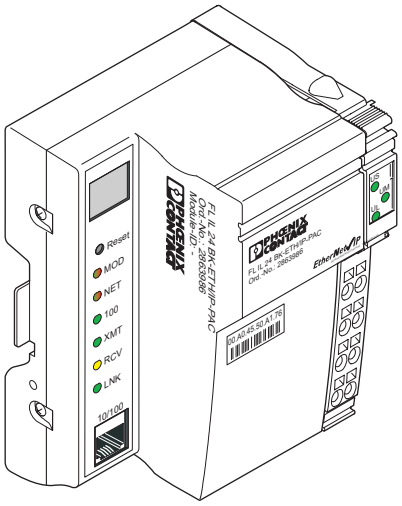
PHOENIX CONTACT
INSPIRING INNOVATIONS

FL IL 24 BK ETH/IP-PAC



Inline Ethernet/IP Bus Coupler

AUTOMATIONWORX

Data Sheet

Description

ETHERNET/IP bus coupler for Inline, 24 V DC, complete Ethernet 10/100TX capability with accessories (connector and labeling field).

Inline Features

- Up to 63 additional Inline modules can be connected (process data channel)
- Up to 8 PCP modules
- Local LEDs and two digit diagnostics display
- Local indication of network communications loss
- Field installable with no software required for automatic station configuration
- COS and Latching inputs functions
- Status History Diagnostic Log
- Reservation of I/O memory for future expansion (No hardware needed)
- I/O and Station Status via XML polling

Ethernet & CIP Features

- Device Profile Type: 0x0C Communications Adapter
- Total CIP connections supported: 128 (eight typical)
- Explicit Messaging: Target Max# of connections 128 (eight typical)
- I/O Messaging: Target Max# of connections 128 (eight typical)
- Device configuration options: EDS, Custom Software
- MAC Parameter Configuration:
  Speed: 10Mbps, 100Mbps, Auto
  Duplex: Half, Full, Auto
- IP Address Configuration: BootP, Custom Software, and SNMP.
- IP Address Configuration: BootP, Custom Software, and SNMP.

For additional information, please refer to the UM EN FL IL 24 BK ETH/IP-PAC, Ord.-No. 28 88 02 6 User Manual.

Ensure that you are always working with the most recently published documentation.
It can be downloaded at www.download.phoenixcontact.com.

A conversion table is available on the Internet at
www.download.phoenixcontact.com/general/7000_en_00.pdf.

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

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Structure of the FL IL 24 BK ETH/IP-PAC Bus Coupler

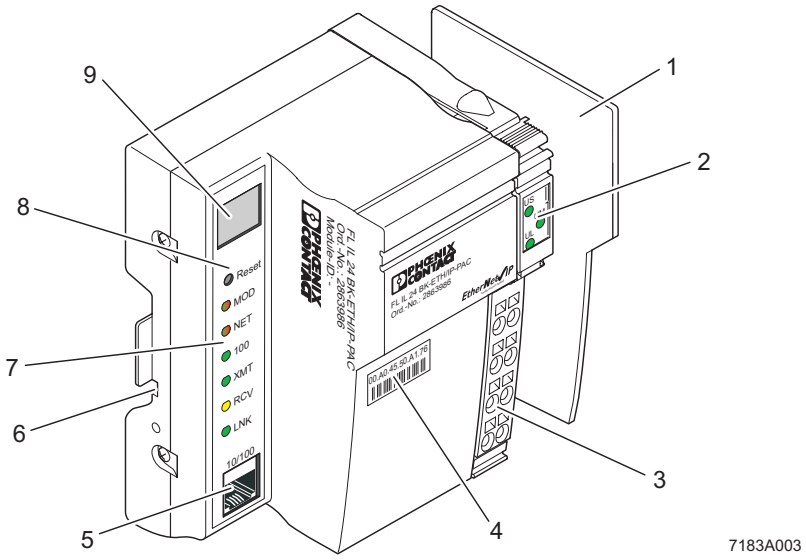


Figure 1 Structure of the FL IL 24 BK ETH/IP-PAC bus coupler

The bus coupler has the following components:

1 End plate to protect the last Inline module

2 Inline diagnostic indicators

3 24 V DC supply and functional earth ground connector

4 MAC address in clear text and as a barcode

5 Ethernet interface (twisted pair cables in RJ45 format)

6 Two FE contacts for grounding the bus coupler using a DIN rail
(on the back of the module)

7 Ethernet status and diagnostic indicators

8 Reset button

9 7-segment display for the device status (Ethernet communication unit)

Connecting the Supply Voltage

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

Typical Connection of the Supply Voltage

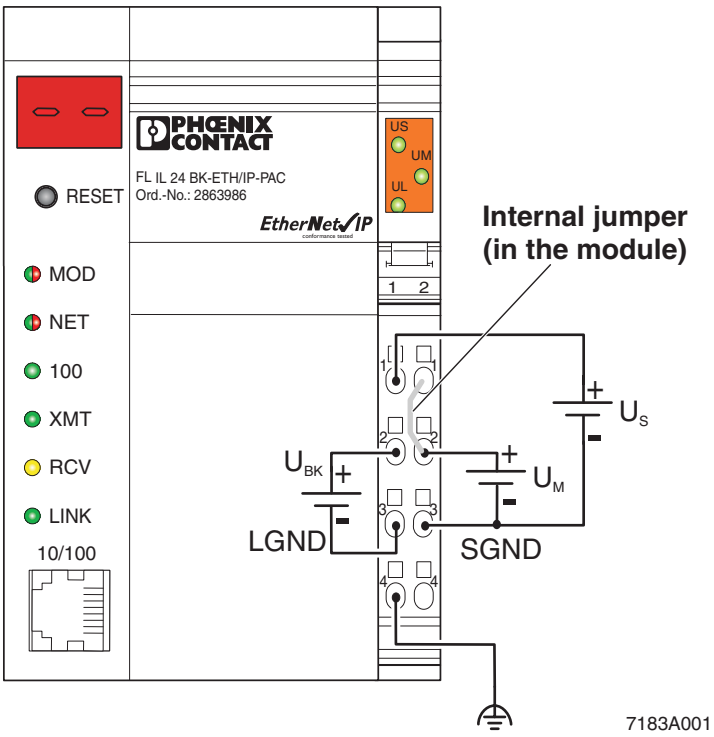


Figure 2 Typical connection of the supply voltage

Connector Assignment

Terminal Point/ Connector	Assignment/Power Connector		Wire Color/Remark
1.1	24 V DC (U_S)	24 V segment supply	The supplied voltage is directly led to the potential jumper.
1.2	24 V DC (U_{BK})	24 V supply	The communications power for the bus coupler and the connected local bus devices is generated from this power. The 24 V analog power (U_{ANA}) for the local bus devices is also generated.
2.1, 2.2	24 V DC (U_M)	Main voltage	The main voltage is routed to the local bus devices via the potential jumpers.
1.3	LGND	Reference potential logic ground for U_{BK}	The potential is the reference ground for the communications power U_{BK}.
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, ground reference for the main and segment supply.
1.4, 2.4	FE	Functional earth ground (FE)	The functional earth ground must be connected to the 24 V DC supply/ functional earth ground connection. 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.

The GND potential jumper carries the total current from the main and segment circuits. The total current must not exceed the maximum current carrying capacity of the potential jumper (8 A). If the 8 A limit is reached at one of the potential jumpers U_S, U_M, and GND during configuration, a new power terminal must be used.

Functional earth ground must be connected through the 24 V DC supply/functional earth ground connection.

Mounting/Removing Modules and Connecting Cables

Installation Instructions

To ensure installation is carried out correctly, please read the "Installation Instructions for the Electrical Engineer" supplied with the bus coupler.

Do not replace modules while the power is connected

Before removing or mounting a module, disconnect the power to the entire station. Make sure the entire station is reassembled before switching the power back on.
Failure to observe this rule may damage the module.

Mounting Inline Modules

An Inline station can be set up by mounting the individual components side by side. No tools are required. Mounting side by side automatically creates voltage and bus signal connections (potential and data routing) between the individual station components.

The modules are mounted perpendicular to the DIN rail. This ensures that they can be easily mounted and removed even within limited space.

After a station has been set up, individual modules can be exchanged by pulling them out or plugging them in. Tools are not required.

DIN Rail

All Inline modules are mounted on 35 mm (1.378 in.) standard DIN rails.

End Clamp/CLIPFIX

Mount end clamps on both sides of the Inline station. The end clamps ensure that the Inline station is correctly assembled. End clamps fix the Inline station on both sides and keep it from moving side to side on the DIN rail.

Phoenix Contact recommends using the CLIPFIX 35 (Order No. 30 22 21 8) or E/UK end clamps (Order No. 12 01 44 2).

To remove the bus coupler, the left end clamp must be removed first.

End Plate

An Ethernet Inline station **must** be terminated with an end plate. It has no electrical function. It protects the station against ESD pulses and the user against dangerous contact voltage. The end plate is supplied with the bus coupler and must not be ordered separately.

Mounting

When mounting a module, proceed as follows (Figure 3):

- First snap on the electronics base, which is required for mounting the station, perpendicular to the DIN rail (detail A).

Ensure that **all** featherkeys and keyways of adjacent modules are interlocked (detail B).

The keyway/featherkey connection links adjacent modules and ensures safe potential routing.

- Next, attach the connectors to the corresponding base.
- First, place the front connector shaft latching in the front snap-on mechanism (detail C).
- Then press the top of the connector towards the base until it snaps into the back snap-on mechanism (detail D).

The keyways of an electronics base do not continue when a connector has been installed on the base. When snapping on an electronics base, there must be no connector on the left-hand side of the base. If a connector is present, it will have to be removed.

Use end clamps to fix the Inline station to the DIN rail (see Ordering Data).

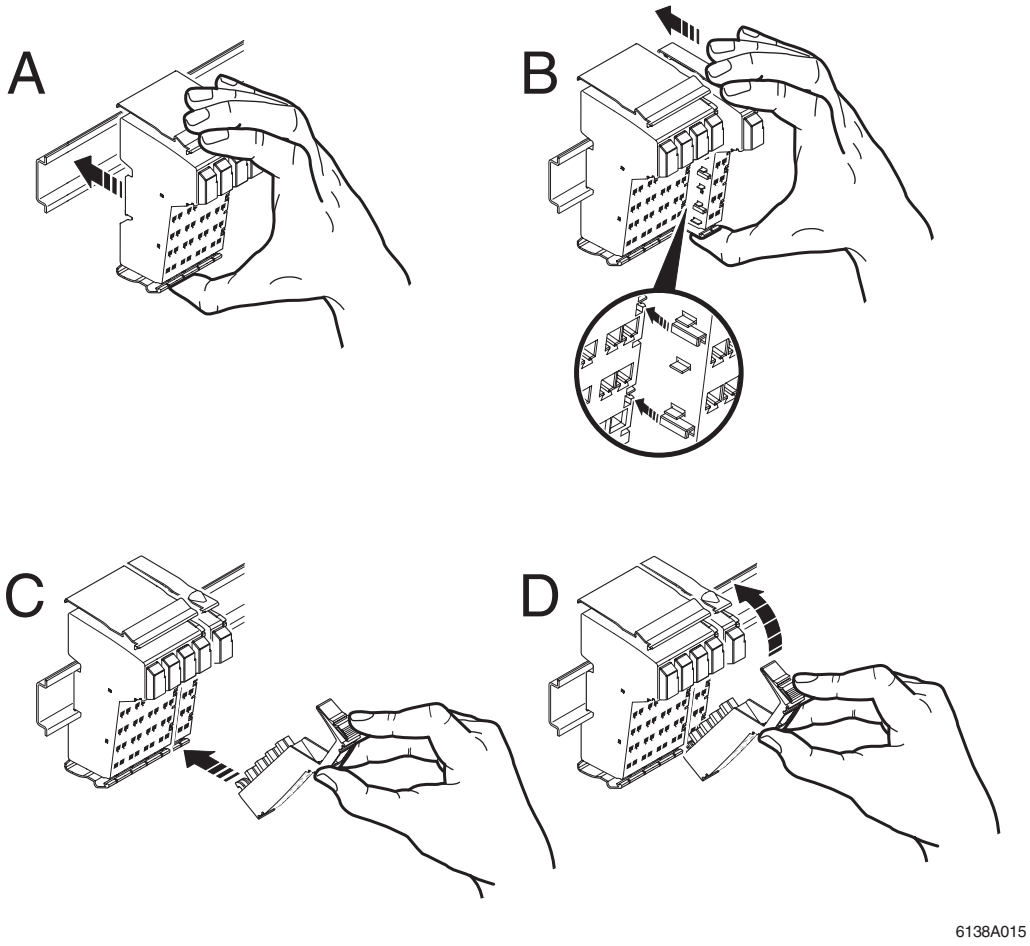


Figure 3 Snapping on a module

Replacing a Module

If you want to replace a module within the Inline station, follow the removal procedure described above. Do not snap the connector of the module directly to the left back on yet. First, insert the base of the new module. Then reconnect all the connectors.

Use end clamps to fix the Inline station to the DIN rail (see Ordering Data).

Sending BootP Requests

Initial Startup:

During initial startup, the device sends a BootP request 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 device.

Further Restarts:

If the device already has valid configuration data, it only sends three more BootP requests on a restart. If it receives a BootP reply, the new parameters are saved. If the device does not receive a reply, it starts with the previous configuration.

Ethernet/IP Object Classes

The Inline bus coupler supports CIP using ODVA standard Discrete Input Points (DIP), Discrete Output Points (DOP), Analog Input Points (AIP) and Analog Output Points (AOP). Additional objects include user defined Configuration, Inline Interface, Inline Module, Inline Special Function, PCP Special Function and Serial Communication objects.

CIP Class Services

The FL IL 24 BK ETH/IP-PAC supports the following class services and instance services:

Service Code	Service Name
01 (0x01)	Get_Attribute_All
02 (0x02)	Set_Attribute_All
05 (0x05)	Reset
14 (0x0E)	Get_Attribute_Single
16 (0x10)	Set_Attribute_Single

Systems Operational Guidelines

Repeat Packet Interval (RPI) Settings

– Configurations requiring RPI rates below 10ms should be tested in advance to confirm operation.
– Configurations requiring PCP modules should use RPI settings at a minimum of 20 ms. Settings below 20 ms should be tested in advanced.

Maximum Connection Consideration

The module firmware supports up to 128 connections total (any mix implicit or explicit). Application considerations such as CPU loading, frequency of data update (RPI parameter), and I/O quantity scanned will impact the actual maximum connections. Fewer connections allow faster data update rates scanned will impact the actual maximum connections. Fewer connections allow faster data update rates (RPI value). For maximum I/O performance the quantity of connections should be limited to 8 or less.

CIP Object Classes

The FL IL 24 BK ETH/IP-PAC supports the following CIP object classes:

Class Code	Object Type
01 (0x01)	Identity
02 (0x02)	Router
04 (0x04)	Assembly
05 (0x05)	Connection Object
06 (0x06)	Connection Manager
08 (0x08)	Discrete Input Point
09 (0x09)	Discrete Output Point
10 (0x0A)	Analog Input Point
11 (0x0B)	Analog Output Point
43 (0x2D)	Acknowledge Handler
100 (0x64)	Configuration Object
101 (0x65)	Inline Interface Object
102 (0x66)	Inline Module Object
103 (0x67)	Inline Special Function Object
104 (0x68)	COS Mask Object
105 (0x69)	PCP Object
106 (0x6A)	Serial Object
244 (0xF4)	Port Object
245 (0xF5)	TCP/IP Interface Object
246 (0xF6)	Ethernet Link Object

Technical Data

General Data	
Function	Ethernet/IP bus coupler
Housing dimensions (width x height x depth)	90 mm x 116 mm x 72 mm
Permissible operating temperature (EN 60204-1)	0°C to 55°C
Permissible storage temperature (EN 60204-1)	-25°C to 85°C
Degree of protection	IP20, DIN 40050, IEC 60529
Class of protection	Class 3 VDE 0106; IEC 60536
Humidity (operation) (EN 60204-1)	5% to 90%, no condensation
Humidity (storage) (EN 60204-1)	5% to 95%, no condensation
Air pressure (operation)	80 kPa to 108 kPa, 2000 m above sea level
Air pressure (storage)	70 kPa to 108 kPa, 3000 m above sea level
Preferred mounting position	Perpendicular to a standard DIN rail
Connection to protective earth ground	The functional earth ground must be connected to the 24 V DC supply/functional earth ground connection. 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.
Environmental compatibility	Free from substances which would hinder coating with paint or varnish (according to VW specification)
Resistance to solvents	Standard solvents
Weight	270 g, typical

24 V Main Supply/24 V Segment Supply	
Connection method	Spring-cage terminals
Recommended cable lengths	30 m, maximum; do not route cable through outdoor areas
Voltage continuation	Through potential routing
Special demands on the voltage supply	The supplies U_M/U_S and the bus coupler supply U_{BK} do not have the same ground potential because they are supplied by two separate power supply units.
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.
Nominal value	24 V DC
Tolerance	-15%/+20% (according to EN 61131-2)
Ripple	±5%
Permissible range	19.2 V to 30 V
Current carrying capacity	8 A, maximum (total current of U_S and U_M)
Safety equipment	
Surge voltage	Input protective diodes (can be destroyed by permanent overload)
Polarity reversal	Pulse loads up to 1500 V are short circuited by the input protective diode. Parallel diodes against polarity reversal; in the event of an error the high current through the diodes causes the pre-connected fuse to blow.

This 24 V area must be fused 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 Bus Coupler Supply	
Connection method	Spring-cage terminals
Recommended cable lengths	30 m, maximum; do not route cable through outdoor areas
Voltage continuation	Via potential routing U_L,U_{ANA}
Safety equipment	
Surge voltage	Input protective diodes (can be destroyed by permanent overload)
Polarity reversal	Pulse loads up to 1500 V are short circuited by the input protective diode. 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 the fuse in the external power supply unit does not trip. Ensure protection of 2 A by fuses through the external power supply unit.

24 V Bus Coupler Supply (Continued)	

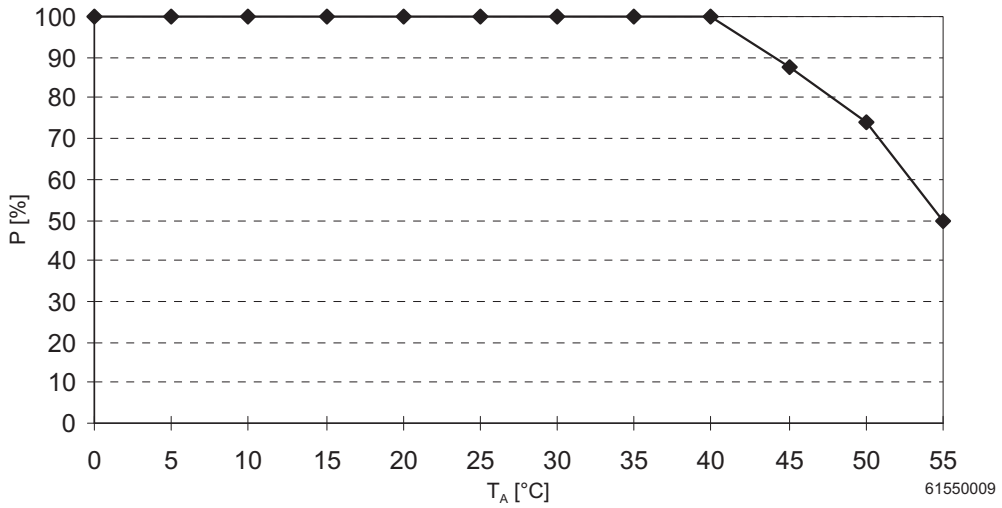
Observe the current consumption of the modules

Observe the logic current consumption of each device when configuring an Inline station. This information is given in every module-specific data sheet. The current consumption can differ depending on the individual module. The permissible number of devices that can be connected therefore depends on the specific station structure.

Nominal value	24 V DC
Tolerance	-15%/+20% (according to EN 61131-2)
Ripple	±5%
Permissible range	19.2 V to 30 V
Minimum current consumption at nominal voltage	92 mA (At no-load operation, i. e., Ethernet connected, no local bus devices connected, bus inactive)
Maximum current consumption at nominal voltage	1.5 A (Loading the 7.5 V communications power with 2 A, the 24 V analog voltage with 0.5 A)

24 V Module Supply	
- Communications Power (Potential Jumper)	
Nominal value	7.5 V DC
Tolerance	±5%
Ripple	±1.5%
Maximum output current	2 A DC (observe derating)
Safety equipment	Electronic short-circuit protection
- Analog Supply (Potential Jumper)	
Nominal value	24 V DC
Tolerance	-15%/+20%
Ripple	±5%
Maximum output current	0.5 A DC (observe derating)
Safety equipment	Electronic short-circuit protection

Derating of the Communications Power and the Analog Terminal Supply



P [%]	Loading capacity of the power supply unit for communications power and analog supply in %
T_A [°C]	Ambient temperature in °C

Power Dissipation

Formula to Calculate the Power Dissipation of the Electronics

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

$$P_{EL} = 2.6\ W + \left(1.1\frac{W}{A} \times \sum_{n=0}^{a} I_{Ln}\right) + \left(0.7\frac{W}{A} \times \sum_{m=0}^{b} I_{Lm}\right)$$

Where	
P_{EL}	Total power dissipation in the terminal
P_{BUS}	Power dissipation for bus operation without I/O load (permanent)
P_{PERI}	Power dissipation with I/O connected
I_{Ln}	Current consumption of the device *n* from the communications power
n	Index of the number of connected devices (n = 1 to a)
a	Number of connected devices (with communications power supply)
$\sum_{n=0}^{a} I_{Ln}$	Total current consumption of the devices from the 7.5 V communications power (2 A, maximum)
I_{Lm}	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 connected analog devices (supplied with analog voltage)
$\sum_{m=0}^{b} I_{Ln}$	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/O is connected gives the following result:

P_{PERI} = 2.2 W + 0.35 W = 2.55 W

2.55 W corresponds to 100% current carrying capacity of the power supply unit in the derating curves on page 13.

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 with the formula, the total current carrying capacity of the connected I/O is relevant (P_{PERI}). If, for example, no current is drawn from the analog supply, the percentage of current coming from the communications power can be increased.

Example:

Ambient temperature: 55°C

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

I_{LLogic} = 1 A, $I_{LAnalog}$ = 0.25 A

P_{PERI} = 1.1 W + 0.175 W

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

Possible logic current if the analog supply is not loaded:

P_{PERI} = 1.1 W/A x I_{LLogic} + 0 W

P_{PERI} / 1.1 W/A = I_{LLogic}

I_{LLogic} = 1.275 W / 1.1 W/A

I_{LLogic} = 1.159 A

Safety 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 against polarity reversal; in the event of an error the high current through the diodes causes the pre-connected 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 the fuse in the external power supply unit does not trip. Ensure protection of 2 A by fuses through the external power supply unit.

Bus Interface of the Lower-Level System Bus	
Interface	Inline local bus
Electrical isolation	No
Number of Inline terminals that can be connected	
Limited by software	63, maximum
Limited by power supply unit	Maximum logic current consumption of the connected local bus modules: $I_{max} \leq 2$ A DC

Observe the current consumption of the modules

Observe the logic current consumption of each device when configuring an Inline station. This information is given in every module-specific data sheet. The current consumption can differ depending on the individual module. The permissible number of devices that can be connected therefore depends on the specific station structure.

Interfaces	
Ethernet Interface	
Number	One
Connection format	8-pos. RJ45 socket on the bus coupler
Connection medium	Twisted pair cable with a conductor cross section of 0.14 mm^2 to 0.22 mm^2
Cable impedance	100 Ω
Transmission speed	10/100 Mbps
Maximum network segment expansion	100 m

Mechanical Tests	
Shock test according to IEC 60068-2-27	Operation: 25g, 11 ms period, half-sine shock pulse 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 in place)
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

Warning

Portable radiotelephone equipment (P ≥ 2 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	
Approvals	cUL 508, cUL 2279, cUL 1604 Class 1 Div 2

Ordering Data

Bus Coupler

Description	Type	Order No.
Ethernet/IP bus coupler with connector and labeling field	FL IL 24 BK ETH/IP-PAC	28 63 98 6
Connector, with color print	IB IL SCN-8-CP	27 27 60 8
Labeling field	IB IL FIELD 8	27 27 50 1

Accessories and Tools

Description	Type	Order No.
RJ45 **gray** connector set for linear cable (2 pieces)	FL PLUG RJ45 GR/2	27 44 85 6
RJ45 **green** connector set for crossed cable (2 pieces)	FL PLUG RJ45 GN/2	27 44 57 1
Double sheathed Ethernet cable	FL CAT5 HEAVY	27 44 81 4
Flexible Ethernet cable	FL CAT5 FLEX	27 44 83 0
Assembly tool for RJ45 connector	FL CRIMPTOOL	27 44 86 9
Media converter 660 nm	FL MC 10BASE-T/FO POF	27 44 51 3
Voltage supplies	QUINT-PS ... see "INTERFACE" catalog	

Accessories and Tools (Continued)

Description	Type	Order No.
Keying profile (100 pcs./package)	CP-MSTB see "COMBICON" catalog	17 34 63 4
Zack markers for labeling terminals	ZB 6 ... see "CLIPLINE" catalog	
Labeling field covering one connector	IB IL FIELD 2	27 27 50 1
Labeling field covering four connectors	IB IL FIELD 8	27 27 51 5
Insert strips for IB IL FIELD 2, perforated, can be labeled using a laser printer, marker pen or CMS system (72 strips, 1 pcs./package)	ESL 62X10	08 09 49 2
Insert strips for IB IL FIELD 8, perforated, can be labeled using a laser printer, marker pen or CMS system (15 strips, 5 pcs./package)	ESL 62X46	08 09 50 2
DIN EN 50022 DIN rail, 2 meters perforated unperforated	 NS 35/ 7,5 PERF 2000MM NS 35/ 7,5 UNPERF 2000MM	 08 01 73 3 08 01 68 1
End clamp snapped on without tools (50 pcs./package)	CLIPFIX 35	30 22 21 8
End clamp fixed using screws (50 pcs./package)	E/UK	12 01 44 2
Screwdriver according to DIN 5264, blade width 3.5 mm	SZF 1-0,6X3,5	12 04 51 7

Software

Description	Type	Order No.
Factory Manager, network management software	FL SWT	28 31 04 4

Documentation

Description	Type	Order No.
User Manual FL IL 24 BK ETH/IP-PAC	UM EN FL IL 24 BK ETH/IP-PAC	28 88 02 6
"Configuring and Installing the INTERBUS Inline Product Range" user manual	IB IL SYS PRO UM E	27 43 04 8

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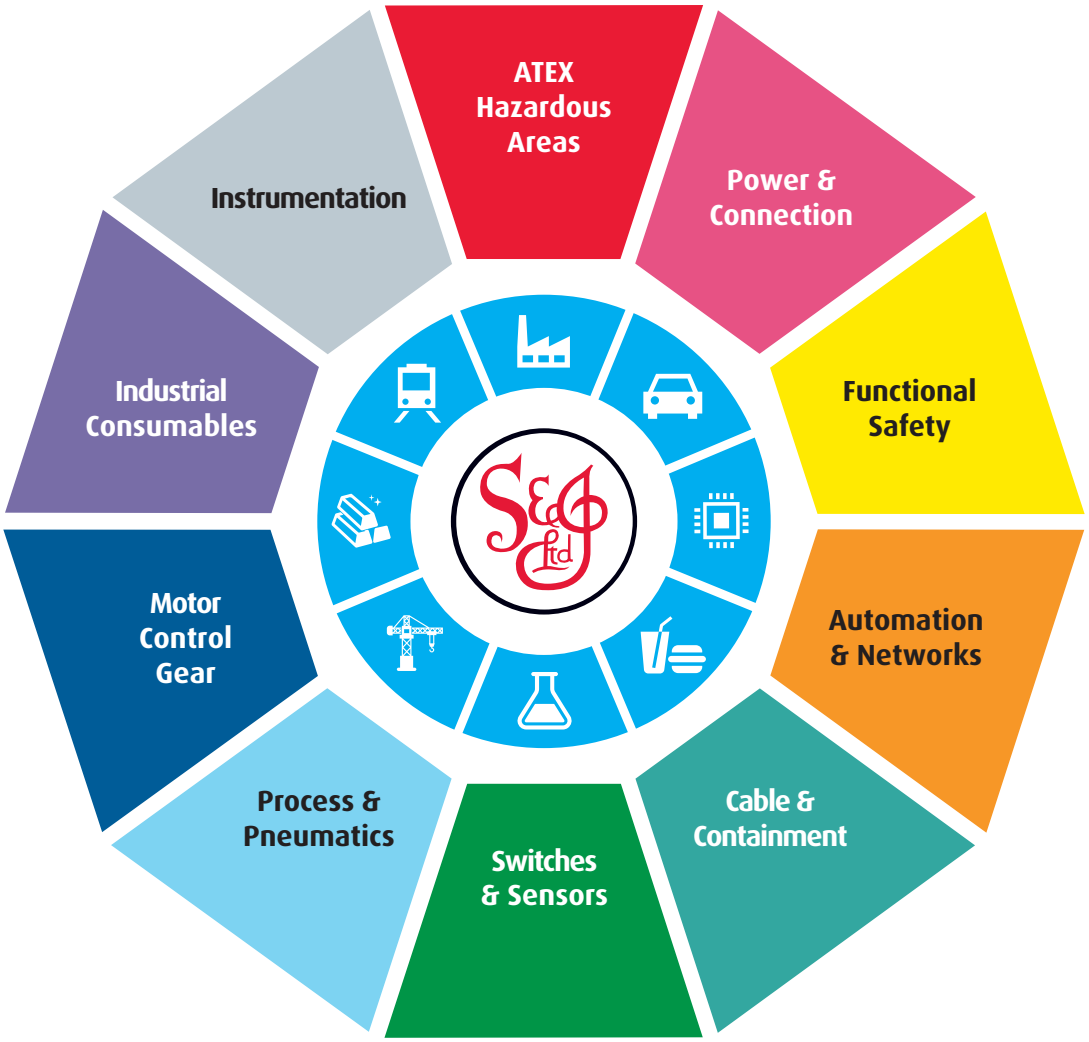

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