

Operating Manual

UV Monitor UVT 18

Software version 1.6



Imprint

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Warning notes and symbols in the operating instructions

These operating instructions describe the UV signal monitor UVT 18, its operation and its uses. The safety and warning notices explain the safe, proper handling of the device.

You will find the symbols listed below next to all safety and warning instructions in these operating instructions where there is danger to life and limb. An additional signal word indicates the severity of a possible danger.

Observe these notes closely and be especially careful in these cases in order to preclude accidents.

DANGER! The signal word marks a danger with high risk or an immediately threatening danger. If it is not avoided, death or very severe injuries / damage to health will result. Damage to property is possible.

WARNING! The signal word marks a danger with medium risk or dangerous situation. If it is not avoided, death or very severe injuries / damage to health could result. Damage to property is possible.

CAUTION! The signal word marks a danger with low risk or marks a possible danger. If it is not avoided, slight injury / damage to health could be possible. Damage to property is possible.

The symbols used in these operating instructions have the following meaning:



This symbol warns of a hazard area.



This symbol warns of a hot surface.



This symbol warns of hazardous electrical voltage.

The two following symbols are used to address practices for optimal operation and/or prevention of damage to the equipment. These information are not related to hazardous situations. Additionally, the signal words **ATTENTION** and **NOTE!** are used.



ATTENTION!

This symbol with signal word is found at those places in the operating instructions which must be observed so that damage or destruction of the equipment is prevented.



NOTE!

This symbol is found next to notes, tips on operation and useful information.

1 Device and function description

1.1 Application

The signal monitor UVT 18 was developed for the control of small to medium UV systems and is fully compatible with the requirements of the standards DVGW W294 and ÖNORM M5873. In conjunction with UV sensors, it allows monitoring the irradiance. In addition, there is the possibility to connect additional sensors for the detection of other important variables, such as temperature, flow and air pressure, as well as an irradiation dose.

1.2 Description

The monitor is designed for switchboard installation. All connections are fed via the connection box on the back of the monitor housing. The front panel contains, in addition to the control buttons, a two-line, alphanumeric display with multi-colored background lighting for displaying measured values and operating conditions. In line 1, all operating states and in line 2 all measured values are displayed in a rolling manner. The scrolling of the measured values can be switched off in the menu. By means of the front-panel operating buttons ▲ ▼, the measured values in line 2 can be queried manually at any time.

The complete setting / programming of the monitor is also performed via the front-panel buttons. A password protection, which can be activated on request, limits the operating functions to a reduced menu for standard operation.

Furthermore the UVT 18 monitor includes an RS485 interface for convenient programming via a PC and for transferring the measured values to a higher-level control system. Alternatively, this interface can also be used to connect digital sensors for different measured variables.

1.3 Assembly

The monitor is designed as a switchboard device and must be installed in a cutout of B x H 92^{+0,8} x 92^{+0,8} mm or as per drawing. The required installation depth, including clearance for cable connections, is at least 75 mm. The mounting is carried out using the supplied screw terminals. The connectors are protected by various sizes and coding.

ATTENTION!



Please check the correct connection before commissioning!

Damage caused by incorrect connection is not covered by the warranty!

1.4 Commissioning

After the supply voltage has been applied, the device starts automatically. During this phase, the software version is displayed, with light blue background lighting. After a few seconds, the monitor automatically changes to the measurement mode.

Softwareversion
UVW 1.3

If a warm-up time of the UV lamps is set, this is indicated in the next step. During this time, the display will be blue backlit to indicate that a particular operating state is present. However, the normal measurement mode is already recorded and in line 2, all values are displayed in a rolling manner. The menu allows to set whether the main alarm should be active during heat-up.

heat-up time
UV1rel 12.5%

Now the desired settings can be made via the front-panel keys according to the menu. When the password is activated, only a reduced menu is available. Here, only the counter readings can be reset resp. adjusted after a lamp change. For details, please refer to the description of the menu structure. The settings can be read out for repeated use via the RS485 interface. To read out a programmed monitor or to program further devices with this setup, uv-technik provides a free Windows program on request. For larger quantities the delivery of pre-programmed devices can be agreed.

1.5 Operation of the keys, navigation in the menus

At the beginning, the device must be adapted to its external wiring. A keypad with 6 buttons on the front panel is available for navigating the menu and setting / programming all values. Navigating the menu is intuitive. A short press of the keys is sufficient. A long press only has a special function for the ESC key.

1.6 Function of the keys

- ◀▶ Cursor one position to the left or right, scrolls in the menu
- ▲▼ Increase or decrease the number at the cursor position by 1, scroll through the menu
- Enter** select the menu / submenu Confirm the input
- Esc** Cancel without change, return to the higher menu level or to the basic display
Special function: Long press of this button calls the reference measurement function.

If no button is pressed for two minutes, the monitor automatically returns to the basic display.

1.7 Displays

In the basic display, the **operating state** is always displayed in the **first line** of the monitor display. The background color changes according to the indicated operating state from dark green in normal operation to yellow green with pre-alarm to red with main alarm (see illustration). If several alarms are active, they are displayed scrolling in the first line every 2 seconds. The higher-priority alarm determines the background color (e.g., pre-alarm lifetime and main alarm UV1 => background color red due to main alarm).

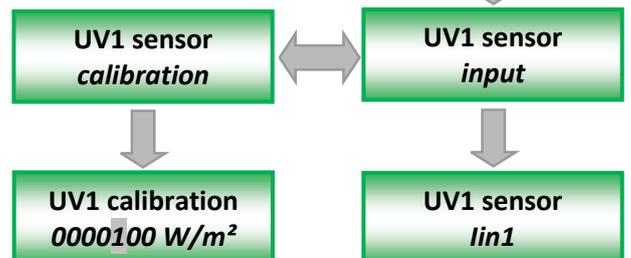


The **second line** shows the **values** of all activated measurement functions. Use the arrow keys ▲▼ to scroll through the values manually. Four minutes after the last key press, the values in line 2 starts scrolling automatically except the scrolling is switched off in the menu.

The device will be programmed via the menu. Press the **Enter** key to enter the **main menu**. The first line displays the **menu level**, the second line shows the **menu item** (e.g., *UV1 Sensor*). The menu items can be browsed using the ▲▼ or ▶◀ buttons.



Press the Enter key to enter the displayed **submenu**. The **submenu level** is displayed in the first line, and the **value to be set** in the second line (e.g., *input*). The possible setting values can be browsed using the ▲▼ or ▶◀ buttons. Confirm the value with Enter.



When selecting an adjustment menu (e.g., calibration), a numeric value must be entered. Using the buttons ▶◀, the flashing cursor is navigated to the number to be set and the numerical value is set using the ▲▼ buttons. By pressing **Enter** the values are confirmed and saved.

During programming, the backlighting also corresponds to the current operating state. The basic display is returned automatically after 2 minutes without key operation.

The entire menu structure is explained in point 7.

1.8 Reference measurement

For the reference measurement, the system must be in a stable operating state and the display must not fluctuate. If the ESC button is pressed for more than 3 seconds from the basic display, the monitor freezes the current measured values of the connected UV sensors for two minutes and suppresses all alarms. The special operating status is indicated by the blue background lighting. In this state, the system sensors can be removed without an alarm trigger and replaced by a reference sensor. The measured value displayed on the reference radiometer can now be conveniently compared with the frozen measured values in line 2 of the monitor display. In addition to the UV values, the monitor also shows the remaining time in line 1 so that you can switch back to the plant sensor in time. After two minutes, the monitor automatically returns to the measurement mode. You can also return to the basic display early by long pressing the ESC key. After returning to the measuring mode, it must be checked whether the UV indicator has changed. If this is the case, a stable operating state has not yet been reached and the measurement has to be repeated.



ref. mode 115 s
UV1ref 77.2 W/m²



NOTE!

For the reference measurement, we recommend our reference radiometers MUV 2.4 WR resp. KUV 2.4 WR. For these devices reference sensors are available according to DVGW (measuring field angle 40 ° and 160 °) as well as ÖNORM (measuring field angle 160 °).

2 Safety instructions

2.1 General information

A sound knowledge of all basic safety regulations is essential to ensure safe and fault-free operation of the UVT 18.

This operating manual contains all important safety regulations to ensure safe operation of the equipment.

This operating manual, and in particular the safety instructions, must be observed by all persons working with the equipment.

In addition, all relevant rules and accident prevention regulations relating to the operation site must be observed. In regular intervals, the operator will check that all personnel are observing the safety regulations.

2.2 Appropriate use

The UV monitor UVT 18 is an electronic device for the monitoring UV low pressure lamps. Any other use or use above and beyond these terms is defined as inappropriate.

The operator may only operate the equipment as stipulated by the operating instructions in this manual.

The following are further conditions for appropriate use:

- the observance of all points listed in this user manual
- compliance with the general and specific safety instructions in this user manual
- compliance with the relevant accident prevention regulations

ATTENTION!



uv-technik is not liable for damage resulting from inappropriate use of the equipment.

2.3 Staff obligation

Before commencing work, all persons entrusted with work to be performed on the UVT 18 undertake the following:

- to observe the safety at work and accident prevention regulations
- to read the chapter on safety and the warnings printed in this manual and to observe them at all times while using the equipment

2.4 Hazards from handling the equipment

The UVT 18 has been manufactured in accordance with the very latest state-of-the-art technology and the recognized rules of safety technology.

The equipment may only be used under the following conditions:

- it is used for the purpose for which it was constructed
- in a condition in which the equipment complies with all safety technology requirements



DANGER! – HAZARDOUS ELECTRICAL VOLTAGE!

Attention: Danger of life

Before working on the connections of the device, the main switch and the main contactor must be switched off in order to avoid the risk of electric shock.

2.5 Warranty and liability

The General sales and delivery conditions of uv-technik apply. The operator will have received these terms, at the latest upon signing the contract. The uv-technik is not liable for any damage to persons or property arising from any one or more of the following:

- inappropriate use of the device
- incorrect assembly, commissioning and operation
- operation of the device with faulty and/or non functioning safety and protection device
- non observance of the instructions given in the user's manual with reference to the safety, transport, storage, assembly, commissioning, operation and servicing of the device
- unauthorized repair or alterations to the construction of the device
- catastrophes, the action of foreign bodies or acts of God
- damages or losses originated from the use or a defect of the device

2.6 Organizational measures

All safety devices on the equipment must be tested for correct functioning regularly, prior to carrying out work and at each shift change. Look for external signs of damage.

2.7 Informal safety measures

In addition to this user manual, the generally and locally applicable accident prevention and environmental protection regulations must be made available and observed.

Danger due to electricity



DANGER! – HAZARDOUS ELECTRICAL VOLTAGE!

There is a danger caused by direct or indirect contact with electricity!

The electrical components of the UVT 18 must be inspected regularly.

Before commencing work:

- check all equipment components for external signs of damage
- check that all electric cables are in perfect condition

Loose connections must be tightened and damaged wiring replaced immediately.

2.8 Service, maintenance, remedying faults

In the case of faults or in the case of damage or defects of the UVT 18, contact the customer service of the uv-technik.

In the event of claims under the warranty, for our repair and spare parts service, please contact: info@uv-technik.co.uk.



No changes may be made to the UVT 18, no fittings may be added or conversions may be carried out.

Opening of the device or the breaking of the existing device inspection seals will void all warranty claims!

3 Transport, storage, delivery

The UVT 18 will be delivered in an appropriate packing.

Any damage detected must be documented at once and reported immediately to your specialist dealer or directly to the uv-technik.

NOTE



Packing material must be disposed of in an environment friendly way or re-used if possible. We would recommend that the packing material be kept to protect the equipment if it needs to be shipped onward or otherwise transported.

4 Order data for equipment

Order equipment from:

E-Mail: info@uv-technik.co.uk

Devices

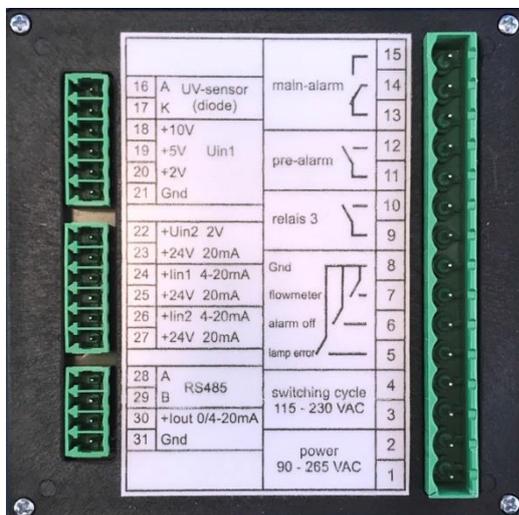
Description	Article-/Order Number
UV Monitor UVT 18 with uv-technik front sticker	321 12000 0001
UV Monitor UVT 18 with neutral front sticker	321 12000 0003
UV Monitor UVT 18 with customer specified front sticker	321 12000 xxxx

** The buyer assumes responsibility for the marking and documentation according to the applicable rules!*

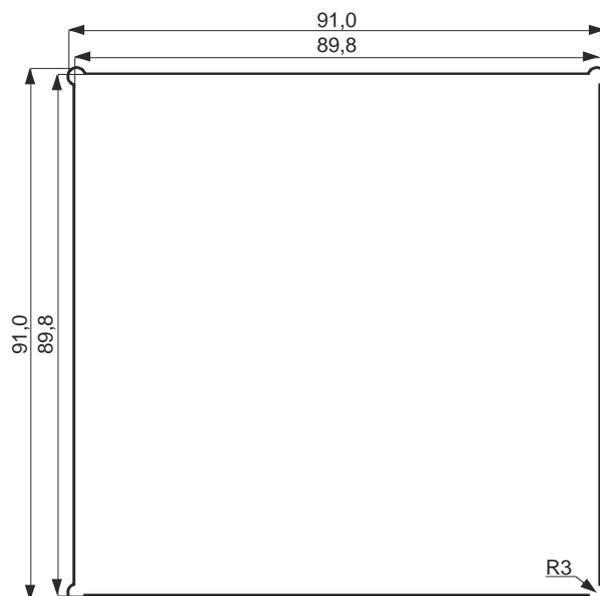
The sales and distribution department of uv-technik provide you advise regarding to the creation of customer-specific device variants

5 Technical documentation

5.1 Connections



5.2 Drawing housing



5.3 Technical data

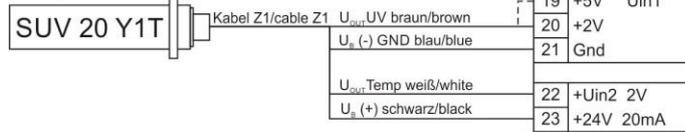
Supply	90-264 V AC 50 to 60 Hz resp. 100-300 V DC, input power 2.5 W
Size B x H x T dimension	panel mounting housing 96 x 96 x 64, mounting with screw clamps, cut-out 92+0,8 x 92+0.8 acc. DIN 43700, installation depth with connection terminals at least 75 mm
Connections	plug-in screw terminals (partly coded), suitable wire cross sections 0.25 -1.5 mm ²
Display	alphanumeric LCD display, two lines, colored background illumination according to alarm state
Operation	via 6 button on the front
Temperature	ambient temperature 0 to 40°C
Weight	approx. 500 g
Inputs	<ul style="list-style-type: none"> - UV diode input for direct connection of photodiodes or sensors for relative measurement - input for UV sensors with voltage output 0..2/5/10 V DC - input for UV sensors with voltage output 0..2 V DC - two inputs for current loop sensors 4-20 mA, internal burden resistance 100 Ohm, threshold for cable break detection 3.6 mA - pulse input (for flow meter) - potential free pulse input 115..230 V AC for switch-on cycle counter (connect to ballast net supply) - switching input lamp fault (connect to potential free relay contacts of the electronic ballasts), I_e = 5 mA - switching input to block all alarms while service/maintenance
Outputs	<ul style="list-style-type: none"> - analogue output 0/4-20 mA DC, via menu adjustable, load max. 100Ω - output for 24 V DC supply voltage for 2 voltage and current loop sensors each - relay output main alarm (changer), min. 5 V DC, 50 mA, max. 250 V AC, 5 A ohmic load - relay output pre alarm (closer), min. 5 V DC, 50 mA, max. 250 V AC, 5 A ohmic load - relay output temperature alarm (closer) , min. 5 V DC, 50 mA, max. 250 V AC, 5 A ohmic load
Interface	- RS485 interface (slave) for communication with higher-level control (PLC) and for factory read-out and read-in of a plant-specific programming (can be programmed alternatively as master for connection to digital UV sensors)
Functions	<ul style="list-style-type: none"> - counter for total operation hours (not resettable), lamp operation hours and switch-on cycles - display of necessary lamp replacement according to programmed threshold - display of lamp fault - display of main alarm, pre alarm according to programmed thresholds - background color illumination changes according to alarm level - test with reference sensor during operation according to DVGW/ÖNORM
Possible modifications	<ul style="list-style-type: none"> - customer specified front sticker - customer specified programming to a setup ex works (from 10 pieces) - customer specified program version (from 100 pieces) - special hardware version from 200 pieces possible
Protection degree	front IP65, connection side IP00
Standards fulfilled	CE, EMC, and low voltage guideline fully compatible to DVGW W294 and ÖNORM M5873 rules

5.4 Assignment of terminals

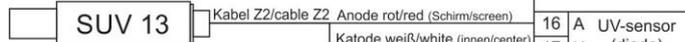
Terminal number	Wiring / intended use
1/2	input supply voltage for the monitor (90-264 V AC or 100-300 V DC)
3/4	input supply voltage of the electronic ballasts (115-230 V AC) for counting lamp hours and switching cycles
5/8	input for fault contacts of the electronic ballasts
6/8	switching input for blocking all alarms
7/8	pulse input for flow meters with pulse output
9/10	switching output temperature alarm (relay closer)
11/12	switching output UV pre alarm (relay closer)
13/14/15	switching output main alarm for UV, dose and lamp fault (relay changer)
16/17	input for UV sensor (relative), diode, 16-anode, 17-cathode
18/19/20/21 U _{in1}	input for UV sensor with voltage output 2/5/10 V DC (21/31-GND, internally connected)
21/22 U _{in2}	input for sensor with voltage output 2 V DC (temperature / flow / UV)
21/23	24 V DC supply voltage for both sensors with voltage output
24/25 lin1	input for current loop sensors 4-20 mA (UV, flow), internal supply voltage 24 V DC and 100 Ohm load
26/27 lin2	input for current loop sensors 4-20 mA (flow, UV), internal supply voltage 24 V DC and 100 Ohm load
28/29	RS485 for connection to super ordinate control, setup storage/programming
30/31	output 0/4-20 mA for transfer of the measured value (UV1, UV2, dose) to a super ordinate control

5.5 Wiring

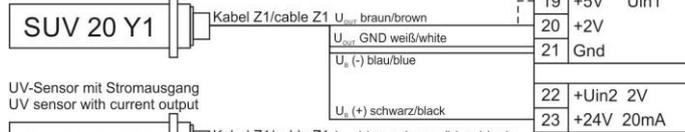
UV/Temp.-Sensor mit Spannungsausgang
UV/Temp. sensor with voltage output



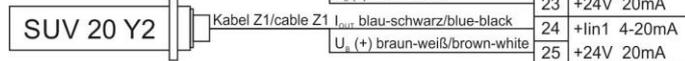
UV-Sensor Diode
UV sensor diode



UV-Sensor Spannungsausgang
UV sensor with voltage output

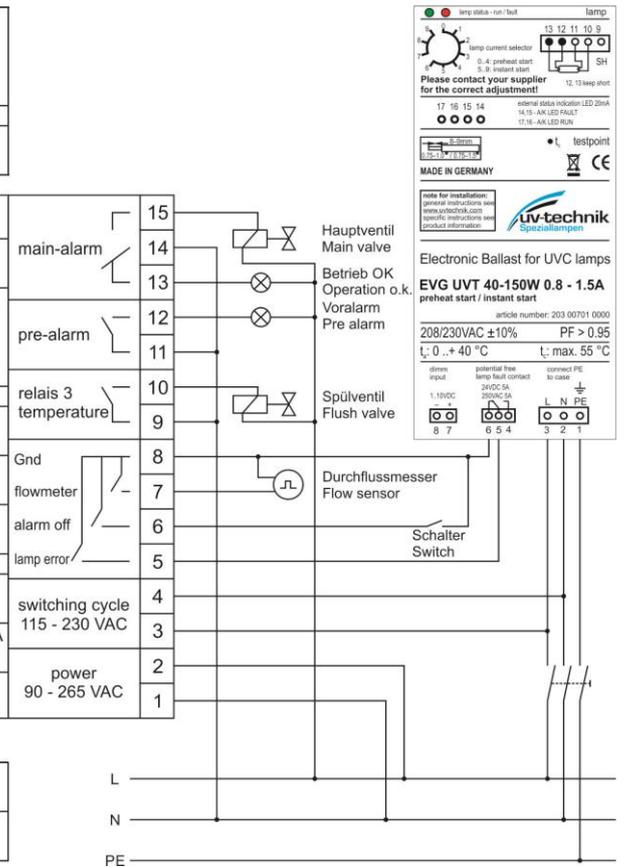
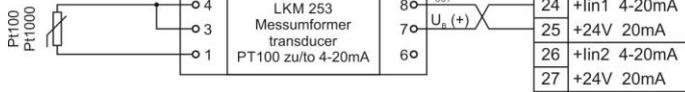


UV-Sensor mit Stromausgang
UV sensor with current output

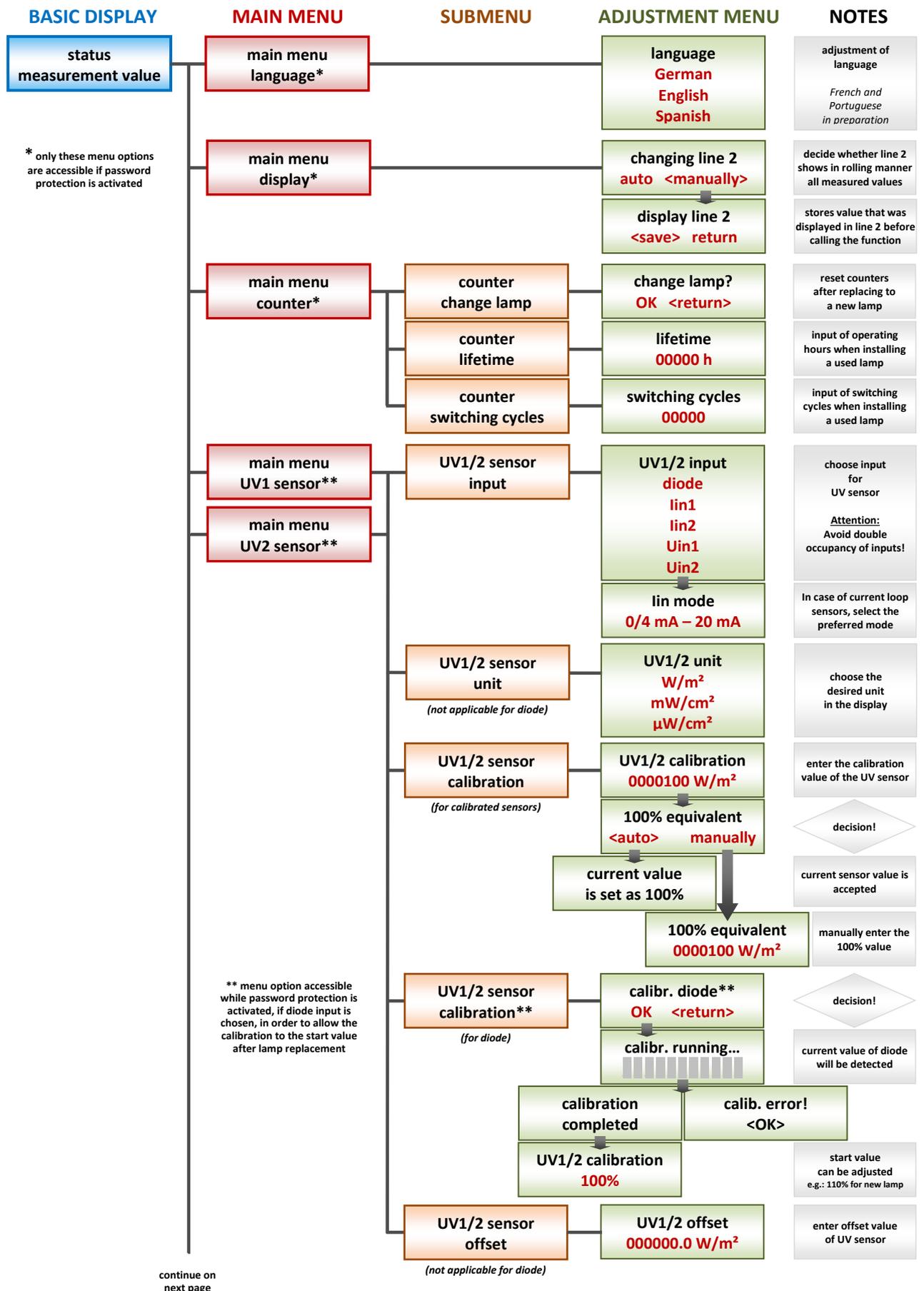


zur übergeordneten Steuerung
to higher level control

Temperatursensor
temperature sensor



7 Menu structure



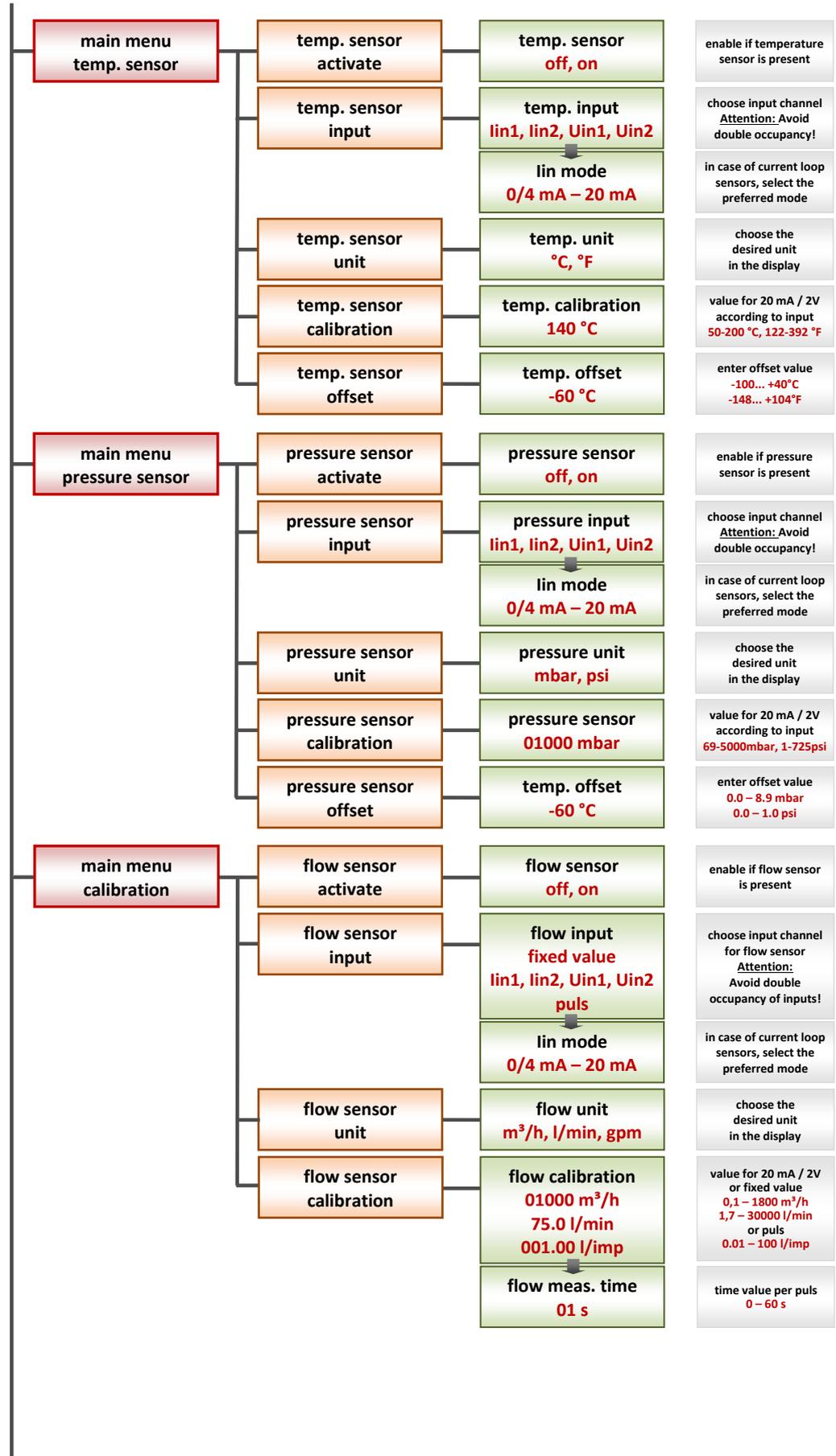
BASIC DISPLAY

MAIN MENU

SUBMENU

ADJUSTMENT MENU

NOTES

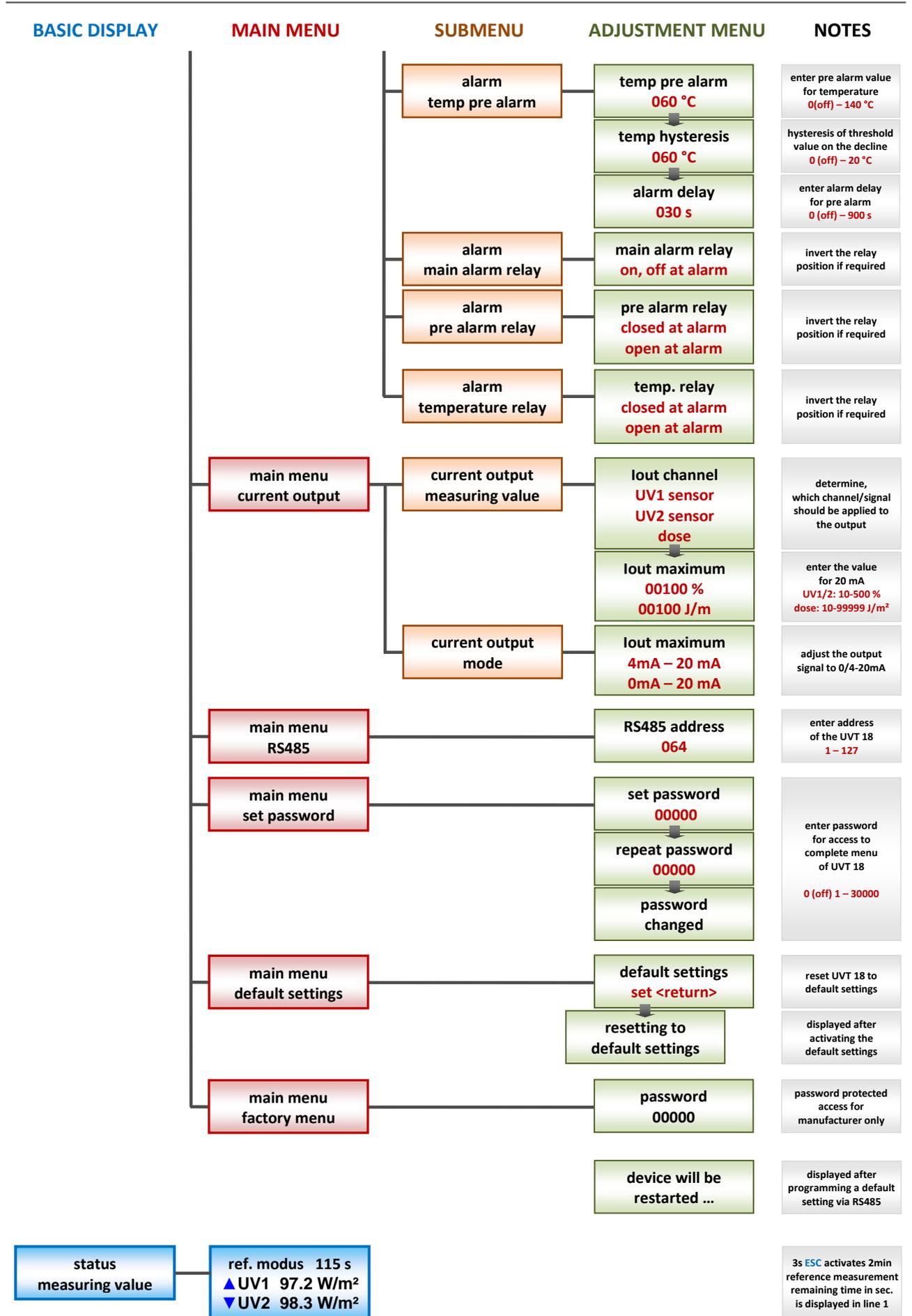


BASIC DISPLAY

	MAIN MENU	SUBMENU	ADJUSTMENT MENU	NOTES	
	main menu dose calculation	dose calculation activate	dose calculation off, on	enable if dose calculation is desired	
		dose calculation reactor volume	reactor volume 0007 l	enter reactor volume 1 – 1000 l	
		dose calculation correction factor	correction factor 0100 %	correction factor acc. biosimetry testing 1 – 1000%	
	main menu sensor average		no. of readings 03	number of measured values for averaging (sampling every 0.5 s) 1 – 20 (0.5-10 s)	
	main menu alarm	alarm warm up time	warm up time 001 s	time to reach the operation temperature of lamps 0 (off) – 900 s	
			during heat-up main alarm off main alarm on	determine, whether the heat-up time is interpreted as alarm	
		alarm UV1/2 main alarm	UV1/2 main alarm 050.0 %	enter main alarm value for UV sensor 0(off) – 99 %	
			alarm delay 030 s	enter alarm delay for main alarm 0 (off) – 900 s	
		alarm UV1/2 pre alarm	UV1/2 pre alarm 075.0 %	enter pre alarm value for UV sensor 0(off) – 99 %	
			alarm delay 030 s	enter alarm delay for pre alarm 0 (off) – 900 s	
		alarm lamp error	lamp error closed at alarm open at alarm input inactive	alarm delay 030 s	determine, how the input for lamp error (5/8) affects the main alarm relay
				alarm delay 030 s	enter alarm delay for main alarm 0 (off) – 900 s
		alarm dose main alarm	dose main alarm 00400 J/m ²	alarm delay 030 s	enter main alarm value for dose 0(off) – 99999 J/m ²
				alarm delay 030 s	enter alarm delay for main alarm 0 (off) – 900 s
		alarm dose pre alarm	dose pre alarm 00500 J/m ²	alarm delay 030 s	enter pre alarm value for dose 0(off) – 99999 J/m ²
				alarm delay 030 s	enter alarm delay for pre alarm 0 (off) – 900 s
		alarm lifetime alarm	lifetime alarm 08000 h	lifetime hours of UV lamps 0(off) – 30000 h	
	alarm temp main alarm	temp main alarm 060 °C	temp hysteresis 060 °C	hysteresis of threshold value on the decline 0 (off) – 20 °C	
			alarm delay 030 s	enter alarm delay for main alarm 0 (off) – 900 s	

continue on
next page

continue on
next page



8 Protocol

8.1 Description

The interface provides a wired, digital communication with units of type UVT 18. To secure an undisturbed connection also over larger distances, the interface is based on a differential, serial data transmission according to **RS485 half-duplex** standard. **The standard signal level is 5V**, voltages up to 12V are tolerated. The communication protocol is based upon the industrial popular **MODBUS® RTU** standard whereby a simultaneous operation with corresponding components on a shared bus is possible. Intended interface parameters are **19200 baud, 8 data bits, 1 stop bit, even parity (8E1)**. The protocol is a single-master protocol. This master controls the complete transmission and monitors incidental timeout (no answer from addressed unit). The connected units may only send telegrams after request from the master.

8.2 Usual frame structure

device address	function	data / parameter	CRC-checksum
1 Byte	1 Byte	n Byte	2 Byte

In principle, transmitted frames (master -> slave) and received frames (slave -> master) have the same structure.

A **delay** of at least **3.5 characters** must be maintained between two consecutive frames, which serves as a **stop condition** for the individual bus participants and thus marks the end of a data frame.

The **device address** specifies which bus subscriber is to be addressed or from which device a response originates. Allowed addresses are **0x01 to 0x7F**.

The **function code** represents the command to be executed and is also transmitted to the master with the corresponding response. The protocol mainly uses the range reserved in the MODBUS® standard for user-defined functions from **0x41 to 0x48**.

function code	function	answer	meaning
0x41	ReadSerial	5 Byte, ASCII	Serial number
0x43	ReadMeasVal	42 Byte	query of status / measurement values

For calling the device serial number from the monitor 0x40, the master would send the following telegram:

device address	function	CRC-checksum
0x40	0x41	0XF040

In this case, the answer of the slave would be for example:

device address	function	data				CRC-checksum	
0x40	0x41	0x41	0x33	0x30	0x30	0x31	0xB345

So the unit serial number would be A3001.

The calculation of the CRC checksum will be discussed separately.

The MODBUS® function **DIAGNOSTICS**, function code **0x08** is also available. The transmitted telegram is returned 1:1. In this way, a simple connection test can be performed.

8.3 Query of status / measurement values

To query the measured values, the master would send the following telegram:

device address	function	CRC-checksum
0x40	0x43	0X7181

In this case, the answer of the slave would be for example:

device address	function	data	CRC-checksum
0x40	0x43	42 Byte	2 Byte

Configuration of the data bytes:

Byte: 1							
status byte 1 (data type: unsigned Integer 8 Bit)							
Bit 7	6	5	4	3	2	1	0
UV1 main alarm	UV1 pre alarm	UV2 main alarm	UV2 pre alarm	temperature alarm	dose alarm	operation hour alarm	lamp error

Byte: 2							
status byte 2 (data type: unsigned Integer 8 Bit)							
Bit 7	6	5	4	3	2	1	0
0	0	0	0	0	0	warm-up time	alarm off

If a bit is set to 1, the corresponding alarm or status has been triggered.

Byte: 3	4	5	6	7	8	9	10
UV1 sensor: relative measured value * 10 (data type: signed Integer 32 Bit)				UV1 sensor: absolute measured value * 10 (data type: signed Integer 32 Bit)			

Byte: 11	12	13	14	15	16	17	18
UV2 sensor: relative measured value* 10 (data type: signed Integer 32 Bit)				UV2 sensor: absolute measured value*10 (data type: signed Integer 32 Bit)			

Byte: 19	20	21	22	23	24	25	26
temperature sensor: measured value *10 (data type: signed Integer 32 Bit)				flow sensor: measured value * 10 (data type: signed Integer 32 Bit)			

Byte: 27	28	29	30
dose: measured value *10 (data type: signed Integer 32 Bit)			

Byte: 31	32	33	34	35	36	37	38
operation hours * 10 (data type: signed Integer 32 Bit)				lamp operation hours * 10 (data type: signed Integer 32 Bit)			

Byte: 39	40	41	42
switch on counter (data type: signed Integer 32 Bit)			

If a measurement value is not valid, it is coded as follows:

error code	meaning
-8888	measurement not active
-7777	sensor error
-9999	measurement overload

8.4 Specific frames

A special frame structure is provided for functions that write to the **device configuration**. In order to gain access to these functions, the **password-protected user configuration** mode must first be enabled. The password is used to protect against accidental changes to the device configuration and is generally **0x095A**. A customer-specific password change is possible at the factory.

function	password	CRC-checksum
0x45	0x095A	2 Byte

In this case, the slave's response is already established (as described), the data byte **0x00** being appended after the function code in order to acknowledge a **successful connection**.

To enable the user configuration mode of the device 0x40, the master would send the following telegram:

device address	function	Password	CRC-checksum
0x40	0x45	0x095A	0x825A

In this case, the answer of the slave would be for example:

device address	function	data	CRC-checksum
0x40	0x45	0x00	0x4284

Once the user configuration mode has been enabled, the following configuration commands are available until the power supply voltage is switched off and on again.

function code	function	Parameter	meaning
0x46	SetAdress	0x01...0x7F	new unit address

A new bus address is set using a standard data frame. In this case, the slave's response is as already described, with the **new address** already being used and the data byte **0x00** being appended after the function code in order to acknowledge a **successful address change**.

To change the device address from 0x40 to 0x50, the master would send the following telegram:

device address	function	new address	CRC-checksum
0x40	0x46	0x50	0x4248

In this case, the answer of the slave would be for example:

device address	function	data	CRC-checksum
0x50	0x46	0x00	0x43B1

8.5 Error handling

If a slave detects an **irregularity** during the communication, it is displayed as part of its response to the master. For this purpose, the **most significant bit of the function code is set** and an **error code** (1 byte) is transmitted in the data area of the frame. Possible error codes are:

error code	meaning
0x01	Unknown function code
0x02	CRC-error

Faulty function calls are **discarded** after acknowledgment and are not processed further. If **parity or timing errors** occur during function calls, the entire frame is discarded and is **not acknowledged** to avoid collisions in case of incorrect addressing.

8.6 CRC-calculation

The CRC checksum is calculated over all remaining characters of the frame. The **low-order byte** is then transmitted to **penultimate**, the **high-quality byte** at the **last** position of the telegram.

The respective receiver of a telegram calculates the checksum again and compares it with the received checksum.

The calculation algorithm corresponds to the **CRC16** standard using the **generator polynomial 0xA001** and the **CRC start value 0xFFFF**.