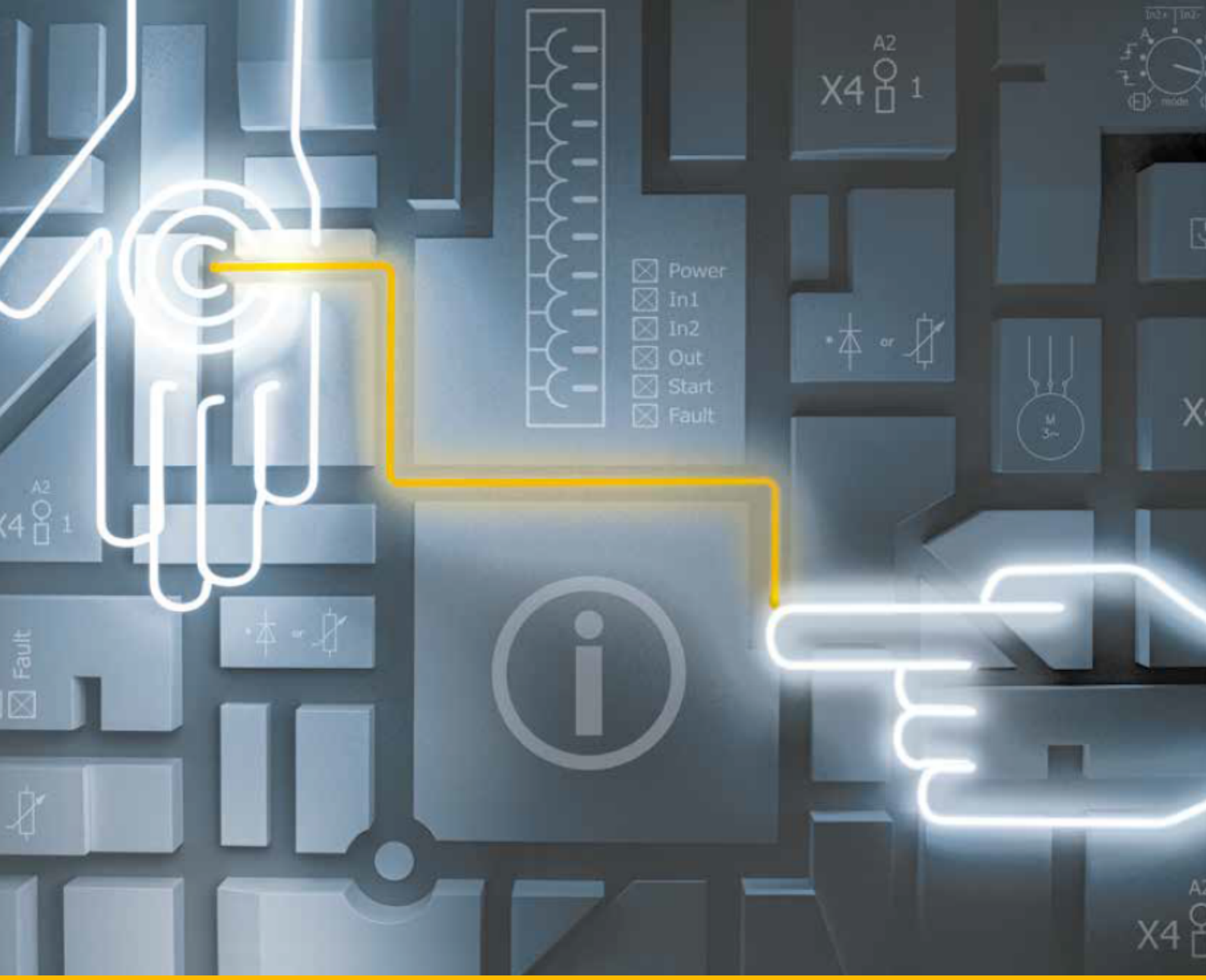


PSSu E F INC(-T)

PILZ
THE SPIRIT OF SAFETY

Operating Manual-1001454-EN-10

- Decentralised system PSSuniversal I/O

This document is the original document.

Where unavoidable, for reasons of readability, the masculine form has been selected when formulating this document. We do assure you that all persons are regarded without discrimination and on an equal basis.

1 Introduction

1.1 Validity of documentation

This documentation is valid for the products PSSu E F INC and PSSu E F INC-T. It is valid until new documentation is published.

This operating manual explains the function and operation, describes the installation and provides guidelines on how to connect the product.

1.1.1 Retaining the documentation

This documentation is intended for instruction and should be retained for future reference.

1.1.2 Terminology: System environment A and B

The PSSu system can be used in two different system environments. The module's application area is described in the chapter "Intended Use" of the manual.

The distinction is made between

- PSSu in system environment A
- PSSu in system environment B

The distinction is based on the application area of the PSSu system.

PSSu in system environment A may be used in the

- Decentralised system PSSu I/O
- **Not** in the automation system PSS 4000

PSSu in system environment B may be used in the

- Automation system PSS 4000, e.g. with
  - Decentralised system PSSu I/O with SafetyNET p
  - Control system PSSu PLC
  - Control system PSSu multi

The modules PSSu E F INC and PSSu E F INC**(-T)** are exclusively for use in system environment B (automation system PSS4000).

1.2 Definition of symbols

Information that is particularly important is identified as follows:

DANGER!

This warning must be heeded! It warns of a hazardous situation that poses an immediate threat of serious injury and death and indicates preventive measures that can be taken.

WARNING!

This warning must be heeded! It warns of a hazardous situation that could lead to serious injury and death and indicates preventive measures that can be taken.

CAUTION!

This refers to a hazard that can lead to a less serious or minor injury plus material damage, and also provides information on preventive measures that can be taken.

NOTICE

This describes a situation in which the product or devices could be damaged and also provides information on preventive measures that can be taken. It also highlights areas within the text that are of particular importance.

INFORMATION

This gives advice on applications and provides information on special features.

2 Overview

2.1 Module structure

A module consists of

- Electronic module and
- Base module with
  - Screw terminals or
  - Cage clamp terminals

The base modules are the carrier units for the electronic modules and are used to connect the field wiring. The electronic modules are inserted on to the base modules and determine the module's function.

Details of the base modules that can be used are available in the chapter entitled “Intended Use”.

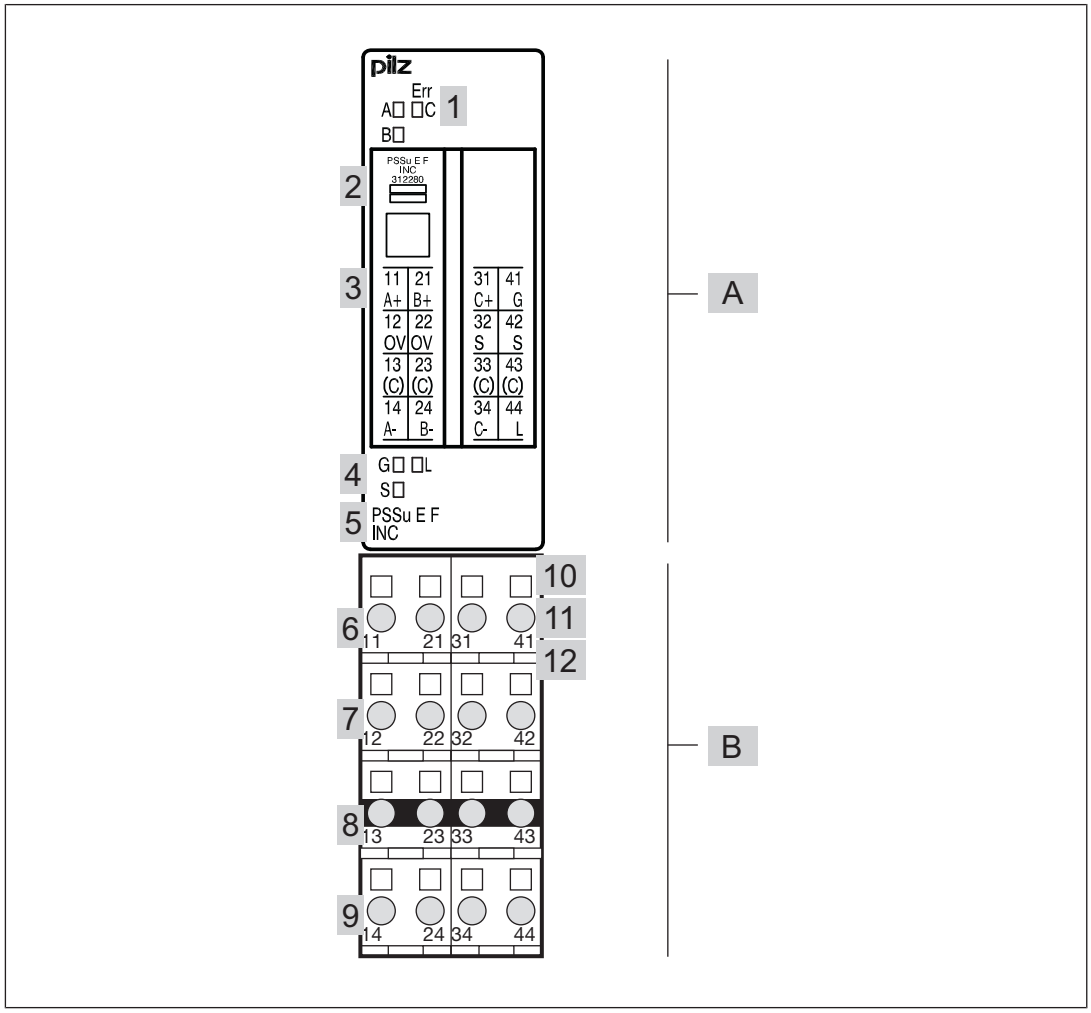
2.2 Module features

The product has the following features:

- Inputs for
  - Counter pulses (inputs A, B)
  - Zero pulse (input C)
  - Stopping the counter (input G, Gate)
  - Memory function (Input L, Latch)
  - Rotary encoder status (Input S, Status)
- Resolution of the counter and latch memory: 32 Bit
- Operating modes:
  - Incremental encoder
  - Counter
- Inputs A, B, C are operated as differential inputs with inverted signals (A-, B-, C-).
- LEDs for:
  - Data transfer per input A, B, C
  - Status per functional input (Gate, Latch, Status)
  - Module error
- For failsafe applications in system environment B (automation system PSS 4000)
- T-type:

  PSSu E F INC-T: for increased environmental requirements

2.3 Front view



Legend:

- A: Electronic module
- B: Base module
- 1: LEDs for
  - Module diagnostics
  - Status of the input channels A, B, C
- 2: Labelling strip with:
  - Name of electronic module
  - Order number
  - Serial number
  - Hardware version number
  - 2D code
- 3: Labelling strip for the terminal configuration on the base module
- 4: LEDs for
  - Status of function inputs G, L, S
- 5: Name of electronic module

- 6: Connection level 1 (terminals 11, 21, 31, 41)
- 7: Connection level 2 (terminals 12, 22, 32, 42)
- 8: Connection level 3 (terminals 13, 23, 33, 43)
- 9: Connection level 4 (terminals 14, 24, 34, 44)
- 10: Square mounting holes (connection levels 1, 2, 3 and 4)
  - With screw to loosen/tighten the screw terminal on base modules with screw terminals
  - With mechanism to operate the cage clamp on base modules with cage clamp terminals
- 11: Round connection holes (connection levels 1, 2, 3 and 4) for connecting the signal lines
- 12: Mounting slot for colour marker to label the connection level (connection levels 1, 2, 3 and 4)

3 Safety

3.1 Intended use

The module may be used for failsafe applications in system environment B (automation system PSS 4000).

The modules PSSu E F INC and PSSu E F INC-T can be used as a PESSRAL (programmable electronic system in safety-related applications for lifts) in accordance with the Lifts Directive 2014/33/EU. The modules meet the requirements in accordance with EN 81-20, EN 81-50 for passenger and goods lifts the requirements in accordance with EN 115-1 for escalators and moving walks.

The module/the safety controller should be installed in a protected environment. Example: Protected inside space or control cabinet with protection class and corresponding air conditioning specified in Technical details [📖 37].

With the counter module you can implement the following safety functions:

Monitoring of:

- Position
- Speed
- Standstill

To guarantee safety integrity you will need to use

- 2 sensors and
- 2 counter modules: a PSSu E F INC and a PSSu E F ABS SSI and
- the function blocks FS_IncrementalEncoder, FS_AbsoluteEncoder and FS_CounterDual

This means that with redundant and diverse input values, PL e and SIL CL 3 can be achieved.

To apply the module you will need to have read and understood the description of the function blocks (s. Online help).

Requirements of the PSSu system:

- The counter modules must be part of a control system PSSu PLC or PSSu multi (not decentralised I/O system).
- The function blocks have to be assigned to the FS resource of the PSSu system where the counter modules are inserted. Control via SafetyNet is not permitted.

Demands on the sensors:

- Incremental encoders with RS422 interfaces may be used as sensors.
- Connect the sensors mechanically independently to the axis. If this is not possible, the connection should be positive-locking without wearing parts as e.g. chains or drive belts. If it is not possible to avoid this, the mechanical connection of the sensors must be monitored.
  Alternatively, it is possible to use a sensor that internally has 2 independent measured value recording systems.

Please note during configuration and within the user program:

- The input values must be diverse. This can be achieved through different
  - Scaling

  - Direction of rotation/count direction
  - Offset
- If more than two counters are used, each individual counter module of a PSSu system must supply diverse input values to the other counter modules of the PSSu system.
- Safe standstill monitoring must be carried out by feasibility with a safe travel command in the function block.
- Test the safety functions when commissioning or recommissioning.

Intended use includes making the electrical installation EMC-compliant. Please refer to the guidelines stated in the "PSSuniversal Installation Manual". The module is designed for use in an industrial environment. It is not suitable for use in a domestic environment, as this can lead to interference.

The following is deemed improper use in particular:

- Any component, technical or electrical modification to the module
- Use of the module outside the areas described in this manual
- Any use of the module that is not in accordance with the technical details.

INFORMATION

The module is supported by PAS4000 from Version 1.1.1. We recommend that you always use the latest version (download from www.pilz.de).

The PSSu E F INC module may be used in conjunction with the following base modules:

- PSSu BP 2/16 S
- PSSu BP 2/16 C
- PSSu BP-C 2/16 S
- PSSu BP-C 2/16 C

The module PSSu E F INC-T may be used in conjunction with the following base modules:

- PSSu BP 2/16 S-T
- PSSu BP 2/16 C-T
- PSSu BP-C 2/16 S-T
- PSSu BP-C 2/16 C-T

3.2 Safety regulations

3.2.1 Use of qualified personnel

The products may only be assembled, installed, programmed, commissioned, operated, maintained and decommissioned by persons who are competent to do so.

A competent person is a qualified and knowledgeable person who, because of their training, experience and current professional activity, has the specialist knowledge required. To be able to inspect, assess and operate devices, systems and machines, the person has to be informed of the state of the art and the applicable national, European and international laws, directives and standards.

It is the company's responsibility only to employ personnel who

- Are familiar with the basic regulations concerning health and safety / accident prevention,
- Have read and understood the information provided in the section entitled Safety
- Have a good knowledge of the generic and specialist standards applicable to the specific application.

3.2.2 Warranty and liability

All claims to warranty and liability will be rendered invalid if

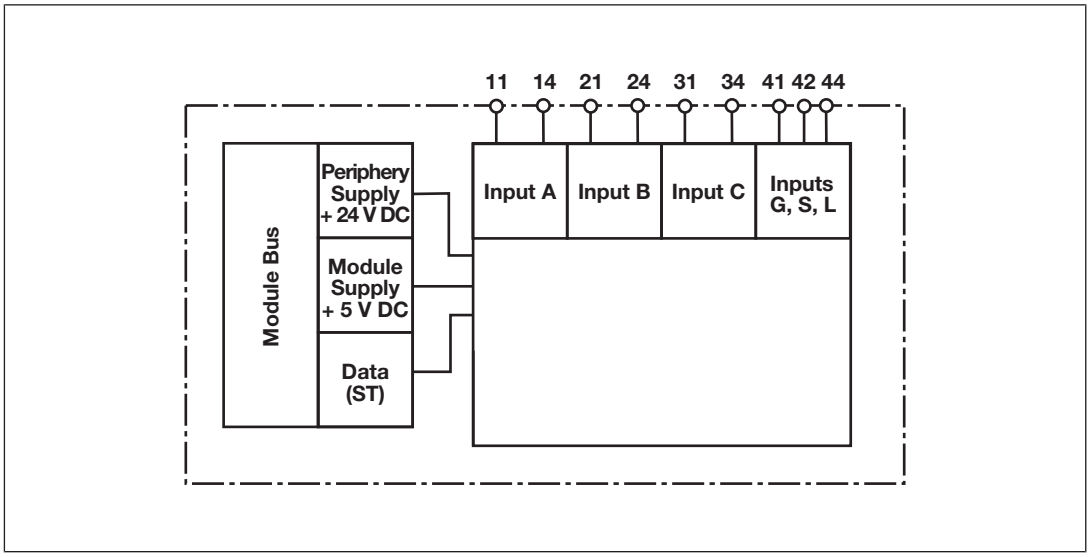
- The product was used contrary to the purpose for which it is intended,
- Damage can be attributed to not having followed the guidelines in the manual,
- Operating personnel are not suitably qualified,
- Any type of modification has been made (e.g. exchanging components on the PCB boards, soldering work etc.).

3.2.3 Disposal

- In safety-related applications, please comply with the mission time T_M in the safety-related characteristic data.
- When decommissioning, please comply with local regulations regarding the disposal of electronic devices (e.g. Electrical and Electronic Equipment Act).

4 Function description

4.1 Block diagram



4.2 Integrated protection mechanisms

When the PSSu E F PS1(-T) or PSSu E F PS2(-T)(-R) is used to supply the system, the module supply is buffered for 20 ms if the supply voltage is interrupted.

The module detects the following errors:

- Start-up error
- Configuration error
- ST communication error
- Bus termination error

4.3 Function description

Module supply

- The module supply provides the module with voltage.

Inputs

- 3 dual-pole, differential inputs A, B, C for connecting an incremental encoder or an encoder that provides rising edges as counter pulses.
- 3 single-pole inputs referenced to earth: G, L, S, for special functions

Operating modes

- Incremental encoder
- Counter

Functions

- Period length measurement
  or
- Storing the counter status in latch memory after a latch pulse or zero pulse

- Setting the counter status

The module transfers the data and status information to the head module via the module bus. The choice of function and the function's configuration are defined via the system software.

4.3.1 Functional inputs (G, L, S)

The single-pole inputs (G, L, S) are used for special functions. Inputs G and L may be connected to external signal sources, e.g. to a higher order control system. If the gate signals are generated by a non-safety-related device or if the gate inputs are connected, common cause failures may arise. A failure mode and effects analysis must be carried out when wiring the gate inputs.

- Input G (gate input)
  The counter is stopped with a 1 signal. The module ignores the counter pulses at the inputs until a 0 signal returns.
- Input L (input for latch pulse)
  At a rising edge, the module stores the current counter value in the latch memory. The counter continues counting; it is not stopped by the latch pulse. The module transmits the stored value to the head module. The period length measurement may be configured as an alternative to the latch function.
- Input S (status input)
  The encoder's fault signal output can be connected to the status input. The module transmits the input state to the head module with the status information.

4.3.2 Overflow

In both operating modes the counter can accept values from 0000 0000_H to FFFF $FFFF_H$.

- With an underflow the value drops below 0000 0000_H and the counter continues from FFFF $FFFF_H$.
- With an overflow the value FFFF $FFFF_H$ is exceeded and the counter continues from 0000 0000_H.

The overflow or underflow is signalled to the head module as status information.

The status information overflow is reset:

- if the value again falls below 0000 0000_H (underflow).
- if 5555 0000_H is exceeded (the lower third of the value range).

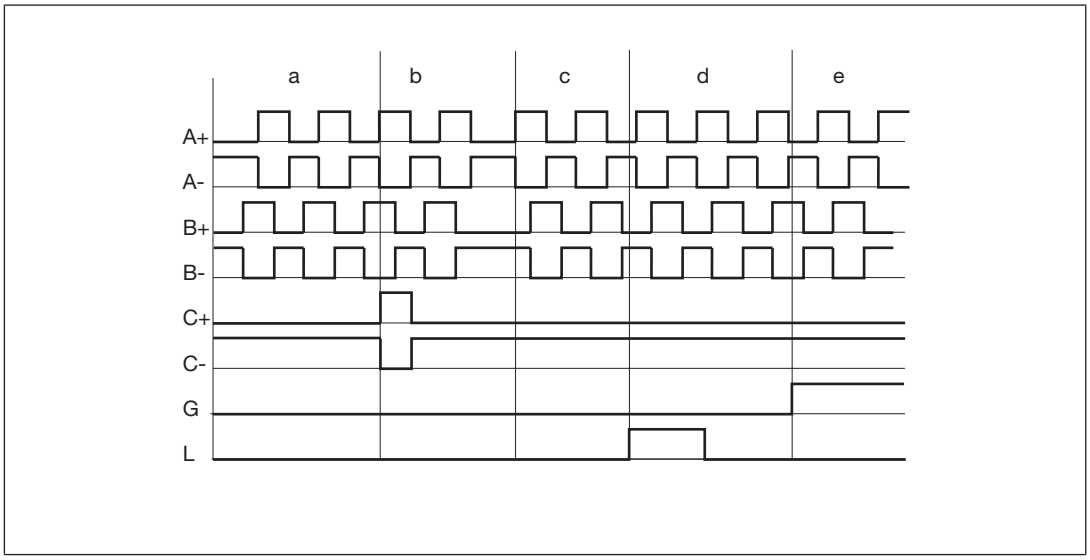
The status information underflow is reset:

- if FFFF $FFFF_H$ is exceeded again (overflow).
- if AAAA $FFFF_H$ is exceeded (the upper third of the value range).

4.4 Incremental encoder operating mode

The counter outputs and the output for the incremental encoder's zero pulse are connected to the dual-pole inputs (A, B, C).

- Inputs A, B
  The first channel of the encoder is connected to input A, the second to input B. The second channel is 90° out of phase. If channel A is leading, the module counts forwards. If channel A is lagging, the module counts backwards (see timing diagram).
- Input C
  The output for the incremental encoder's zero pulse is connected to input C. An incremental encoder typically supplies one zero pulse per rotation. If the zero pulse function is activated, the module copies the last value prior to the zero pulse into the latch memory and passes it to the process image of inputs (see chapter entitled "Transfer counter status via latch pulse").



Legend:

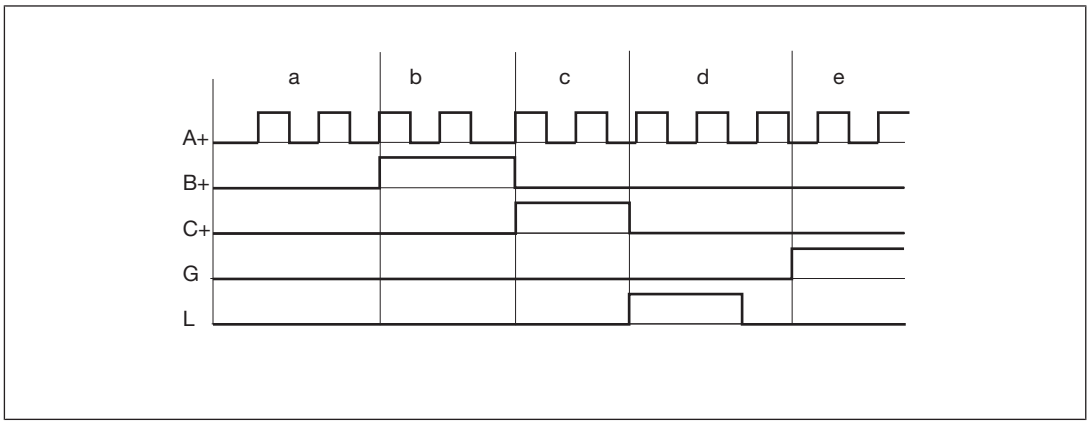
- a: The counter counts backwards because the signal at channel A is lagging.
- b: The module has received a zero pulse. Provided the function is activated, the counter value is copied into the latch memory with a rising edge at input C+.
- c: The counter counts forwards because the signal at channel A is leading.
- d: The module has received a latch pulse. Provided the function is activated, the counter value is copied into the latch memory with a rising edge at input L.
- e: The counter is disabled because there is a 1 signal at input G.

4.5 Counter operating mode

"Counter" operating mode is not recommended for safety functions because pulses can be generated if there are any track errors. Compare errors can arise as a result, which can lead to a shutdown or to common cause errors.

In "Counter" operating mode, the module's dual-pole, differential inputs A, B, C have the following functions:

- Input A (Count)
  Input A is the input for the encoder's counter pulses. The module counts each rising edge.
- Input B (Up/down)
  At a 0 signal the module counts forwards. At a 1 signal the module counts backwards.
- Input C (Gate/Latch)
  The counter is stopped with a 1 signal. The module ignores the counter pulses at the input until a 0 signal returns.



Legend:

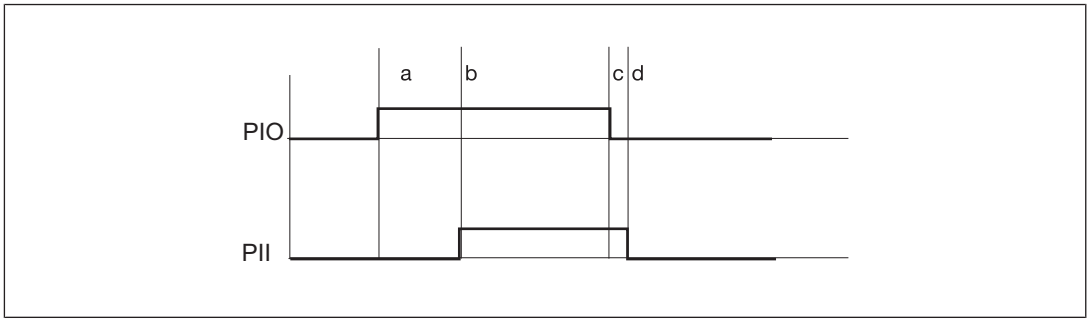
- a: The counter counts forwards because there is 0 signal at channel B.
- b: At the next rising edge at channel A, the counter counts backwards because there is a 1 signal at channel B.
- c: The counter is disabled because there is a 1 signal at input C.
- d: The module has received a latch pulse. Provided the function is activated, the counter value is copied into the latch memory with a rising edge at input L.
- e: The counter is disabled because there is a 1 signal at input G.

4.6 Functions

4.6.1 Measure period length

The module can record the period length of the counter pulses on channel A. The period length is the time between two rising edges at channel A. It is transferred to the process image of inputs as multiple of 200 ns.

Prerequisite: This function is configured in PAS4000.



Legend:

- PIO: Process image of outputs, I/O datum: OutputData.LatchOrMeasure
- PII: Process image of inputs, I/O datum: InputData.LatchOrMeasureDone

Key to timing diagram:

Section	Function	Procedure for PSSu in system environment B
a	Start measurement	In the user program, set OutputData.LatchOrMeasure
b	Output measured value Set status bit	Measured value is written in InputData.LatchOrPeriod The module sets InputData.LatchOrMeasureDone
c	Finish measurement	In the user program, reset OutputData.LatchOrMeasure
d	Ready for new measurement	The module resets InputData.LatchOrMeasureDone

The result of the last period length measurement remains in the process image of inputs until the module signals a new measurement result by setting the status information. Before the initial measurement the process image of inputs contains 0000 0000_H or FFFF $FFFF_H$.

The module issues the result of period length measurement in multiples of 200 ns.

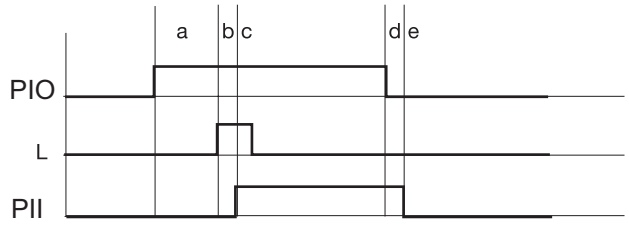
Example:

- The process image of inputs contains $32_H/50_D$
- The period length is 200 ns x 50 = 10 µs

4.6.2 Transfer counter status via latch pulse

A signal output can be connected to input L on the module for a latch pulse. The latch pulse may come from a PLC or position switch, for example. Using the latch function it is possible to record and transmit the counter status at the time of this latch pulse.

Prerequisite: This function is configured in PAS4000.



Legend:

- PIO: Process image of outputs, I/O datum: OutputData.LatchOrMeasure
- L: Input L for external latch
- PII: Process image of inputs, I/O datum: InputData.LatchOrMeasureDone

Key to timing diagram:

Section	Function	Procedure for PSSu in system environment B
a	Activate latch function	In the user program, set OutputData.LatchOrMeasure
b	Fill latch memory	Rising edge at input L: Counter status is transferred to the latch memory
c	Output counter status Set status bit	Counter status is written in InputData.LatchOrPeriod The module sets InputData.LatchOrMeasureDone
d	Finish latch function	In the user program, reset OutputData.LatchOrMeasure
e	Ready for new latch function	The module resets InputData.LatchOrMeasureDone

The contents of the latch memory remains in the process image of inputs until the module signals a new memory value by setting the status information. Before the initial transfer the process image of inputs contains 0000 0000_H or FFFF $FFFF_{H.}$

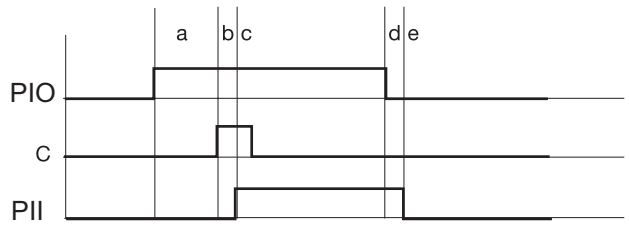
The module always transmits the counter status when the first latch pulse occurs after the function has started. All subsequent latch pulses are ignored until the function is completed and reset.

4.6.3 Transfer counter status via zero pulse

The output for the incremental encoder's zero pulse is connected to input C (C+/C-). An incremental encoder typically supplies one zero pulse per rotation. Using the zero pulse function it is possible to record the last counter status before the zero pulse and transmit it via the process image of inputs.

INFORMATION

In Counter operating mode, a rising edge at input C stops the counter.



Legend:

- PIO: Process image of outputs, I/O datum: OutputData.ZeroPulseActive
- C: Input C
- PII: Process image of inputs, I/O datum: InputData.ZeroPulse

Key to timing diagram:

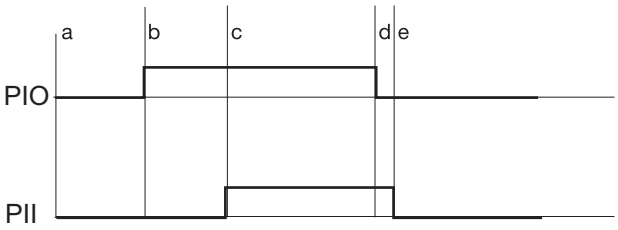
Section	Function	Procedure for PSSu in system environment B
a	Activate zero pulse function	In the user program, set OutputData.ZeroPulseActiv
b	Fill latch memory	Rising edge at input C: Counter status is transferred to the latch memory
c	Output counter status Set status bit	Counter status is written in InputData.LatchOrPeriod The module sets InputData.ZeroPulse
d	Finish zero pulse function	In the user program, reset OutputData.ZeroPulseActiv
e	Ready for new latch function	The module resets InputData.ZeroPulse

The zero pulse function has priority over the latch function and the "Period length measurement" function. If this function is activated, both the other functions are ignored, even if they have been activated.

The module always transmits the counter status when the first zero pulse occurs after the function has started. The counter statuses on all subsequent zero pulses are ignored until the function has been completed and reset.

4.6.4 Set counter status

The "Set counter status" function sets the counter to any value. The value is stated in the user program. The module transfers the value and continues counting from this counter status.



Legend:

- PIO: Process image of outputs, I/O datum: OutputData.SetCounter
- PII: Process image of inputs, I/O datum: InputData.SetCounterDone

Key to timing diagram:

Section	Function	Procedure for PSSu in system environment B
a	Enter counter status	In the user program, assign the default counter status to OutputData.NewCounterValue
b	Transfer counter status	In the user program, set OutputData.SetCounter
c	Acknowledge transfer	The module sets InputData.SetCounterDone; InputData.Underflow and InputData.Overflow are reset
d	Finish transfer	In the user program, reset OutputData.SetCounter
e	Ready for new function	The module resets InputData.SetCounterDone

4.7 Configuration

4.7.1 Operating modes and parameters

The module has the following configuration options:

Configuration	Default value	Meaning
Operating mode	X	Incremental encoder mode
		Counter mode
Period length measurement or latch function	X	Latch function
		Period length measurement
Status input	X	The status at input S is transmitted via a bit.
		The status is transmitted via two redundant bits.
		The status is transmitted via two diverse bits.[1]

[1] Transmitting the status via two bits enables simple fault detection: Two redundant bits must always be the same, two diverse bits must always be different, otherwise the transmission is faulty.

4.7.2 Input/output data

4.7.2.1 PSSu assignment in system environment B

Data access is via pre-defined I/O data types:

I/O data name	I/O data type	I/O data element	Meaning
OutputData	FS_O_INC	ZeroPulseActiv: BOOL	FALSE: Input C (zero pulse) inactive TRUE: Input C (zero pulse) active
		LatchOrMeasure: BOOL	FALSE: Input L (latch pulse) inactive/period length measurement inactive TRUE: Input L (latch pulse) active/ period length measurement active
		SetCounter: BOOL	FALSE: Do not transfer default counter status TRUE: Transfer default counter status
		NewCounterValue: DWORD	Default counter status

I/O data name	I/O data type	I/O data element	Meaning
InputData	FS_I_INC	CurrentData: DWORD	Current counter status in incremental encoder or counter mode
		LatchOrPeriod: DWORD	Counter status after a latch or zero pulse or period length
		ZeroPulse: BOOL	FALSE: No zero pulse at input C TRUE: Zero pulse at input C
		LatchOrMeasure-Done: BOOL	FALSE: Period length or contents of latch memory not transferred TRUE: Period length or contents of latch memory transferred
		SetCounterDONE: BOOL	FALSE: Default counter status not transferred TRUE: Default counter status transferred
		Underflow: BOOL	FALSE: No counter underflow TRUE: Counter underflow
		Overflow: BOOL	FALSE: No counter overflow TRUE: Counter overflow
		State1: BOOL	FALSE: Status input, Bit 1 (message from encoder) TRUE: Status input, Bit 1
		State2: BOOL	FALSE: Status input, Bit 2 (1) TRUE: Status input, Bit 2

(1) When configuring the module, users can determine the evaluation method for the status input: single, redundant or diverse. Transmitting the status via two bits enables simple fault detection: Two redundant bits must always be the same, two diverse bits must always be different, otherwise the transmission is faulty.

5 Installation

5.1 General installation guidelines

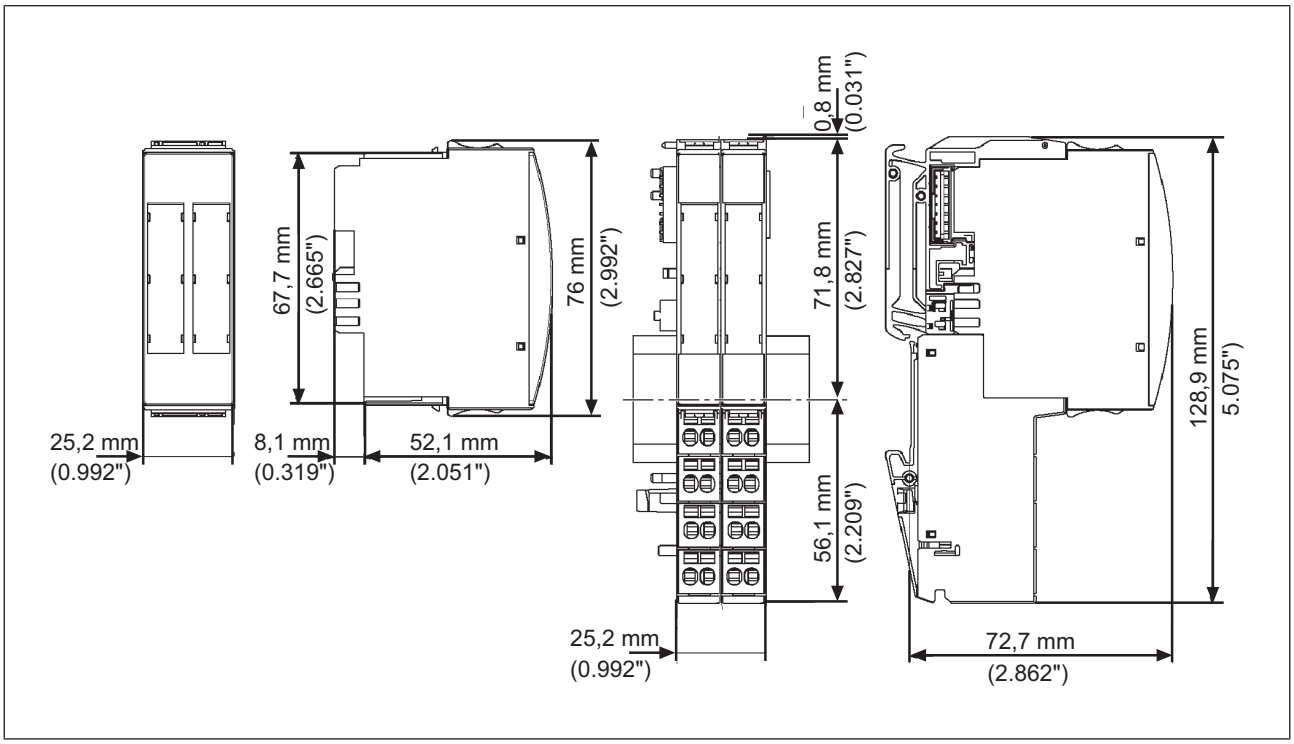
Please refer also to the PSSuniversal Installation Manual.

NOTICE

Damage due to electrostatic discharge!

Electrostatic discharge can damage components. Ensure against discharge before touching the product, e.g. by touching an earthed, conductive surface or by wearing an earthed armband.

5.1.1 Dimensions



5.2 Installing the base module

Prerequisite:

- The head module must be installed.
- If the head module does not have an integrated power supply, a supply voltage module must be installed to the right of the head module.

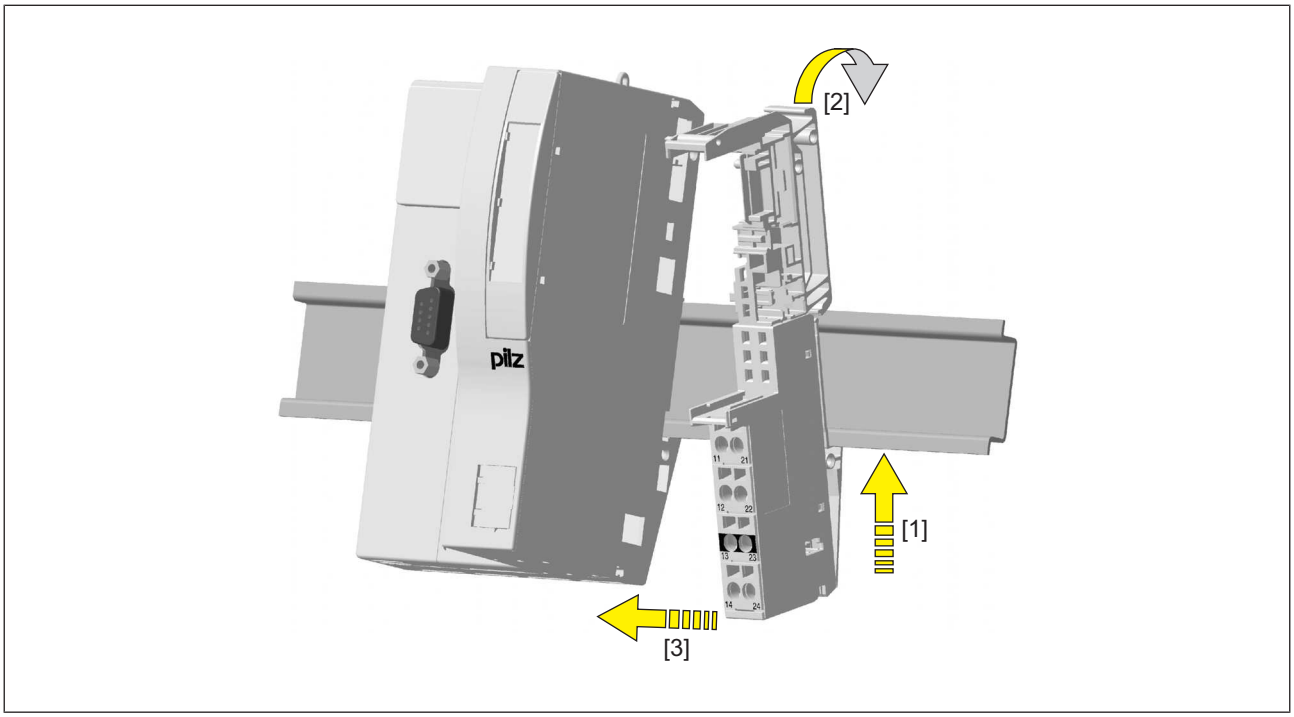
Please note:

- For mechanical reasons it is not possible to mix base modules with screw terminals and base modules with cage clamp terminals.
- All contacts should be protected from contamination.
- The mechanics of the base modules are designed for 50 plug in/out cycles.

Procedure:

- We recommend that you wire up the base modules before inserting the electronic modules.
- Slot the groove on the base module on to the mounting rail from below [1].
- Push the base module back [2] until you hear it lock into position.
- On the mounting rail, slide the base module to the left until you hear the two lateral mounting hooks on the adjacent module lock into position [3].

Schematic representation:



5.3 Inserting and removing an electronic module

Please note:

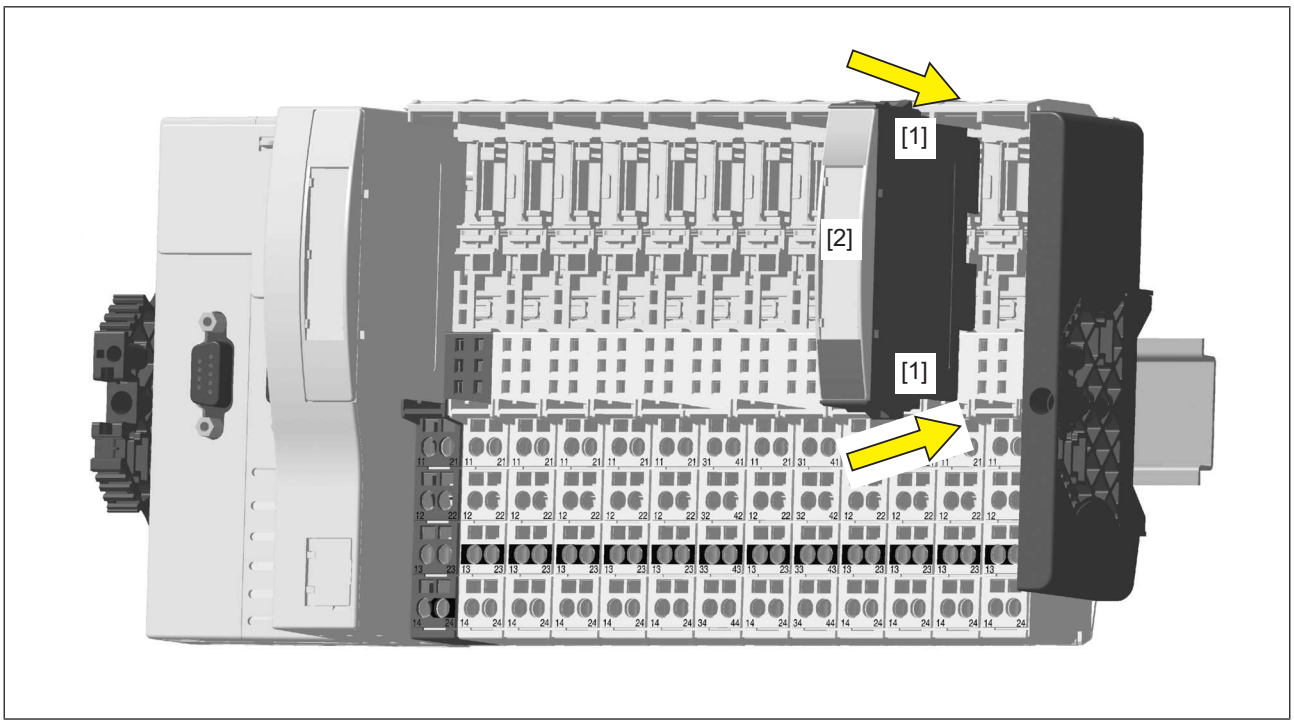
- Only insert on to base modules that are already installed.
- Preferably these base modules should be ready wired.
- Electronic modules with outputs may only be inserted and removed when the load is switched off. Unforeseeable error reactions may be triggered if modules are inserted and removed under load.
- When an electronic module is plugged into a base module for the first time, one part of the coding element remains on the electronic module, while its counterpart is fixed on to the base module. This is how the base module is coded.
- The mechanics of the electronic modules are designed for 50 plug in/out cycles.

5.3.1 Inserting an electronic module

Procedure:

- The electronic module must audibly lock into position [1].
- Mark the electronic module using the labelling strips [2].

Schematic representation:

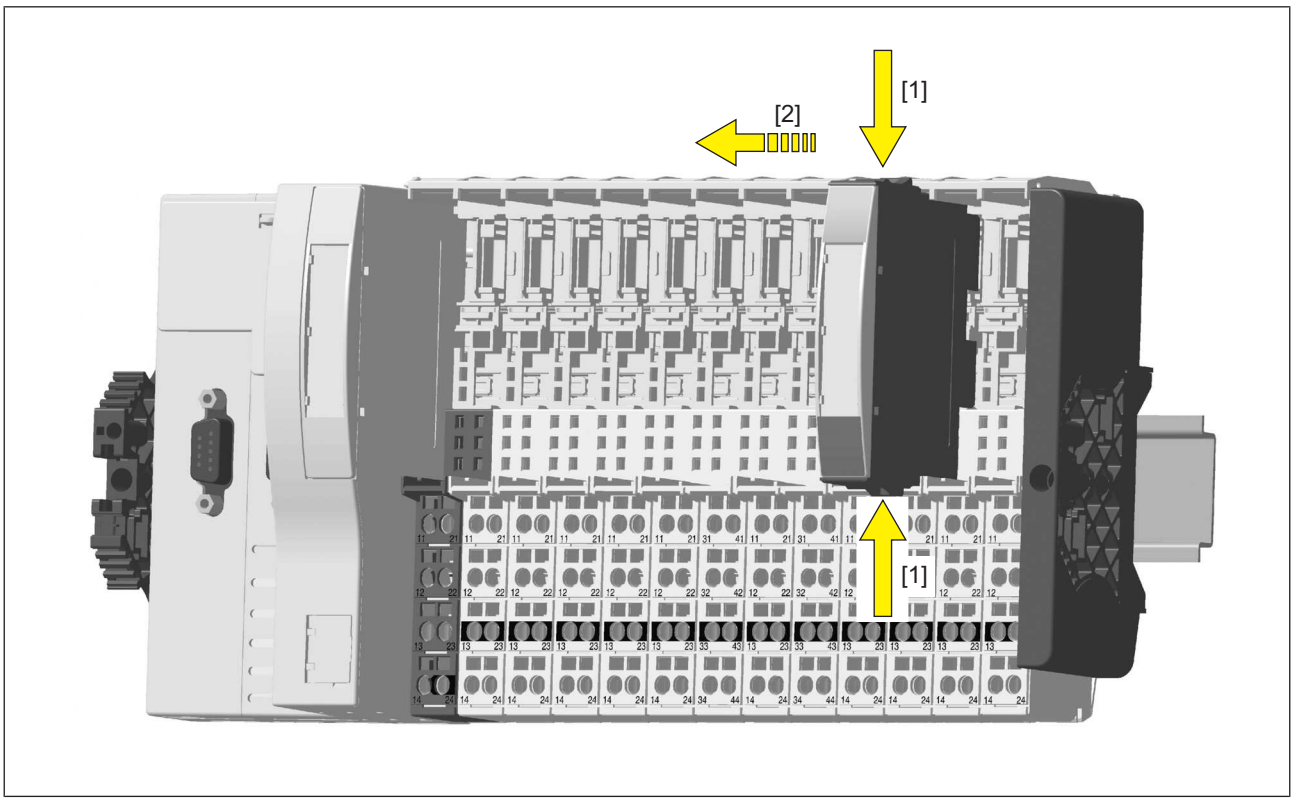


5.3.2 Removing an electronic module

Procedure:

- Press the locking mechanisms [1] together simultaneously.
- Pull out the electronic module [2].

Schematic representation:



5.3.3 Changing an electronic module during operation

It is possible to change an electronic module during operation. The configuration data is retained when a module is changed.

Effects:

- System environment A:
  - In the event of a potential FS communication error, the FS section of the PSSu system and all relevant I/O-Groups (SafetyBUS p) switch to a STOP condition.
- System environment B:
  - All FS hardware outputs on the PSSu system switch to a safe condition.
  - The substitute values are used for the modules' FS outputs, with Valid Bits = FALSE.

CAUTION!

Sparking can cause interference and errors!

Only change the module when the load is switched off!

6 Wiring

6.1 General wiring guidelines

Please note:

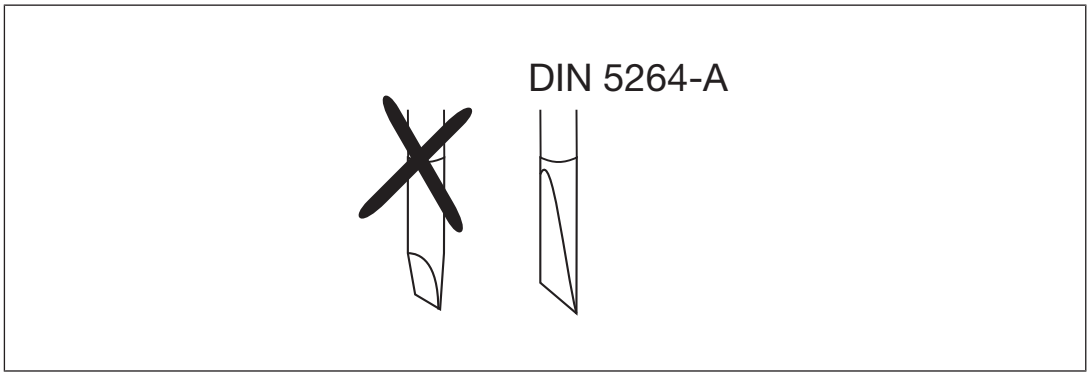
- The module's connections are galvanically isolated from the module supply and periphery supply.
- For EMC reasons we recommend that you operate inputs A, B, C exclusively as differential inputs with inverted signals (A+/A-, B+/B-, C+/C-).
- The module evaluates open differential inputs (A+/A-, B+/B-, C+/C-) as a 1 signal.
- The module evaluates open function inputs (G, L, S) as a 0 signal.
- Use twisted pair cables to carry the inverted signals. This will increase the noise immunity.
- Use shielded signal cables with metallic plugs.
- On base modules with C-rail:
  - Connect the shield to the terminals on the C-rail.
  - Connect the C-rail with low impedance to the functional earth.
- On base modules without C-rail:
  - Connect the shield as shown in the terminal configuration section.
  - The module connects the shield to the functional earth via the mounting rail.
- The channel for the incremental encoder's zero pulse has a different designation depending on the manufacturer (N, C, Z, 0,...)
- The power supply must meet the regulations for extra low voltages with protective electrical separation (SELV, PELV).
- Use copper wiring.
- Connect the two sensors via separate cables. This also applies to compact encoders.
- The terminal configuration as stated on the front plate applies for base modules with C-rail. The terminal configuration as stated in the technical documentation applies for all other base modules.
- Counter modules with low input signals detect even very small signal changes. In a particularly disturbed environment it can happen that signal changes caused by interferences are also detected.

  In these cases, we recommend the following measures:
  - Earth the mounting rail on both sides of the modules.
  - Earth the shield connection of the cables on both sides (on the sensor/encoder and either on the module or directly on the point where the cable enters the control cabinet).
  - Ensure that no transient currents flow across the cable screening, which may damage the cables or the connectors.

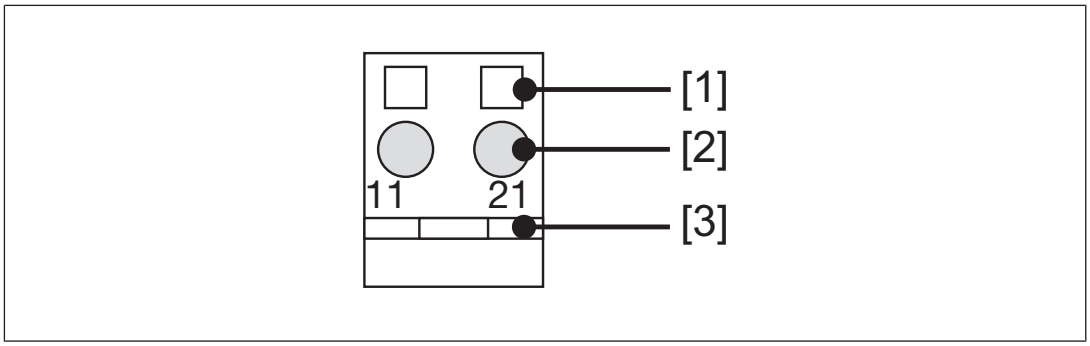
6.1.1 Mechanical connection of the base modules

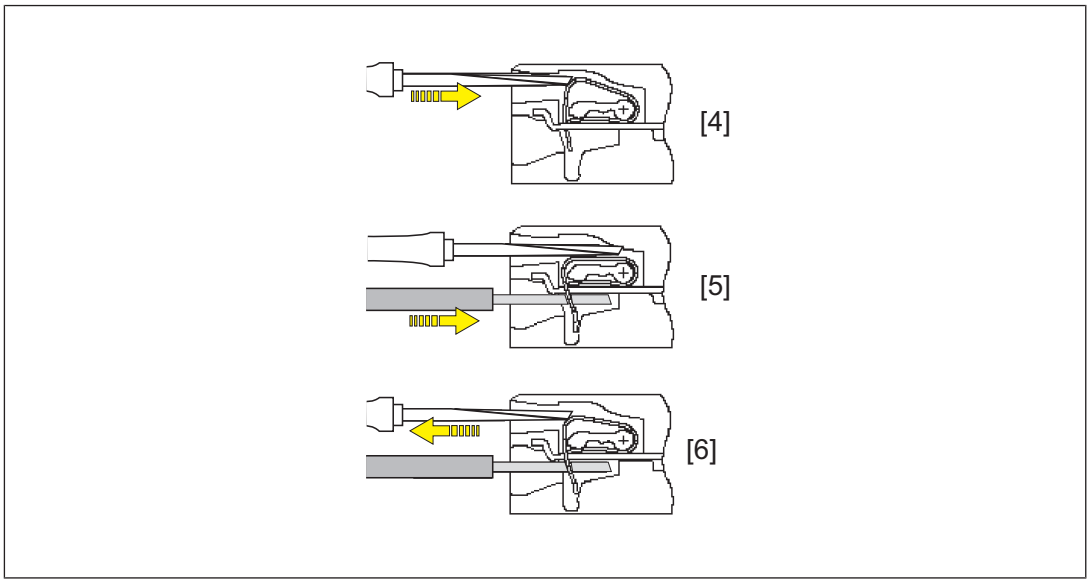
Procedure:

- Use a flat blade screwdriver (DIN 5264-A)!



- Strip the wire back 8 mm.
- If necessary, label the connection level with a colour marker [3].
- Base module with screw terminals:
  - Use a screwdriver to loosen the screw on the screw terminal [1]
  - Insert the stripped cable into the round fixing hole [2], as far as it will go.
  - Tighten up the screw on the screw terminal.
  - Check that the cable is firmly seated.
- Base module with cage clamp terminals:
  - Insert the screwdriver [4] into the square hole [1].
  - Insert the stripped cable into the round fixing hole [2], as far as it will go [5].
  - Pull out the screwdriver [6].
  - Check that the cable is firmly seated.

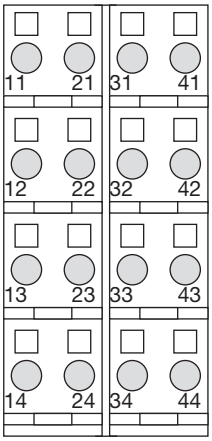


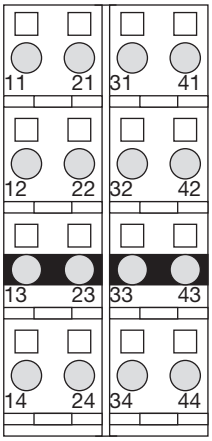


Please note:

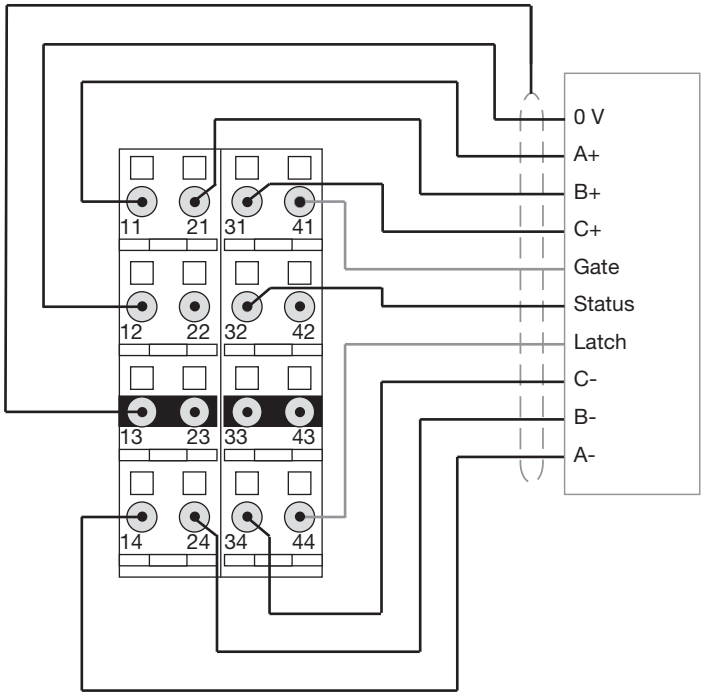
- The minimum cable cross section for field connection terminals on the base modules is 0.14 mm^2 (AWG26).
- The maximum cable cross section for field connection terminals is:
  - Digital inputs: 1.5 mm^2 (AWG16)
  - Digital outputs: 2.0 mm^2 (AWG14)
  - Inputs/outputs on the counter modules: 1.5 mm^2 (AWG16)
  - Analogue inputs/outputs: 1.5 mm^2 (AWG16)
  - Communication cables: 1.5 mm^2 (AWG16)
  - Test pulse outputs: 1.5 mm^2 (AWG16)
  - Power supply: 2.5 mm^2 (AWG12)
  - Functional earth: 2.5 mm^2 (AWG12)
- On base modules with screw terminals:
  - If you use a multi-strand cable to connect the I/Os, it is recommended that you use ferrules conforming to Parts 1 and 2 of DIN 46228, 0.14 ... 1.5 mm^2, Form A or C, although this is not essential. To crimp the ferrules you can use crimp pliers (crimp form A or C) conforming to EN 60947-1, such as the PZ 1.5 or PZ 6.5 from Weidmüller, for example.
  - Maximum torque setting: 0.8 Nm
- Use copper wiring.

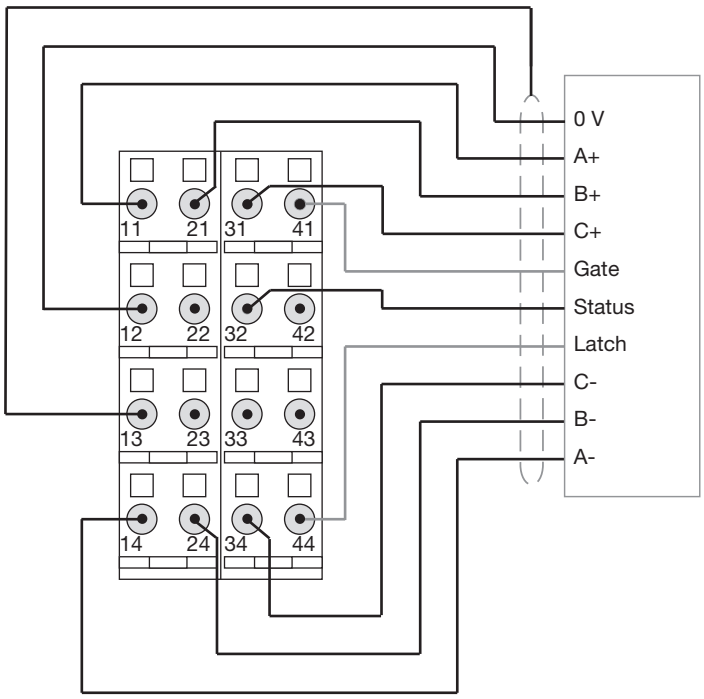
6.2 Terminal configuration

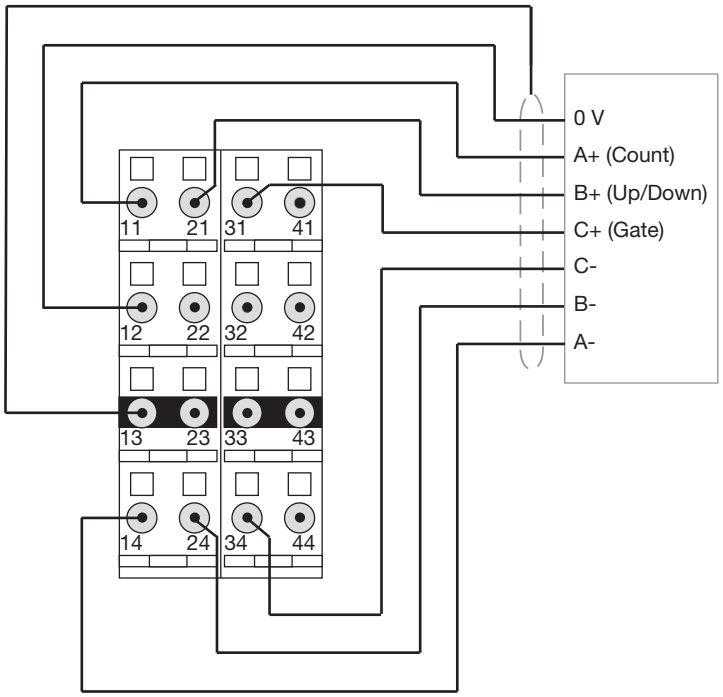
Base module	Terminal configuration	
Screw terminals: PSSu BP 2/16 S PSSu BP 2/16 S-T Cage clamp terminals: PSSu BP 2/16 C PSSu BP 2/16 C-T	Without C-rail: 11: Input A+ 21: Input B+ 31: Input C+ 41: Input G (Gate) 12-22: 0 V counter (12-22 linked within the base module) 32-42: Input S (Status) (32-42 linked within the base module) 13-23-33-43: Shield connection (13-23, 33-43 linked within the base module) 14: Input A- 24: Input B- 34: Input C- 44: Input L (Latch)	

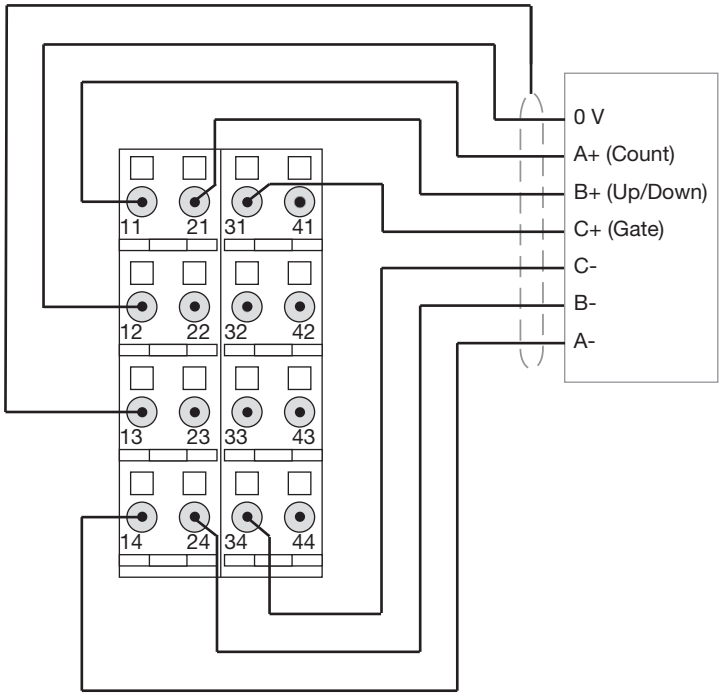
Base module	Terminal configuration	
Screw terminals: PSSu BP-C 2/16 S PSSu BP-C 2/16 S-T Cage clamp terminals: PSSu BP-C 2/16 C PSSu BP-C 2/16 C-T	With C-rail: 11: Input A+ 21: Input B+ 31: Input C+ 41: Input G (Gate) 12-22: 0 V counter (12-22 linked within the base module) 32-42: Input S (Status) (32-42 linked within the base module) 13-23-33-43: C-rail supply shield connection (13-23, 33-43 linked within the base module) 14: Input A- 24: Input B- 34: Input C- 44: Input L (Latch)	

6.3 Connecting the module

Incremental encoder operating mode	With C-rail
Encoder supply via the PSSu E PD module	

Incremental encoder operating mode	Without C-rail
Encoder supply via the PSSu E PD module	

Counter operating mode	With C-rail
Encoder supply via the PSSu E PD module Function inputs (G, L, S) not connected.	

Counter operating mode	Without C-rail
Encoder supply via the PSSu E PD module Function inputs (G, L, S) not connected.	

INFORMATION

To achieve the safety values PL e and SIL CL 3 , 2 counter modules must be used: a PSSu E F INC and a PSSu E F ABS SSI.

7 Operation

7.1 Messages

A module error is displayed via the "Err" LED, signalled to the head module and then entered in the head module's diagnostic log.

The module can detect the following errors:

Module error	Declaration	Remedy
Start-up error	Error as the PSSu system starts up	Change faulty module.
Configuration error	Incorrect module type configured.	The configured hardware registry does not match the actual hardware registry.
ST communication error	Error during ST communication	Change faulty module.
Bus termination error	There is no terminating plate or there is a bad contact with the module bus.	Install a terminating plate with integrated end bracket or insert the base modules together correctly.

7.2 Display elements

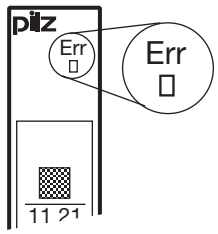
Legend

☼ LED on

● LED off

7.2.1 Display elements for module diagnostics

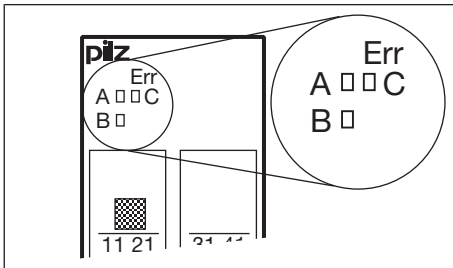
The module has an LED for displaying module errors ("Err" LED).



LED			Meaning
Name	Colour	Status	
Err	- - -	●	No error
	Red	☼	Module error

7.2.2 Display elements for counter status

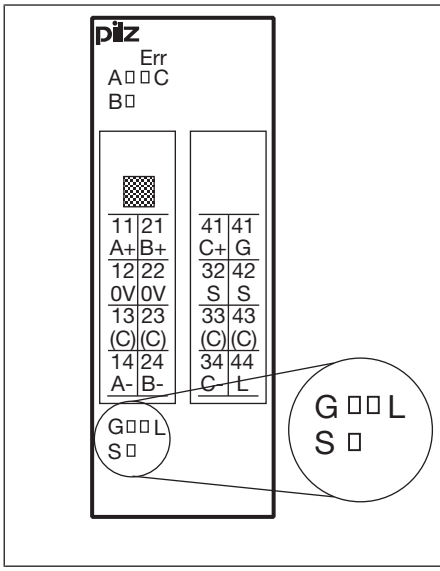
The module has three LEDs for the status of the counter inputs (LEDs "A", "B" and "C").



LED			Meaning
Name	Colour	Status	Signal
A	- - -	●	0 signal at counter input A
	Green	☼	1 signal at counter input A
B	- - -	●	0 signal at counter input B
	Green	☼	1 signal at counter input B
C	- - -	●	0 signal at counter input C
	Green	☼	1 signal at counter input C

7.2.3 Display elements for status of the functional inputs

The module has three LEDs for the status of the function inputs (LEDs "G", "L" and "S").



LED			Meaning
Name	Colour	Status	Signal
G	- - -	●	0 signal at function input G
	Green	☼	1 signal at function input G
L	- - -	●	0 signal at function input L
	Green	☼	1 signal at function input L
S	- - -	●	0 signal at function input S
	Green	☼	1 signal at function input S

7.3 Status information

The I/O data with status information is described in the chapter entitled "Function Description", under "Input/output data".

8 Technical Details

General	312280	314280
Certifications	**CE, EAC, KOSHA, TÜV, UKCA, cULus Listed**	**CE, EAC, TÜV, UKCA, cULus Listed**
Application range	**Failsafe**	**Failsafe**
Module's device code	**0324h**	**0324h**
Number of ST input bits	**64**	**64**
Number of ST output bits	**32**	**32**
Number of ST status bits	**8**	**8**
Number of ST control bits	**8**	**8**
Application in system environment B		
from FS firmware version, head modules	**1.0.0**	**1.0.0**
Electrical data	**312280**	**314280**
Internal supply voltage (module supply)		
Module's power consumption	**0,79 W**	**0,79 W**
Periphery's supply voltage (periphery supply)		
Voltage range	**16,8 - 30 V**	**16,8 - 30 V**
Module's current consumption with no load	**15 mA**	**15 mA**
Module's power consumption with no load	**0,37 W**	**0,37 W**
Max. power dissipation of module	**1,2 W**	**1,2 W**
Incremental encoder input	**312280**	**314280**
Number of counter inputs	**1**	**1**
Type of counter inputs	**Incremental encoder**	**Incremental encoder**
Signal at counter inputs A and B and/or C	**Differential signal (RS-422/TTL)**	**Differential signal (RS-422/TTL)**
Permitted low signal range on LATCH/GATE/STATUS signals	**-3 - 5 V**	**-3 - 5 V**
Permitted high signal range on LATCH/GATE/STATUS signals	**11 - 30 V**	**11 - 30 V**
Typ. input current of the LATCH and/or GATE and/or STATUS signals at low level	**0 mA**	**0 mA**
Typ. input current of the LATCH and/or GATE and/or STATUS signals at high level	**4 mA**	**4 mA**
Max. number of bits on the counter input	**32 Bit**	**32 Bit**
Evaluation of counter pulses	**1x**	**1x**
Phase offset between differential signals A and B	**90 deg**	**90 deg**
Phase offset tolerance	**30 deg**	**30 deg**

Incremental encoder input	312280	314280
Maximum cutoff frequency	**5 MHz**	**5 MHz**
Time constant of input filter on LATCH signal	**50 µs**	**50 µs**
Time constant of input filter on GATE signal	**50 µs**	**50 µs**
Time constant of input filter on STATUS signal	**50 µs**	**50 µs**
Typ. processing time	**0,1 ms**	**0,1 ms**
Potential isolation between input/ output and periphery supply	**Yes**	**Yes**
Potential isolation between input/ output and voltage for the internal module bus	**Yes**	**Yes**
Environmental data	**312280**	**314280**
Climatic suitability	**EN 60068-2-1, EN 60068-2-14, EN 60068-2-2, EN 60068-2-30, EN 60068-2-78**	**EN 60068-2-1, EN 60068-2-14, EN 60068-2-2, EN 60068-2-30, EN 60068-2-78**
Ambient temperature		
in accordance with the standard	**EN 60068-2-14**	**EN 60068-2-14**
Temperature range	**0 - 60 °C**	**-40 - 70 °C**
Storage temperature		
in accordance with the standard	**EN 60068-2-1/-2**	**EN 60068-2-1/-2**
Temperature range	**-40 - 70 °C**	**-40 - 70 °C**
Climatic suitability		
in accordance with the standard	**EN 60068-2-78**	**EN 60068-2-78**
Humidity	**93 % r. h. at 40 °C**	**93 % r. h. at 40 °C**
Condensation during operation	**Not permitted**	**EN 60068-2-30, short-term**
Max. operating height above SL	**2000 m**	**5000 m**
EMC	**EN 12015, EN 12016, EN 61000-6-2, EN 61000-6-4, EN 61131-2**	**EN 12015, EN 12016, EN 61000-6-2, EN 61000-6-4, EN 61131-2**
Vibration		
in accordance with the standard	**EN 60068-2-6**	**EN 60068-2-6**
Frequency	**10 - 150 Hz**	**10 - 1000 Hz**
Acceleration	**10 m/s²**	**50 m/s²**
Broadband noise		
in accordance with the standard	–	**EN 60068-2-64**
Frequency	–	**5 - 500 Hz**
Acceleration	–	**19 m/s² eff.**
Shock stress		
in accordance with the standard	**EN 60068-2-27**	**EN 60068-2-27**
Number of shocks	**6**	**6**
Acceleration	**150 m/s²**	**150 m/s²**
Duration	**11 ms**	**11 ms**

Environmental data	312280	314280
Airgap creepage		
in accordance with the standard	**EN 61131-2**	**EN 61131-2**
Overvoltage category	**II**	**II**
Pollution degree	**2**	**2**
Protection type		
in accordance with the standard	**EN 60529**	**EN 60529**
Housing	**IP20**	**IP20**
Terminals	**IP20**	**IP20**
Mounting area (e.g. control cabinet)	**IP54**	**IP54**
Mechanical data	**312280**	**314280**
Material		
Bottom	**PC**	**PC**
Front	**PC**	**PC**
Coding	**PA**	**PA**
Mounting type	**plug-in**	**plug-in**
Dimensions		
Height	**76 mm**	**76 mm**
Width	**25,2 mm**	**25,4 mm**
Depth	**60,2 mm**	**60,2 mm**
Weight	**49 g**	**51 g**
Mechanical coding		
Type	**J**	**J**
Colour	**Yellow**	**Yellow**

Where standards are undated, the 2022-01 latest editions shall apply.

8.1 Safety characteristic data

NOTICE

You must comply with the safety characteristic data in order to achieve the required safety level for your plant/machine.

Operating mode	EN ISO 13849-1: 2015 PL	EN ISO 13849-1: 2015 Category	EN IEC 62061 SIL CL/ maximum SIL	EN IEC 62061 PFH_D [1/h]	EN/IEC 61511 SIL	EN/IEC 61511 PFD	EN ISO 13849-1: 2015 T_M [year]
–	PL e	Cat. 4	SIL CL 3	3,34E-09	SIL 3	5,62E-06	20

If the module is operated at an ambient temperature above 60° C, the values stated in the table for PFH_D and PFD will need to be doubled when a safety function is calculated.

All the units used within a safety function must be considered when calculating the safety characteristic data.

INFORMATION

A safety function's SIL/PL values are **not** identical to the SIL/PL values of the units that are used and may be different. We recommend that you use the PAScal software tool to calculate the safety function's SIL/PL values.

9 Order reference

9.1 Product

Product type	Features	Order no.
PSSu E F INC	Electronic module	312280
PSSu E F INC-T	Electronic module, T-type	314280

9.2 Accessories

Base modules

Product type	Features	Order no.
PSSu BP 2/16 S	Base module without C-rail with screw terminals	312628
PSSu BP 2/16 S-T	Base module without C-rail with screw terminals, T-type	314628
PSSu BP 2/16 C	Base module without C-rail with cage clamp terminals	312629
PSSu BP 2/16 C-T	Base module without C-rail with cage clamp terminals, T-type	314629
PSSu BP-C 2/16 S	Base module with C-rail and screw terminals	312630
PSSu BP-C 2/16 S-T	Base module with C-rail and screw terminals, T-type	314630
PSSu BP-C 2/16 C	Base module with C-rail and cage clamp terminals	312631
PSSu BP-C 2/16 C-T	Base module with C-rail and cage clamp terminals, T-type	314631

10 EC declaration of conformity

This product/these products meet the requirements of the directive 2006/42/EC for machinery of the European Parliament and of the Council. The complete EC Declaration of Conformity is available on the Internet at www.pilz.com/downloads.
Authorised representative: Norbert Fröhlich, Pilz GmbH & Co. KG, Felix-Wankel-Str. 2, 73760 Ostfildern, Germany

11 UKCA-Declaration of Conformity

This product(s) complies with following UK legislation: Supply of Machinery (Safety) Regulation 2008.
The complete UKCA Declaration of Conformity is available on the Internet at www.pilz.com/downloads.

Representative: Pilz Automation Technology, Pilz House, Little Colliers Field, Corby, Northamptonshire, NN18 8TJ United Kingdom, eMail: mail@pilz.co.uk

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