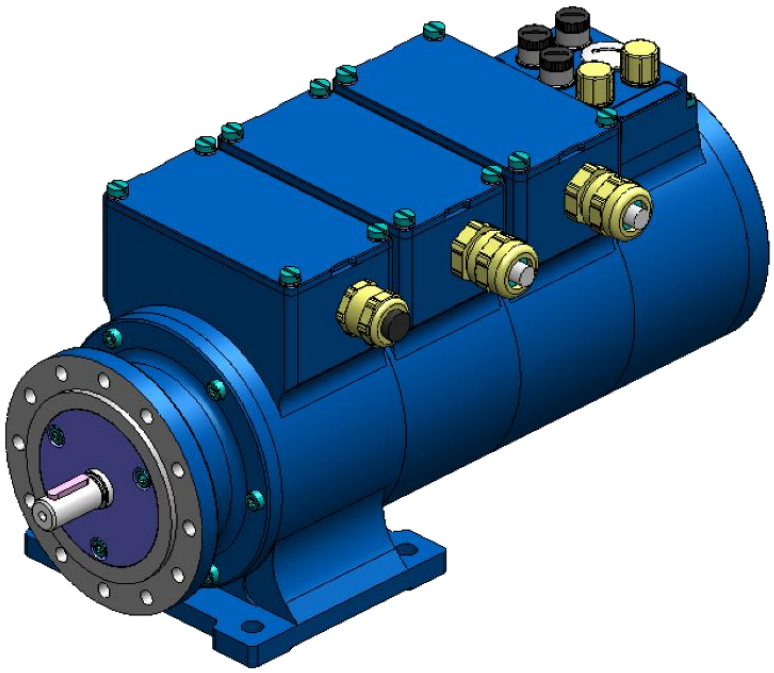
English

JOHANNES HÜBNER GIESSEN
ideas and solutions



Operating and Assembly Instructions
U-ONE®-SAFETY-Compact USC 42 Universal Encoder System

Functional safety according to EN 61508: SIL CL2 and EN ISO 13849: PL d

Read the operating and assembly instructions prior to assembly, starting installation and handling!
Keep for future reference!

SIL CL2 Functional Safety PL d

c UL us LISTED

Translation of the original Operating and Assembly Instructions
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Johannes Hübner Fabrik elektrischer Maschinen GmbH is listed by Underwriters Laboratories.

UL certificates can be requested from us.

An overview of our UL devices can be found at the following link:

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UL File Number: E351535

„Universal encoder system, Series USC42, followed by -I, -F or -G, may be followed by -A, -AA, -D, -DD, -P, -R or a combination of these. “

Subject to errors and changes due to technical improvements.

Table of contents

1 General

1.1 Information about the Operating and Assembly Instructions

These operating and assembly instructions provide important instructions for working with the U-ONE®-SAFETY-Compact. They must be carefully read prior to starting all tasks, and the instructions contained herein must be followed. The U-ONE®-SAFETY-Compact is referred as USC 42 in the following documentation.

In addition, applicable local regulations for the prevention of industrial accidents and general safety regulations must be complied with.

1.2 Scope of delivery

The scope of supply of the U-ONE®-SAFETY-Compact includes the fastening screws, the operating and assembly instructions, the configuration instructions for further function modules, the Software & Support CD as well as a USB programming cable.

1.3 Explanation of symbols

Warnings are indicated by symbols in these operating and assembly instructions. The warnings are introduced by signal words that express the scope of the hazard. To prevent accidents, personal injuries and material damage it is imperative to observe the information provided and proceed with due care and attention at all times.

	**WARNING!** Indicates a possibly dangerous situation that can result in death or serious injury if it is not avoided.
	**CAUTION!** Indicates a possibly dangerous situation that can result in minor injury if it is not avoided.
!	**CAUTION!** Indicates a possibly dangerous situation that can result in material damage if it is not avoided.
	**NOTES!** Indicates useful tips and recommendations as well as information for efficient and trouble-free operation.
	**NOTES!** Do not use a hammer or similar tool when installing the device due to the risk of damage occurring to the bearings or coupling.
	**DANGER!** **Life-threatening danger due to electric shock!** Indicates a life-threatening situation due to electric shock. If the safety instructions are not complied with there is danger of serious injury or death. The work that must be executed should only be performed by a qualified electrician.

1.4 Warranty and liability

In principle the "General Terms and Conditions" of Johannes Hübner Fabrik elektrischer Maschinen GmbH apply. These are available to the operator with the Order Confirmation or when the contract is concluded at the latest. Warranty and liability claims in the case of personal injury or damage to property are excluded, as well as the operating license expires if they result from one or more of the following causes:

- Non-observance of the operating and assembly instructions.
- Non-intended use of the USC 42.
- Improper assembly, installation, start-up and programming of the USC 42.
- Work carried out incorrectly on the USC 42.
- Operation of the USC 42 with technical defects.
- Mechanical or electrical modifications to the USC 42 undertaken autonomously.
- Repairs carried out autonomously.
- Third party interference and Acts of God.
- Deployment of non-qualified personnel.
- Opening of the USC 42 (with the exception of terminal boxes) or modifications.

1.5 Declaration of Conformity

The device is tested in accordance with the following Directives:

- 2006/42/EG, 2014/30/EU and 2011/65/EU (EU)
- S.I. 2008/1597, S.I. 2016/1091 und S.I. 2012/3032 (UK).

1.6 Organizational measures

- The operating and assembly instructions must always be kept ready-to-hand at the place of use of the USC 42.
- In addition to the operating and assembly instructions, generally valid legal and other binding regulations on accident prevention and environmental protection must be observed and communicated.
- The respective applicable national, local and system-specific provisions and requirements must be observed and communicated.
- The operator is obliged to inform personnel on special operating features and requirements.
- Prior to commencing work, personnel working with the measuring system must have read and understood the chapter 2.
- The nameplate and any prohibition or instruction symbols applied on the measuring system must always be maintained in a legible state.
- Do not undertake any mechanical or electrical modifications to the measuring system, except for those expressly described in this operating and assembly instructions.
- Repairs may only be undertaken by the manufacturer or a center or person authorized by the manufacturer.

1.7 Copyright

NOTES!
Content information, text, drawings, graphics, and other representations are protected by copyright and are subject to commercial property rights.
It is strictly forbidden to make copies of any kind or by any means for any purpose other than in conjunction with using the device without the prior written agreement of the manufacturer. Any copyright infringements will be prosecuted.

1.8 Guarantee terms

The guarantee terms are provided in the manufacturer´s terms and conditions.

1.9 Customer service

For technical information personnel is available that can be reached per telephone, fax or email. See manufacturer´s address on page 2.

2 Basic safety instructions

DANGER!
This section provides an overview of all the important safety aspects that ensure protection of personnel, as well as safe and trouble-free device operation.
If these safety instructions are not complied with significant hazard can occur.

2.1 Responsibility of the owner

The USC 42 is used in commercial applications. Consequently the owner of the USC 42 is subject to the legal occupational safety obligations, and subject to the safety, accident prevention, and environmental protection regulations that are applicable for the USC 42 area of implementation.

2.2 Personnel selection and qualification; basic obligations

- All work on the USC 42 must only be carried out by qualified personnel. Qualified personnel includes persons, who, through their training, experience and instruction, as well as their knowledge of the relevant standards, provisions, accident prevention regulations and operating conditions, have been authorized by the persons responsible for the system to carry out the required work and are able to recognize and avoid potential hazards. They are capable of identifying and avoiding potential hazards.
- The definition of “qualified personnel” also includes an understanding of the standards VDE 0105-100 and IEC 364 (source: e.g. Beuth Verlag GmbH, VDE-Verlag GmbH).
- The responsibility for assembly, installation, commissioning and operation must be clearly defined. The obligation exists to provide supervision for trainee personnel.

2.3 Intended use

Depending on the device configuration, the USC 42 can be used to,

- to detect angular movements (SPB/SPN)
- for safe, position-dependent switching of floating relay contacts (SRC C-R)
- for safe, speed-dependent switching of floating relay contacts (SGS C-R)
- for safe, error-dependent switching of floating relay contacts (SRC C-R/SGS C-R)

The system manufacturer must check that the characteristics of the USC 42 satisfy his application-specific safety requirements. The responsibility or decision regarding the use of the USC 42 lies with the system manufacturer. The USC 42 is designed for unattended continuous operation.

Intended use also includes:

- observing all instructions in this operating and assembly instructions
- observing the nameplate and any prohibition or instruction symbols on the USC 42
- observing the operating instructions from the machine/system manufacturer
- operating the USC 42 within the limit values specified in the technical data
- ensuring that the fail-safe processing unit (F-Host) fulfils all required safety functions
- safe mounting (form-closed) of the measuring system to the driving axis
- Omission of a non-intended use

  For UL and CSA:

  For the use in NFPA 79 applications only.

2.4 Non-intended use

WARNING!
Danger of death, physical injury and damage to property in case of non-intended use of the USC 42!
The following areas of use are especially forbidden:

- in environments where there is an explosive atmosphere.
- use in environments with radioactive radiation.
- use on ships.
- for medical purposes.
- fastening transport or lifting tackle to the device,for example a crane hook to lift a motor.
- fastening packaging components to the device,for example ratchet straps, tarpaulins etc..
- using the device as a step,for example by people to climb onto a motor.

2.5 Safety information

WARNING! NOTICE! NOTES!

Destruction, damage and malfunction of the USC 42!

- Only carry out wiring work or opening and closing of electrical connections with the system de-energized.
- Falling below or exceeding the permissible operating temperature limit values must be prevented through an appropriate heating/cooling measure at the place of installation.
- The power adapter used must not exceed a voltage of 36 VDC even in the event of a fault.
- Potential hazards resulting from interactions with other systems and equipment which are or will be installed in the vicinity must be checked. The user is responsible for taking appropriate measures.
- The power supply must be protected with a fuse suitable for the supply lead cross-section.
- Cables used must be suitable for the temperature range.
- A defective USC 42 must not be operated.
- Make sure that the installation environment is protected from aggressive media (acids etc.).
- Avoid shocks (e.g. hammer blows) to the shaft during installation.
- Using the device as a step etc. is non intended.
- Opening the USC 42 is forbidden (with the exception of terminal boxes).
- Make sure that the access to the address switches and LEDs is locked after the settings with the screw plug. Tighten firmly.
- The type plate specifies the technical characteristics of the USC 42. If the type plate is no longer legible or if the type plate is completely missing, the USC 42 must not be operated. Contact Hübner Service (see page 2).

NOTES!

Disposal

If disposal has to be undertaken after the lifespan of the USC 42, the respective applicable country-specific regulations are to be observed.

3 Assembly

3.1 Safety instructions

WARNING!

- At assembly, dismantling and other work to the device the basic safety instructions to chapter 2 must be observed.
- The assembly and the dismantling of the measuring system must only be carried out by qualified personnel.

DANGER! NOTICE!

Danger of death, serious physical injury and/or damage to property due to deactivation of safety functions, caused by an unstable shaft drive!

- The system manufacturer must implement suitable design measures, so that the drive of the USC 42 is ensured at all times through the shaft and mounting (see chapter 3.2) of the USC 42 (fault exclusion). The specifications of DIN EN 61800-5-2:2008 "Adjustable speed electrical power drive systems, Safety requirements - Functional, Table D.16 – Motion and position sensors" must be observed.
- In general, the requirements and acceptance conditions for the complete system must be taken into account for mounting.
- If it is not possible to use a coupling for which fatigue and design strength calculations are available, a coupling must be used capable of withstanding 10 times the loads that occur during normal operations as stated in the data sheet.

  For mounting the USC 42, we recommend our specially designed mechanical safety components: clearance-free, torsionally rigid HKS5 coupling with fault exclusion (see chapter 10.2 coupling) and intermediate flange with fault exclusion.

As the installation situation is application-dependent, the following notes are not exhaustive.

- All fastening screws must be secured against unintentional loosening.
- In case of applications with low operating temperatures, increased values for the start-up torque result. This fact is to be considered when the assembling and wave drive is performed.
- A suitable coupling with positive connection must be used for the application.
- The coupling manufacturer's information and installation requirements must be observed.

In particular, you must ensure that:

- the coupling is suitable for the possible axial and radial offset, as well as the permissible speed range,
- the coupling is not radially and axially loaded,
- the clamping screws are tightened with the torque defined by the coupling manufacturer and are secured against unintentional loosening, so that the coupling cannot slip on the drive shaft or onto the USC 42 shaft.

3.2 Technical notes

NOTES!
Do not use a hammer or similar tool during installing, disassembly or other work on the USC 42 due to the risk of damage occurring to the bearings or coupling.

Housing surface temperature
The housing surface temperature must be within the permissible range (see chapter 5.3).

Degree of protection
The USC 42 complies with the specified degree of protection (see chapter 5.3) only with screwed-on mating connectors or blind plugs and closed terminal boxes.

To fulfill degree of protection requirements the diameter of the connection cable must correspond to that of the cable gland.

	Connection-thread	**Sealing area** max./min. Ø mm	**Sealing area without inlet** max./min. Ø mm	**Sealing area with inlet** max./min. Ø mm
Basis X1	M20x1,5	13,0 – 9,0	-	-
	M25x1,5	20,0 – 11,0	20,0 – 16,0	16,0 – 11,0
Extensions X2; X3; X4; X5	M20x1,5	14,0 – 5,0	14,0 – 9,0	9,0 – 5,0
	M25x1,5	20,0 – 11,0	20,0 – 16,0	16,0 – 11,0

Deep groove ball bearings
The USC 42 are fitted with maintenance-free, greased "for-life" deep groove bearings. Bearings must be changed by the manufacturer only.

Screw retention
All fastening screws must be secured against unintentional loosening. We recommend using Loctite® 243 (thread locker medium strength).

Required tools
- Spanners: 10 mm, 13 mm, 22 mm, 24 mm 30 mm
- Allen key: 5 mm, 6 mm
- Flat-blade screwdriver
- Assembly grease
- Loctite® 243 (thread locker medium strength)

Fastening screws

To ensure the encoder is reliably mounted the following conditions must be satisfied:

Construction type	**B5 flange mounting**	**B3 foot mounting**	
Screws	ISO4017 M6	ISO4017 M8	
Washers	ISO7089 A6	DIN6340 A8	
Number of screws	Min. 6 pcs.	4 pcs.	
Property class ISO 898-1	8.8	12.9	
Length of screws	20 mm	30 mm	35 mm
Tensile strength of internal thread	Min. 280 N/mm²	Min. 330 N/mm²	Min. 230 N/mm²
Tightening torque	6 Nm	27 Nm	
Centering	85_{j6}	-	

NOTES!
Suitable measures must be taken if the minimum tensile strength of the internal thread of the customer interface does not meet requirements (e.g. fit a threaded insert).

Mounting preparations

1. Ensure all accessories are available.
2. Preparing the place of attachment: Clean the drive shaft, centering, bolting surfaces and fastening threads; check for damage. Repair any damage!

Personnel

Mounting and commissioning must only be carried out by qualified personnel.

NOTES!
Observe the safety instructions contained in **chapter** 2 when mounting or commissioning.

3.3 Mounting B5 type (flange)

- NOTES!
- For a mounting example please refer to dimension drawing (chapter 11).
- The installation described below is offered as an example only and may vary according to the coupling and flange type. It is essential to observe the specific instructions provided by the manufacturer of the coupling.
- You must be able to mount the coupling without force. Ream out the bores of used couplings, if necessary.
- If possible, fit the intermediate flange (4) in a manner that ensures the screwed sealing plug (16) points downwards.
- If possible, fit the USC 42 in a manner that ensures the cable gland points downwards Exchange the position of the cable gland (19) and the blanking plug (16), if necessary.
- To carry out step 9, it may be necessary to turn the drive shaft (1) to the correct position.
- Intermediate disc (10), flange (4) and coupling (3) must meet the requirements for safe mounting. See also Chapter 10.2.

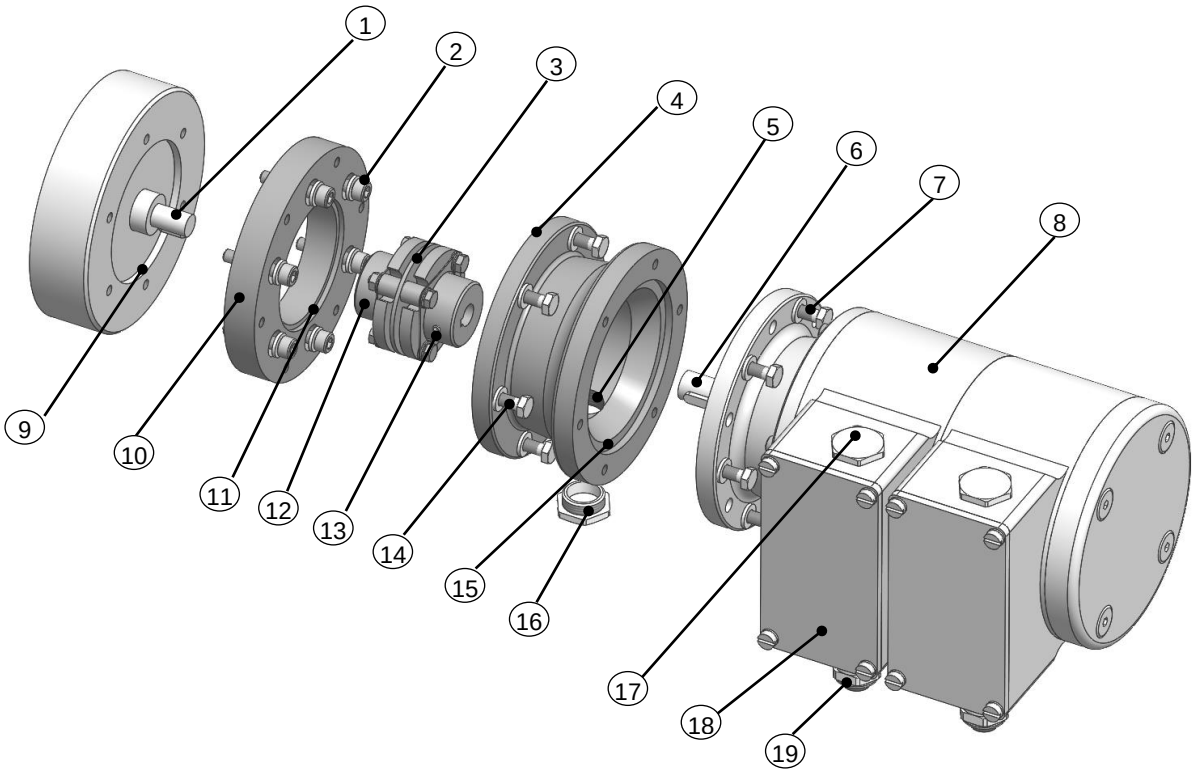


Fig. 3-1 Example construction type B5

1. Grease the drive shaft lightly (1).
2. Fit coupling (3) onto drive shaft (1).
3. Secure the coupling hub on the drive shaft (1) using a grub screw or a screw (12) (depending on the coupling type).

4. Fasten the intermediate disc (10) on the drive side by using of the fastening screws and washers (2).
5. Fasten the intermediate flange (4) to the intermediate disc (10) by using the fastening screws(14) and washers (14).
6. Grease the USC 42 shaft lightly (6).
7. Fit the USC 42 (8) into both the centering (15) and coupling hub (13) at the same time.
8. Secure the USC 42 with min. 6 screws (7) and washers evenly distributed around the circumference of the flange (4).
9. Remove the sealing plug (16) from the access bore (5) to the coupling.
10. Secure the coupling hub on the shaft with a grub screw or screw (13) (depending on the coupling type).
11. Close access bore in the intermediate flange (4) for coupling with the sealing plug (16).

3.4 Mounting of construction type B35 (flange and foot)

NOTES!

- B35 type encoders can be attached by means of a flange (B5, please refer to chapter 3.3) or foot (B35).
- For a mounting example please refer to dimension drawing (chapter 11).
- The assembly procedure described below is offered as an example only and may vary according to the type of coupling. It is essential to observe the specific instructions provided by the manufacturer of the coupling.
- You must be able to mount the coupling (3) without force! Ream the bores of used couplings, if necessary.
- Angle misalignment and parallel displacement between the (drive) shaft (1) and the encoder shaft are mounting errors and should be kept as small as possible.

  Mounting errors
  - Cause radial forces to act on the USC 42 shaft.
  - Reduce the service life of the bearings and the coupling.
  - Degrade the quality of the signals (harmonic content).

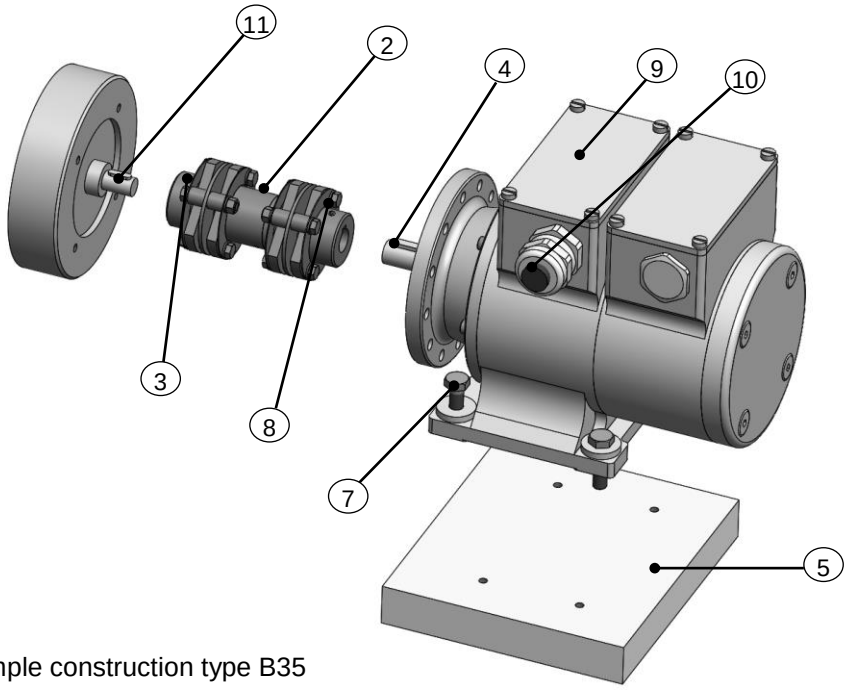


Fig. 3-2 Example construction type B35

1. Grease the drive shaft lightly (1).
2. Secure the coupling hub on the drive shaft (1) with a grub screw or cheese head screw (3) (depending on the coupling type).
3. Grease the USC 42 shaft lightly (4).
4. Align the USC 42 shaft (4) to the drive shaft (1) and insert into the coupling hub.
5. Fasten USC 42 foot with 4 screws-M8 and matching washers (7).
6. Secure the coupling hub on the USC 42 shaft with a grub screw or with a screw (8) (depending on the coupling type).

3.5 Dismantling

Personnel

Dismantling must be carried out by qualified personnel only.

WARNING!

Observe the safety instructions contained in chapter 2 when dismantling the USC 42.

NOTES!

Do not use a hammer or similar tool when dismantling the USC 42 due to the risk of damage occurring to the bearings or coupling.

3.5.1 Dismantling the USC 42

Remove all electrical connection cables of the USC 42 before dismantling.

To dismantle the USC 42 follow the instructions given in chapter 3.3 or rather 3.4 in the reverse order.

3.5.2 Replacing the USC 42

The following points must be noted when replacing the USC 42:

- The new USC 42 must have the same order number (ID) as the USC 42 being replaced.
- The new USC 42 must be installed in accordance with the specifications and requirements in chapter 4.2.
- The new USC 42 must be connected in accordance with the specifications in chapter 4.2.
- The configuration of the USC 42 to be exchanged can be transferred to the new USC 42 (see configuration manual).
- When recommissioning the replaced USC 42, correct functioning must be ensured first of all by means of a protected test run.

in addition, with USC 42 with PROFIBUS or PROFINET

- With a new USC 42 ensure that the PROFIBUS address and bus termination set via hardware switches match that of the USC 42 to be installed (applies only to PROFIBUS).
- As the F-Parameters and i-Parameters of the USC 42 are stored in the safety program of the control, the new USC 42 is parameterized with the projected settings in the start-up phase. (PROFIBUS and PROFINET).

- If the project does not support a neighbourhood detection, in case of a device replacement it must be ensured that the device name assigned before also is assigned to the new USC 42. When the system boots up the device name is detected again and the new MAC-Address and IP-Address is assigned to the device name automatically (only PROFINET).

4 Installation

4.1 Basic rules

WARNING!

- The power supplies used must not cut out in the event of a fault in the energy supply (safe under single fault conditions). Observe SELV and PELV requirements (IEC 60364-4-41).
- Equipotential bonding measures must be provided throughout the entire processing chain of the plant.
- Route power and signal cables separately.
- Observe the manufacturer's instructions for the installation of converters and for shielding power cables between frequency converter and motor.
- Ensure adequate dimensioning of the energy supply.
- The line cross-section of the voltage supply line must be designed in such a way that the max. Voltage drop is < 3V

PROFIBUS

- All devices used on the bus must have a PROFIBUS – certificate or must have a corresponding declaration of the manufacturer.
- All safety devices must also have a certificate from a "Notified Body" (e.g. TÜV, BIA, HSE, INRS, UL, etc.).
- Only use M12 connectors for connecting the measuring system, which guarantee good contact between the cable shield and connector housing. The cable shield must be connected to the connector housing over a large area.

PROFINET

- All PROFIsafe devices used on the bus must have a PROFINET and a PROFIsafe – certificate.

4.2 Electrical connection

i	**NOTES for UL and CSA!** Do only use copper cables.

1. Open the terminal box cover (9) (Fig. 3-2).

!	**CAUTION!** Do not allow moisture to enter the terminal box when the terminal cover is open.

2. Remove the cap of the cable gland (10) (Fig. 3-2).
3. Feed the cable into the terminal box trough the cable gland.

i	**NOTES! (only SCU C)** The signal cable shielding can be connected directly to the housing via the EMC cable gland. A coil spring integrated in the cable gland ensures all-round contact is made with the bare cable shielding to ensure a good shield connection. This type of shield connection should be preferred. To achieve an effective shielding the cable shield must also be connected in the electrical cabinet. Ensure no equipotential bonding currents are able to flow across the shielding.

4. Tighten the cable gland and blanking plugs using a spanner.

i	**NOTES!** Prior to delivery cable glands and blanking plugs are tightened finger tight only. To ensure that the terminal box is reliably sealed tighten all cable glands and blanking plugs before starting up for the first time.

5. Use a spanner to tighten the cable gland until the cable is securely clamped and properly sealed.

i	**NOTES!** Prevent lateral pulling forces acting on the cable and plugs so as not to impair the degree of protection of the cable gland.

6. Strip cable insulation, crimp wire-end ferrules. Connect the supply voltage and signal cable (see connection diagrams, chapter 11.2).

!	**CAUTION!** Do not apply supply voltage to the signal outputs, as this will destroy the USC 42.

7. Close the terminal box cover.

i	**NOTES!** Before closing the terminal box cover check the sealing surface is clean and that the seal is in a good condition; clean or replace damaged seals as necessary.

!	**CAUTION!** Ensure when closing the terminal box cover that no cable becomes jammed.

5 Technical Data

5.1 Type plate

The figure below shows an example of a type plate.

The nameplate and UKCA label are located on the side of the housing and contain the following information:

Fig. 5-1: type plate (example)

- Manufacturer, address, CE-mark
- Type
- Module
- Resolution
  S= singleturn, M= multiturn
- Serialnumber (S/N)
- Order number (ID)
- Date of manufacturing (Y)
- Degree of protection
- Supply voltage (supply)
- Current output
- Certification information
- QR-code

5.2 Type key

USC 42_I - function modules (see table)

U-ONE®-SAFETY-Compact

I: Current output 4 … 20 mA

G: Current output + incremental output

Housing modules:
The individual housing modules may contain 1 or 2 functional modules , they are separated by „-“ (eg. USC 42I-DD-A). and listed in the sequence they are installed after the basic unit.

Identification	Description
USC 42I	Safety Control Unit (SCU C) with 2 digital inputs (reset, preset) and 2 digital outputs (status, error) as well as current output 4 … 20 mA (identification: I)
A	3 safe speed switches (SGS C-R) (1 function module - max. switching voltage: 230 V AC / DC)
AA	6 safe speed switches (SGS C-R) (2 function modules - max. switching voltage: 230 V AC / DC)
D	3 safe position switches (SRC C-R) (1 function module - max. switching voltage: 230 V AC / DC)
DD	6 safe position switches (SRC C-R) (2 function modules - max. switching voltage: 230 V AC / DC)
P	PROFIsafe via PROFIBUS
R	PROFIsafe via PROFINET

5.3 Mechanical data

Specification	Value	
Max. encoder shaft load	≤ 100 N axial, ≤ 120 N radial	
Shaft end	Ø 14j6 x 30 mm	
Mech. permissible speed	max. 2800 rpm	For UL and CSA max. 1800 1/rpm
Working temperature	-25°C … + 70° C	For UL and CSA max. 62°C
Derating	Ta = 69- (0,003286*n) in °C	
Vibration resistance	5 g (DIN EN 60068-2-6 (8,7 … 500 Hz))	
Shock resistance	25 g (DIN EN 60068-2-27 (6 ms))	
Bearing life time L_{10} - speed - operating temperature	≥ 1.1 * 10^{11} revolutions at 2800 rpm 70 °C	
Bearing grease life time - max. speed - max. operating temperature	20 years at 2800 rpm 65 °C	
Rotor moment of inertia	approx. 330 gcm²	
Permissible angular acceleration	≤ 10^4 rad/s²	
Breakaway torque	approx. 3,5 Ncm	
Degree of protection acc. to DIN EN 60529	IP66 with axial shaft seal	For UL and CSA Type 1
Max. operating hight above sea level	3000 m	
Weight	Construction type B35 (basic unit + 1 module) Construction type B5 (basic unit) for each additional module	approx.5 kg approx.3.6 kg + approx 0.8 kg

Calculations pertaining to the service life were carried out using data from the manufacturer of the bearings. The stated service lifetimes are based on the modified rating life L_{10} in accordance with ISO 281. That means, the probability that the bearings will attain or exceed the specified service lifetime is 90%.

The following factors influence the service life of the bearings

- Operating temperature
- Mechanical loads from vibration and shock
- Drive dynamics
- The influence of transport and storage (bearing grease ageing)
- Installation errors

6 Design and function

The USC 42 consists of a basic unit as well as maximum 4 housing modules in which it is possible to integrate a maximum of 6 function modules.

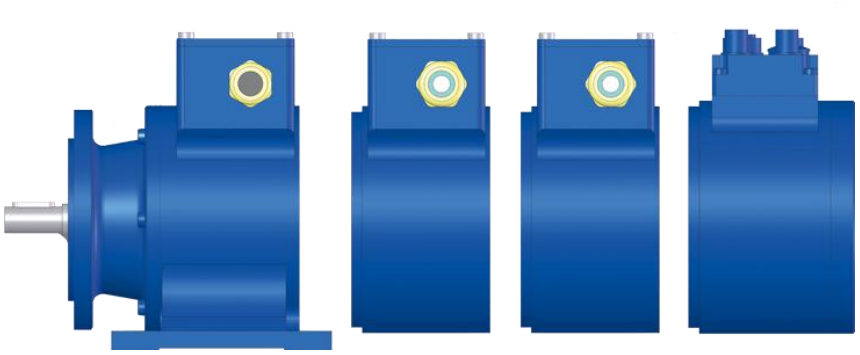


Fig. 6-1: Basic unit with 3 housing modules

In Fig. 6-2, the basic unit with a position switch module (SRC C-R) is shown.
It is possible to utilize max. 6 function modules, which are connected to the system bus.
The base unit consists of:

- Two-channel scanning system, for generation of safe measured data through internal channel comparison
- Channel 1, master system:
  optical Single-Turn scanning via code disk with transmitted light and magnetic Multi-Turn scanning
- Channel 2, inspection system:
  magnetic Single and Multi-Turn scanning
- A common drive shaft

Due to its technology the optical system possesses greater accuracy; therefore it is used as master system. The data of the master system are unevaluated in the non-safety-oriented process data channel with a short cycle time.

The magnetic scanning system serves for the internal safety check The "safe data" is obtained through two-channel data comparison.

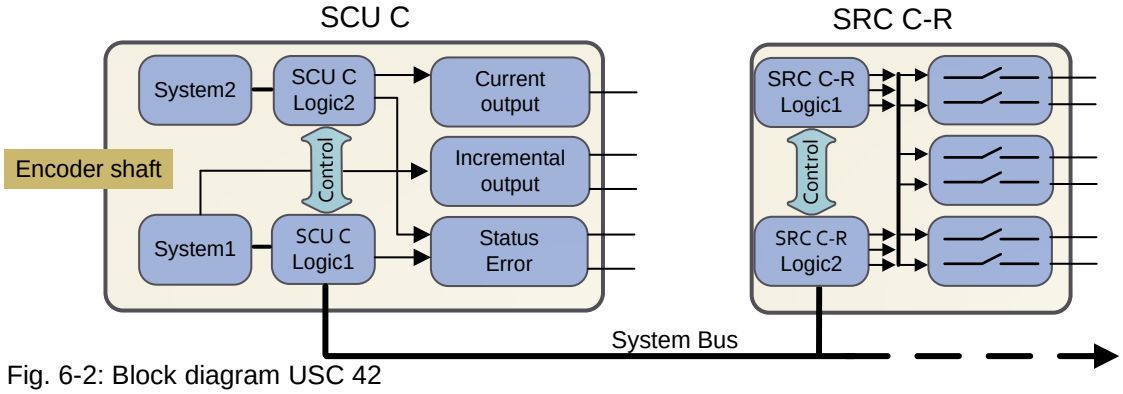


Fig. 6-2: Block diagram USC 42

The USC 42 is configured using a Laptop/PC running a Windows® operating system (version XP SP3, Vista, 7, 8, 8.1, 10) in conjunction with the programming software US42Pro included in the scope of supply. The physical interface is USB.2.0 in the terminal box of the basic unit SCU C.

6.1 Basic unit (SCU C)

The SCU C module is the central control module of the USC 42. The following options are available:

1. SCU C-I current output (included with the standard version)
2. SCU C-G additional incremental output to the current output

A detailed description of the parameterization is given in the separate configuration manual.

6.1.1 Electrical Data SCU C:

Specification	Value
Supply voltage	15 V…27 VDC acc. to IEC 60364-4-41, SELV/PELV For UL and CSA Class 2 supplied
Power consumption	max. 5 W plus power consumption of next modules
Connection	screw-type terminal 0,25 mm² - 1,5 mm²
Connecting diagram	PN164-401c (see chapter 11.2)
Programming interface	USB 2.0
Resolution Singleturn	13 Bit
Resolution Multiturn	15 Bit
Preset input (see also Chap.6.1.5)	Preset voltage Low: 0 V < U < 5 VDC Preset voltage High 8 VDC < U < 27 VDC (Ri: ca. 39 kΩ)
Reset input (see also Chap.6.1.4)	Reset voltage Low: 0 V < U < 5 VDC Reset voltage High 8 VDC < U < 27 VDC (Ri: ca. 39 kΩ)
Error output, status output (see also Chap. 6.3.1)	2-channel type with current-limited, short-circuit proof push-pull line driver Output voltage: HTL Load: max. 50 mA at 24 V

!	**NOTICE!** The supply voltage must not exceed a voltage of 36 VDC even in the event of a fault. This may be for examle by a power supply with output voltage monitoring (for example. Sitop PM1507), or by appropriate voltage limiting measures, e.g. the use of an overvoltage protection device can be realized.

6.1.2 Operating statuses and indicators

Operating status	Terminal box SCU C		Output status (HTL)	Output error (HTL)	Error switch (optional)	Position / speed switch (optional)	Bus module (optional)
	Status LED (green)	Failure LED (red)					
Start	Flashing 2 Hz	on	Low	Low	Open	Open	Not ready for operations
Normal	On	Off	High	High	Closed	As per program	Reday for operations
Parameter assignment	Flashing 1 Hz	Off	Change 1 Hz	High	Closed	As per program	Reday for operations
Test	Flashing 1 Hz	Off	Change 1 Hz	High	Off	As per Test	Reday for operations
Bootloader	Flashing 1 Hz	On	High	Low	On	On	Not ready for operations
Reset	→ START						
Preset	1s off	Off	1s Low	High	Off	As per program	Reday for operations
Warning	Flashing 1 Hz	Flashing 1 Hz	Low	High	Off	As per program	Reday for operations
Error	Off	On	Low	Low	On	As per program	Error

Warning
A warning is generated:

1. 80% of the relay life (16,000,000 switching cycles) has been reached.
2. USC 42 usage period (20 years) has been reached.

!	**ATTENTION!** **Parameterization, calibration and switching on is only possible during standstill!** The USC 42 is set to the safe state during a rotary movement. Switching on is possible up to a speed of approx. 15 rpm.

6.1.3 Error- and status output

The basic unit of the USC 42 is equipped with an error and a status output. Both outputs are 2 channel (Cat. 3) types.

Error output

An error is indicated by a low-level signal at the error output, which can only be reset via the configuration software "US42Pro" (factory setting).

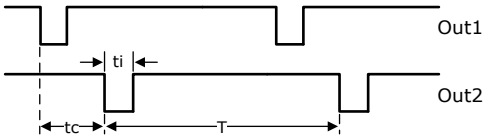


Fig. 6-3: Error output

It is possible to set the error performance via the software so that a reset will be initiated by interrupting the supply voltage (> 2s) or by initiating a reset at the reset input. The reset initiates a system reboot including a complete system test. If an error is determined again, the device remains in an error condition. Error logs are saved in the error memory. The error output is dynamic; when ON it sends test pulses (factory setting). The USC 42 monitors the output to ensure it is functioning properly. The receiver must suppress the test pulses to avoid unwanted switching operations. It is possible to set the times ti and T in the configuration software (see configuration manual). tc = 2 x ti.

For non-safety relevant applications it is possible to deactivate the test pulses.

Status output

The status output indicates the operating status in conjunction with the error output (see chapter 6.1.2).

6.1.4 Reset input

A reset leads to the entire USC 42 being re-initialized.

The reset input is a 2 channel (Cat. 3) type.

When quiescent both inputs must be high. A reset is initiated if both input signals are low. It is possible to configure the duration of the low level signal T1 (factory setting: 200-2000 ms).

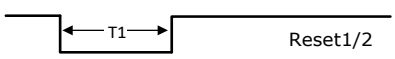


Fig. 6-4: Reset input

6.1.5 Preset input

A preset signal sets the current position to the preset position configured in the USC 42. A low-level status output signal (approx. 1s) indicates a valid preset procedure.

The preset input is a 2 channel (Cat. 3) type. When quiescent the inputs must be high. A high-low transition on both inputs initiates the preset procedure. Valid low-high transitions trigger the preset procedure. It is possible to
configure the duration of the low level signal T1 (factory setting: 200 ms ... 2000 ms).

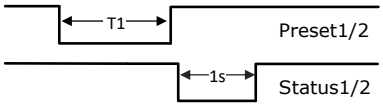
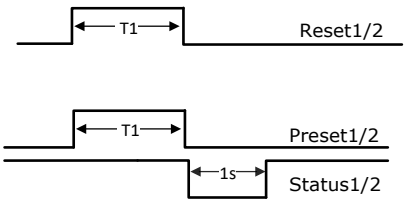


Fig. 6-5: Preset input

In the parameterization software, the behavior of the reset and preset inputs can be switched from low active
to high-active.



	NOTES! If test pulses are used on the inputs they must not exceed max. ¼ of the min. duration of T1 (5 ms or rather 50 ms).

	WARNING! Setting the preset "on the fly" is only permissible if the results of a risk analysis determine the application is suitable for such an operation.

	WARNING! A preset does not influence the position value of the bus module (SPB, SPN). It is only possible to alter this position value via the bus interface.

6.1.6 Incremental output (non safety-related)

The optional incremental output supplies 1024 or 4096 pulses / rotation. The output signals opposite are available (factory setting: 1024).

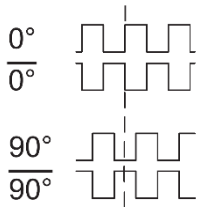


Fig. 6-6: Incremental signals

6.1.6.1 Electrical data incremental output

	Value
Pulse rates	4096 / 1024 (configurable)
Outputs	Current limited and short-circuit proof push-pull line driver with integrated characteristic impedance matching for 30-140 Ω lines.
Signal amplitude (HTL)	Approximately equal to the supply voltage, output saturation voltage < 0.4 V at I_L 30 mA
Output current^	Max. 50 mA at 24 V
Pulse duty factor	1 : 1 ± 5%
Phase shift 0°, 90°	90° ± 5%
Max. frequency	190 kHz
Connection diagram	PN164-402c (see Chap.11.2)

6.1.7 Current output 4–20mA (not safety-oriented)

The current output is configurable using the software US42Pro. The current value can be obtained either from the speed value or from the difference between two position values.

The load impedance (internal resistance of the measuring device) must not exceed max. 400 Ω for supply voltages < 16V and 600 Ω for supply voltages < 16V. The amplitude of the unloaded output can increase at most to the amplitude of the supply voltage.

6.1.7.1 Current value of the speed value

The max. current (I = 20 mA) can be assigned to any integer speed value (speed $_{20\,mA}$), whereat the speed $_{20mA}$ value must not exceed the max. permissible speed of the USC 42.
The range is divided linearly into 4096 (12 bit) steps.
If the speed is greater than the speed of $_{20\,mA}$-value, the following output current arises:

Variant 1: I = 0 mA (high resistance)
Variant 2: I = 20 mA

The behavior is configurable. Factory setting: I = 0 mA

Electrical data current output speed:

Specification	Value
Max. speed	2800 rpm
Accuracy	0,5% FSR
Update rate	approx. 2 ms
Max. load resistance	400 at supply voltage < 16V 600 at supply voltage ≥ 16V
Connection diagram	PN164-401c (see Chap.11.2)

6.1.7.2 Current value of the difference between two position values

It is possible to select any 2 position values within the system limits. The smaller position value is assigned the current Imin = 4 mA and larger position value I_{max} = 20 mA. The selected position values must be within the resolution range of the USC42. If the current position is outside of the defined position range, the following current output raises:

Variant 1: I = 0 mA (high impedance)
Variant 2: Position range undershot: I = 4 mA
Position range overshot: I = 20 mA

The behavior is configurable. Factory setting: I = 0 mA

Electrical data current output position:

Specification	Value
Max. position difference	32768 revolutions
Max. setting accuracy	1 / 8192 revolutions
Accuracy of the current output	0,5% FSR
Update rate	approx. 1 ms
Max. load resistance	400 Ω at supply voltage < 16V 600 Ω at supply voltage ≥ 16V
Connection diagram	PN164-401c (see chapter 11.2)

6.2 Safety Position switch module with safety relays(SRC C-R)

The position switch open or close depending on the position value. The user is able to configure a cam with a switch, in other words, a switch-on and switch-off position (red line) and the associated hysteresis switching points (blue line).

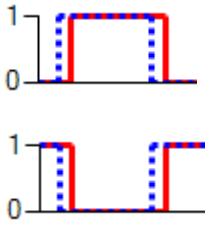


Fig. 6 - 7: Switch states SRC C-R

To set an inverted switching behavior select inverted position evaluation.

A SRC C-R type housing module contains 3 or 6 safe position switches. As shown in the graphic opposite each position switch is a 2 channel (Cat. 3) design. The switch states are depicted when no voltage is applied.

A detailed description of the parameterization is given in the separate configuration manual.

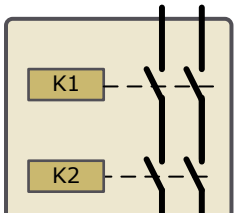


Fig. 6 - 8: Switch arrangement SRC C-R

6.2.1 Electrical data safety position switch

Specification	Value
Supply voltage	is supplied by SCU C
Additional module power consumption SCR C-R	3 switches max. 2,5 W / 6 switches max. 5 W
SRC C-R (positively driven relay contacts)	5 VAC … 230 VAC 5 mA … 500 mA 5 VDC … 30 VDC 5 mA … 500 mA 5 VDC … 230 VDC 5 mA … 180 mA
Mechanical relay life time	>20.000.000 operations
Time between 2 switching operations required of a relay	≥ 135 ms
max. position difference	32768 revolutions
Connection	screw-type terminal 0,25 mm² - 1,5 mm²
Connecting diagram	PN164-420e, PN164-421e (see chapter 11.2)

Install a back-up fuse (max. 2A) to protect the relay contacts against overcurrents.

WARNING!

- Overvoltage category III:
  In case of a mixed population between adjacent relay outputs with SELV/PELV and mains voltage a double / reinforced insulation can be stated up to 150 V AC or 212 V DC, assuming a maximum altitude of 2000 m.
  An appropriate fixing of the wires is necessary to avoid cross faults between the different voltage areas. For higher voltages it must be ensured that sufficient spacing is maintained, e.g. by leaving one relay output in-between unconnected.
- At a height of 2000 m - 3000 m the max. switching voltage is 150 VAC or 212 VDC.

6.3 Safe Speed switch module with safety relay (SGS C-R)

The speed switches open and close depending on the speed value. With a speed switch the user is able to configure overspeed cut-off and/or underspeed cut-off and the associated hysteresis switching points (dotted line).
By selecting the inverted speed evaluating an inverted switching behavior can be set.

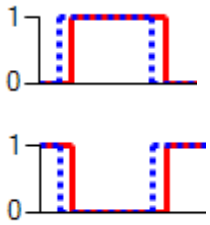


Fig. 6 - 9: Switch statuses SGS C-R

A SGS C-R type housing module contains 3 or 6 safe speed switches. As shown in the graphic opposite each speed switch is a 2 channel (Cat. 3) design. The switch statuses are depicted when no voltage is applied.

A detailed description of the parameterization is given in the separate configuration manual.

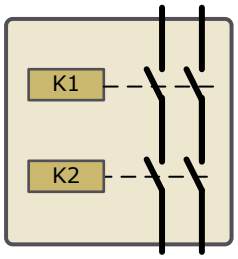


Fig. 6 - 10: Switch arrangement SGS C-R

6.3.1 Electrical data safety speed switch:

Specification	Value
Supply voltage	Is supplied by SCU C
Additional module power consumption SGS C-R	3 switches max. 2,5 W / 6 switches max. 5 W
SGS C-R (positively driven relay contacts)	5 VAC … 250 VAC 5 mA … 500 mA 5 VDC … 30 VDC 5 mA … 500 mA 5 VDC … 230 VDC 5 mA … 180 mA
Mechanical relay life time	>20.000.000 operations
Time between 2 switching operations required of a relay	≥ 135 ms
Switching accuracy	See chapter 6.3.2
Connection	Screw-type terminal 0,25 mm² - 1,5 mm²
Connecting diagram	PN164-420e, PN164-421e (see chapter 11.2)

Install a back-up fuse (max. 2A) to protect the relay contacts against overcurrents.

WARNING!

- Overvoltage category III:
  In case of a mixed population between adjacent relay outputs with SELV/PELV and mains voltage a double / reinforced insulation can be stated up to 150 V AC or 212 V DC, assuming a maximum altitude of 2000 m.
  An appropriate fixing of the wires is necessary to avoid cross faults between the different voltage areas. For higher voltages it must be ensured that sufficient spacing is maintained, e.g. by leaving one relay output in-between unconnected.
- At a height of 2000 m - 3000 m the max. switching voltage is 150 VAC or 212 VDC.

6.3.2 Switching accuracy

The switching accuracy (max. switching errors) Δn is made up of:

- Switching time T_{Sw}: ≤10 ms
- Measuring accuracy ΔF (Error in the determination of speed): ≤ 2 %
- Measuring angle φ: approx. 0,25°

The following formula arises from it:

$$\Delta n = \sqrt{n_0{}^2 + \frac{\alpha \cdot \varphi}{3}} + \alpha \cdot \frac{T_{Sw}}{1000} + \Delta F \cdot n_0 - n_0$$

Δ_n:	max. switching failure [rpm]
n_0:	switching point [rpm]
α	acceleration [rpm / s]
φ:	measuring angle [°]
T_{Sw}:	switching time [ms]

6.4 Error switch

It is possible to assign the error switch function to a single or several speed and position switches as required using the configuration software (see configuration manual). The switch is closed when no errors occur during operations.

As shown in the graphic opposite each error switch is a 2 channel (Cat. 3) design. The switch statuses are depicted when no voltage is applied.

A detailed description of parameter assignments is provided in a separate configuration manual.

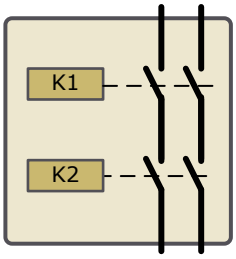


Fig. 6-11: Switch arrangement - error switch

!	Install the error switch in such a manner that the application enters a "safe state" in the event a fault occurs (relay contact opens). During error-free start up of the USC42 the fault switch closes approx. 100 ms before the fault and status output reaches high.

6.5 Safe PROFIBUS module (SPB C)

The Profibus module includes:

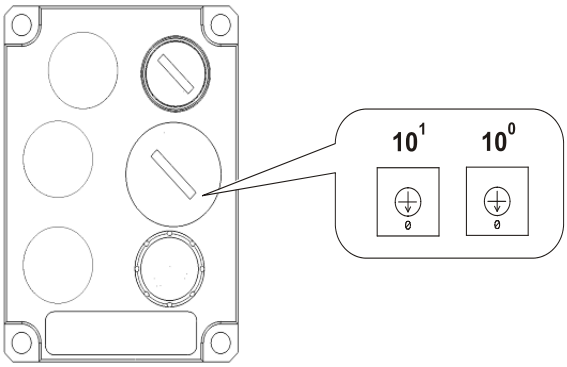
- PROFIBUS interface with PROFIsafe protocol, for transfer of a safe position and speed.
- Quick process data channel via PROFIBUS, not safety-oriented

The "safe data" obtained through two-channel data comparison are packed into the PROFIsafe protocol and also transmitted to the control via the PROFIBUS.
Upon completion of assembly work, a visual inspection with report should be carried out.
Wherever possible, the quality of the network should be verified using a suitable bus analysis tool: no duplicate bus-addresses, no reflections, no telegram repetitions etc.
A detailed description of parameter assignments is provided in a separate configuration manual.

6.5.1 Electrical data PROFIBUS

Detail	Value
Supply voltage	is supplied by SCU C
Additional module power consumption SPB	max. 1,5 W
Total resolution	≤ 28 Bit
Singel-turn functional	≤ 13 Bit (8192 steps/revolution)
Single-turn safety-oriented	8 Bit (256 steps/revolution)
Multi-turn	≤ 15 Bit (32768 revolutions)
PROFIBUS-DP V0 interface	IEC 61158, IEC 61784
PROFIsafe profile	3.192b according to IEC 61784-3-3
Additional functions	Preset
Parameter	parameterizable via PROFIBUS-DP
Integration time Safe	50 ms…500 ms
Integration time Unsafe	5 ms…500 ms
Size of monitoring window	50…4000 increments
Idleness tolerance Preset	1…5 increments/integration time Safe
Counting direction	forward, backward
Transmission	RS485 twisted and shielded copper cable with a single conductor pair (cable type A)
Output code	binary
Addressing	1 – 99, settable via rotary switch
Baud rate	9,6 kbit/s…12 Mbit/s
JHG-specific functions (parameterizable via PROFIBUS-DP)	speed output in increments/integration time Safe
Cycle time	
Not safety-oriented	0.5 ms, output via JHG-PROFIBUS module
Safety-oriented	5 ms, output via JHG-PROFIsafe module
Preset write cycles	≥ 4 000 000
Electrical connection	M12 connector
connection diagram	PN164-410a (see chapter 11.2)

6.5.2 Bus addressing



WARNING! CAUTION!

- Destruction, damage and malfunction of the USC 42 in case of infiltration of foreign substances and damp.
- The access to the address switches has to be locked after the settings with the screw plug. Tighten firmly.

Valid PROFIBUS-addresses: 1 – 99

10^0: Setting the 1st position

10^1: Setting the 10th position

The USC 42 will not start up with an invalid station address.

The set PROFIBUS address automatically gives the PROFIsafe destination, see F_Source_Add/F_Dest_Add
in the separate configuration manual.

6.5.3 PROFIBUS transfer technology, cable specification

All devices are connected in a bus structure (line). Up to 32 clients (master or slaves) can be connected together in a segment.

The bus is terminated with an active bus termination at the beginning and end of each segment. For stable operation, it must be ensured that both bus terminations are always supplied with voltage. The bus termination must be provided externally via the connection plug.

Repeaters (signal amplifiers) have to be used with more than 32 clients or to expand the network scope in order to connect the various bus segments.

All cables used must conform with PROFIBUS specifications for the following copper data cable parameters:

Parameter	Cable type A
Wave impedance in Ω	135...165 at a frequency of 3...20 MHz
Operating capacitance (pF/m)	30
Loop resistance (□/km)	≤ 110
Wire diameter (mm)	> 0,64
Wire cross section (mm²)	> 0,34
Shielding	Generally for shielding with braided shield

The transmission speed for PROFIBUS is selectable in the range between 9.6 kBit/s and 12 MBit/s and is automatically detected by the measuring system. It is selected for all devices on the bus at the time of commissioning the system.

The range is dependent on the transmission speed for cable type A:

Baud rate (kBit/s)	9,6	19,2	93,75	187,5	500	1500	12000
Range / segment (m)	1200	1200	1200	1000	400	200	100

Upon completion of installation, a visual inspection with report should be carried out. Wherever possible, the quality of the network should be verified using a suitable bus analysis tool: no duplicate IP-addresses, no reflections, no telegram repetitions etc.

NOTES!

To ensure safe and fault-free operation, the

- PROFIBUS Planning Guideline, PNO Order no.: 8.012,
- PROFIBUS Assembly Guideline, PNO Order no.: 8.022,
- PROFIBUS Commissioning Guideline, PNO Order no.: 8.032,
- PROFIsafe „Environmental Requirements“, PNO Order no.: 2.232, and the referenced Standards and PNO Documents contained in it must be observed!

In particular the EMC directive in its valid version must be observed!

6.5.4 Bus termination

If the USC 42PROFIBUS module is the last station in the PROFIBUS- segment, the bus must be terminated via flange socket Xn.3 in accordance with the PROFIBUS standard.

The bus termination can also be obtained from Johannes Hübner Giessen (see chapter 10).

6.6 Saftey PROFINET module (SPN C)

The PROFINET module includes:

- PROFINET IO interface with PROFIsafe protocol, for transfer of a safe position and speed
- Quick process data channel via PROFINET IO, not safety-oriented

The "safe data" obtained through two-channel data comparison are packed into the PROFIsafe protocol and also transmitted to the control via the PROFINET IO.

Upon completion of installation, a visual inspection with report should be carried out. Wherever possible, the quality of the network should be verified using a suitable bus analysis tool: no duplicate IP-addresses, no reflections, no telegram repetitions etc.

A detailed description of the parameterization is given in the document „USC42_SPN-Config manual".

6.6.1 Electrical data PROFINET

Detail	Value
Supply voltage	is supplied by SCU C
Additional module power consumption SPN	max. 1,5 W
Total resolution	≤ 28 bit
Single-Turn functional	≤ 13 bit (8192 steps/revolution)
Single-Turn safety oriented	8 bit (256 steps/revolution)
Multi-Turn	≤ 15 bit (32768 revolutions)
PROFINET IO interface	according to IEC 61158 und IEC 61784
PROFIsafe profile	3.192b according to IEC 61784-3-3
Additional functions	preset
Parameter	parameterizable via PROFINET IO
Integration Time Safe	50 ms…500 ms
Integration Time Unsafe	5 ms…500 ms
Size of monitoring window	50…4000 increments
Idleness tolerance preset	1…5 increments/Integration Time Safe
Counting direction	forward, backward
PROFINET specification	V2.2
Software stack	V3.2.0.1
Conformance class	conformance class B, C
Physical Layer	PROFINET 100Base-TX, Fast Ethernet, ISO/IEC 8802-3
Output code	binary
Cycle time	≥ 1 ms (IRT / RT)

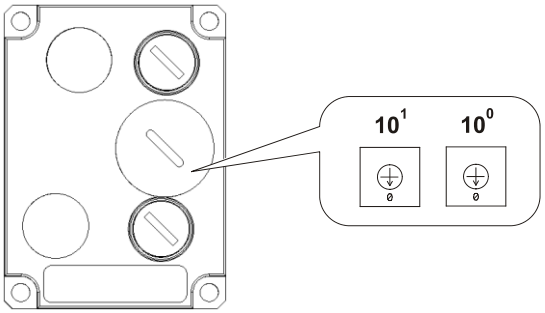
Detail	Value
Transmission rate	100 Mbit/s
Transmission	CAT-5 cable, shielded (STP), ISO/IEC 11801
Addressing (parameterizable via PROFINET IO)	by name (name allocation about engineering tool). Assignment name→MAC during system boot
Cycle time	
Not safety-oriented	0.5 ms, output via JHG-PROFIBUS module
Safety-oriented	5 ms, output via JHG-PROFIsafe module
Preset write cycles	≥ 4 000 000
Electrical connection	M12 connector
Connection diagram	PN164-412a (see chapter.11.2)

6.6.2 PROFIsafe destination address “F_Dest_Add”

WARNING! NOTICE!

Destruction, damage and malfunction of the USC 42 in case of infiltration of foreign substances and damp!

The access to the address switches has to be locked after the settings with the screw plug. Tighten firmly!



The PROFIsafe destination address corresponds to the F-parameter `F_Dest_Add` and defines an unique source address within a PROFIsafe cluster. Valid addresses: 1…99, also see chapter „F_Source_Add / F_Dest_Add“ in the separate configuration manual.

6.6.3 PROFINET IO transfer technology, cable specification

The safety-related PROFIsafe communication as well as the PROFINET communication is transferred about the same network

PROFINET supports linear, tree or star structures. The bus or linear structure used in the field buses is thus also available for Ethernet. This is particularly practical for system wiring, as a combination of line and stubs is possible. Because the PROFINET module already has an integrated switch, the line topology can be realized in a simple manner.

Use only cables and connectors which are provided with a PROFINET manufacturer's declaration. The cable type A/B/C, the mechanical and chemical properties as well as the type of the PROFINET cable have to be defined according to the automation task. The cables are designed for bit rates of up to 100 Mbit/s. The transmission speed is automatically detected by the PROFINET module and does not have to be set by means of switches.

Addressing by switches as in the case of the PROFIBUS-DP is also not necessary, this is done automatically using the addressing options of the PROFINET-Controller, however the PROFIsafe destination address “F_Dest_Add” must be adjusted, note chapter 6.6.2.

The cable length including patch cables in case of copper wiring between two subscribers may amount max. 100 m. This transmission link has been defined as PROFINET end-to-end link. Within an end-to-end link the number of detachable links is limited up to six connector pairs (male connector/female connector). If more than six connector pairs are required, make sure that the attenuation values for the entire link are observed (channel class-D values).

NOTES!

In case of IRT communication the topology is projected in a connection table. Thereby pay attention on a right connection of the ports 1 and 2.

With RT communication this is not the case, it can be cabled freely.

7 Functional safety

7.1 Safety characteristics

Figures determined according to DIN EN ISO 13849-1 for the USC 42

Architecture	Category	PL	SIL CL	Service life
1oo2 (2-channel)	3	d	2 (high demand)	20 years

7.2 Reliability indices for the whole system USC 42

The following table shows the safety characteristics for various USC 42 variants with a service life (T_M) of 20 years.

For the MTTFD calculation it is assumed that 1 switching output or 3 switching outputs of a switching module for a safety function with respectively 500,000 switching cycles / year can be used, with a current load of 100 mA.

Unit type	PFD_{AV}	PFH [FIT]	DCavg [%]	1 switch $MTTF_D$ [a]	2 switches $MTTF_D$ [a]
USC 42I-D, USC 42I-DD, USC 42I-DD-A	6,02E-05	0,34	97,2	116,8	83,3
USC 42I-DD-P, USC 42I-DD-A-P	9,52E-05	0,54	96,8	86,4	67,5
USC 42I-DD-R, USC 42I-DD-A-R	1,11E-04	0,64	96,8	85,8	67,1

Reliability indices for other device configurations and switching operations can be calculated using the calculation tool "FitCalc" in the parameterization software.

7.3 Device data

7.3.1 Timing

Power-on time T_{Pw}

After the supply voltage is turned on initial internal diagnostic checks are carried out before the USC 42 is ready for operations.
The power-on time is approx. 6 s.

Switching time T_{sw}

The switching time T_{Sw} = max. 10 ms of the relays consists of the calculation time and the switching time of the switches.

Error response time: ≤ 50 ms

7.3.2 Speed-Switching accuracy

See chapter 6.3.2.

7.3.3 Safe state

- If an error is detected the error outputs of the main module (SCU C) are switched to LOW".
- If the function error switch is used, its relays contacts open in the event an error occurs.
- **Exception:**
  Fault in the PROFIBUS or PROFINET - bus box
  – PROFIsafe data channel: all outputs are set to 0
  – PROFIsafe status: Error bit 2 (Device_Fault) is set
  – PROFIsafe CRC: valid

7.4 Information about functional safety

CAUTION!

- The power supply unit used must not exceed a voltage of 36 VDC even during a fault condition or corresponding voltage limiting measures must be employed, for example installing a surge suppressor.
- The user must ensure that the system limits are not exceeded even in the switched-off state.
- The relay contacts must be protected against over current by a backup fuse (2A).
- Relays which do not change the switching state for longer than one year due to the application must be tested once a year as part of a maintenance operation.
- An error switch must be used in such a way that the application assumes the "safe state" in the event of an error.
- When possible, all devices / circuits should go to a safe state or to safe conditions when the switch is opened (see EN ISO 13849-2: 2013 table D.2).
- The controller must check the switching states of both channels of a switching output for equality. Unequal states are an error.
- In applications without a safety- SPS, an error switch of the USC 42 must be connected in such a way that when the switch is opened, the application assumes the "safe state" (basic safety principle see chap. 12.2).
- In applications with a safety- SPS, both channels of the error output (Error1, Error2) must be evaluated (see chapter 12.1). The test pulses must be suppressed in the application in order to avoid unintended switching operations. In the event of a fault, the SPS must take appropriate measures so that the application takes the "safe state".
- The USB interface is only to be used for parameterization and commissioning and is not designed for continuous operation in a "rough" environment.
- The option "Error reset via the Reset input or interruption of the voltage supply" may only be used if a risk analysis has shown that the application is suitable for this purpose.
- Setting the preset "on the fly" is only permissible if a risk analysis has shown that the application is suitable for this purpose.

8 Inspections

8.1 Safety instructions

WARNING/PERSONNEL!

Skilled technical staff only are permitted to inspect the USC 42 and its installation.

Observe the safety instructions contained in chapter **2** when inspecting or working on the USC 42!

8.2 Maintenance information

The USC 42 is maintenance-free. However, to guarantee optimum fault-free operations we recommend that you carry out the following inspections.

The inspection work described in this section must be carried out by skilled technical staff only. We remind you of your obligation to observe and adhere to all operating and owner-relevant accident prevention regulations, laws regarding the safeguarding of machinery and plant as well as application and country-specific regulations, laws and standards.

8.3 Inspection schedule

NOTES!

No interventions other than the cyclic tests described in the test schedule are necessary on the USC 42. Any intervention on the USC 42 renders all guarantee claims null and void!

Interval	Inspections
Yearly	Inspect the coupling for damage and ensure it is free of play
	Ensure the fastening screws are properly tightened
	Ensure cable connections and connection terminals are properly tightened
	Ensure the blanking plugs are sealing properly
	Check, and if necessary restore, the legibility of labels and nameplates
	Test the switch (See chapter switch test in the separate Configuration manual).
After approx. 16 000 – 20 000 hours of operation or higher levels of continuous load	Check deep groove ball bearings for noise, running smoothly. Bearings must be replaced by the manufacturer only.

8.4 Fault table

Faults	Possible cause	Remedy
Failure output Low	No supply voltage Control: LEDs in terminal box does not shine	Check connection cable and supply voltage
	A failure was recognised	Start the US42Pro software and then connect to the device. The error is displayed according to error table (see document configuration manual). Corresponding remedial measures are to be initiated. Internal errors are e.g. triggered by deviations of the device-internal program sequence. For more information, see the document configuration manual "Error Handling".
Moisture in the terminal box	Soiled gasket or seal surfaces of terminal box cover	Clean gasket of terminal box cover and seal surfaces
	Damaged gasket of terminal box cover	Replace O-ring of terminal box cover
	Cable gland/blanking plug not tightened	Tighten cable gland/blanking plug
	Unsuitable cable for cable gland	Use suitable cable and cable glands
Contact Hubner-Service (page 2) if none of the remedies listed above provides a solution!		

8.5 Checklist

We recommend that you print out and work through the checklist for commissioning, replacing the measuring system and when changing the parameterization of a previously accepted system and store it as part of the overall system documentation.

Documentation reason	Date	Edited	Checked

Sub-item	To note	Can be found under	Yes
Present user manual has been read and understood.			☐
Check that the USC 42 can be used for the present automation task on the basis of the specified safety requirements.	Intended use Compliance with all technical data	chapter 2.3 chapter 5.3	☐
Fulfilment of the installation requirements defined in the user manual	Safe mechanical fixing of the USC 42 and safe positive connection of the driving shaft with the USC 42	chapter 3	☐
Requirements for the supply voltage	The power supply used must meet the requirements of SELV/PELV (IEC 60364-4-41:2005).	chapter 6.1.1	☐
Correct PROFIBUS/PROFINET installation	Observance of the international standards valid for PROFIBUS/PROFINET / PROFIsafe or the directives specified by the PROFIBUS User Organization	chapter 6.5.3 / chapter 6.6.3	☐
System test after commissioning and parameter changes	During commissioning and after each parameter change all affected safety functions must be checked.	chapter Parameterization in the separate configuration manual	☐
Preset Adjustment Function	The preset adjustment function may only be executed when the affected axis is stationary. It must be ensured that the preset adjustment function cannot be inadvertently triggered. After execution of the preset adjustment function the new position must be checked before restarting.	chapter Preset Adjustment in the separate configuration manual	☐
Device replacement	It must be ensured that the new USC 42 corresponds to the replaced USC 42. All affected safety functions must be checked.	chapter 3.5.2	☐

9 Transport, packaging and storage

9.1 Safety information concerning transport

!	**CAUTION!** **Material damage caused by improper transport!** Observe the symbols and information on the packaging: Do not throw - risk of breakage Keep dry Do not expose to heat above 40 °C or direct sunlight.

9.2 Goods inward inspection

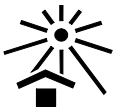
Check the delivery immediately upon receipt for transit damage or short delivery.
Inform the carrier immediately on receipt if you determine that damage has occurred during transit (take photos as proof).

9.3 Packaging (disposal)

The packaging is not taken back; dispose of according to the respective valid statutory provisions and local regulations.

9.4 Storing packages (devices)

	**Keep dry!** Keep packages dry and free from dust; protect from moisture.

	**Protect against heat!** Protect packages from heat above 40 °C and direct sunlight.

If you intend to store the device for a longer period of time (> 6 months) we recommend you use protective packaging (with desiccant).

	**NOTES!** Turn the shaft of the USC42 every 6 month to prevent the bearing grease solidifying!

9.5 Returning devices (repairs/goodwill/warranty)

The devices which have got into contact with radioactive radiation or radioactive materials will not be taken back.

The devices which have got into contact with possibly noxious chemical or biological substances must be decontaminated before the return.

They must also be accompanied by a safety clearance certificate.

9.6 Disposal

The manufacturer is not obligated to take back electronics waste.
The USC 42 consists of hybrid components, and in part must be disposed of as special waste (electronic scrap) according to country-specific legislation.
Local municipal authorities or specialized disposal companies provide information on environmentally responsible disposal.

10 Accessories

The scope of supply of the USC 42 includes:
The Operating and Assembly Instructions, configuration instructions,
the Software & Support CD and the USB programming cable, which can also be requested separately.

10.1 Spare parts

Description	Order number
Software & Support CD	ID 69768
Operating and Assembly Instructions	ID 71110
SCU configuration instructions	ID 71111
PROFIBUS configuration instructions	ID 71112
PROFINET configuration instructions	ID 71113
USB programming cable	ID 69629
PROFIBUS terminating plug (M12 plug, B-coded, 220 Ω) 	ID 68746 (PROFIBUS terminating plug is not included in the scope of supply)
O-ring to seal terminal box	ID 69260
Breather drain	ID 65653

10.2 Coupling

We recommend our zero-backlash, torsio-resistant couplings with fault exclusion HKS(I) 5 (single joint couplings) or HKDS(I) 5 (double joint couplings) for mounting the USC 42.

The couplings meet the following requirements:

Description			Value
shock resistance	(DIN EN 60068-2-27 (6 ms)		100 g
vibration resistance	(DIN EN 60068-2-6 (8,7 … 2000 Hz)		20 g
torque			3 Nm
temperature range			-25°… +85° C
max. speed			6000 rpm
mounting accuracy	HKS 5 / HKSI 5:	axial offset:	± 1 mm
		angular:	0,5°
	HKDS 5 / HKDSI 5:	axial offset:	± 1,5 mm
		radial offset:	± 0,5mm

For further information please do not hesitate to contact our sales department.

11 Documents

11.1 Dimension drawing

HM 15 M 109663

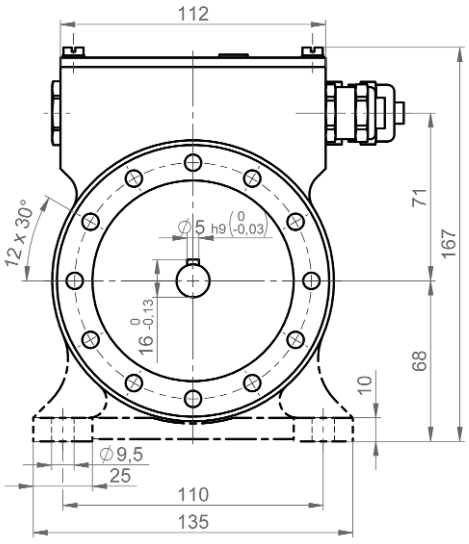


Fig. 11-1 – front view

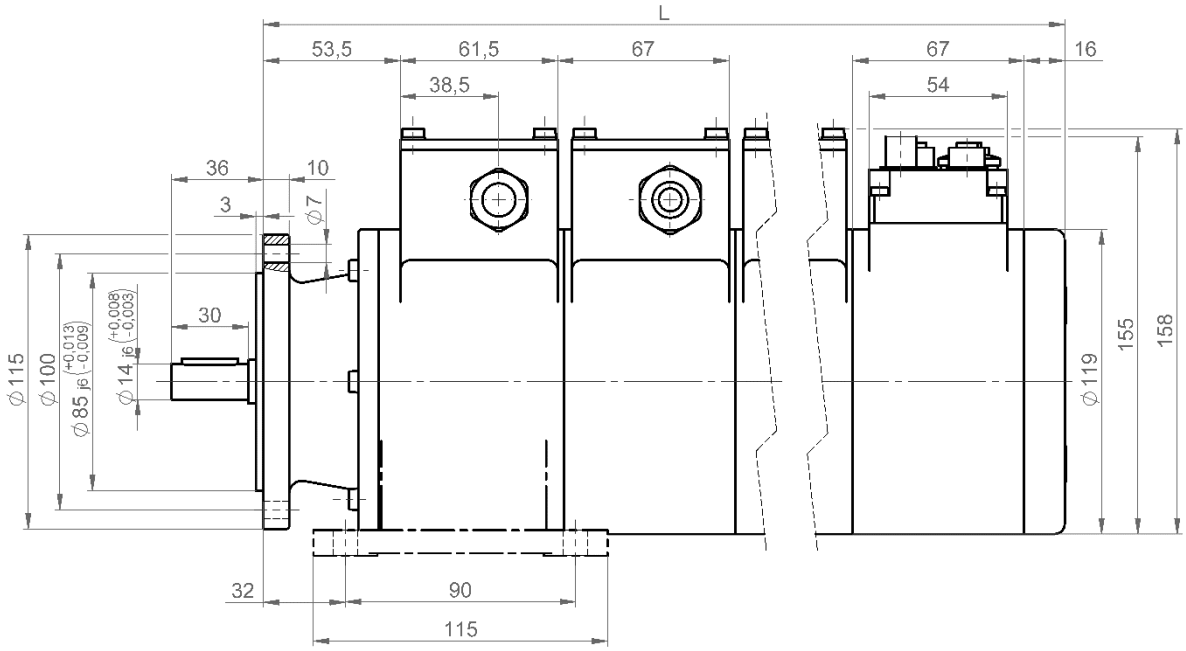
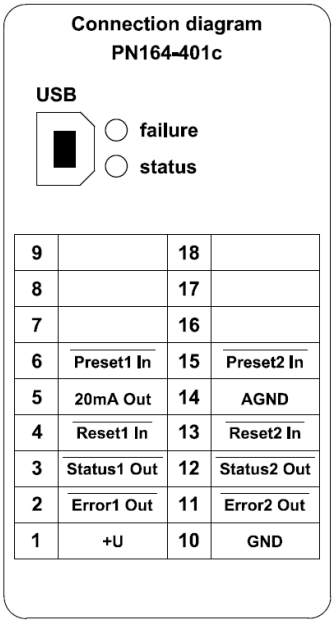


Fig. 11-2 – side view

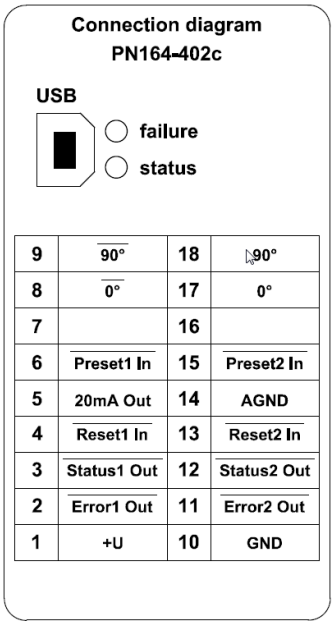
Modulanzahl	L
X1	134
X2	201
X3	268
X4	335
X5	402

11.2 Connection Diagrams

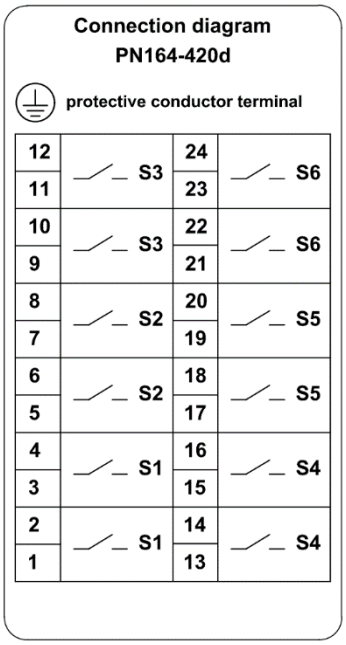
NOTES!
The connection diagrams are depicted on the respective terminal box cover.



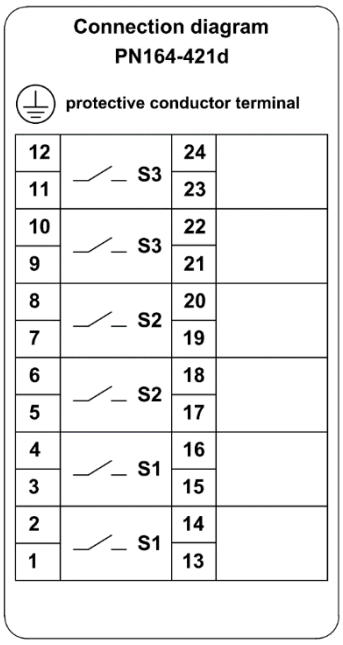
The shield of the signal cable is connected directly to the housing via the EMC cable gland.



Connection diagram SCU C-I incl. current output (standard)	PN164-401c
Connection diagram SCU C-G Option G (incremental output)	PN164-402c

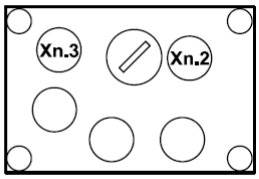


No shielded connection cable needed.



Connection diagram switching module, dual	PN164-420e
Connection diagram switching module, single	PN164-421e

Steckerzuordnung
connector assignment



n : Klemmkastennummer
n : Number of the terminal box

Kabelspezifikation / *Cable specification*

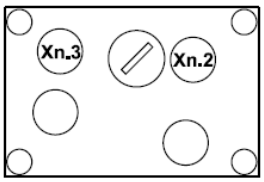
Datenleitung / *Data cable*

Kabelspezifikation: min. 0,25mm², paarig verseilt und geschirmt
Cable specification: min. 0.25mm², stranded in pairs and shielded

	M12-Stecker *M12 plugs*		Anschlussplan *Connection diagram*	PN164-410a *PN164-410a*
PROFIBUS / *PROFIBUS*				
Xn.2	Stift, M12x1, 5 polig *Pin, M12x1, 5 pole* B-coded		1	N.C.	-
			2	PROFIBUS, Data A	PROFIBUS_IN, grün *PROFIBUS_IN, green*
			3	N.C.	-
			4	PROFIBUS, Data B	PROFIBUS_IN, rot *PROFIBUS_IN, red*
			5	N.C.	-
				Gewinde *Thread*	Schirmung *Shielding*
Xn.3	Buchse, M12x1, 5 polig *Socket, M12x1, 5 pole* B-coded		1	+5V	für Terminierung *for termination*
			2	PROFIBUS, Data A	PROFIBUS_OUT, grün *PROFIBUS_OUT, green*
			3	GND	für Terminierung *for termination*
			4	PROFIBUS, Data B	PROFIBUS_OUT, rot *PROFIBUS_OUT, red*
			5	N.C.	-
				Gewinde *Thread*	Schirmung *Shielding*

Connection diagram PROFIBUS PN164-410a

Steckerzuordnung
connector assignment



n : Klemmkastennummer
n : Number of the terminal box

Kabelspezifikation / *Cable specification*

Datenleitung / *Data cable*

Kabelspezifikation: min. 0,25mm², paarig verseilt und geschirmt
Cable specification: min. 0.25mm², stranded in pairs and shielded

	M12-Stecker *M12 plugs*		Anschlussplan *Connection diagram*	PN164-412a *PN164-412a*
PROFINET / *PROFINET*				
Xn.2	Buchse, M12x1, 4 polig *Socket, M12x1, 4 pole* D-coded		PORT 2		
			1	TxD+	Sendedaten + *Transmission Data +*
			2	RxD+	Empfangsdaten + *Receive Data +*
			3	TxD-	Sendedaten - *Transmission Data -*
			4	RxD-	Empfangsdaten - *Receive Data -*
			Gewinde *Thread*		Schirmung *Shielding*
Xn.3	Buchse, M12x1, 4 polig *Socket, M12x1, 4 pole* D-coded		PORT 1		
			1	TxD+	Sendedaten + *Transmission Data +*
			2	RxD+	Empfangsdaten + *Receive Data +*
			3	TxD-	Sendedaten - *Transmission Data -*
			4	RxD-	Empfangsdaten - *Receive Data -*
			Gewinde *Thread*		Schirmung *Shielding*

Connection diagram PROFINET PN164-412a

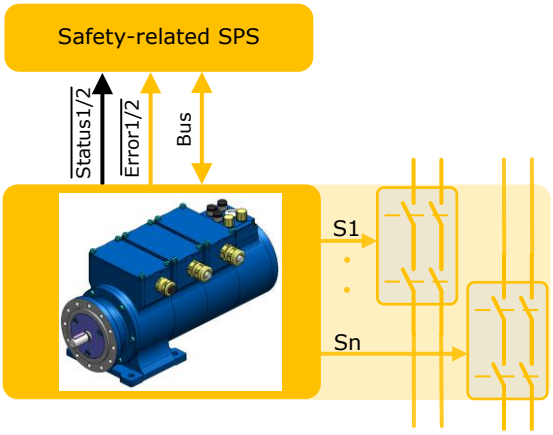
12 Application examples

The USC 42 makes available safe position / speed switches and position values via a bus module. The switches are depicted with no voltage applied.
Not safety-related data lines and switches are depicted in black.

12.1 Application with safety-SPS

The graphic opposite depicts the USC 42 as a safe subsystem of a safety-related SPS.

Description:
The bus provides the SPS with safe position values. This is where the position / speed dependent decisions are made. The USC 42 monitors the test pulses from the error outputs.
If the SPS is malfunctioning, the speed or the position switching points of the USC 42 (S1 … Sn) are monitored in emergency operating mode.

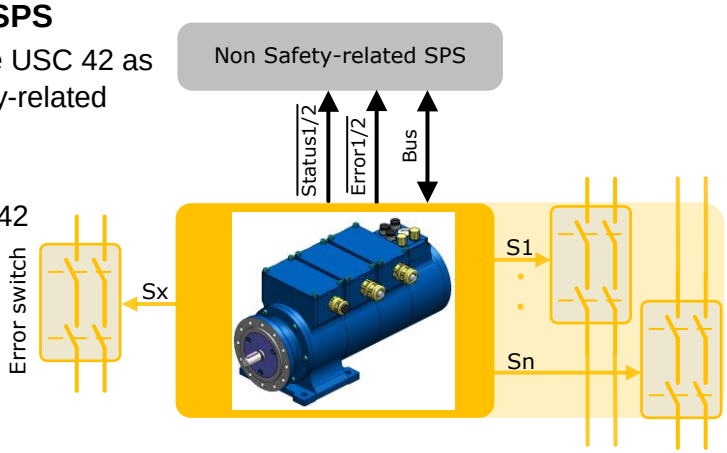


⚠	**Safe error detection:** Both error outputs of the USC 42 (Error1, Error2) incl. test pulses must be monitored by the SPS. Error = permanent “low level signal”. In the event an error occurs the SPS must initiate appropriate measures to ensure the application enters a “safe state”.

12.2 Application without safety-SPS

The graphic opposite depicts the USC 42 as a safe subsystem of a non safety-related SPS.

Description:
The safety switches of the USC 42 (S1 … Sn) monitor the speed and position switching points. Bus, status and error output can all be evaluated by the SPS (non safety-related).



⚠	**Safe error detection:** An unspecified, free position or speed switch (S1 ... Sn) is configured as an error switch (Sx) using the configuration software. The switch opens if a fault is detected. Install the switch in such a manner that the application enters a "safe state" in the event a fault occurs.