

Rexroth Inline terminal for absolute encoders with SSI interface

R911170584
Edition 01

R-IB IL SSI-IN-PAC

For absolute encoders with SSI interface
Configurable up to 25 bits

11/2009



Description

The Inline terminal is used to read data from absolute encoders with SSI interface up to 25 bits (single-turn, multi-turn or length measuring systems). It supports encoders with Gray and binary code and converts Gray code into binary code.

The R-IB IL SSI-IN increases operational reliability by automatically checking the data received at the SSI interface for parity.

The terminal has a channel in the local bus protocol, which is requested and configured via two process data words.



This data sheet is only valid in association with the DOK-CONTRL-ILSYSINS***-AW..-EN-P user manual or the Inline system manual for your bus system.

Applications

All standard absolute encoders with SSI interface can be connected with the following properties:

- Single-turn, multi-turn or length measuring systems
- 8 to 25 bits (configurable)
- Gray code, binary code
- No, even or odd parity monitoring
- Transmission speeds of 100 kHz, 200 kHz, 400 kHz, 800 kHz, 1 MHz

Features

- 5 V DC encoder supply
- Diagnostic and status indicators
- Supply of 24 V encoders via adjacent terminals

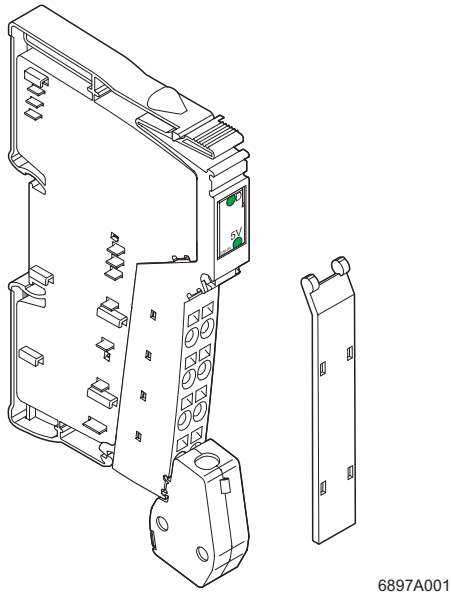


Fig. 1 The R-IB IL SSI-IN-PAC terminal
with connector and labeling field

Function description

The R-IB IL SSI-IN terminal is part of the Inline product range. It is a universal module designed for use within an Inline station. The R-IB IL SSI-IN terminal is used to read position and angular information and is designed for the connection of absolute encoders with SSI interface up to 25 bits (single-turn, multi-turn or length measuring systems with SSI interface).

The terminal outputs a clock pulse train for reading the encoder and provides the control system with the incoming data stream bus-synchronously in the corresponding process data.

The bit pattern for the selection of different operating modes, such as transmission frequencies, bit widths, and code conversions, is downloaded to the terminal permanently by the control system.

The evaluating logic of the terminal automatically generates a pulse sequence, which is used to trigger the connected encoder for the serial output of a bit string. The encoder uses these serial bits to indicate the current position. The terminal reads the position values synchronously to the bus cycle. The timing is designed so that the time delay between reading the data from the encoder and transferring it to the bus is very low. This improves the positioning accuracy of the subsequent positioning control systems or position controllers.

The data width in the bus system is 32 bits. The IN register has seven bits available for status indicators and 25 bits available for actual position values. The OUT register has seven bits available for control codes and 25 bits available, of which 12 are used to

specify the configuration of the SSI interface (see ["Process data words" on page 9](#)).

Error messages

The terminal has monitoring mechanisms, which trigger in the event of the following errors and generate an error message:

1. I/O error (monitoring of the 5 V encoder power supply)
On a failure or overload of the encoder supply, an I/O error is triggered. Unless the terminal is in "Offline" mode, it changes to the "Error" state and generates the corresponding message code.
2. Functional error
 - Parity monitoring of the encoder signals
If a parity error is detected, the terminal changes to the "Error" state and generates a corresponding message code. This error may be caused by a transmission error or a wire break on an encoder cable.
 - Invalid control code
If an invalid control code (word OUT0 bits 15 to 9) is detected, the terminal changes to the "Error" state and generates a corresponding message code.
 - Invalid configuration data
If invalid configuration data (word OUT0 bits 8 ... 0 and OUT1 bits 15 to 0) is detected, the terminal changes to the "Error" state and generates a corresponding message code.

Position detection

To start position detection after switching on the terminal, the terminal must be adapted to the connected encoders (configured). The following control bits are written to the terminal via process data output words OUT0 and OUT1:

- Parity monitoring
- Reversal of direction of rotation
- Encoder resolution
- Transmission frequency of the SSI interface
- Encoding for the encoder

The terminal then starts position detection. Unless the operating state ("Read position") is exited, the actual position value (process data words IN0 and IN1) provide the position values.

The terminal outputs an absolute position value.

Ordering data

Products

Description	Type	MNR	Pcs./Pkt.
Rexroth Inline terminal for absolute encoders with SSI interface up to 25 bits	R-IB IL SSI-IN-PAC	R911171514	1

Documentation

Description	Type	MNR	Pcs./Pkt.
Application description: "Automation terminals of the Rexroth Inline product range"	DOK-CONTRL-ILSYSINS***-AW..-EN-P	R911317017	1
Application description: "Configuring and installing the Rexroth Inline product range for INTERBUS"	DOK-CONTRL-ILSYSPRO***-AW..-EN-P	R911317022	1



For additional ordering data (accessories), please refer to the product catalog at www.boschrexroth.com.

Technical data

General data

Housing dimensions (width x height x depth)	12.2 mm x 120 mm x 72 mm
Weight	71 g (with connector)
Ambient temperature (operation)	-25°C to +55°C
Ambient temperature (storage/transport)	-25°C to +85°C
Permissible humidity (operation/storage/transport)	10% to 95% according to DIN EN 61131-2
Permissible air pressure (operation/storage/transport)	70 kPa to 106 kPa (up to 3000 m above sea level)
Degree of protection	IP20 according to IEC 60529
Class of protection	Class 3 according to VDE 0106, IEC 60536
Connection data for Inline connector	
Connection type	Spring-cage terminals
Conductor cross-section	0.08 mm ² to 1.5 mm ² (solid or stranded), 28 - 16 AWG

Interface

SSI interface	Comprising a differential input and output according to RS-422
Encoder supply	5 V, GND; 250 mA, maximum

Power consumption

Communications power U_L	7.5 V DC
Current consumption from U_L	28 mA, maximum
Power consumption from U_L	0.21 W, maximum
I/O supply from U_M	24 V DC (nominal value)
Current consumption from U_M	65.7 mA, maximum

Supply of the module electronics and I/O through bus coupler/power terminal

Connection method	Through potential routing
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Absolute encoder inputs

Number	1
Encoder signal	Clock, clock inverted Data, data inverted
Signal connection method	Shielded cables



Unshielded cables may lead to erroneous results in environments with heavy noise.

Encoder

Encoder types	Single-turn or multi-turn
Resolution	8 to 25 bits (configurable)
Encoding	Gray code, binary code (configurable)
Parity monitoring	None, even, odd (configurable)
Reversal of direction of rotation	Yes, no (configurable)
Transmission frequency	100 kHz, 200 kHz, 400 kHz, 800 kHz, 1 MHz (configurable)
Encoder supply	5 V; 250 mA, maximum
Cable length	< 30 m for shielded cable (to ensure conformance with EMC directive 89/336/EEC)

Encoder supply

Voltage range	4.75 V to 5.25 V
Short-circuit protection	Electronic and thermal
Current carrying capacity	250 mA, maximum



The status of the 5 V encoder supply is indicated by the green "5V" LED. If the internal voltage for the encoder electronics fails or is overloaded, an I/O error is generated. This error is indicated by the diagnostic LED flashing at 2 Hz and transmitted to the controller board.

Limitation of simultaneity, derating

Derating	No limitation of simultaneity, no derating
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Electrical isolation/isolation of the voltage areas

Common potentials	The 24 V main voltage, 24 V segment voltage, and GND have the same potential. FE is a separate potential area.
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Separate potentials in the system consisting of bus terminal/power terminal and I/O terminal

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

Electrical isolation/isolation of the voltage areas

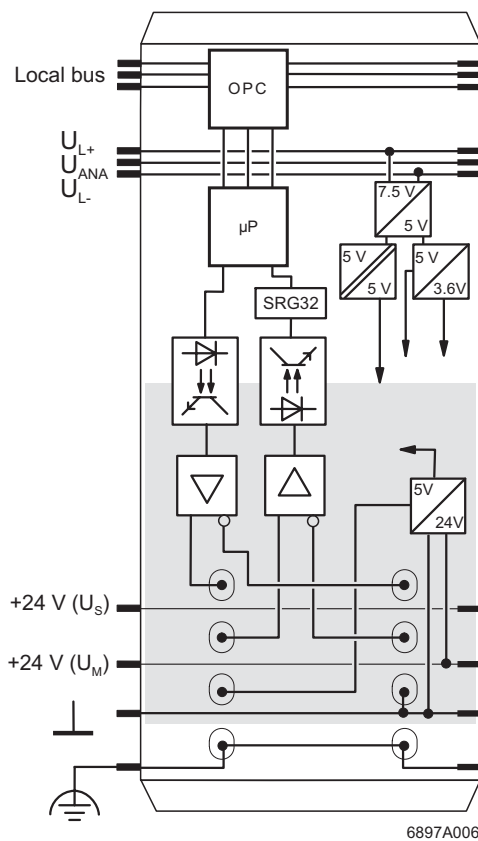
Electrostatic discharge (ESD)	EN 61000-4-2/IEC 61000-4-2	Criterion A 6 kV contact discharge 8 kV air discharge
Electromagnetic fields	ENV 50140 IEC 61000-4-3	Criterion A Field strength: 10 V/m
Fast transients (burst)	EN 61000-4-4/IEC 61000-4-4	Criterion A Supply lines: 2 kV Signal/data lines: 2 kV
Transients (surge)	EN 61000-4-5:1995	Criterion B Supply lines: ±0.5 kV symmetrical ±0.5 kV asymmetrical Signal/data lines: Up to ±1 kV asymmetrical
Conducted interference	ENV 50141 IEC 61000-4-6	Criterion A Test voltage 10 V
Noise emission of housing	EN 55011	Class A

Error messages to the higher-level control or computer system

Yes, failure or overload of the 5 V encoder supply

Approvals

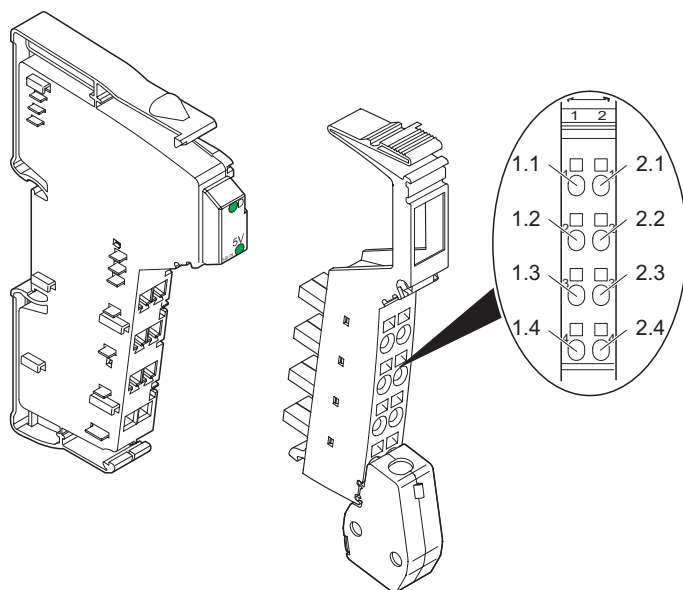
For the latest approvals, please visit www.boschrexroth.com.

Basic circuit diagram**Key:**

	Protocol chip (bus logic including voltage conditioning)
	Microprocessor
	Power supply unit without electrical isolation
	Power supply unit with electrical isolation
	32-bit shift register
	Optocoupler
	RS-422 interface
	Terminal point
	Ground (GND)
	Functional earth ground (FE)
	Electrically isolated area

Fig. 2 Internal wiring of the terminal points

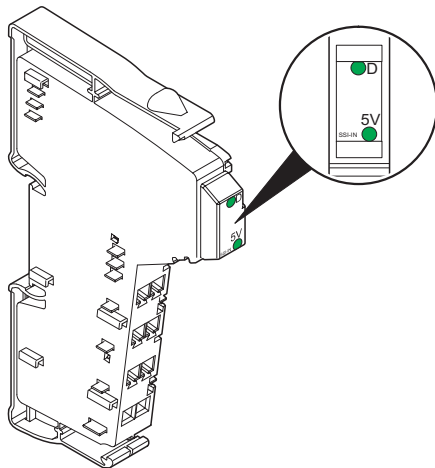
Terminal point assignment



6897A003

Fig. 3 Inline terminal with appropriate connector

Terminal point	Signal	Assignment
1.1	T	Clock
2.1	T	Clock inverted
1.2	D	Data
2.2	D	Data inverted
1.3	5 V	5 V encoder supply
2.3	0 V	0 V encoder supply
1.4, 2.4	Shield	Encoder cable shield

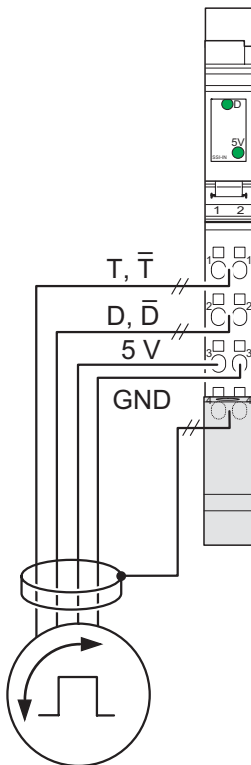
Local diagnostic and status indicators

6897A002

Fig. 4 Local diagnostic and status indicators

Des.	Color	Meaning
D	Green LED	Diagnostics
	ON:	Bus active
	Flashing:	
	0.5 Hz:	Communications power present, bus not active
	2 Hz:	Communications power present, bus active, I/O error
	4 Hz:	Communications power present, previous terminal failed, subsequent terminals are not part of the configuration frame
	OFF:	Communications power not present, bus not active
5V	Green LED	5 V encoder supply
	ON:	5 V encoder supply present
	OFF:	5 V encoder supply not present or short circuit/overload

Connection example



6897A004

Fig. 5 Typical connection with 5 V encoder supply

Key:



Absolute encoder

Connection notes



Encoders should always be connected using **shielded** twisted pair cables. Unshielded cables may lead to erroneous results in environments with heavy noise. On the terminal side, the shield is capacitively connected to functional earth ground (FE) via the shield connector. On the encoder side, the shield must be connected with the grounded encoder housing.

If the encoder does not have a shield connection, the shield can also be directly connected in the control cabinet to functional earth ground via an additional shield connection clamp.



For additional information about shielding and connecting the shielded cables, please refer to the DOK-CONTRL-ILSYSINS***-AW..-EN-P user manual or the Inline system manual for your bus system.



Please also observe the manufacturer's installation instructions for the absolute encoder.

Programming data/configuration data

INTERBUS

ID code	5F _{hex} (95 _{dec})
Length code	02 _{hex} (2 _{dec})
Process data channel	32 bits
Input address area	2 words
Output address area	2 words
Parameter channel (PCP)	0 bytes
Register length (bus)	2 words
Firmware version and sub ID (can only be read via process data)	OUT1 XXXD _{hex}

Other bus systems



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

Process data words

Process data input words IN0 to IN1

(Word.bit) view	Word	Word 0															
	Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
IN0	Assignment	Status								Actual position value (bit 16 to 25)							

(Word.bit) view	Word	Word 1															
	Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
IN1	Assignment	Actual position value (bit 0 to 15)															

Status:

See Table ["Status" on page 10](#)

Actual position value:

See Table ["Actual position value" on page 10](#)

**Firmware version and sub ID
(control code 3C00):**

See Table ["Special function "Read firmware version and sub ID"" on page 12](#)

Status

IN0 Bit 15 ... bit 9 bin hex		Description	Actual position value
000 0000	00	Offline: The module is in the idle state. The configuration data is checked by sending the "Read position" command. If this is valid, the module changes to the "Operation" state.	Invalid
000 0001	01	Operation: If bit 9 = TRUE, the measured value (the position) of the position sensor is valid, i.e., the configuration data is valid and valid position values have been read by the encoder.	Valid
X1X XXX0	XX	Acknowledgment for the "Acknowledge error" control code. Once the control code at "Read position" has been modified, the terminal changes to the "Read position" state (if the error has been removed) or returns to one of the error states.	Invalid
100 0010	42	Error: Encoder supply not present or short circuit.	Invalid
100 0100	44	Error: Parity error During serial data transmission from the absolute encoder to the terminal, a transmission error occurred.	Invalid
100 1000	48	Error: Invalid configuration data The configuration data is outside the limit values.	Invalid
101 0000	50	Error: Invalid control code An unknown or invalid control code was transferred.	Invalid

Actual position value

The current absolute position is displayed right-aligned in binary format.

Status (7 bits)	Actual position value (25 bits)	
IN0	IN0	IN1
Bit 15 ... bit 9	Bit 8 ... bit 0	Bit 15 ... bit 0
000 0001	X XXXX XXXX	XXXX XXXX XXXX XXXX

OUT process data output words

The process data output words are evaluated as soon as the control code is mirrored in the process data input words.



The process data output words specify the output values in each bus cycle. The configuration data must be complete.

Without complete configuration data, the terminal will not change to the ready state.

(Word.bit) view	Word	Word 0															
	Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
OUT0	Assignment	Control code								0	0	0	Parity	0	0	0	Rev

(Word.bit) view	Word	Word 1																
	Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
OUT1	Assignment	0	0	0	Resolution					0	Speed				0	0	0	Code

**Ensure data consistency**

Ensure data consistency of two words to prevent the possibility of misinterpreting the values.

Control code:	See Table "Control code" on page 11
Parity:	See Table "Parity" on page 12
Rev:	See Table "Rev" on page 12
Resolution:	See Table "Resolution" on page 13
Speed:	See Table "Speed (SSI frequency)" on page 13
Code:	See Table "Code" on page 14
"0" (unused):	



"0" bits ("unused" bits) should **not** be set (unknown configuration)

Control code

The control code is used to select terminal operating states. When the terminal has detected the control code, it is mirrored in the status (see Table ["Status" on page 10](#)).

Code OUT0 bit 15 ... bit 9		Control code
bin	hex	
000 0000	00	No action (ignored)
000 0001	01	Read position: On the transition from the "Offline" state to the "Operation" state, the configuration data is checked and the terminal is configured. When position acquisition is successful, the module changes to the "Operation" state, i.e., the configuration data is valid.
000 0010	02	Switch "Offline": The terminal changes from the "Operation" state to the "Offline" state; the configuration is reset.
010 0001	21	Acknowledge error: On the transition from the "Error" state to the "Operation" state, the configuration is maintained.

Special function "Read firmware version and sub ID"

The R-IB IL SSI-IN has a special function, which can be used to read its firmware version and sub ID. The sub ID can be used to distinguish between other Inline terminals with the same ID code. The R-IB IL SSI-IN has the sub ID "D".



The firmware version and sub ID can only be requested in the "Offline" state. During operation, this control command generates an error message.

Process data word OUT0					Process data word OUT1				
Bit 15 bit 0					Bit 15 bit 0				
0011	1100	0000	0000	(bin)	0000	0000	0000	0000	(bin)
3	C	0	0	(hex)	0	0	0	0	(hex)
Process data word IN0					Process data word IN1				
In the status of the mirrored control code					Firmware version (e.g., 100) and sub ID				
Bit 15 bit 0					Bit 15 bit 0				
0011	1100	0000	0000	(bin)	0001	0000	0000	1111	(bin)
3	C	0	0	(hex)	1	0	0	D	(hex)

Parity

This parameter is used to select the parity monitoring function for the SSI interface.

Parity OUT0 bit 4 ... bit 5		Parity
bin	hex	
00	0	None
01	1	Odd
10	2	Even
11	3	Reserved

Rev

The "Rev" parameter is used to set the reversal of the direction of rotation. If the reversal of the direction of rotation is activated, the terminal inverts all position values read by the encoder, i.e., the position value is changed by activating this function.

Rev OUT0 bit 0		Reversal of direction of rotation
bin	hex	
0	0	Off
1	1	On

Resolution

The "Resolution" parameter is used to adjust the terminal to the resolution of the relevant absolute encoder (8 to 25 bits).

Resolution OUT1 bit 8 ... bit 12		Encoder resolution
bin	hex	
0 0000	00	Reserved
0 0001	01	8
0 0010	02	9
0 0011	03	10
0 0100	04	11
0 0101	05	12
0 0110	06	13
0 0111	07	14
0 1000	08	15
0 1001	09	16
0 1010	0A	17
0 1011	0B	18
0 1100	0C	19
0 1101	0D	20
0 1110	0E	21
0 1111	0F	22
1 0000	10	23
1 0001	11	24
1 0010	12	25
1 0011	13	Reserved
...	...	
1 1111	1F	

Speed (SSI frequency)

The "Speed" parameter is used to select the transmission speed at which the encoder data is read via the SSI interface.

Speed OUT1 bit 4 ... bit 6		Transmission speed
bin	hex	
000	0	Reserved
001	1	100 kHz
010	2	200 kHz
011	3	400 kHz
100	4	800 kHz
101	5	1 MHz
110	6	Reserved
111	7	Reserved

Code

This parameter specifies the code in which the encoder outputs information.

Code OUT1 bit 0		Encoding
bin	hex	
0	0	Binary code: The terminal forwards the data to the local bus without modification.
1	1	Gray code: The terminal converts the data from Gray code to binary code and then forwards it to the local bus.

Configuration example

- SSI encoder
- No parity (OUT0, bits 5 and 4)
- No reversal of direction of rotation (OUT0, bit 0)
- Resolution 13 bits (OUT1, bits 12 to 8)
- 400 kHz clock (OUT1, bits 6 and 4)
- Binary code (OUT1, bit 0)

(Word.bit) view	Word	Word 0															
	Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
OUT0	Assignment	Control code							0	0	0	0	0	0	0	0	0

(Word.bit) view	Word	Word 1															
	Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
OUT1	Assignment	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	0



"0" bits ("unused" bits, OUT0 bits 8, 7, 6, 3, 2, 1, and OUT1 bits 15, 14, 13, 7, 3, 2, 1) must **not** be set (unknown configuration).



"Reserved" bits for the individual configuration parameters must **not** be set (unknown configuration).

Notes:

DOK-CONTRL-
ILSSIIN****-KB01-EN-P

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