



## Operating and assembly instructions

### UO-SCU or UO-SCU-G Safety certified Control Unit

## U-ONE<sup>®</sup>-SAFETY-LWL Universal encoder system – Generation II

Read the operating and assembly manual before carrying out assembly, starting installation, or completing other work.  
Store the manual for future use.

**Manufacturer / Publisher**

Johannes Hübner	Phone:	+49 641 7969 0
Fabrik elektrischer Maschinen GmbH	Fax:	+49 641 73645
Siemensstr. 7	Internet:	www.huebner-giessen.com
35394 Giessen / Germany	E-Mail:	info@huebner-giessen.com

Further current information on this product series can be found online in our Service Point.

Simply scan the QR Code and open the link in your browser.



These instructions and the enclosed declaration of conformity can also be accessed via our Service Point. For this purpose, the QR code on the type plate of the corresponding device must be scanned.

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**Change reservation**

The manual has been drawn up with the utmost care and attention. Nevertheless, we cannot exclude the possibility of errors in form and content.

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## 1 General information

### 1.1 Information on the operating and assembly manual

This operating and assembly manual provides important information on how to use the UO-SCU electronic function module. It must be read carefully before beginning any work and must be observed. The UO-SCU electronic function module is called the SCU in the following documentation.

Furthermore, local accident prevention regulations and general safety regulations applicable in the area where the module is used must be observed.





### 1.2 Scope of delivery

The scope of delivery of the function modules includes the declaration of conformity and the operating and configuration instructions.

The SCU also comes with 2 end brackets for the mounting rail, the software & support data carrier and the USB programming cable.

### 1.3 Explanation of symbols

Warning notices in this operating and assembly manual are designated using symbols. Information is preceded by signal words which express the extent of the danger involved. Always comply with these notices, and use caution to avoid accidents, personal injury and property damage.

	<p><b>WARNING!</b> Indicates a potentially hazardous situation that could lead to death or severe injury if it is not avoided.</p>
	<p><b>CAUTION!</b> Indicates a potentially hazardous situation that could lead to minor or slight injuries if it is not avoided.</p>
	<p><b>CAUTION!</b> Indicates a potentially hazardous situation that could lead to property damage if it is not avoided.</p>
	<p><b>NOTE!</b> Emphasises useful tips and recommendations, and provides information useful for efficient, smooth operation.</p>

## 1.4 Warranty and liability


Only the “General Terms and Conditions” of the company Johannes Hübner Fabrik elektrischer Maschinen GmbH apply. These will be available to the operator at the latest when the order is confirmed or when the contract is concluded. All warranty and liability claims for personal injury and property damage are excluded, and the operator's operating permit will be null and void if one or more of the following apply:

- Failure to observe the operating and assembly manual.
- Improper use of the function module.
- Improper assembly, installation, commissioning and programming of the function module.
- Operating the function module despite technical defects.
- Independently carrying out mechanical or electrical modifications to function modules.
- Independently carrying out repairs.
- Catastrophes due to external interference or force majeure.
- Use of non-qualified personnel.
- Opening the function module.

## 1.5 Organisational measures

- The operating and assembly manual must always be stored easily within reach in the area where the function module is used.
- In addition to the operating and assembly manual, general statutory and other binding regulations on accident prevention and environmental protection must be observed. Operators must be trained on these regulations.
- Applicable national, local, and system-specific provisions and requirements must be observed. Operators must be trained on these provisions.
- The operator is obligated to inform personnel of special operating considerations and requirements.
- The type plate and any prohibitions or notice signs adhered to the function modules must always be legible.
- Repairs may only be carried out by the manufacturer, or by an agency or individual authorised by the manufacturer.

## 1.6 Copyright protection

	<p><b>NOTE!</b></p> <p>Content information, texts, drawings, images, and other illustrations are copyright protected and subject to industrial property rights. Copying of any kind not associated with use of the function modules prohibited without a written declaration from the manufacturer. Violations will result in claims for damages.</p>
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## 1.7 Warranty provisions

Warranty provisions are outlined in the manufacturer's General Delivery Conditions.

## 1.8 Customer service

Contact persons are available by phone, fax, or e-mail for technical questions. See the manufacturer's address on page 2.

## 2 Basic safety information

	<p><b>CAUTION!</b></p> <p>This section provides an overview of all significant safety aspects necessary to protect personnel and ensure safe, fault-free operation of the function module. Failure to observe this information may result in significant danger.</p>
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### 2.1 Responsibility of the operator

The function modules are used in a commercial capacity. The operator of the function modules, therefore, is subject to statutory occupational safety requirements and the safety, accident prevention and environmental regulations applicable to the areas in which the function modules are used.

### 2.2 Selecting and qualifying personnel; basic obligations

- All work on function modules may be carried out only by qualified personnel. Qualified personnel are personnel with the training, experience, and instruction, as well as expertise on relevant standards, specifications, accident prevention regulations and operating circumstances necessary to carry out the required work, and who have been authorised to do so by the persons responsible for the safety of the system. They are able to identify and avoid potential hazards.
- In addition, please see standards VDE 0105-100 and IEC 60364 for the definition of “qualified personnel” (reference, e.g. Beuth Verlag GmbH, VDE-Verlag GmbH)
- Responsibilities for assembly, installation, commissioning and operation must be clearly defined. Personnel who are receiving instruction or training must be supervised.

### 2.3 Proper use


The UO-SCU electronic function module must be used in conjunction with the USL(H) 42 base device. Further function modules may be added depending on the application.

The system manufacturer must review whether the properties of the function module fulfil the safety requirements in its specific application. The system manufacturer is responsible for use of the function module and for deciding whether to use the module. Function modules are designed for unsupervised, continuous operation.



**Proper use also includes:**


- observing all information in this operating and assembly manual,
- observing type plates and any prohibition or information signs,
- observing the operating manual of the machine or system manufacturer,
- operating the function module within the limits stipulated in the technical data,
- not engaging in improper use.

## 2.4 Improper use

	<p><b>WARNING!</b></p> <p>Danger of death, physical injury and property damage due to improper use of the function module!</p> <p>In particular, the following uses are prohibited:</p> <ul style="list-style-type: none"> <li>● Use in environments with an explosive atmosphere,</li> <li>● Use in environments with radioactive radiation,</li> <li>● Use for medical purposes.</li> </ul>
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## 2.5 Safety information


  	<p><b>WARNING! CAUTION!</b></p> <p>Destruction, damage or impact to the function of the function module.</p> <ul style="list-style-type: none"> <li>● Only complete wiring work and only connect or disconnect electrical connections when the module is powered down.</li> <li>● Review any potential hazards due to interactions with other systems and devices currently installed in the surrounding area, or which are to be installed. The user is responsible for taking relevant measures.</li> <li>● The power supply must be secured with a fuse appropriate for the diameter of the intake line.</li> <li>● Cables used must be suitable for the temperature range.</li> <li>● Defective function modules may not be operated.</li> <li>● Opening function modules is prohibited.</li> <li>● The type plates specify the technical properties of the function modules. If a type plate is no longer legible, or if a type plate is missing entirely, the function module may not be operated. Please contact Hübner service (see page 2).</li> <li>● This module is not intended for use in residential areas and cannot provide adequate protection for radio reception in such areas. The device is classified in Group 1 and Class A according to EN 55011 and is intended for use in an industrial environment only.</li> </ul>
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	<p><b>NOTE!</b></p> <p><b>Disposal:</b></p> <p>If the function module needs to be disposed after its service life, applicable national regulations must be observed.</p>
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### 3 Assembly

#### 3.1 Safety instructions


	<p><b>WARNING!</b></p> <ul style="list-style-type: none"> <li>• Installation and removal may only be carried out by qualified personnel.</li> <li>• In general, the requirements and acceptance conditions of the overall system must be taken into account for the installation.</li> <li>• Equipotential bonding measures must be provided for the entire processing chain of the system. Uninterrupted, low-resistance machine earthing must be ensured across all parts of the system. Ensure that connections have good electrical contact.</li> <li>• The power supply used must not exceed 60 VDC under any circumstances.</li> <li>• When connecting the supply cable, ensure that the insulation of all cables is intact. Damaged cables must not be used.</li> <li>• When laying the cables, ensure that there are no tripping hazards.</li> </ul>
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  	<p><b>WARNING! CAUTION!</b></p> <p><b>Risk of death, serious injury and/or damage to property due to overriding of the safety functions caused by an unsafe shaft drive!</b></p> <p>In general, the requirements and acceptance conditions of the entire system must be taken into account for the attachment.</p>
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#### 3.2 Basic rules

	<p><b>NOTE!</b></p> <ul style="list-style-type: none"> <li>• The supply cable of the base unit must be laid at a sufficient distance from power and high-voltage cables.</li> <li>• Shield the power cables between the frequency inverter and motor in accordance with the manufacturer's specifications.</li> <li>• Generous mounting distances must be maintained to actuators/systems with high energy density or electromagnetic emissions (e.g. contactors, relays, inverters, motors, solenoid valves, brakes).</li> <li>• Inductors (e.g. relays, contactors, solenoid valves, brakes) must be wired with interference suppressors to minimize both conducted and airborne interference.</li> <li>• Further information on good installation practice can be found in the USL installation instructions electronics.</li> </ul>
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#### 3.3 Connection

	<p><b>NOTE!</b></p> <ul style="list-style-type: none"> <li>• Sufficient dimensioning of the power supply.</li> <li>• The conductor cross-section of the power supply cable must be such that the maximum voltage drop is less than 3 V. A wire size of 0.75 mm<sup>2</sup> is recommended.</li> <li>• The DC power distribution for one or more USL systems should be designed in a star configuration for function modules, base units, and cabling. Ensure symmetrical wiring of the forward and return conductors as a twisted pair or cable.</li> </ul>
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|--|---|
|  | <ul style="list-style-type: none"> <li>• The use of a separate power supply is recommended for the U-ONE function group, including its peripherals and the base unit.</li> <li>• It is also recommended to use a remote power supply for the base unit if the required length of the connecting cable would exceed 30 meters (100 ft.).</li> <li>• Shielded cables must be used for all power and signal lines that are routed outside a cabinet. The cable shields must be connected to the machine ground at both ends.</li> <li>• Always use shielded cables to connect the incremental and current outputs.</li> <li>• Shield connection terminals must be used in the control cabinet to connect the cable shields over a large area.</li> </ul> |
|--|---|

### **3.4 Replacing function modules**

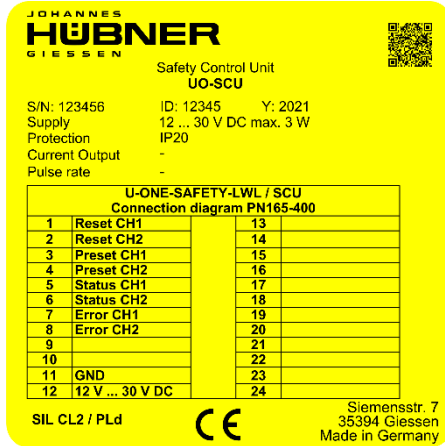
When replacing function modules, observe the following:

- The new function module must have the same item no. (ID) as the old one.
- The configuration of the function module to be replaced may be transferred to the new function module (see configuration instructions).
- When recommissioning the replaced function module, a secure test run must be completed first to ensure it functions correctly.

## 4 Technical data and functions

### 4.1 Type plate

The following image shows an example of a type plate.

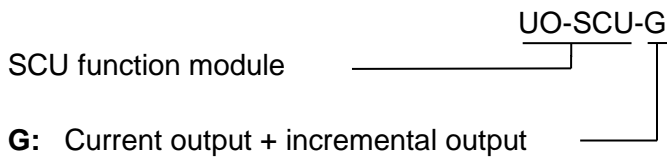


The type plate is located on the outside of the housing, and includes the following information:

- Manufacturer
- Type, year of construction
- CE mark
- Serial number (S/N)
- Protective class
- Supply voltage
- ID number
- Maximum permitted speed
- Certification information

Fig. 4-1: Type plate (example)

### 4.2 Type designation



Label	Description
SCU	Safety Control Unit (SCU) with <ul style="list-style-type: none"> <li>• 2 digital inputs (reset and preset - 2 channel) and</li> <li>• 2 digital outputs (status and errors - 2 channel)</li> </ul>
SCU-G	Additionally: <ul style="list-style-type: none"> <li>• Current output 4 ... 20 mA</li> <li>• Incremental output with programmable division factor 1, 2, 4, 8</li> </ul>

### 4.3 Electrical data

Information	Value
Supply voltage	12 V...30 VDC CAUTION: 60 VDC must not be exceeded under any circumstances (even in the event of a fault).
Device temperature range	-25°C...+ 60°C
Power consumption	UO-SCU: < 3 W UO-SCU-G: < 4 W
Connection technology	Screw terminals 0.25 mm <sup>2</sup> - 1.5 mm <sup>2</sup> (see section 8.2)
Programming interface	USB 2.0
Preset input	Preset voltage low: 0 V < U < 5 VDC Preset voltage high: 8 VDC < U < 30 VDC (Ri: approx. 32 kΩ)
Reset input	Reset voltage low: 0 V < U < 5 VDC Reset voltage high: 8 VDC < U < 30 VDC (Ri: approx. 32 kΩ)
Error output, Status output	2-channel with current-limited, short circuit resistant push-pull line drivers Output voltage: HTL, max. 50 mA at 24 V
Protective class in accordance with DIN EN 60529	IP20 for cabinet installation Degree of protection of cabinet: ≥ IP54
Elevation above sea level	≤ 3000 m

#### 4.3.1 Operating statuses and displays

Operating status	Status LED	Output Status (HTL)	Output Error (HTL)
<b>Start</b>	Flashing yellow/green 2 Hz	Low	Low
<b>Normal</b>	green	High	High
<b>Module not configurable</b>	yellow	Low	High
<b>Configure the module</b>	Flashing yellow/green 1 Hz	Changing 1 Hz	High
<b>Test</b>	Flashing yellow/green 1 Hz	Changing 1 Hz	High
<b>Bootloader</b>	Flashing yellow/red 1 Hz	High	Low
<b>Reset</b>	Start		
<b>Preset</b>	green 1s off	1s Low	High
<b>Warning</b>	Flashing yellow 1 Hz	High	High

Operating status	Status LED	Output Status (HTL)	Output Error (HTL)
<b>Error</b>	Red	Low	Low

### Warning

A warning is generated:

1. when the number of switching cycles for at least one switching relay is  $\geq 19,900,000$ .
2. once the U-ONE®-LWL system has reached the end of its service life (20 years).

### 4.4 Error output

The error output is 2-channel (cat. 3).

An error is displayed with a low level on the error output (see USL configuration instructions).

The error output is dynamic and transmits test pulses (default setting). The status of the error output is monitored. The receiver must hide the test pulses in order to avoid unintentional switching processes. The times  $t_i$  and  $T$  can be set using the configuration software (see USL configuration instructions).

The test pulses can be deactivated for non-safety related applications.

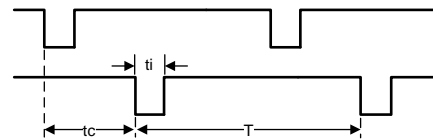


Fig. 4-2: Error output  
The receiver must hide the test pulses in order to avoid unintentional switching processes. The times  $t_i$  and  $T$  can be set using the configuration software (see USL configuration instructions).

### 4.5 Status output

The status output is 2-channel (cat. 3) and displays the operating status in conjunction with the error output (see section 4.3.1).

### 4.6 Reset input

A reset will restart the function module.

The reset input is 2-channel (cat. 3). Both inputs must be on high level when idle. A low level on both inputs will execute a reset. The duration of low level  $T_1$  is configurable (default setting: 200 ms ... 2000 ms).

The configuration software can be used to change the behaviour of the reset input from low-active to high-active.

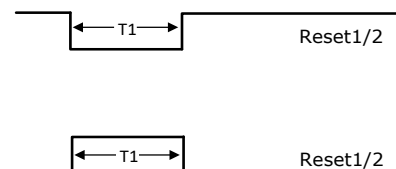


Fig. 4-3: Reset input

## 4.7 Preset input

A preset will set the current position of the preset position which can be configured in the SCU. A low level on the status output (approx. 1s) indicates a valid preset process.

The preset input is 2-channel (cat. 3). The inputs must be on high level when idle. A transition between high and low on both inputs will initiate the preset process. Valid transitions between low and high will trigger a preset. The duration of the low level T1 is configurable (default setting: 200 ms ... 2000 ms).

The configuration software can be used to change the behaviour of the preset input from low-active to high-active.

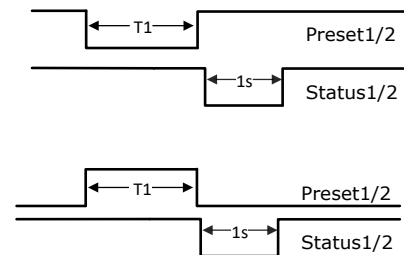




Fig. 4-4: Preset input

	<p><b>NOTE!</b></p> <ul style="list-style-type: none"> <li>• If test pulses are used on the inputs, they may be a max. of ¼ the min. duration of T1 (5 ms to 50 ms).</li> <li>• Changing the input behaviour will impact both reset and preset inputs equally.</li> <li>• The reset and preset inputs must be activated before use with the configuration software.</li> </ul>
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	<p><b>WARNING!</b></p> <ul style="list-style-type: none"> <li>• A preset can only be set “on the fly” if a risk analysis has indicated that the application is suitable for this purpose.</li> <li>• A preset will not influence the position value for the bus module. This position value can only be changed using the field bus interface.</li> </ul>
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## 4.8 Calculating safety-specific speed switching points

The safety speed is determined based on the safe position values for the base device and calculated in the SCU. A comparison with configurable switching points provides speed switching information which is provided to the switching modules.

### 4.8.1 Precision of speed switching points

The following errors must be taken into consideration:

- The switching time for safety relay  $T_{Sw}$  is indicated in the data sheet for the switching module.
- Measurement precision  $\Delta F$  (error when determining the speed):  $\leq 2\%$ .
- Measurement angle for speed measurement  $\varphi$ : approx.  $0.25^\circ$ .

The max. switching deviation  $\Delta n$  is calculated using the following formula:

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

$\Delta n$ :	max. switching error [1/min]
$n_0$ :	Switching point [1/min]
$\alpha$ :	Acceleration [1/min / s]
$\varphi$ :	Measurement angle [°]
$T_{Sw}$ :	Switching time [ms]

## 4.9 Calculating safety-specific position switching points

The safety-specific position values for the base device are compared to configurable switching points. The comparison provides position switching information which can be provided to the switching modules.

#### **4.9.1 Precision of position switching points**

The precision of the position switching points is specified by the base device.

#### **4.10 Control signal for error relay**

The signal from the error output is also delivered to the switching modules. An additional switching delay caused by the switching module must be taken into consideration.

#### 4.11 Incremental output (not safety-related)

The optional incremental output delivers the number of pulses delivered by the base device. The output signals listed here are available (default setting: division factor 1).

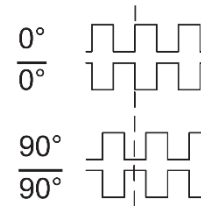


Fig. 4-5: Incremental signals

##### 4.11.1 Electrical data Incremental output

	Value
Number of pulses	Specified by the base device, e.g. 4096 pulses/revolution.
Pulse division	1, 2, 4, 8 (configurable)
Outputs	Current-limited, short-circuit resistant push-pull line drivers with integrated characteristic impedance adjustment for 30 ... 140 Ω lines
Signal amplitude (HTL)	Roughly equivalent supply voltage, output saturation voltage < 0.4 V at I <sub>L</sub> 30 mA
Output current	max. 50 mA at 24 V
Duty cycle	1 : 1 ± 8 %
Phase shift 0°, 90°	90° ± 6 %
Max. frequency	190 kHz
Max. line length	30 m



#### 4.12 Power output 4 – 20 mA (not safety-related)

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

The load impedance (interior impedance of the measuring device) may be a maximum of 400 Ω at supply voltages < 16V and 600 Ω at supply voltages ≥ 16V. The amplitude of the unloaded output may increase at a maximum to the amplitude of the supply voltage.

##### 4.12.1 Current value from the speed value

The max. current value ( $I = 20 \text{ mA}$ ) can be assigned to any whole number speed value ( $\text{Speed}_{20\text{mA}}$ ), whereby the value  $\text{Speed}_{20\text{mA}}$  may not exceed the maximum permitted speed of the USL. The area is divided in a linear fashion into 4096 (12Bit) steps.

If the speed is greater than the  $\text{Speed}_{20\text{mA}}$  value, the following output current will be set:

Variation 1:  $I = 0 \text{ mA}$  (high-impedance)

Variation 2:  $I = 20 \text{ mA}$

The behaviour is configurable. Default setting:  $I = 0 \text{ mA}$

##### Electrical data power output

###### Speed

Information	Value
Max. speed	Specified by the base device
Precision	0.5% FSR
Update time	approx. 2 ms
Max. load impedance	400 Ω at supply voltage < 16V 600 Ω at supply voltage ≥ 16V

##### 4.12.2 Current value based on the difference of the two position values

Any 2 position values within the system limits can be selected. The smaller position value is assigned to current  $I_{\min} = 4 \text{ mA}$  and the larger position value  $I_{\max} = 20 \text{ mA}$ . The position values selected must be within the resolution range for the USL. The area is divided in a linear fashion into 4096 (12Bit) steps.

If the current position is outside of the set position range, then the following output current will be set:

Variation 1:  $I = 0 \text{ mA}$  (high-impedance)

Variation 2: Below position range:  $I = 4 \text{ mA}$

Exceeds position range:  $I = 20 \text{ mA}$

The behaviour is configurable. Default setting:  $I = 0 \text{ mA}$

##### Electrical data power output

###### Position

Information	Value
Max. position difference	32000 revolutions
max. setting precision	1 / 8192 revolution
Precision of the current output	0.5 % FSR
Update time	approx. 2 ms
Max. load impedance	400 Ω at supply voltage < 16V 600 Ω at supply voltage ≥ 16V

## 5 Functional safety

### 5.1 Safety parameters

Parameters set for the SCU according to DIN EN ISO 13849-1.


Architecture	Category	PL	MTTF <sub>D</sub> [a]	Service life
1oo2 (2-channel)	3	d	207.9	20 years

Parameters set for the SCU according to IEC 61508 and DIN EN 62061.

PFD <sub>AV</sub>	PFH [FIT]	DC <sub>avg</sub> [%]	SIL
3.20E-05	0.36	97.2	2 (high demand)

Calculations for the safety parameters of the overall system are provided in the configuration manual.

### 5.2 Information on functional safety

	<p><b>CAUTION!</b></p> <ul style="list-style-type: none"> <li>• The USB interface may only be used for configuration and commissioning, and is not designed for continuous operation.</li> <li>• The option “Error reset via the reset input or interrupting the power supply” may only be used if a risk analysis has indicated that the application is suitable for this purpose.</li> <li>• A preset can only be set “on the fly” if a risk analysis has indicated that the application is suitable for this purpose.</li> </ul>
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## 6 Inspections

### 6.1 Maintenance information


The SCU is maintenance-free.

### 6.2 Error table

Error	Possible cause	Troubleshooting
Error output low	No power supply <u>Control:</u> LEDs not illuminated	Check the connection cable and power supply
	An error was found	See USL configuration manual
If the measures taken do not correct the error, please contact Hübner service (see page 2).		

## 7 Transportation, packaging and storage

### 7.1 Transportation safety information

	<p><b>CAUTION!</b> <b>Property damage due to improper transportation!</b></p> <p>These symbols and information on the packaging must be observed: Do not throw, risk of breakage, protect against wetness</p>
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### 7.2 Incoming goods controlling


The delivery must be checked promptly for transportation damage and to ensure it is complete upon receipt.

If there is transportation damage, the carrier must be informed directly upon delivery (take photos as evidence).

### 7.3 Packaging (disposal)

Packaging will not be taken back, and must be disposed of according to applicable statutory specifications and local regulations.

### 7.4 Storing packages (devices)

	<p><b>Protect against wetness!</b></p> <p>Protect packages against wetness, store in a dry and dust-free location.</p>
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In case of long storage times (> 6 months), we recommend packaging the devices in protective packaging (with desiccants).

### 7.5 Returning equipment (repair/goodwill/warranty)

Service requests (repair/goodwill/warranty) can be initiated directly via the following online form:

<https://www.huebner-giessen.com/en/service-support/after-sales-service/>

There you will also find contact details for our service, as well as questions and answers regarding the processing.

Devices that have come into contact with radioactive radiation or materials will not be taken back.

Devices that have come into contact with biological or chemical substances that could be hazardous to health must be decontaminated before they are returned.

A clearance certificate must be enclosed.

## 7.6 Disposal

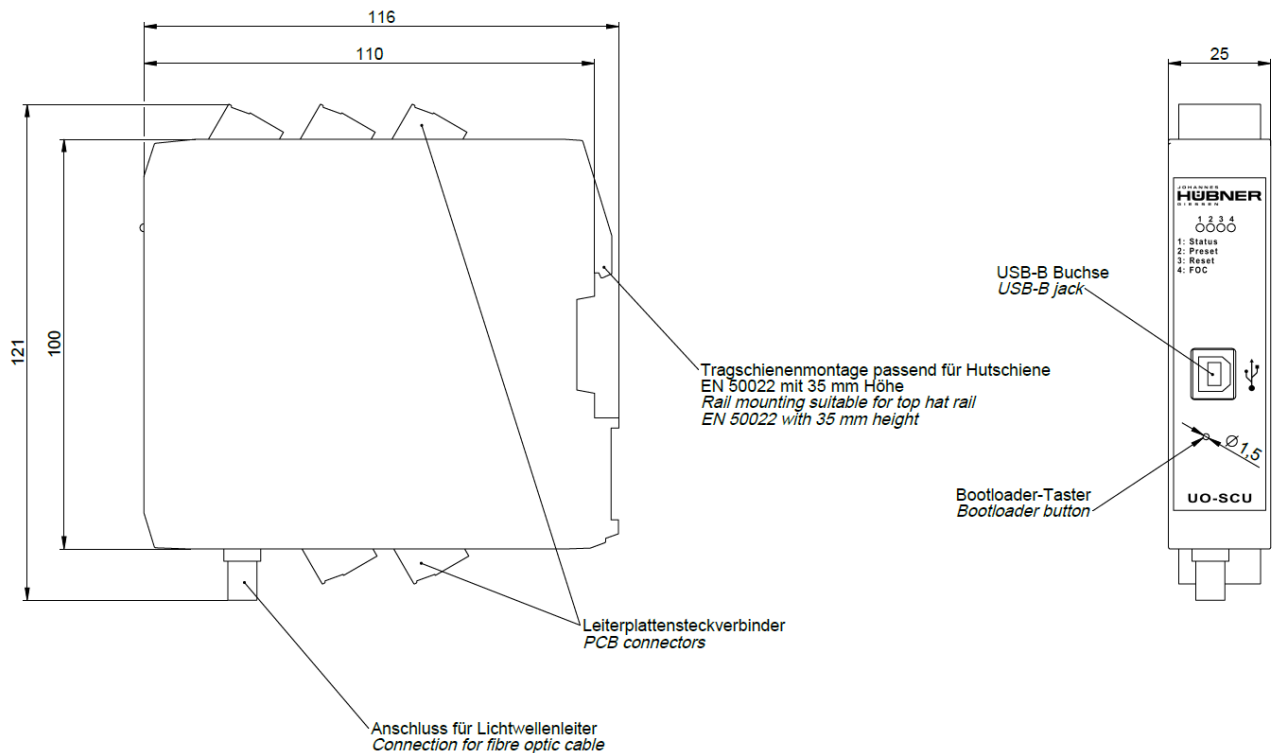
The manufacturer is not obligated to take back the devices.

The SCU must be treated as special electronic waste, and must be disposed of according to specific national law.

Local municipal authorities or speciality disposal companies can provide information on environmentally-appropriate disposal.

## 8 Documents

### 8.1 Dimensional drawing



## 8.2 Connection diagrams

U-ONE -SAFETY-LWL / SCU Connection diagram PN165-400			
1	Reset CH1		13
2	Reset CH2		14
3	Preset CH1		15
4	Preset CH2		16
5	Status CH1		17
6	Status CH2		18
7	Error CH1		19
8	Error CH2		20
9			21
10			22
11	GND		23
12	12 V...30 V DC		24

U-ONE -SAFETY-LWL / SCU-G Connection diagram PN165-403				
1	Reset CH1		13	
2	Reset CH2		14	
3	Preset CH1		15	
4	Preset CH2		16	
5	Status CH1		17	Incr. Output 0°
6	Status CH2		18	Incr. Output 0° invers
7	Error CH1		19	Incr. Output 90°
8	Error CH2		20	Incr. Output 90° invers
9			21	
10			22	
11	GND		23	Output 20 mA
12	12 V...30 V DC		24	GND 20 mA