{LLogic} = 1.275 \text{ W} / 1.1 \text{ W/A}$$

$$I_{LLogic} = 1.159 \text{ A}$$

## Protective equipment

Surge voltage

(segment supply/main supply/bus coupler supply)

Input protective diodes (can be destroyed by permanent overload)

Pulse loads up to 1500 V are short circuited by the input protective diode.

Polarity reversal

(segment supply/main supply)

Parallel diodes for protection against polarity reversal; in the event of an error the high current through the diodes causes the preconnected fuse to blow.

Polarity reversal

(bus coupler supply)

Serial diode in the lead path of the power supply unit; in the event of an error only a low current flows. In the event of an error, no fuse trips within the external power supply unit. Ensure protection of 2 A by fuses through the external power supply unit.

## Mechanical tests

Shock test according to IEC 60068-2-27

Operation: 25g, 11 ms period, half-sine shockpulse

Storage/transport: 50g, 11 ms period, half-sine shock pulse

Vibration resistance according to IEC 60068-2-6

Operation/storage/transport: 5g, 150 Hz, Criterion A

Free fall according to IEC 60068-2-32

1 m

## Conformance with EMC directives

Developed according to IEC 61000-6.2

IEC 61000-4-2 (ESD)

Criterion B  
6 kV contact discharge  
6 kV air discharge (without labeling field)  
8 kV air discharge (with labeling field)

IEC 61000-4-3 (Radiated noise immunity)

Criterion A

IEC 61000-4-4 (Burst)

Criterion B

IEC 61000-4-5 (Surge)

Criterion B

IEC 61000-4-6 (Conducted noise immunity)

Criterion A

IEC 61000-4-8 (Noise immunity against magnetic fields)

Criterion A

EN 55011 (Noise emission)

Class A



### NOTE: Errors

Portable radiotelephone equipment ( $P \geq 2 \text{ W}$ ) must not be operated any closer than 2 m. There should be no strong radio transmitters or ISM (industrial scientific and medical) devices in the vicinity.

## Approvals

For the latest approvals, please visit [www.download.phoenixcontact.com](http://www.download.phoenixcontact.com) or [eshop.phoenixcontact.com](http://eshop.phoenixcontact.com).

## 4 Installation instructions



### NOTE: Electrostatic discharge

The terminal contains components that can be damaged or destroyed by electrostatic discharge. When handling the terminal, observe the necessary safety precautions against electrostatic discharge (ESD) in accordance with EN 61340-5-1 and EN 61340-5-2.



### NOTE:

The terminal is designed for SELV operation in accordance to IEC 950 / EN 60950 / VDE 0805.



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.

## 5 Local diagnostic and status indicators

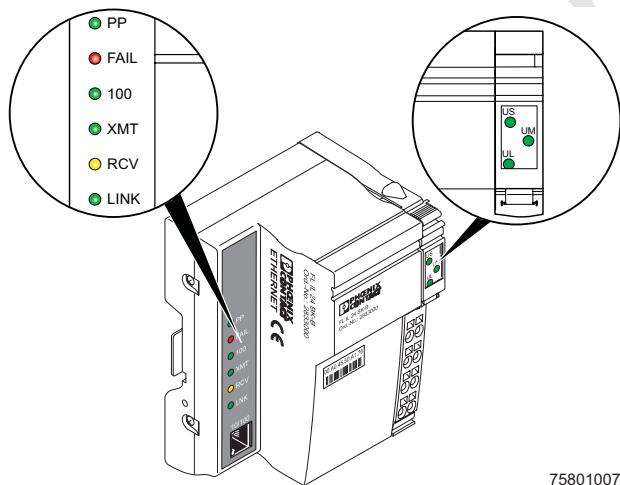


Figure 1 Diagnostic and status indicators

Des.	Color	Status	Meaning
<b>Module electronics</b>			
UL	Green	ON	24 V supply for 7 V communications power/interface supply present
		OFF	24 V supply for 7 V communications power/interface supply not present
UM	Green	ON	24 V supply for main circuit present
		OFF	24 V supply for main circuit not present
US	Green	ON	24 V segment supply present
		OFF	24 V segment supply not present
<b>Ethernet port</b>			
PP	Green	ON	Plug & play mode active
		OFF	Plug & play mode is not active
FAIL	Red	ON	The firmware has detected an error.
		OFF	The firmware has not detected an error.
100	Green	ON	Operation with 100 Mbps (if LNK LED active)
		OFF	Operation with 10 Mbps (if LNK LED active)
XMT	Green	ON	Sending of data telegrams
		OFF	No sending of data telegrams
RCV	Yellow	ON	Receiving of data telegrams
		OFF	No receiving of data telegrams
LNK	Green	ON	Physical network connection ready to operate
		OFF	Physical network connection interrupted or not present

### Reset

The bus coupler can be reset by switching the supply voltage off and on again.

## 6 Connecting Ethernet and supply

### 6.1 Connecting Ethernet

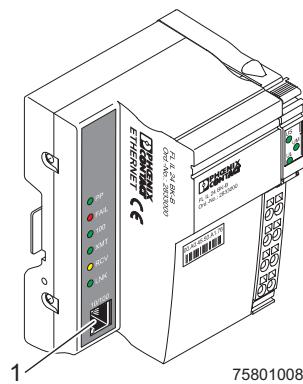


Figure 2 Ethernet connection

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

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

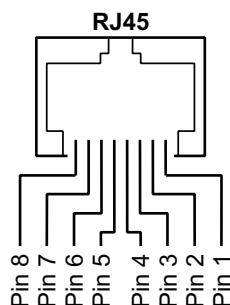


Figure 3 8-pos. RJ45 female connectors

## 6.2 Connecting the supply

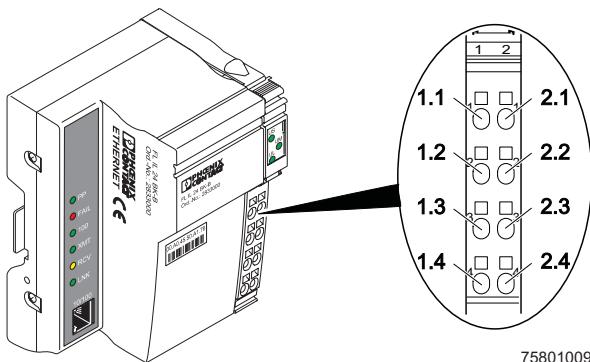


Figure 4 Terminal point assignment of the Inline connector



### NOTE:

The maximum total current through the potential jumpers  $U_M$  and  $U_S$  is 8 A.



### NOTE:

Functional earth ground must be connected through the -24 V DC power/FE connector.

## Typical connection of the supply voltage

The module is operated using a +24 V DC SELV.

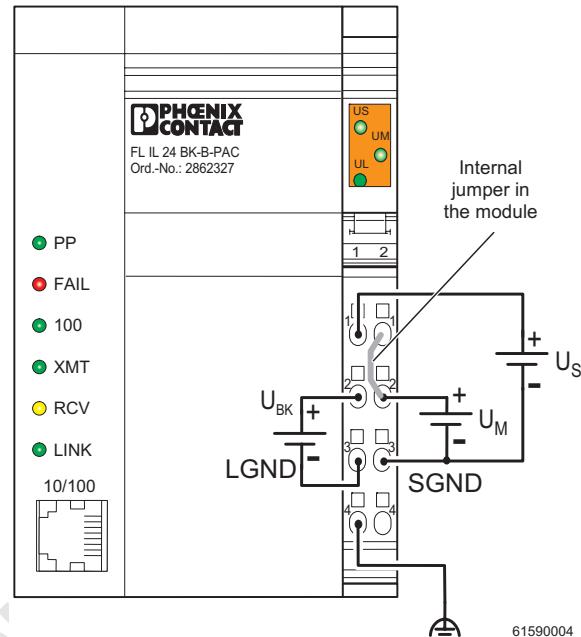


Figure 5 Typical connection of the supply voltage

## Terminal point assignment of the Inline connector

Terminal point	Assignment	Wire color/remark
1.1	24 V DC	$U_S$ 24 V segment supply The supplied voltage is directly routed to the potential jumper.
1.2	24 V DC	$U_{BK}$ 24 V bus coupler supply The communications power for the bus coupler and the connected local bus devices is generated from this power. The 24 V analog voltage ( $U_{ANA}$ ) for the local bus devices is also generated.
2.1, 2.2	24 V DC	$U_M$ 24 V main supply The supplied voltage is directly led to the potential jumper.
1.3	LGND	LGND of the bus coupler supply This potential is reference ground for the bus coupler electronics.
2.3	SGND	Reference potential for $U_S$ and $U_M$ The reference potential is directly led to the potential jumper and is, at the same time, reference ground for the main and segment supply.
1.4, 2.4	FE	Functional earth ground Grounding of the bus coupler and therefore of the Inline station The contacts are directly connected to the potential jumper and the FE spring on the bottom of the housing.
		 Functional earth ground is only used to discharge interference.

## 7 Notes on using the terminal in potentially explosive areas

### 7.1 Approval according to EC directive 94/9 (ATEX)

 II 3G Ex nAC IIC T4 X

This Inline bus coupler conforms to the requirements of protection type "n" and can be installed in a zone 2 potentially explosive area. This Inline bus coupler is a category 3G item of electrical equipment.



**WARNING: Explosion hazard**  
**Only use Inline terminals that are approved for use in potentially explosive areas.**

Before using an Inline terminal in a zone 2 potentially explosive area, first check that the terminal has been approved for installation in this area.

For a list of terminals approved for use in zone 2 potentially explosive areas, please refer to the AH EN IL EX ZONE 2 application note.

Check the labeling on the Inline terminal and the packaging (see Figure 6).



Figure 6 Typical labeling of terminals for use in potentially explosive areas



**WARNING: Explosion hazard**

**Before startup, ensure that the following points and instructions have been observed.**

1. When working on the Inline bus coupler, always disconnect the supply voltage.
2. The Inline bus coupler may only be installed, started up, and maintained by qualified specialist personnel.
3. Mount the Inline bus coupler in a control cabinet or metal housing. The minimum requirement for both items is IP54 protection according to EN 60529.
4. The Inline bus coupler must not be subject to mechanical strain or thermal loads, which exceed the limits specified in the product documentation.
5. The Inline bus coupler must not be repaired by the user. Repairs may only be carried out by the manufacturer. The Inline bus coupler is to be replaced by an approved bus coupler of the same type.
6. During operation, only category 3G equipment must be connected to Inline bus couplers in zone 2.
7. Observe all applicable standards and national safety and accident prevention regulations for installing and operating equipment.

### 7.2 Restrictions



**WARNING: Explosion hazard**

When using terminals in potentially explosive areas, observe the technical data and limit values specified in the corresponding documentation (user manual, data sheet, package slip).



**WARNING: Explosion hazard**

**Restrictions regarding the Inline system**

Please make sure that the **maximum permissible current of 4 A** flowing through potential jumpers  $U_M$  and  $U_S$  (total current) is not exceeded when using the Inline terminals in potentially explosive areas.