IB IL DI 8/S0-PAC

**Inline, Digital input terminal,
digital inputs: 8 (S0 counter inputs), 24 V DC,
connection method: 4-wire**

Datenblatt
7610_en_02

1 Description

The terminal is designed for use within an Inline station. It is designed to detect counting pulses from impulse encoders with S0 interface according to DIN 43864 and from Class A impulse encoders according to IEC 62053-31.

Class B impulse encoders according to IEC 62053-31 can be connected (no risk of damage to the encoder or terminal). Correct operation in strict accordance with the standard is not guaranteed, but is very probable.

The counters can be used in pulse counter or operating hours counter mode. The counter states and configuration are saved retentively. All inputs can be configured independently of one another.

Features

- Eight inputs
- Connection of S0 impulse encoders, floating contacts or outputs with negative logic (e.g., open collector, open drain)
- Connection of sensors in 2, 3, and 4-wire technology
- 32-bit counter range
- Communication via process data
- Maximum permissible load current per sensor: 250 mA
- Maximum permissible load current from the terminal: 2 A
- Diagnostic and status indicators

Pulse counter:

- Maximum counting frequency of up to 150 Hz
- In addition, current period length or pulse length (ON or OFF) can be read with a resolution of 1 ms (16-bit counting range)

Operating hours counter:

- 1 s resolution
- Counter enabled on active or inactive input (configurable)

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 phoenixcontact.net/products.

Inhaltsverzeichnis

2 Ordering data

Description	Type	Order No.	Pcs./Pkt.
Inline, Digital input terminal, Digital inputs: 8 (S0 counter inputs), 24 V DC, Connection method: 4-wire, Transmission speed in the local bus 500 kbps, Degree of protection IP20, including Inline connectors and marking fields	IB IL DI 8/S0-PAC	2897020	1

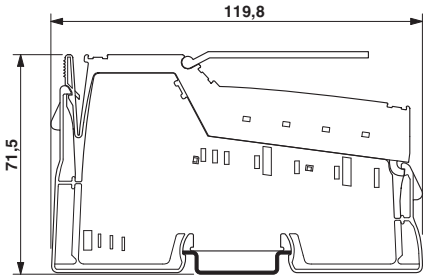
Accessories	Type	Order No.	Pcs./Pkt.
Connector, for digital 1, 2 or 8-channel Inline terminals (Connector/Adapter)	IB IL SCN-8	2726337	10
Inline connector, colored (Connector/Adapter)	IB IL SCN-8-CP	2727608	10
Connector set	IB IL DI/DO 8-PLSET	2860950	1
Connector set, for IB IL DI/DO 8, copper, with color print. (Connector/Adapter)	IB IL DI/DO 8-PLSET/CP	2860963	1
Labeling field, width: 12.2 mm (Marking)	IB IL FIELD 2	2727501	10
Labeling field, width: 48.8 mm (Marking)	IB IL FIELD 8	2727515	10
Insert strip, Sheet, white, unlabeled, can be labeled with: Office printing systems, Plotter: Laser printer, Mounting type: Insert, Lettering field: 62 x 10 mm (Marking)	ESL 62X10	0809492	1
Insert strip, Sheet, white, unlabeled, can be labeled with: Office printing systems, Plotter: Laser printer, Mounting type: Insert, Lettering field: 62 x 46 mm (Marking)	ESL 62X46	0809502	5

Dokumentation

Description	Type	Order No.	Pcs./Pkt.
User manual, English, Automation terminals of the Inline product range	IL SYS INST UM E	–	–

3 Techncal data

Dimensions (nominal sizes in mm)	



Width	48.8 mm
Height	119.8 mm
Depth	71.5 mm
Note on dimensions	Housing dimensions

Allgemeine Daten	
Weight	183 g (with connectors)
Operating mode	Process data mode with two words
Ambient temperature (operation)	-25 °C ... 55 °C
Ambient temperature (storage/transport)	-25 °C ... 85 °C
Permissible humidity (operation)	10 % ... 95 % (non-condensing)
Permissible humidity (storage/transport)	10 % ... 95 % (non-condensing)
Air pressure (operation)	80 kPa ... 106 kPa (up to 2000 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	
Designation	Inline connector
Connection method	Spring-cage connection
Conductor cross section solid / stranded	0.08 mm² ... 1.5 mm² / 0.08 mm² ... 1.5 mm²
Conductor cross section [AWG]	28 ... 16
Stripping length	8 mm

Interface Inline local bus	
Connection method	Inline data jumper
Transmission speed	500 kbps

Power supply for module electronics	
Connection method	Inline potential jumper
Supply voltage	24 V DC
Supply voltage range	19.2 V DC ... 30 V DC (including all tolerances, including ripple)

Leistungsbilanz	
Segment circuit supply U_S	24 V DC
Current consumption from U_S	max. 2 A (incl. sensor supply), max. 70 mA (without sensor supply, inputs active)
Communications power U_L	7.5 V DC
Current consumption from U_L	max. 55 mA

Digitale Eingänge	
Number of inputs	8 (S0 counter inputs)
Description of the input	IEC 62053-31 and DIN 43864
Connection method	Spring-cage connection
Connection method	4-wire
Nominal input voltage	24 V DC
Switching threshold	
Off	I < 2.2 mA
On	I > 9 mA
Common potentials	Segment supply, ground
Permissible range	$0 \leq U_{IN} \leq U_S$

NOTE: Module damage

The input voltage of the digital inputs is limited with protective diodes to GND and U_S. Diode overload can result in damage to the terminal.

Maximum non-load voltage at the open input	< 14 V
Maximum input current at $U_{IN} = 0$	< 14 mA
Current flow	Non-linear (constant current; 11 mA, typical)
Permissible conductor length to the sensor	100 m

Programming data (INTERBUS, local bus)	
ID code (hex)	BF
ID code (dec.)	191
Length code (hex)	02
Length code (dec.)	02
Process data channel	32 Bit
Input address area	4 Byte
Output address area	4 Byte

Programming data (INTERBUS, local bus)	
Parameter channel (PCP)	0 Byte
Register length (bus)	4 Byte

For the programming data/configuration data of other bus systems, please refer to the corresponding electronic device data sheet (e.g., GSD, EDS).

Configuration and parameter data in a PROFIBUS system	
Required parameter data	1 Byte
Need for configuration data	5 Byte

Error messages to the higher level control or computer system

I/O error message in the event that the communications power U_L is not reached

I/O error message in the event of inconsistent non-volatile memory (counter, configuration)

Power Dissipation

Formula to calculate the power dissipation of the electronics

$P_{TOT} = 0.6\ W + n * 0.2\ W$

Dabei sind:

P_{TOT} Total power dissipation in the terminal

n Number of active inputs, n = 0 to 8

Limitation of simultaneity, derating

No limitation of simultaneity/no derating over the entire operating temperature range.

Safety equipment	
Overload in the segment circuit	No
Surge voltage	Protective elements in the power terminal
Polarity reversal	Protective elements in the power terminal

Electrical isolation/isolation of the voltage areas

Test section	Test voltage
7.5 V supply (bus logics)/24 V supply (I/O)	500 V AC, 50 Hz, 1 min.
24 V supply (I/O) / functional earth ground	500 V AC, 50 Hz, 1 min.
7.5 V supply (bus logics) / functional earth ground	500 V AC, 50 Hz, 1 min.

To achieve electrical isolation between the logic level and the I/O area, supply these areas from separate power supply units. Interconnection of the power supply units in the 24 V area is not permitted (see IL SYS INST UM E user manual).

Approvals

For the latest approvals, please visit phoenixcontact.net/products.

4 Internal circuit diagram

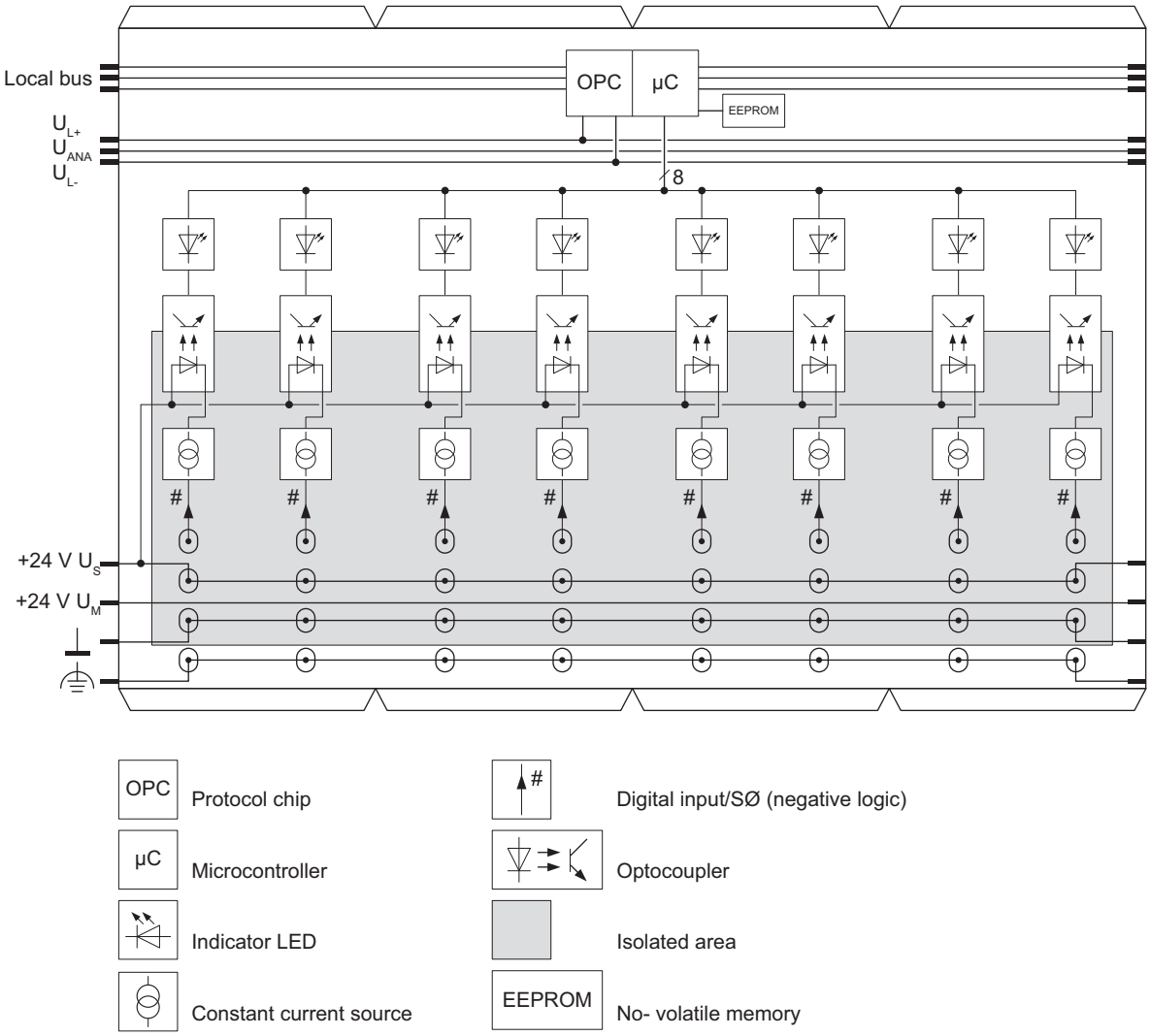
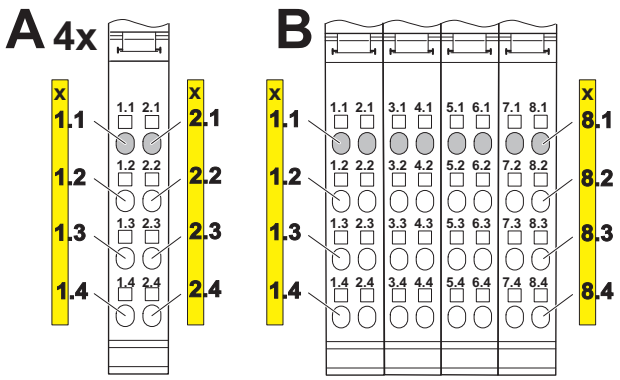


Figure 1 Internal wiring of the terminal points

Explanation for other used symbols has been provided in the IL SYS INST UM E user manual.

5 Terminal point assignment

Terminal point assignment for each connector



Terminal point numbering

A Using the terminal with the connectors provided

Using individual connectors
(IB IL SCN-8 or IB IL SCN-8-ICP)

B Using the IB IL DI/DO 8-PLSET or
IB IL DI/DO 8-PLSET/CP connector sets

Terminal point	Signal	Assignment
x.1	IN	Signal input
x.2	U_S	24 V DC segment voltage, internally connected to the potential jumper U_S
x.3	GND	Segment voltage ground connection, internally connected to the potential jumper GND
x.4	FE	Functional earth ground, internally connected to the potential jumper FE

6 Local diagnostic and status indicators

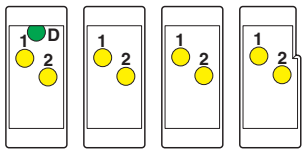


Figure 2 Local diagnostic and status indicators

Desig-nation	Color	Meaning
D	green	Diagnostics (bus and logic voltage)
Je Stecker		
1, 2	gelb	Status of the inputs

Function identification

Orange

7 Connection examples

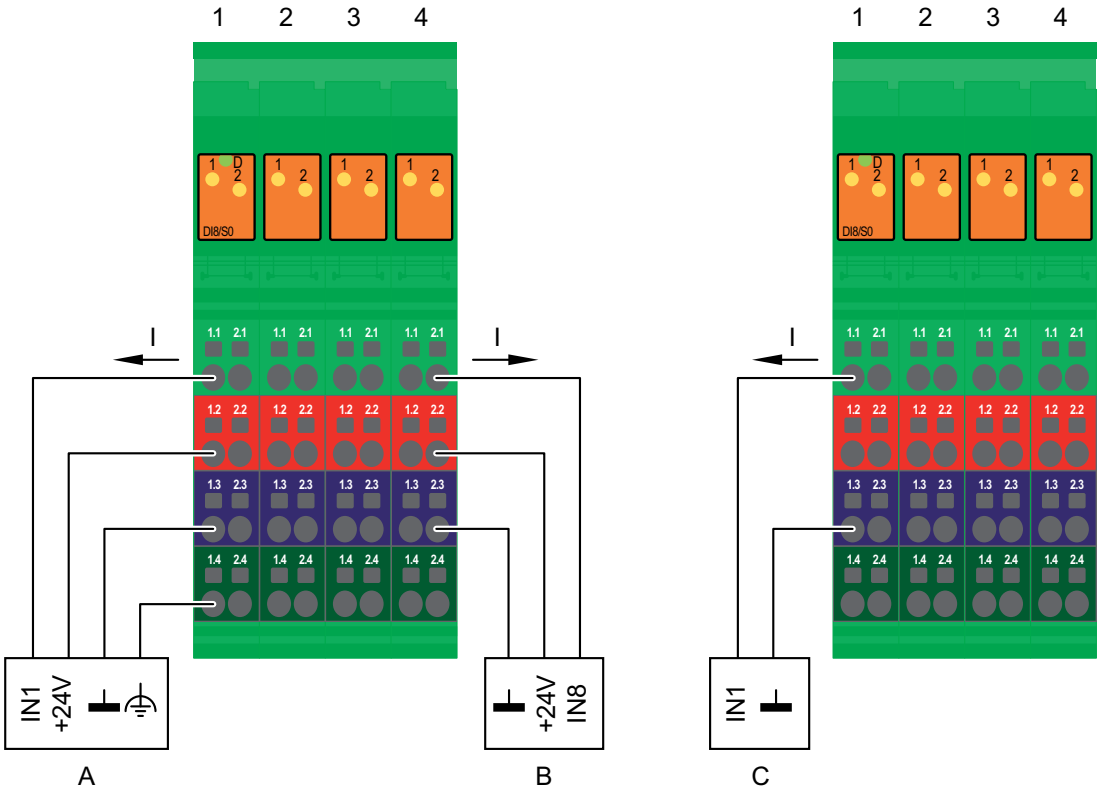


Figure 3 Connection examples

A: 4-wire termination
B: 3-wire termination
C: 2-wire termination

Figure 3 shows the direction of the current flow for negative logic..

8 Process data

8.1 OUT process data

OUT0 (control word)															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0		Command			Channel			0							

Command field in control word OUT0

Value		Command	Description
bin	hex		
000	0	RD_L	Read least significant counter word Most significant counter word is buffered for RD_H
001	1	RD_H	Read buffered most significant counter word; only after RD_L on the same channel
010	2	WR_L	Write least significant counter word; word is buffered and only written on WR_H
011	3	WR_H	Write most significant counter word (together with buffered least significant counter word); only after WR_L on the same channel
100	4	RD_MS	Read period length or pulse length
101	5	RD_CFG	Request operating mode
110	6	WR_CFG	Set operating mode
111	7	RD_FW	Read firmware ID

With the exception of RD_FW, all commands are channel-specific. For RD_FW the channel field is ignored.

Process data output word OUT1 is used as a parameter word. It is used for all write commands (WR_L, WR_H, WR_CFG) and should be set to 0 otherwise.

OUT1 for WR_L															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Least significant word of the counter state to be set															

OUT1 for WR_H															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Most significant word of the counter state to be set															

OUT1 for WR_CFG															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0										DEB			INV	ON	GC

Configuration of an input channel

Field	Description
GC	Operating mode 0 = Pulse counter (default) 1 = Operating hours counter
ON	Period length or pulse length measurement 0 = Period length measurement (default) 1 = Pulse length measurement Can only be executed in pulse counter mode.
INV	Inversion of inputs 0 = No inversion (default) 1 = Inversion Can only be executed for operating hours counter and pulse length measurement.
DEB	Debouncing of inputs 0 = 1 sample (debouncing off) 1 = 2 samples 2 = 4 samples 3 = 8 samples (default) 4 = 16 samples 5 = 32 samples 6 = 64 samples 7 = 128 samples For a valid status change for the input, n samples must return the same value consecutively. The sample interval is around 1 ms.

Depending on the combination, not all configuration bits can be executed:

INV	ON	GC	Operating mode
x	0	0	Pulse counter with period length measurement
0	1	0	Pulse counter with pulse length measurement ON pulse
1	1	0	Pulse counter with pulse length measurement OFF pulse
0	x	1	Operating hours counter, enabled when ON
1	x	1	Operating hours counter, enabled when OFF

8.2 IN process data

IN0 (status word)															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SB	0	Mirroring of OUT0						Digital inputs							

Status word IN0 mirrors control word OUT0. In addition, the status of the digital inputs is always shown in the lower 8 bits independently of the control word. The assignment of the terminal points to the IN process data is shown in the table opposite.

Error bit SB indicates an error. When the error bit is set, it is not necessary to evaluate process data input word IN1. Possible causes for the error bit being set:

– Reading the most significant counter word (RD_H) without reading the least significant counter word of the same channel (RD_L) directly beforehand.
– Writing the most significant counter word (WR_H) without writing the least significant counter word of the same channel (WR_L) directly beforehand.
– Initialization error (CRC error in the retentively saved counter values and configuration). In this case, an I/O error message is also triggered at the bus coupler.

The contents of process data input word IN1 depend on the command:

Command	Contents of input word IN1
RD_L	Least significant counter word
RD_H	Most significant counter word
WR_L	Least significant counter word
WR_H	Most significant counter word
RD_MS	Period length or pulse length
RD_CFG	Channel configuration (structure as for OUT1)
WR_CFG	Channel configuration (structure as for OUT1)
RD_FW	Terminal firmware version

IN1 for RD_FW															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1				2				3				4			
Firmware Version 1.234 (example)															

Assignment of the terminal points to process data input word IN0

(Byte.Bit) view	Byte	Byte 0							
	Bit	7	6	5	4	3	2	1	0
Assign-ment	Slot	4		3		2		1	
	Terminal point* (signal)	2.1	1.1	2.1	1.1	2.1	1.1	2.1	1.1
		8.1	7.1	6.1	5.1	4.1	3.1	2.1	1.1
Input	IN	8	7	6	5	4	3	2	1
Status indicator	Slot	4		3		2		1	
	LED	2	1	2	1	2	1	2	1

* Represents the number:
– When using the original connectors or IB IL SCN-8... (1.1/2.1) connectors
– When using a connector set (1.1 ... 8.1)

9 Function description

Each of the eight digital inputs is assigned a 32-bit main counter and an additional 16-bit counter internally. In contrast to the main counter, the 16-bit counter is volatile and is used to measure the period length or pulse length of the current counting pulse (RD_MS).

The main counter and configuration are written to the non-volatile memory when the supply voltage U_L starts to fail.

The 32-bit main counter has normal overrun behavior. In the event that the maximum possible counter value (2^{32}-1) is exceeded, the counter returns to 0. No error message is generated.

9.1 Digital inputs

The current valid status of the digital inputs is always shown in the least significant 8 bits of IN0 regardless of the command. The valid status is thus the status following debouncing. However, the status indicators of the inputs indicate the physical status prior to debouncing.

Configuration bit INV does not affect the representation of the digital inputs.

9.2 Reading counters

As the 32-bit counter range of the main counter is greater than the data word width that can be used, the entire counter is read in two steps using the RD_L and RD_H commands.

RD_L must always be sent first. The terminal returns the least significant counter word to IN1 and saves the corresponding most significant counter word to a buffer.

The most significant counter word is then requested with RD_H. The terminal then returns the counter word from the buffer to IN1.

It is not permitted to request the most significant counter word without requesting the least significant counter word directly beforehand. This error is acknowledged by setting bit SB.

To speed up the request process, it is recommended to only request the least significant counter words once the entire main counter has been read. In the event that an overrun is detected, increase the most significant counter word by one. This ensures that every overrun is detected reliably. However, this is not a problem at all, as the least significant part takes at least around 2 minutes to overrun (counter mode without debouncing).

9.3 Writing counters

As for reading counters, writing must also be carried out in two steps. First, the least significant counter word is transferred to OUT1 using WR_L and is written to an internal buffer.

The most significant counter word is then transmitted to OUT1 using WR_H. The complete 32-bit counter is now available in the terminal and is immediately used as the valid counter value.

It is not permitted to write the most significant counter word without writing the least significant counter word directly beforehand. This error is acknowledged by setting bit SB.

9.4 Operating hours counter

The operating hours counter is just a special operating mode of the main counter. The counter states are accessed as described above.

The counter value represents the accumulated release time of the operating hours counter in seconds. This gives a formal counter range of around 136 years.

Changing the operating mode from pulse counter to operating hours counter does not affect the counter status of the 32-bit counter. This must be carried out explicitly using the WR_L and WR_H write commands.

9.5 Period length and pulse length

Period length and pulse length measurement is only possible in pulse counter mode. This can be used, for example, to determine the current power at power meters more precisely.

For this, the terminal uses a 16-bit counter internally that is independent of the main counter, which can be read using the RD_MS command via IN1. Alternating requesting of the main counter using RD_L/RD_H and the auxiliary counter using RD_MS is supported.

The nominal resolution is 1 ms. However, it is limited indirectly by the debouncing time setting.

If no valid pulses have been detected by the terminal yet, the value $FFFF_{hex}$ is returned. For period length measurement, the terminal returns to this value after around 65 s if no valid pulses have been detected within this time. For pulse length measurements, this overrun only occurs if the input remains active for longer than around 65 s. However, if the input remains in the inactive state following a valid pulse length measurement, this measured value is output indefinitely.