



## Configuration instructions

### 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.

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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.

**All rights, subject to errors and changes due to technical improvements reserved.**

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## 1 System description

In this document, the U-ONE®-SAFETY-LWL system is referred to as the USL, and the USL function module is referred to as the “module”.

This manual describes how to configure the module using the US42Pro software and transfer configurations to the device.

### 1.1 Explanation of symbols

Warning information is 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>

## 1.2 System structure and function

The USL consists of a basic device, a section of fibre optic cable, a UO-SCU module, and other optional modules.

The SCU is the central control module for the USL. All function modules and the basic device are registered and managed in the UO-SCU. USB communication between the PC and USL, as well as firmware updates of the individual modules, are controlled by the UO-SCU. The overall system fulfils the requirements of certification level SIL CL2 / PL d.

### Application:

Applications are in heavy-duty machinery, such as crane and harbour technology, mining, the steel industry, oil and gas or offshore areas, as well as in general in drives with functional safety requirements.



Fig. 1-1: Basic unit with 4 modules

Figure 1-1 shows a basic unit with a section of fibre optic cable and the modules UO-SCU (controller), UO-SGS-R (speed switch), UO-SRC-R (position switch), and UO-EPB-1 (Profibus interface). Yellow modules are safety-related (safe), while those shown as grey are not (non-safe). Modules are electrically connected via DIN rail bus connectors.

In addition to the UO-SCU module,

- a maximum of 5 switching modules (corresponding to 15 switching outputs), may be combined, a maximum of 2 of which may be UO-SGS-R speed switching modules,
- plus a maximum of 2 bus modules. Different bus types and safe and non-safe types may be combined.

## 2 Software

### 2.1 Software installation

#### System requirements:

Commonly available Windows® laptops/PCs with the following system requirements are used as configuration computers:

- Windows® 7 / 8 / 8.1 / 10.
- 64-bit operating system
- Free space on the HDD: 150MB (+ dot.net Framework).
- Free USB 2.0 interface or higher.
- 1 GB RAM, CPU: 1GHz, screen resolution: 1024 x 768.

Ensure that there is a USB connection between the device and your laptop/PC. If the “New hardware search assistant” starts automatically, click “Cancel” to close it.

Insert the enclosed data storage medium, or execute *Setup.exe* after downloading. Navigate to the CD-ROM drive using the explorer, and launch *Setup.exe* there.

The setup will guide you through the installation. Please follow the instructions on the monitor.

#### Windows 7

Unfortunately, because support for your operating system has run out, we will no longer be able to sign your drivers. Therefore, you must confirm installation manually. To do so, click “Install this driver software anyway”. Then the setup routine will continue.



Fig. 2-1: Win7 drivers

#### 2.1.1 Manual driver installation



#### NOTE!

A user with administrator rights should carry out driver installation. Ensure that all programs are closed.

If you need to install drivers manually, please use the following steps depending on your operating system.

Connect the enclosed programming cable to the UO-SCU and your laptop/PC. Press the “Windows key” + “Pause” or press “Computer” (right click) “Properties” on a desktop to access the system properties.

There, open the device manager, which will list all connected devices. Select “JHG Dev” (right click) “Update driver software ...”.

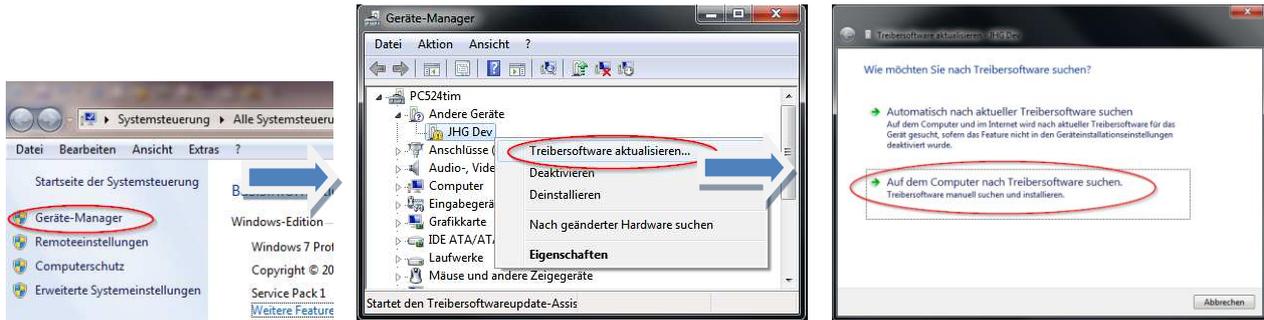


Fig. 2-2: Driver installation

Now, as the installation source, select the path for your installation by clicking “Search”. There, select the *drivers* folder. Click “Continue” to start the installation. Click “Continue” to complete installation of the driver software for the USL. End the installation by clicking “Close”. The USL can now be used.

## 2.2 General description of the software

This section describes how you can use the US42Pro configuration software to set the specific device configuration for the USL.

The user interface is divided into thematic areas for ease of use.

### Header:

The header contains the menu bar for basic software operation.

### Display area:

The display area is always visible, and displays the available modules and their status

The current position, current speed, direction of rotation and current at the analogue output (optional) are displayed in the top area.

The modules are listed in the order they are arranged in the control cabinet.

### Configuration area:

The module configuration is entered into the tabs here.

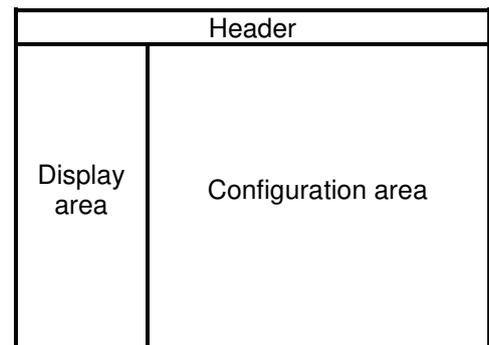


Fig. 2-3: Overview diagram for the user interface

### 2.2.1 Language selection

#### Pull-down menu: Options → Language

The language used for the US42Pro software will be selected based on the country settings for your Windows operating system. If there is no such data set available, English will be selected as the language. Use the “Language” menu item to change the selection.

### 2.2.2 Change password

#### Pull-down menu: Options → Change password

Use “Change password” to assign the Admin and Tester password. A closed lock in the header indicates that a user-specific password has been assigned.

### Authorisation levels:

There are 3 authorisation levels for users. 2 of these can only be activated through password

authentication.

The password must be between 6 and 12 ASCII characters (0x20 - 0x7E) long.

Level 0: Observer (no password)

The following functions are available:

- Establishing communication with the modules
- Entering a password
- Displaying the set configuration
- Displaying stored configurations

Level 1: Tester (password level 1)

In addition to level 0, the following functions are available here:

- Complete switch test
- Generate testing protocol

Level 2: Admin (password level 2)

In addition to level 1, the following functions are available here:

- Changing the configuration
- Saving configurations

The default passwords on delivery are “huebner1” for password level 1 and “huebner2” for password level 2. An open lock symbolises that the password “huebner2” has not yet been changed, and that the configuration is not secure against unauthorised changes.

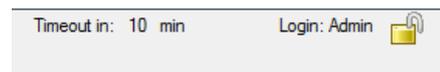


Fig. 2-4: Partial view header

A closed lock indicates that the configuration is secure against unauthorised changes. The method for saving the configuration is described in section 2.2.4.

The authorisation level (level here: Admin) with which the user is logged into the modules is displayed in clear text to the left of the lock symbol.

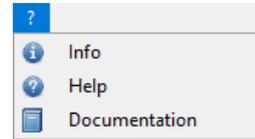
	<p><b>NOTE!</b> The default login password is “huebner1” or “huebner2”.</p>
	<p><b>NOTE!</b> You must change the Admin password to protect the configuration from unauthorised access. (Section 2.2.2)</p>

### 2.2.3 Help

#### Pull-down menu “?”

#### 2.2.3.1 Information

The software version and contact information for the Johannes Hübner company are displayed here. A support file can be generated.



#### 2.2.3.2 Help

This option opens the available configuration manual in PDF format.

#### 2.2.3.3 Documentation

This option opens the folder with USL 42 documentation. The connection diagrams, dimensional drawings, and operating, assembly and configuration manuals are stored here.

#### 2.2.3.4 Generate support file

The button  under “Info” in the “?” pull-down menu is used to generate a support file used for troubleshooting. If the e-mail control box is activated, the file is transmitted directly to the installed e-mail program.

	<p><b>Note:</b> Please send the support file via e-mail to the manufacturer (<a href="mailto:service@huebner-giessen.com">service@huebner-giessen.com</a>) with a brief description of the conditions under which the error occurred.</p>
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Fig. 2-5: Info

### 2.2.4 Save configuration data

A formal review of all entries will be completed before data transmission.

Incorrect entries will be highlighted in red, and transmission will be stopped.

If entries are correct according to the rules (sec. 3.5.2.1), then the values are transmitted to the module, checked, activated, and saved temporarily. A control window displays values from the input screens and values from the modules.

Compare

Values to write:	Values from device:
<p>Name: <input type="text" value="Main Device"/></p> <p>T/ti: <input type="text" value="1000"/></p> <p>Test pulse duration ti: <input type="text" value="1 ms"/></p> <p><input type="checkbox"/> Reset input enabled</p> <p><input type="checkbox"/> Preset input enabled</p> <p><input type="checkbox"/> Preset/Reset high-aktiv</p> <p>Trigger periode T1: <input type="text" value="200 ... 2000"/></p> <p>Preset value: <input type="text" value="15"/></p> <p><input type="checkbox"/> Reset internal error via reset or via power on/off</p> <p>Pulse rate: <input type="text" value="4096"/></p> <p><input type="checkbox"/> Current output enabled</p>	<p>Name: <input type="text" value="Main Device"/></p> <p>T/ti: <input type="text" value="1000"/></p> <p>Test pulse duration ti: <input type="text" value="1 ms"/></p> <p><input type="checkbox"/> Reset input enabled</p> <p><input type="checkbox"/> Preset input enabled</p> <p><input type="checkbox"/> Preset/Reset high-aktiv</p> <p>Trigger periode T1: <input type="text" value="200 ... 2000"/></p> <p>Preset value: <input type="text" value="15"/></p> <p><input type="checkbox"/> Reset internal error via reset or via power on/off</p> <p>Pulse rate: <input type="text" value="4096"/></p> <p><input type="checkbox"/> Current output enabled</p>
<p> Please compare the values to write to the values from the device and confirm.</p>	
<p><input checked="" type="checkbox"/> <input type="checkbox"/></p>	

Fig. 2-6: Comparison window

By clicking the green check box, the user confirms that the values are correct. The values are now permanently saved.

### 3 Basic system configuration

	<p><b>Required modules</b></p> <ul style="list-style-type: none"> <li>• USL(H) 42 Basic Device</li> <li>• UO-SCU Module</li> </ul> <p>Please see the specific module operating and assembly manuals for further important information.</p>
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Take sufficient time to plan your work and to configure the module. Please note that errors in planning and configuration could endanger personnel. Take organisational measures to ensure the system is safe during configuration.

Ensure that systems and system parts monitored by devices connected to the module cannot cause any hazardous conditions during configuration.

**You will need the following to configure the USL:**

- Operating and configuration manual
- Laptop /PC with Windows® operating system
- US42Pro configuration software (administrator rights for software installation)
- USB programming cable to connect the laptop/PC and the UO-SCU

#### 3.1 Planning

	<p><b>NOTE!</b></p> <p>Before configuring the USL, you must have already fully planned the application.</p>
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Planning must include the following, for instance:

- A detailed safety analysis of the planned application
- A complete list of all equipment required, their connections and the signals and switching points provided or required by these modules.

Furthermore, the following requirements must be fulfilled:

- The UO-SCU and basic device must be connected to a power supply.
- The safety components must be connected electrically to the modules.

Read the relevant operating and assembly manuals.

#### 3.2 Basic process

Configure the module by completing the following steps:

1. Turn on the laptop/PC
2. Connect the UO-SCU to the USB port on the laptop/PC
3. Turn on the USL
4. Configure the USL (see section 3.3)
5. Check the set configuration
6. Check the settings for the USL on the secured system

After completing these steps, the USL will be ready for operation.

### 3.3 Start the US42Pro software

The home screen will appear after you start the software.

Click “Connect” to establish communication with the USL. The display to the right of the button indicates the connection status.

Display	Status
grey	not connected
alternating light green / dark green	connected

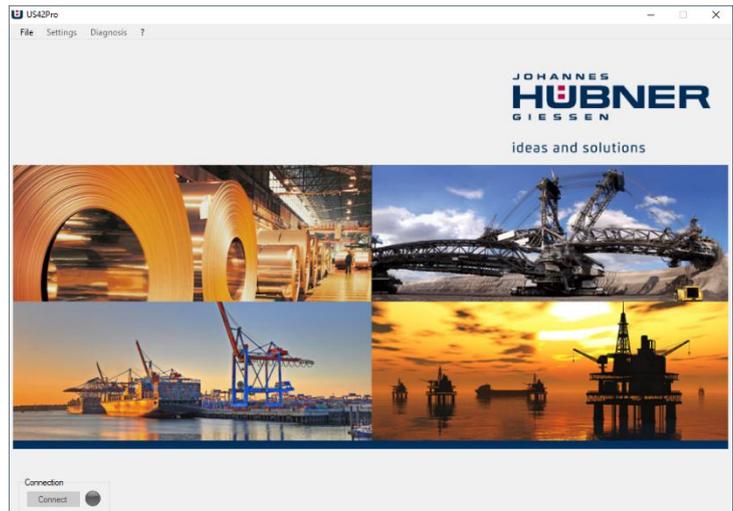


Fig. 3-1: Home screen

System data are read out after the connection is established. Now, the user can enter the Admin password to calibrate or configure the modules. Calibration and configuration can only be carried out by users on the “Admin” password level.



Fig. 3-2: Login



**NOTE!**

You must change the Admin password “huebner2” to protect the configuration and calibration from unauthorised access. (Section 2.2.1)



**NOTE!**

The module can only be configured while shut down. If a rotational movement is detected during configuration, the USL is switched to a safe state.

### 3.4 Select operating mode

There are 2 different operating modes for the USL:

#### 3.4.1 Speed mode

There are no position-dependent switching points or position-dependent current values 4 mA... 20 mA available in this operating mode. No calibration of the position system is required. Working area limits are not monitored.

#### 3.4.2 Position and speed mode

If position-dependent switching points or position-dependent current values 4 mA ... 20 mA are used, the operating mode “Position and speed mode” must be selected. Calibration of the position system is required in this operating mode (sec. 3.5).

### 3.5 Calibrating the position system

The position system is calibrated (adjusting the internal group processing to the reality at the installation location) using “Edit calibration settings”



The calibration settings are displayed and edited here. Settings can be changed using “Start configuration”.

	<p><b>NOTE!</b></p> <ul style="list-style-type: none"> <li>• <b>Restricted system resolution</b> The 15 Bit Multiturn area (32768 revolutions) of the USL(H) 42 is limited to 32000 usable revolutions.</li> <li>• <b>Position system calibration does not apply to the modules UO-SPN-1, UO-SPB-1 and UO-EPB-1.</b></li> </ul>
---	---

#### 3.5.1 Defining working area limits

The working area for the application must always be between the upper and lower working area limits. If the working area limits are not met or are exceeded, an error is triggered.

	<p><b>NOTE!</b></p> <p>Always keep sufficient distance between the working area limits and the working area, to prevent working area limit errors during normal operation.</p>
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#### 3.5.2 Determining the calibration factor

The calibration factor is the adjustment factor between system units and device units. This transmission ratio is assumed to be constant.

If the calibration factor is unknown, it can be determined with  (see sec. 3.5.2.1). 2 calibration points are used to determine the calibration factor. These should be as far apart as possible and may not be outside of the working area limits.

##### 3.5.2.1 Determining the calibration factor using two calibration points

1. Enter calibration point 1 and calibration point 2. The following restrictions apply:

- Lower working area limit < calibration point 1
- Calibration point 1 < calibration point 2
- Calibration point 2 < upper working area limit

2. Approach calibration point 1 and shut off drive, press the  button.

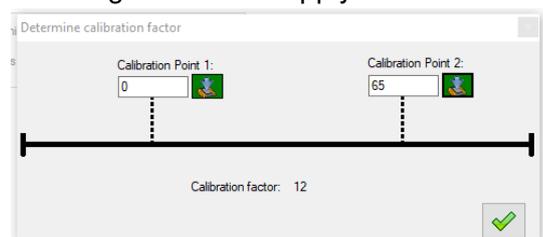


Fig. 3-3: Determining the calibration

The current position is adopted as calibration point 1.

3. Approach calibration point 2 and shut off drive, press the  button. The current position is adopted as calibration point 2.

4. The calibration factor is now calculated and inserted into the relevant window.

### 3.5.2.2 Determining the calibration factor through calculation

Calibration factor = (rotations of the device shaft) x 8192 / real distance in system units.

**Example:**

34.5 m travel distance, corresponding to 125.7 rotations of the device shaft.

Calibration factor =  $125.7 \times 8192 / 34.5 = 29847.37$

### 3.5.3 Determining the preset position

The preset position is a defined position point (calibration point).

Approach the calibration point (preset), turn off the drive and press the  button. The current position is adopted as the calibration point.

	<p><b>Note</b></p> <p>The calibration point must be between the upper and lower working area limits.</p>
---	--

### 3.5.4 Completing the calibration process

- values are saved in the USL by pressing



- Press    to complete the calibration. The system is calibrated and can now be configured.

## 4 Configuring safety-related functions

### 4.1 Position switch (UO-SRC-R)

	<p><b>Required modules</b></p> <ul style="list-style-type: none"> <li>• USL(H) 42 Basic Device</li> <li>• UO-SCU Module</li> <li>• UO-SCR-R module</li> </ul> <p>Please see the specific module operating and assembly manuals for further important information.</p>
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The UO-SRC-R is a safe position switch module, and contains 3 position switches. The position switches open and close depending on the position value. The position switches are 2-channel (2 normally open contacts, cat. 3). A position switch can be used to create a cam, e.g. a switch-on and switch-off position, as well as the associated hysteresis switching points.

- **P1:** Hysteresis switching point from P2.
- **P3:** Hysteresis switching point from P4.
- **Inverted:** The switch works in an inverted fashion (see switch S3).
- **Error switch:** Switch only opens if there is an error (see switch S2).
- **Opening in case of an error:** Switch works as configured, but opens in case of an error.

This graphic shows the switching points in the correct positions. A marker indicates the current position. Conclude configuration of the module by clicking "Write to device".

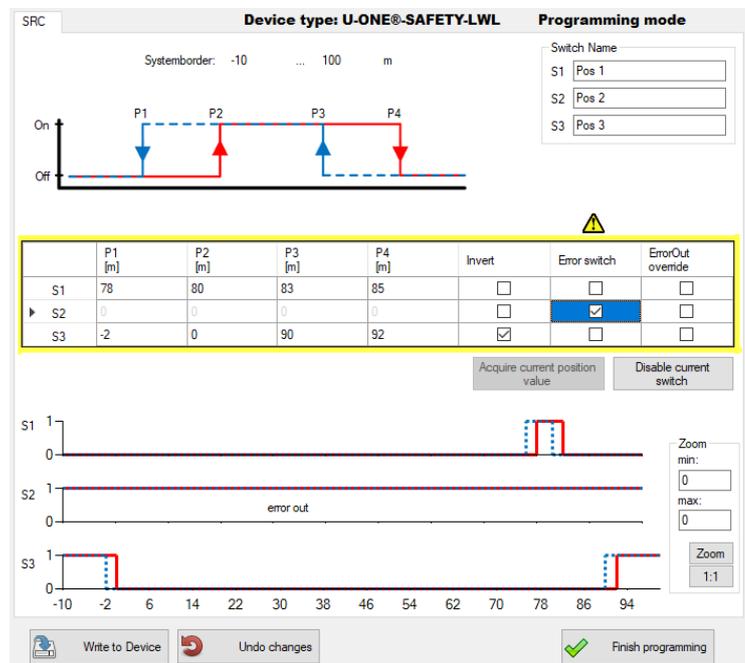


Fig. 4-1: UO-SCR-R configuration

	<p><b>Note</b></p> <p>The following condition applies to the position switch points: <math>P1 &lt; P2 &lt; P3 &lt; P4</math></p>
---	--

The entered position values must be within the working area limits. Each position switch can be assigned an application-specific designation (max. 12 characters). The configuration values are entered into the table as shown here.

P1 [m]	P2 [m]	P3 [m]	P4 [m]	Invert	Error switch	ErrorOut override
1	1.5	1.7	1.9	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.11	1.13	1.15	1.2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.05	2.25	2.5	2.75	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Fig. 4-2: Warning

	<p><b>NOTE!</b></p> <p>If the switching points are configured so that the minimum switching distance <math>T_{min}</math> (= 2ms) between two switching state changes may not be met at the max. permitted speed, then relay switching is not ensured, and the fields are marked (warning). In such cases, the user must check the circumstances for their application and ensure that <math>T_{min}</math> is always met.</p>
---	--

#### 4.1.1 Illustration in the display area

The module is shown as follows in the display area:

The switching states of the individual switches are illustrated by switch symbols.

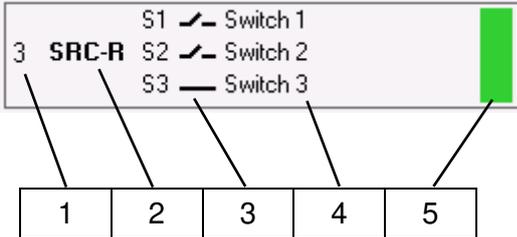
		Designation	Meaning
	1	Module position	3. Module
	2	Module type	Position switch module
	3	Switching states	Switch symbol Black: error-free Grey: not configured Red: Error
	4	Designation	Switch designation by the user
	5	Module state	Grey: not configured Green: error-free Red: Error

Fig. 4-3: Illustration in the display area

	<p><b>NOTE!</b></p> <p>If a module is in error state, the software indication may be faulty.</p>
---	--

#### 4.1.2 Input precision of position switch points

The input precision of the position switch points will depend on the calibration factor. The position switch point entry is limited to 9 decimal places. The entry is limited to 3 positions after the decimal point.

Calibration factor $c$	Input precision of position switch points	
$c < 10$	XXXXXXXXX	e.g.: 127354345
$10 \geq c < 100$	XXXXXXXX.Y	e.g.: 12735434.5
$100 \geq c < 1000$	XXXXXX.YY	e.g.: 1273543.45
$c \geq 1000$	XXXXXX.YYY	e.g.: 127354.345

X: Positions before the decimal  
Y: Positions after the decimal

## 4.2 Preset

	<p><b>Required modules</b></p> <ul style="list-style-type: none"> <li>• USL(H) 42 Basic Device</li> <li>• UO-SCU Module</li> </ul> <p>Please see the specific module operating and assembly manuals for further important information.</p>
---	--

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

The **time T1** can be set to 20 ms ... 200 ms or to 200 ms ... 2000 ms (for default settings see section: 6.7).

Preset input enabled       Reset input enabled

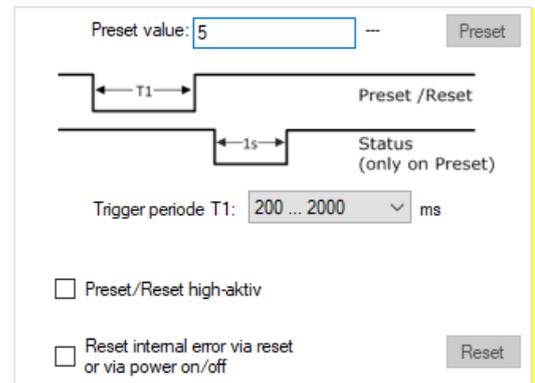


Fig. 4-5: Preset

The behaviour of the reset and preset inputs can be changed using “Preset/Reset high active” from low active to high active.

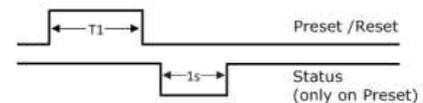


Fig. 4-6: Digital inputs

	<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>• The digital reset and preset inputs must be activated before use.</li> </ul>
---	--

	<p><b>NOTE!</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 bus interface.</li> </ul>
---	--

### 4.3 Speed switch (UO-SGS-R)

	<p><b>Required modules</b></p> <ul style="list-style-type: none"> <li>• USL(H) 42 Basic Device</li> <li>• UO-SCU Module</li> <li>• UO-SGS-R module</li> </ul> <p>Please see the specific module operating and assembly manuals for further important information.</p>
---	---

The UO-SGS-R is a safe speed switching module. The speed switch opens and closes depending on the speed. A speed switching module contains 3 speed switches. In general, the input value for all switching speed inputs must be within the device-specific switching range (such as 0.5 1/min ... 2520 1/min).

All speed-dependent functions are displayed in a graphic diagram at the top of the page.

There is a table with input fields for the speed switching points at the bottom of the page. The table has one line per switch (S1 to S3 or S1R to S3L).

The columns are assigned to the respective speed switching points P1 to P4, as well as to the switching delay P4-Delay (see section 4.3.3).

This graphic shows the switching points. A marker indicates the current speed.

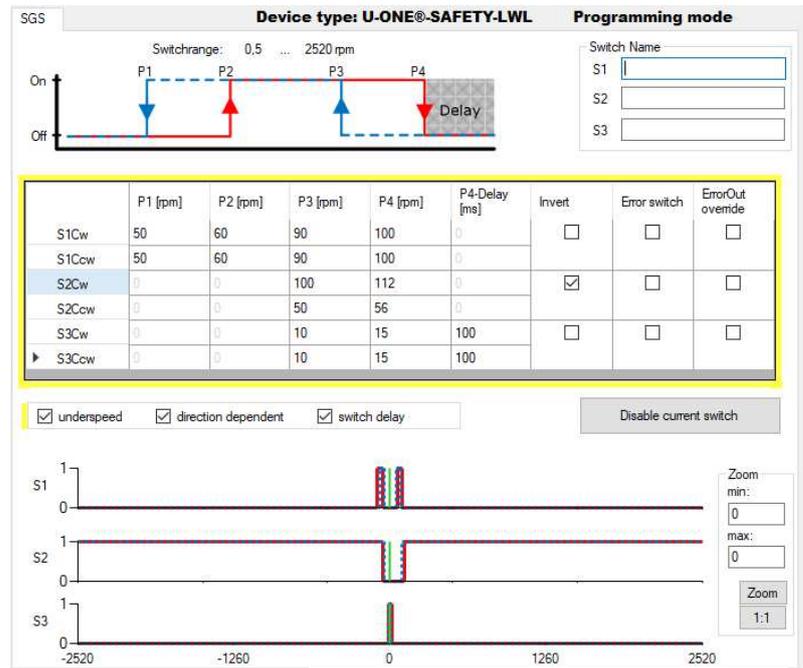


Fig. 4-7: UO-SGS-R configuration

The switches in the lines are assigned as follows	
S1R	Switching speed of switch 1 with clockwise rotation
S1L	Switching speed of switch 1 with anti-clockwise rotation
S2R	Switching speed of switch 2 with clockwise rotation
S2L	Switching speed of switch 2 with anti-clockwise rotation
S3R	Switching speed of switch 3 with clockwise rotation
S3L	Switching speed of switch 3 with anti-clockwise rotation

The values in the columns are assigned as follows	
P1	Hysteresis switching speed for low speed detection
P2	Switch on speed for low speed detection
P3	Hysteresis switching speed for high speed detection
P4	Switch off speed for high speed detection
P4-Delay	Delay in triggering switch off for switching point P4 [ms]

Only the lines and columns relevant for the specific function are displayed, depending on which activation boxes are checked.

	<p><b>Note</b></p> <p>The following conditions apply to the speed switching points:  <math>P1 \leq 0.9 \times P2</math>; <math>P2 \leq 0.9 \times P3</math>; <math>P3 \leq 0.9 \times P4</math> or <math>P1 = P2 = 0</math></p>
---	---

Entering "0" in the fields P1 ... P4 deactivates the relevant switch.  
 Entering "0" in the fields P1 ... P2 deactivates the low speed.

	<p><b>NOTE!</b></p> <p>If a switching delay is activated, the actual switch of speed may be above the set switch off speed.        Please also note the switching precision specified in the "UO-SCU_Manual" operating and assembly manual.</p>
---	---

Conclude configuration of the module by clicking "Write to device".

#### 4.3.1 Low speed

Low speed is detected. The switch will only close when speed P2 is exceeded. If the speed falls below P1, the switch will be opened once again. If low speed detection is activated, the input columns for "P1" and "P2" are visible.

#### 4.3.2 Switching depending on the direction of rotation

Switching speeds S1R ... S3R apply to clockwise rotation. Switching speeds S1L ... S3L apply to anti-clockwise rotation.

If switching depending on the direction of rotation is activated, the input lines for S1R ... S3R and S1L ... S3L are visible.

If switching depending on the direction of rotation is not activated, then the switches are designated as S1 ... S3 without R and L to indicate direction, and the entered switching speeds apply regardless of the direction of travel.

	<p><b>NOTE!</b></p> <p>If switching depending on the direction of rotation is activated along with low speed, the low speed function must be the same for both directions of rotation. This must be either active or inactive.</p>
---	--

#### 4.3.3 Switching delay

The adjustable switching delay can be used to suppress switching of the speed switch if the limit speed is exceeded for only a brief time. This may be useful, for instance, in case of load shedding. Switches S1, S2 and S3 will open after speed P4 is exceeded, but only after the delay time set in the "Delay" field. The time can be set between 0 and 300 ms, in 2 ms steps. If the speed falls back below the value P4 within the delay time, then a switch-off is not triggered.

	<p><b>NOTE!</b></p> <p>The time delay only applies to switching off if the speed P4 is exceeded. All other switching processes are triggered immediately.</p>
---	---

#### 4.3.4 Illustration in the display area

The module is shown in the display area as illustrated in section 4.1.1.

#### 4.3.5 Input precision for switching points

The input precision for speed switching points will depend on the speed range, and is limited to 4 decimal places. The entry is limited to 2 positions after the decimal point.

Switching speed n	Input precision
$n < 100$ 1/min	XX.YY (e.g.: 15.87)
$100 \geq n < 1000$ 1/min	XXX.Y (e.g.: 158.7)
$n \geq 1000$ 1/min	XXXX (e.g.: 1587)

X: Positions before the decimal

Y: Positions after the decimal

#### 4.4 Error output

	<p><b>Required modules</b></p> <ul style="list-style-type: none"> <li>• USL(H) 42 Basic Device</li> <li>• UO-SCU Module</li> </ul> <p>Please see the specific module operating and assembly manuals for further important information.</p>
---	--

When there are no errors, both channels of the error output have a high level and transmit test pulses. The UO-SCU module monitors the outputs to ensure they are functioning correctly.

The receiver must hide the test pulses in order to avoid unintentional switching processes.

- The following settings can be selected for the test pulse duration  $t_i$ :  
100 ms, 10 ms, 1 ms, off (for default settings see section 6.7).
- 10, 100, 1000 can be selected for the quotients test pulse spacing / test pulse duration ( $T / t_i$ ) (for default settings, see section 6.7).
- The test pulse offset (offset of the test pulse between the channels)  $t_c = 3 * t_i$  cannot be adjusted.

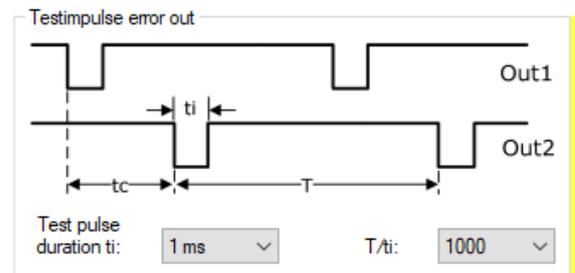


Fig. 4-8: Test pulses

	<p><b>NOTE!</b></p> <p>The test pulses can be deactivated for non-safety related applications, or when using a safe error switch in safety-related applications (see section 4.5). An error is displayed with a low level on the error output (see also section 8).</p>
---	---

	<p><b>NOTE!</b></p> <p>If the error output is used to detect a device error, it must be evaluated in a safe manner (see section 9).</p>
---	---

#### 4.5 Safe error switch

	<p><b>Required modules</b></p> <ul style="list-style-type: none"> <li>• USL(H) 42 Basic Device</li> <li>• UO-SCU Module</li> <li>• UO-SRC-R or UO-SGS-R module</li> </ul> <p>Please see the specific module operating and assembly manuals for further important information.</p>
---	---

The error state can be assigned to a switching output (relay) using the configuration software. The safe error switch must be used so that the application enters a safe state when the switch is opened (see section 9).

#### 4.6 Switching test diagnostics

##### Pull-down menu analysis → Switching test

The switching test can be used to change the switching state using the US42Pro configuration software. The switching test is only available when the encoder shaft is shut down.

The display area can be used to control changes in the switching state.

Confirm with  to activate the switching test.

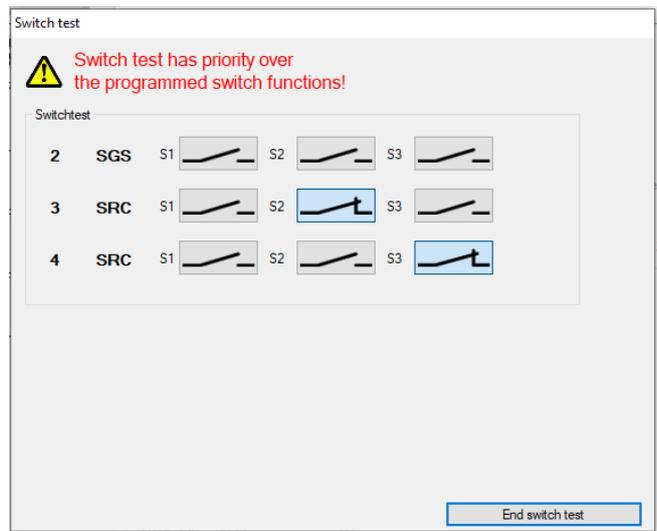


Fig. 4-9: Switching test

	<p><b>NOTE!</b></p> <ul style="list-style-type: none"> <li>• If the encoder shaft turns during the switching test, this will trigger an error.</li> <li>• The switching test takes priority over the programmed switch function.</li> </ul>
---	---

#### 4.7 PROFIBUS-DP interface and PROFIsafe profile (UO-SPB-1)

	<p><b>Required modules</b></p> <ul style="list-style-type: none"> <li>• USL(H) 42 Basic Device</li> <li>• UO-SCU Module</li> <li>• UO-SPB-1 module</li> </ul> <p>Please see the separate configuration manual for further important information and a full description of configuration.</p>
---	--

The UO-SPB-1 module includes:

- A PROFIBUS interface with PROFIsafe protocol, to transfer a safe position and speed
- A fast process data channel via PROFIBUS, not safety-related

The “safe data” received via two-channel data comparison is packaged in the PROFIsafe protocol and is also transmitted to the controller via the PROFIBUS.

	<p><b>NOTE!</b></p> <ul style="list-style-type: none"> <li>• The UO-SPB-1 can only be configured via the field bus interface.</li> <li>• A preset over the field bus interface does not influence the preset specified in the UO-SCU. We recommend setting both presets to the same value when the module is shut down.</li> </ul>
---	--

#### 4.8 PROFINET IO interface and PROFIsafe profile (UO-SPN-1)

	<p><b>Required modules</b></p> <ul style="list-style-type: none"> <li>• USL(H) 42 Basic Device</li> <li>• UO-SCU Module</li> <li>• UO-SPN-1 module</li> </ul> <p>Please see the separate configuration manual for further important information and a full description of configuration.</p>
---	--

The UO-SPN-1 module includes:

- A PROFINET interface with PROFIsafe protocol, to transfer a safe position and speed
- A fast process data channel via PROFINET IO, not safety-related

The “safe data” received via two-channel data comparison is packaged in the PROFIsafe protocol and is also transmitted to the controller via the PROFINET IO.

	<p><b>NOTE!</b></p> <ul style="list-style-type: none"> <li>• The UO-SPN-1 can only be configured via the field bus interface.</li> <li>• A preset over the field bus interface does not influence the preset specified in the UO-SCU.</li> </ul>
--	--

## 5 Configuring non-safety-related functions

The USL can be used to implement non safety-related functions as well as safety-related functions.

### 5.1 Current output

	<p><b>Required modules</b></p> <ul style="list-style-type: none"> <li>• USL(H) 42 Basic Device</li> <li>• UO-SCU-G Module</li> </ul> <p>Please see the specific module operating and assembly manuals for further important information.</p>
---	--

The current output (4 ... 20 mA) is optional and is installed in the UO-SCU-G. The option menu for the UO-SCU can be used to set the current output depending on speed or position, and must be activated before use.

### 5.1.1 Position-dependent current output

2 position values within the working area limits must be entered to configure the position-dependent current output. The smaller position value is assigned to current  $I_{\min} = 4$  mA and the larger position value  $I_{\max} = 20$  mA.

The following restriction applies:

- Pos1 < Pos2

If the current position is outside of the set position range, the current output is switched to a high impedance state ( $I = 0$  mA) (for default setting see section 6.7).

Alternatively, a setting can be selected that will output 4 mA or 20 mA if the set position range is not met or is exceeded.

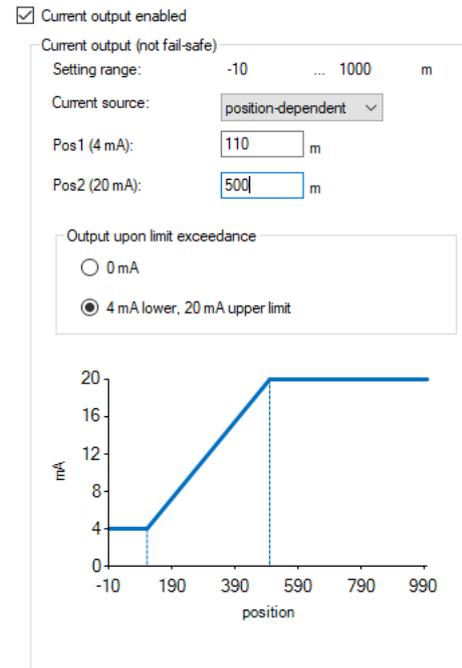


Fig. 5-1: position-dependent current output

### 5.1.2 Speed-dependent current output

The speed  $n_{20mA}$  must be entered to configure the speed-dependent current output. A current of 4 mA will be flowing when the module is at a standstill.

The following restriction applies:

- $n_{20mA} <$  Mech. permitted speed.

If the speed range ( $n_{\text{current}} > n_{20mA}$ ) is exceeded, the current output is switched to high impedance ( $I = 0$  mA) (for default setting see section 6.7).

Alternatively, a setting can be selected that will output 20 mA if the set speed range is exceeded.

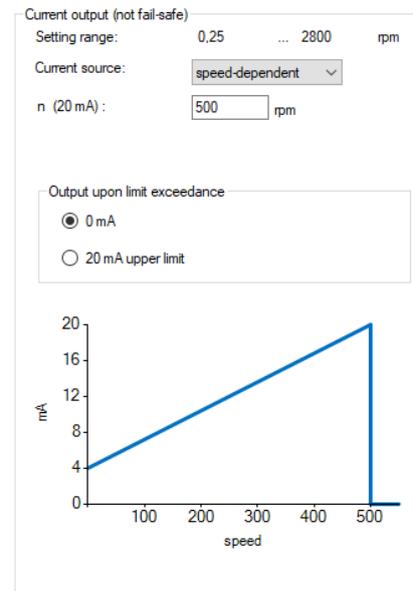


Fig. 5-2: speed-dependent current output

## 5.2 Incremental output

	<p><b>Required modules</b></p> <ul style="list-style-type: none"> <li>• USL(H) 42 Basic Device</li> <li>• UO-SCU-G Module</li> </ul> <p>Please see the specific module operating and assembly manuals for further important information.</p>
---	--

The incremental output is optional and is installed in the UO-SCU-G. A division factor of 1, 2, 4 or 8 can be selected for the incremental output via the option menu. The resulting pulse count is displayed directly (for default setting see section 6.7).

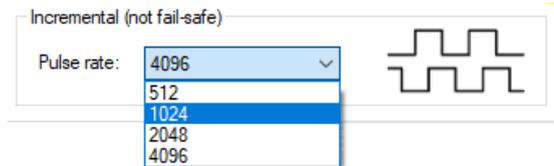


Fig. 5-3: Incremental output

## 5.3 PROFIBUS-DP interface (UO-EPB-1)

	<p><b>Required modules</b></p> <ul style="list-style-type: none"> <li>• USL(H) 42 Basic Device</li> <li>• UO-SCU Module</li> <li>• UO-EPB-1 module</li> </ul> <p>Please see the specific module operating and assembly manuals for further important information.</p>
---	---

The module transmits the Multiturn and Singleturn absolute value for the basic device. It can be configured in profiles CLASS 1 (Hübner 1.0) with configuration of the counting direction and CLASS 2 (Hübner 2.0) with the additional setting for resolution / revolution and the overall resolution.

The profiles Hübner 2.1 and Hübner 2.2 are also available. These also provide the following functions:

- Expanded scaling function
- Setting the counting direction, preset and automatic scaling (teach in) during online operation in commissioning mode.
- Limit switch function
- Speed output

	<p><b>NOTE!</b></p> <ul style="list-style-type: none"> <li>• The UO-EPB-1 can only be configured via the field bus interface.</li> <li>• A preset over the field bus interface does not influence the preset specified in the UO-SCU. We recommend setting both presets to the same value when the module is shut down.</li> </ul>
---	--

## 6 Additional functions

### 6.1 Reset

A reset will reinitialise the entire USL, and will reset errors as well, depending on the configuration (see section 8).

Inteme Fehler über Reseteingang  
oder über Spannung (aus/ein) rücksetzen

### 6.2 Transmit system data to other systems

System data can be transmitted to other USL systems of the same design. Data is saved using:

**Pull-down menu: File → export configuration**

on the laptop/PC and imported using

**Pull-down menu: File → import configuration**

to the new system.

- “Import configuration” can be used to check the content of saved configurations without a device connection.
- If there is a device connection, configurations saved with “Export configuration” can be loaded to the input screens.
- Imported configurations can be saved in the device with a device connection and log in.

### 6.3 Create system data set without U-ONE-SAFETY-LWL

System data sets can also be created in offline mode without a direct device connection, e.g. in the project preparation phase.

#### **Pull-down menu: File → Offline**

Device configurations can be created as follows without a device in offline mode:

- Virtual modules are created when the type designations are entered.
- The configuration can be completed.
- “Export configuration” is used to save the configuration, which can be loaded by another USL with the same modules.

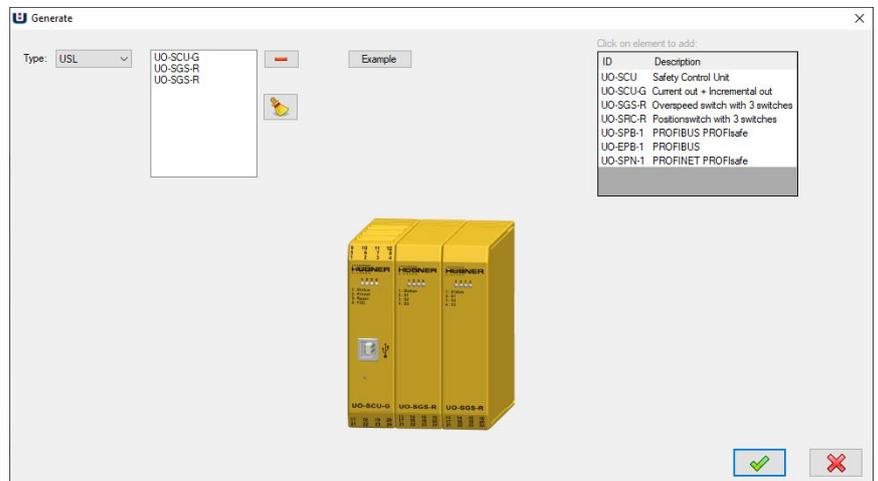


Fig. 6-1: Offline

Use



to exit offline status.

### 6.4 Replacing modules

If the system configuration has been changed or modules have been replaced, this is detected and displayed when the USL is switched on. The system remains in an error state. The changed configuration can be released using the configuration software.

#### 6.4.1 Simple module exchange

No configuration software is required for a simple module exchange.

**Requirement:**

- No change to the system configuration.
- Replacement of individual modules with non-configured modules of the same type.
- A simple module exchange is not possible for the basic device and the UO-SCU module.

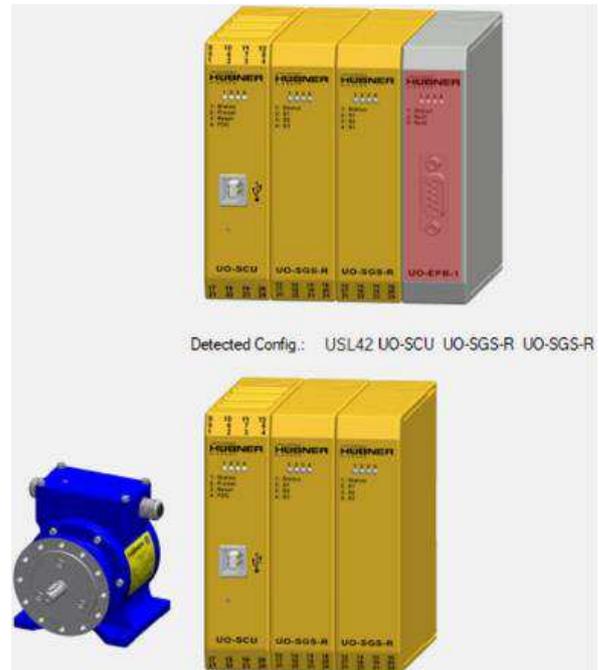
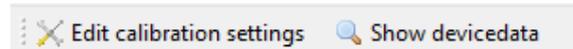


Fig. 6-2: Module

### 6.5 Display device data

“Display device data” is used to display a summary of all device data.



**Device type: U-ONE®-SAFETY-LWL**

Devicedata Error Log

### Modules

USL42 1 - SCU-G 2 - SRC-R 3 - SGS-R

Calibration settings Options

Serial number:	SCU+01	Operation mode:	Position- Speedmode
Firmware version:	0.03.02	Lower systemborder:	-1000
		Upper systemborder:	1000
Last change:	1:35:18	Calibration factor:	8192
		Unit:	m

current electronics temperature [°C]	28,7
Operating hours [h]:	1:37:03

Fig. 6-3: Device data

## 6.6 Firmware update

**Pull-down menu: Options → Firmware update**

### 6.6.1 Module firmware update

The modules are prepared for a firmware update by pressing the button on the front plate of the UO-SCU during the switch on process.

Press the  button to select the update file. "Transfer" starts the update process.

The device must be restarted after the update process.

### 6.6.2 Basic device firmware update

The basic device is prepared for a firmware update by connecting the USB port in the junction box to the PC during the switch on process.

Press the  button to select the update file. "Transfer" starts the update process.

The device must be restarted after the update process.

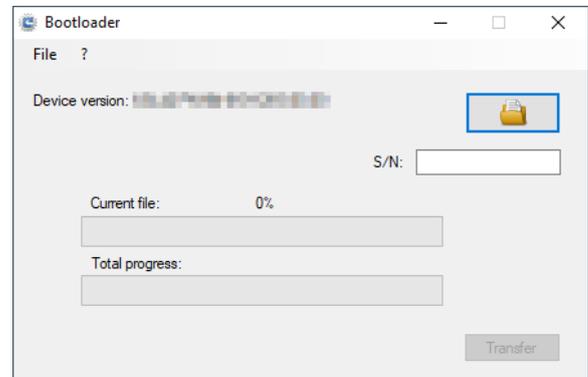


Fig. 6-4: Firmware update

## 6.7 Reset to default settings

**Pull-down menu: Options → Reset to default settings**

The configuration is deleted and the modules are reset to default settings

**Default settings:**

Password Level1	huebner1
Password Level2	huebner2
Operating mode	Position speed mode
Reset and preset inputs	deactivated
Speed and position switch points	deleted
Error reset only with software	active

Test pulse duration	1 ms
T/ti	1000
Current output	deactivated
Current output source	position-dependent
Incremental output (optional)	4096 pulses/revolution

## 6.8 Resetting a password

**Pull-down menu: Options → Reset password**

If you forget your password, you can use “Reset password” to assign a new password by completing the following steps:

1. Select the password level you would like to reset.
2. Use  to generate a key and use  to send it to the manufacturer immediately, or later if there is no internet connection.
3. The manufacturer will generate a security password and return it to the sender.
4. A new password can be assigned after the security password is entered into the relevant field.

Fig. 6-5: Resetting a password

## 7 Safety data sheet

### 7.1 Safety parameters

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

The safety parameters for the U-ONE-SAFETY-LWL are based on the safety parameters of the modules required for the safety function.

#### 7.1.1 Examples

##### Safe speed switch:

The components basic device USL(H)42, the UO-SCU module and the UO-SGS-R module are required with the following parameters for a safe speed switch:

	PFD <sub>AV</sub>	PFH [FIT]	DC <sub>avg</sub> [%]	MTTF <sub>D</sub> [a]
<b>USL(H)42</b>	2.73E-05	0.16	98.1	206
<b>UO-SCU</b>	3.20E-05	0.18	97.2	207.9
<b>UO-SGS-R</b>	3.13E-05	0.18	97.1	227.4

$$PFD_{AVTotal} = \sum PFD_{AV} = 9.06E-05$$

$$PFH_{Total} = \sum PFH = 0.54 \text{ FIT}$$

$$DC_{avgTotal} = \sum DC_{avg} / 3 = 97.5 \%$$

$$MTTF_{DTotal} = 1 / (1 / MTTF_{D-USL} + 1 / MTTF_{D-SCU} + 1 / MTTF_{D-SGS}) = 71.1 \text{ years}$$

##### Safe PROFINET:

The components basic device USL(H)42, the UO-SCU module and the UO-SGS-R module are required with the following parameters to transfer a safe position and speed.

	PFD <sub>AV</sub>	PFH [FIT]	DC <sub>avg</sub> [%]	MTTF <sub>D</sub> [a]
<b>USL(H)42</b>	2.73E-05	0.16	98.1	206
<b>UO-SCU</b>	3.20E-05	0.18	97.2	207.9
<b>UO-SPN-1</b>	2.68E-05	0.15	96.1	317.6

$$PFD_{AVTotal} = \sum PFD_{AV} = 8.61E-05$$

$$PFH_{Total} = \sum PFH = 0.49 \text{ FIT}$$

$$DC_{avgTotal} = \sum DC_{avg} / 3 = 97.1 \%$$

$$MTTF_{DTotal} = 1 / (1 / MTTF_{D-USL} + 1 / MTTF_{D-SCU} + 1 / MTTF_{D-SPN}) = 78 \text{ years}$$

## 7.2 Timing

### Power on time

Internal diagnostic measures are carried out first after the supply voltage is switched on, before the USL is ready for operation.

Function	Time
Power on time	≤ 4 s

## 7.3 Safe state

- If an error is detected, at least one error output on the UO-SCU is switched to “low”.
- If the function “safe error switch” is used, the switching contacts will open if there is an error.
- The bus modules UO-SPN-1 and UO-SPB-1 passivate data for the safety channel

## 7.4 Safety times

Responding to an error	Time
Error outputs of the UO-SCU at low level	≤ 50 ms
Open the switching contacts on the error relay	≤ 60 ms
Passivate the data from the bus module	≤ 57 ms

The speed diagnosis requires a measuring angle of 5°. At low speeds, this can extend the diagnosis time.

## 7.5 Information on functional safety

	<p><b>CAUTION!</b></p> <ol style="list-style-type: none"> <li>1. The user must ensure that the system limits for the basic device are not exceeded when the device is switched off (see section 3.5).</li> <li>2. If possible, all devices/switches should transition to a safe state or safe conditions when the switch is opened (see EN ISO 13849-2:2013 table D.2).</li> <li>3. In applications without a safety PLC, an error switch on the USL must be switched so that the application enters a “safe state” when the switch is opened (basic safety principle).</li> <li>4. In applications with a safety PLC, both error output channels (Error1, Error2) must be analysed or point 3 must be implemented. The test pulses must be suppressed in the application, to avoid accidental switching processes.</li> <li>5. In case of an error (at least 1 error output on low level and / or error switch open), the PLC must take appropriate measures so that the application enters a “safe state”.</li> <li>6. The USB interface may only be used for configuration and commissioning, and is not designed for continuous operation.</li> <li>7. 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>8. 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>9. The relay contacts must be protected against overcurrent via a pre-fuse (2A).</li> </ol>
---	--

	10. Relays that do not change their switching state for longer than 1 year due to the application must be inspected once annually as part of maintenance work.
--	--

## 8 Troubleshooting

While the USL is being switched on and while it is running, a wide range of diagnostic measures check the function and operating conditions of the overall USL. If there is a deviation, the error state (safe state) is initiated, and the error is saved in the error memory. Errors are differentiated into “internal” and “external” errors.



Fig. 8-1: Error message

**External errors** are caused by external influences, such as exceeding the maximum permitted speed or exceeding the maximum permitted temperature. Errors are displayed in the configuration software with a brief description of the error, as shown in sec. 8.2.

External errors are reset via a Reset (reset process or reset knob in the US42Pro software) or by interrupting the supply voltage (> 2s).

**Internal errors** are triggered, for instance, by deviations in the internal device program sequence. The errors are displayed in the configuration software with error numbers and the designation internal error. The causes of the errors can only be analysed by individuals with appropriate expertise. The user must send the contents of the error memory to the manufacturer for this purpose (see section: 2.2.3.4).

Internal errors can only be reset via the Reset button in the US42Pro software (for default setting see section 6.7). The process for resetting internal errors can be set with the US42Pro software so that it corresponds to resetting for external errors

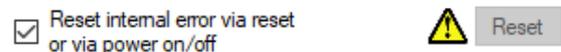


Fig. 8-2: Error reset

Resetting an error will trigger a system restart and complete system test. If an error is found once again, the module will remain in an error state. The error state can be assigned to a switching output using the configuration software.



**NOTE!**

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.

An **error in the basic device** is always reset when the power is interrupted. If there is still an error when it is switched back on, the basic device will remain in an error state.

## 8.1 Error memory

	#	Time	Source	Error number	Log-Text
▶	1	0:03:37.0618	SCU	40	Reset input error

Time: Time at which the error occurred (operating hours)

Source: module causing the error

Error number: Storage location for the error

The error memory is a ring buffer and can record 100 error entries. Internal errors should be sent to the manufacturer for analysis. (See section: 2.2.3.4).

## 8.2 Error table

Error no.	Description
10	End of relay service life reached (Warning)
11	End of service life for the device reached (Warning)
30	Low voltage detected
31, 32	Overvoltage detected
35	Min. temperature not met
36	Max. temperature exceeded
40	Error reset input
45	Error preset input
48	Error output error
50	Working area limit not met
51	Working area limit exceeded
52	USL system limit exceeded (max. 32000 rev.)
55	Maximum device speed exceeded
60	Start-up during configuration
61	Start-up during the switch test
62	Start-up during preset (software only)
63	Invalid state for preset
64	Timeout during the switch test
65	Timeout during configuration
66, 67	Switch off during configuration
68	Start-up during reset to factory settings
70, 71	Interruption of USB communication
75	Firmware in UO-SCU module not compatible

Error no.	Description
80, 84	Basic device not found
82	Basic device was exchanged
83	Basic device firmware not compatible
86, 87	Module removed, exchanged
88	Firmware in module not compatible
90	Max. number of modules exceeded
100 - 255	Internal diagnostic error detected

### 8.3 Check list

We recommend printing out the check list and working through it during commissioning, when replacing the measurement system and when changing the parameters for systems that have already been accepted. The check list should be filed with the general system documentation.

Reason for documentation		Date	processed	reviewed
Sub-item	applicable	found under		yes
The operator has read and understood the included overall system documentation.				<input type="checkbox"/>
Check whether the USL can be used for the current automation task based on the specified safety requirements.	Proper use Compliance with all technical data	Operating and assembly manuals for the individual USL components		<input type="checkbox"/>
Power supply requirement	The power supply used must fulfil the requirements of SELV/PELV (IEC 60364-4-41:2005).			<input type="checkbox"/>
System test after commissioning and parameter changes	All affected safety functions must be reviewed during commissioning and after any configuration change.	See section 3		<input type="checkbox"/>
Preset function	It must be ensured that the preset function cannot be triggered accidentally.	See section 4.2		<input type="checkbox"/>
Module replacement	It must be ensured that the new SCU matches the replaced SCU. All affected safety functions must be inspected.	See section 6.4		<input type="checkbox"/>

## 9 Example applications

The USL provides a safe position / speed switch. The switches are shown powered down. Non safety-related data lines and switches are shown in black.

### 9.1 Use with SAFETY PLC

This illustration shows the USL as a safe sub-system for the safety-related PLC.

#### Description:

If there is a fault on the PLC, the safety switch of the USL (S1 ... Sn) is used to monitor the speed or position switch points in emergency mode.

Test pulses from the error outputs are monitored.



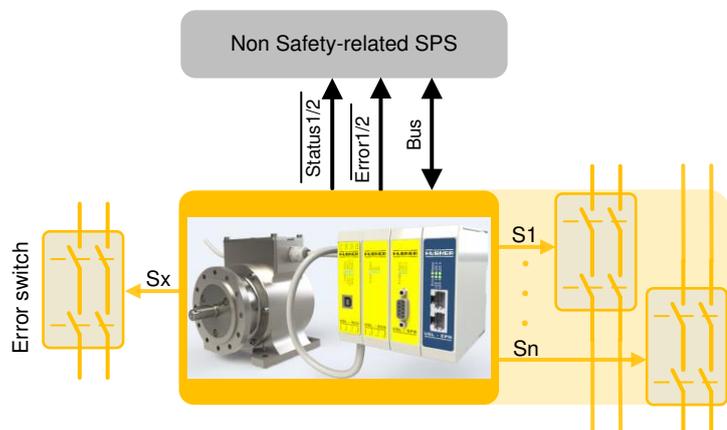
	<p><b>Reliable error detection:</b></p> <p>At least one of the following measures must be taken to ensure reliable error detection:</p> <ul style="list-style-type: none"> <li>Monitoring of the error outputs of the SCU (Error1, Error2) Error = at least 1 error output continuous low level.</li> <li>Use of a safe error switch (see section 4.5, 9.2).</li> </ul> <p>In case of an error, the PLC must take appropriate measures so that the application enters a “safe state”.</p>
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### 9.2 Use without SAFETY PLC

This illustration shows the SCU as a safe sub-system for the safety-related PLC.

#### Description:

The safety switch of the USL (S1 ... Sn) is used to monitor the speed or position switch points. The PLC can analyse bus, status and error outputs (not safety-related).



	<p><b>Reliable error detection:</b></p> <p>Any free position or speed switch (S1 ... Sn) can be configured as a safe error switch (Sx) using the configuration software. If an error is detected, the switch will open. The switch must be used so that the application enters a “safe state” in case of an error.</p>
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