Operating instructions
LIMES

Hardness monitoring device for automated monitoring
of total hardness in the process water

Safety reliably produced.

RLSWacon
analytics GmbH

Contents

Contents

Foreword

Thank you for purchasing a LIMES analyser for online water hardness monitoring.

- The LIMES analyser for monitoring water quality is part of the water treatment system.
- This manual is intended for the manufacturer and the operator of such a system. It contains instructions for the installation and operation of the device.
- Please read this manual carefully before using the appliance.
- We recommend that you always keep the manual close to the appliance during operation.
- Only operate the appliance in accordance with the instructions in this manual.
- Under no circumstances will we be liable for damage caused by operating errors or failure to follow the instructions in this manual.
- Some details and instructions in this manual may differ from the appliance you have actually purchased. We reserve the right to make technical changes without prior notice.

You will always find the latest version of our documentation on our website www.rls-wacon.de.

The LIMES analyser automatically detects hardness breakthroughs in a water treatment system and issues a message if the limit value is exceeded. This message can be used, for example, to trigger regeneration of the water softener.

The LIMES analyser is not a device that prevents hardness breakthroughs.

Conversion for the units of water hardness

		°dH	°e	°fH	ppm	mval/l	mmol/l
German degree	1 °dH =	1	1,253	1,78	17,8	0,357	0,1783
English degree	1 °e =	0,798	1	1,43	14,3	0,285	0,142
French degrees	1 °fH =	0,56	0,702	1	10	0,2	0,1
ppm $CaCO_3$ (USA)	1 ppm =	0,056	0,07	0,1	1	0,02	0,01
mval/l Alkaline earth ions	1 mval/l =	2,8	3,51	5	50	1	0,5
mmol/l Alkaline earth ions	1 mmol/l =	5,6	7,02	10	100	2	1

The unit 1 ppm is used here contrary to the actual meaning of the word in the sense of 1 mg/l $CaCO_3$.

General information

Brief description

With the LIMES analyser, RLS Wacon offers a compact and very easy-to-use analyser for the automatic online monitoring of water treatment plants.
The measuring device works on the principle of "limit value monitoring with colour change" and provides all the important functions for reliable field use.

The LIMES analyser automatically carries out water analyses at regular intervals to determine the total hardness.

A limit value is specified by the user based on the type of indicator used. There are 4 indicators available for monitoring the total hardness.

If the limit value is exceeded, the device issues a message on a potential-free relay output. This message can be further processed by a softening controller. This allows functions such as automatic regeneration triggering to be realised.

The LIMES analyser is characterised by low maintenance costs. Up to 10,000 analyses can be carried out with one 750 ml indicator bottle. The input contact of the device can also be used to connect a flow monitor to the device. This means that the LIMES interrupts the analysis interval when the water softener is not in use and automatically resumes the analysis when it is restarted.

A first value suppression function is provided to prevent faults caused by the counter ion effect. If the limit value is exceeded, this first carries out a further control measurement before a hard water message is issued.

You will find more detailed and much more information about your new LIMES analyser in this manual.

Scope of delivery

The following items are included in the scope of delivery of a new appliance:

- LIMES analyser with 1.75m connection cables
- Operating instructions
- Front cover (transparent)

Optional accessories:

- Junction box (for electrical installation)
- LIMES connection set (for the water supply)
- Stopcock

Further information on accessories can be found from page 65.

General information

These operating instructions describe the installation and operation of the LIMES online analyser. Installation and commissioning may only be carried out by an authorised specialist.

The appliance may only be operated under the conditions described in these operating instructions. The device may only be used for the specified purpose. When installing and operating the analyser, all locally applicable regulations (e.g. EN, DIN, VDE, UVV) must be observed.

The analyser is used for the automatic determination of total water hardness in process water. Correct operation can only be guaranteed if the indicators and spare parts recommended by us are used.

Changes to the electrical wiring and programming may only be carried out by a qualified specialist.

The water connection lines to the appliance should be kept as short as possible and should not be laid together with mains cables or in their immediate vicinity. In the vicinity of strong electromagnetic radiators, interference with the analysis may occur; in this case, special interference suppression measures must be taken, in particular the EMC guidelines must be observed.

It is recommended that you always have access to the analyser when familiarising yourself with these operating instructions so that you can immediately understand the relationships and functions explained. As certain areas build on each other, it is advisable to work through the chapters in the specified order.

If you have any questions when using the analyser, you will receive support from our partners or us. You can reach us by telephone during normal business hours or by e-mail. The contact details of our technicians and partners can be found on our website.

Overview: LIMESBase and LIMESPlus

	LIMESBase	LIMESPlus
Parameters:		
Limit indicators Total hardness	0.1 / 0.5 / 3.0 / 7.0 °dH	
Bottle size indicator	750 ml	750 ml
Shelf life indicator in months	24	24
Contacts:		
Input contact (INPUT, start or stop analysis interval)	✗	✓
Relay output 1 (Border value alarm)	✓	✓
Relay output 2 (device fault or indicator message BoB)	✓	✓
Functions:		
Adjustable rinsing time	✗ Fixed 50 sec.	✓
First value suppression	✓	✓
Adjustable analysis interval	✗	✓
Available analysis intervals	10 min	5 / 10 / 20 / 30 min
Diagnostic mode	✗	✓
Technical data:		
IP protection class without front cover	IP43	IP43
IP protection class with front cover	IP54	IP54
Protection class	SKII	SKII

✓ - Available

✗ - Not available

Further information can be found on page 22 and 68.

Safety instructions and symbols used

In these operating instructions, you will find various safety instructions that indicate possible risks when handling the analyser. In detail, this concerns dangers for

- Persons,
- this product or associated devices and systems,
- the working environment.

Various symbols in these operating instructions indicate specific hazards to prevent personal injury and damage to the appliance. Please read the entire text before starting work.

This symbol indicates useful tips that contribute to a better understanding of the appliance.

This symbol is a general warning that indicates circumstances to be observed.

Pressure

This symbol is a warning that you must expect pressurised pipes.

Stimulating

This symbol indicates the danger of harmful and irritating chemicals. Avoid direct skin contact.

Tension

This symbol indicates the danger of electric current and the danger to persons and electronic components and assemblies.

Transport

Immediately upon receipt, check that the analyser is complete and has not been damaged in transit. The analyser is delivered safe for transport. Nevertheless, damage may occur during transport. Notify the deliverer immediately of any transport damage.

Protect the analyser from possible damage during transport. Remove any liquids that may still be inside beforehand. Remove the indicator bottle and close it to prevent the indicator from leaking.

Storage

Store the analyser in a dry place at temperatures between 0 - 45 °C and out of direct sunlight.

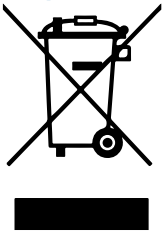
Disposal instructions

This page informs you about the procedure in the European Union with regard to the EU Directives 2002/96/EC and 2008/12/EC for the environmentally friendly disposal of an electrical device with a battery inside. The analyser is intended as professional electrical equipment for commercial use (B2B). The directives have been transposed into national law in the member states and may differ locally in some respects. If in doubt, please contact your local waste disposal company before disposing of the analyser.

Disposal of the battery

The analysers with display contain a CR2032 battery to store the date, time and status parameters. When replacing the battery, disposal in municipal waste is prohibited. The battery must also be removed before the device is handed in for recycling. Empty batteries can be handed in at public collection points. Alternatively, the battery can be handed in anywhere where a battery of the same type can be purchased.

Disposal of analysers taken out of service



The disposal obligation of the manufacturer of commercially used appliances applies to appliances placed on the market after 13 August 2005.
Electrical appliances labelled with this symbol must not be disposed of with municipal waste. Return the device to disposal and collection systems for electrical appliances for recycling. Alternatively, you can return decommissioned analysers to us or your dealer for disposal.

Dispose of the device and battery separately. For data protection reasons, remove or delete the SD card from the device before disposal.

Procedure for the dispatch of decommissioned analysers for disposal

1. **Please inform us before sending your analysers out of service**
   - by a short call to the number +49 (0)5121/28126-24
   - by sending an e-mail (stating the serial number) to support@rls-wacon.de
2. **Wait for an answer**
   - You will receive a free return label for warranty claims
3. **Clean the appliance before you pack it**
   - For the safety of transport service staff and our employees, we ask you to roughly remove reagents from tubes, pumps and measuring chambers
   - If possible, pack these affected components in tear-proof, liquid-tight bags
4. **Use the original packaging if possible**
   - If the original packaging is no longer available, please ensure that it is sufficiently padded
5. **Label your consignment with the words FOR DISPOSAL**
6. **Send the parcel to the following address**
   RLS Wacon analytics GmbH
   - Disposal service -
   Gropiusstr. 12
   D-31137 Hildesheim

Performance features

Fully automatic

The device recognises hardness breakthroughs fully automatically when the limit value of the indicator used is exceeded.
The analysis procedure is more reliable than manual methods and more sustainable than other measurement methods. Compared to swelling resin sensors or electrodes, no regeneration, calibration or replacement of the sensor element is necessary.

Intelligent and self-sufficient

The device does not need to be calibrated. Thanks to the integrated measurement technology and a two-stage analysis process with zero point measurement, external measurement influences such as contamination of the measuring chamber, turbidity of the sample and extraneous light influences are recognised and eliminated when evaluating the analysis.
The integrated full-colour sensor is one of the central components for the self-sufficient operation of the device and does not need to be maintained or replaced.

Selectable interval time (LIMESPlus)

The interval time between two measurements can be set in 4 stages:
Interval times of 5 / 10 / 20 / 30 minutes can be selected. Analyses can also be started via an external switch or paused when the system is at a standstill.

Self-calibrating

Hardness breakthroughs are reliably recognised through the use of LHV limit indicators. Our indicators are calibrated to a fixed limit value during production. You select the indicator to suit your requirements. No further configuration or calibration is necessary.

First value suppression

After a bad measurement, a reference measurement is carried out every 4 minutes to evaluate the result. This prevents false alarms due to the counter ion effect after a system shutdown.

Extensive alarm functions

If a limit value is exceeded, an alarm is issued by switching a potential-free relay. This alarm output can be connected to a control room for signalling or used to activate a horn, close a valve or activate a programme for regenerating a softening system.

Performance features

Diagnostic programme (LIMESPlus)

If technical problems occur on the device, a fault message is issued by switching a potential-free relay. The detailed diagnostics programme in the *LIMESPlus* enables all device functions to be checked step by step. This ensures that the device is thoroughly checked and the cause of the error message is clearly identified.

Minimal maintenance effort

Depending on the set measuring interval or the frequency of the measurements, the measuring chamber must be cleaned. The peristaltic pump cassette and sealing rings typically only need to be replaced every 24 months.

Efficient indicator consumption

The indicator bottle is easy to replace. A freshly inserted 750 ml bottle allows up to 10,000 analyses.

Digital input contact (INPUT, start or stop analysis interval) only with LIMESPlus

The potential-free switch of a flow monitor, a timer or another status switch can be connected to this input, for example. If the contact is open, no analyses are carried out at the programmed interval.
Alternatively, this input can be used as a start input for analyses.

Two potential-free relay outputs

The potential-free relay outputs can be used to signal a limit value alarm, a device fault or an indicator message BoB, e.g. to a control centre. Alternatively, signalling devices or operating valves can be switched.

Specifications

General specifications

Parameters	Value / Range	
Power supply	**100 - 240 VAC (50/60 Hz)**	
Protection class	SKII	
Power consumption	15 VA (in operation)	
Load capacity of the relay outputs	2.5 A per relay	
IP protection class	Without front cover IP43	with front cover IP54
Storage temperature	0 °C - 45 °C	
Ambient temperature	10 °C - 45 °C (from LHV-7.0: 15 - 45 °C)	
Sample water temperature	5 °C - 40 °C	
Air humidity	20 - 90 % RH (without ice or condensation)	
Inlet water pressure	min: 0.5 bar - max: 5 bar / recommended 1 - 2 bar	
Inlet water in general	clear, colourless, solid-free, without gas bubbles	
Water quality requirements for measuring water hardness	pH:	4 - 10
	Iron:	< 3 ppm
	Copper:	< 0.2 ppm
	Aluminium:	< 0.1 ppm
	Manganese:	< 0.2 ppm
	Acid capacity:	KS 4.3 < 5 mmol/l

Note on oxidising agents:
Oxidising agents such as calcium hypochlorite, chlorine, chlorine dioxide, sodium hypochlorite or ozone above the limit values permitted in "TrinkwV 2012" attack the dye contained in the indicator and interfere with the measurement. An exact determination of the water hardness is therefore no longer guaranteed. An activated carbon filter installed upstream of the analyser can remove these oxidising agents from the sample water and thus enable the water hardness to be determined correctly.
The capacity of an activated charcoal filter is used up during operation. The activated carbon filter must therefore be replaced at regular intervals. The effectiveness of the activated charcoal filter can be checked using Caldur® test sets.

Signal input and outputs

Parameters	Value / Range
Relay outputs	2 Relay 2.5 A / 250 VAC 2.5 A / 100 VDC as potential-free outputs NC/NO The relays provide the following functions: • Limit value alarm (relay output 1) • Device fault or indicator message BoB (relay output 2)
Input contact (INPUT, start or stop analysis interval) only with LIMESPlus	Galvanically isolated input contact for connecting a potential-free contact • Start analyses (external analysis interval) • Flow monitor (analysis interval interruption during system standstill)

Specifications

Technical data

Parameters	Value / Range	
Installation	Wall mounting in closed rooms	
Dimensions	without lid:	250 x 330 x 60 mm (W x H x D)
	with lid:	250 x 330 x 90 mm (W x H x D)
Weight	without lid:	approx. 1.8 kg
	with lid:	approx. 2.1 kg
Inlet/outlet connection	Plastic hose with 1/4 inch outer diameter	

Analysis properties

Parameters	Value / Range
Measuring principle	Colourimetric method
The limit value alarm is defined by the indicator used	• Total hardness limit indicators: **Indicator** — **Limit value** LHV - 0.1 — 0.1 °dH LHV - 0.5 — 0.5 °dH LHV - 3.0 — 3 °dH LHV - 7. — 07 °dH *Further information can be found on page 69*
Indicator consumption	• < 0.10 ml / analysis • Up to 10,000 analyses per 750 ml indicator bottle
Accuracy	Measurement accuracy: • ± 15 % of the limit value of the respective indicator used
Durability of the indicators	24 months from date of manufacture
Water consumption	• Approx. 2 litres / analysis • The water consumption varies depending on the inlet pressure and the set flush duration

Maintenance intervals

Interval	Maintenance work
every 6 months	Cleaning the measuring chamber
	In the case of high ambient and water temperatures or water with a high organic load, the cleaning intervals may need to be shortened.
After 24 months of operation	Installation Maintenance set: Changing the hose pump cassette and seals

Further information can be found on pages 52 and 67

Installation requirements

The LIMES analyser may only be used to determine the total hardness of water.

Changes to the electrical wiring and parameterisation may only be carried out by an authorised and experienced specialist.

Tension

The system to be monitored must fulfil the following conditions:

- The maximum permissible load capacity of the relay outputs and the total power of the system must not be exceeded by the connected load.
- All inductive loads (valves, motors, contactors, transformers) in the system must be equipped with suitable overvoltage protection (e.g. RC element, varistor, diode, etc.).
- If there are external devices with a high mains interference level in the vicinity of the control unit, these must be reduced with suitable measures or appropriate external interference suppression measures (mains filter) must be taken at the supply voltage input of the control unit.

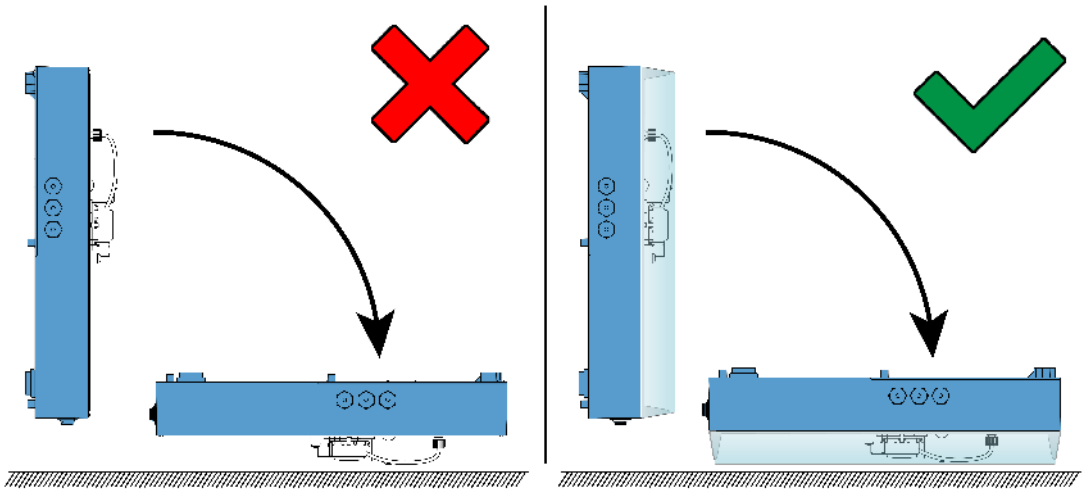


Illustration 1LIMES - Note on storing the analyser

Do not place the analyser on its front without the housing cover. Hoses, connections and other components could be damaged.
Always use the housing cover when working on the rear of the analyser.

Wall mounting LIMES

The LIMES analyser can be mounted directly.

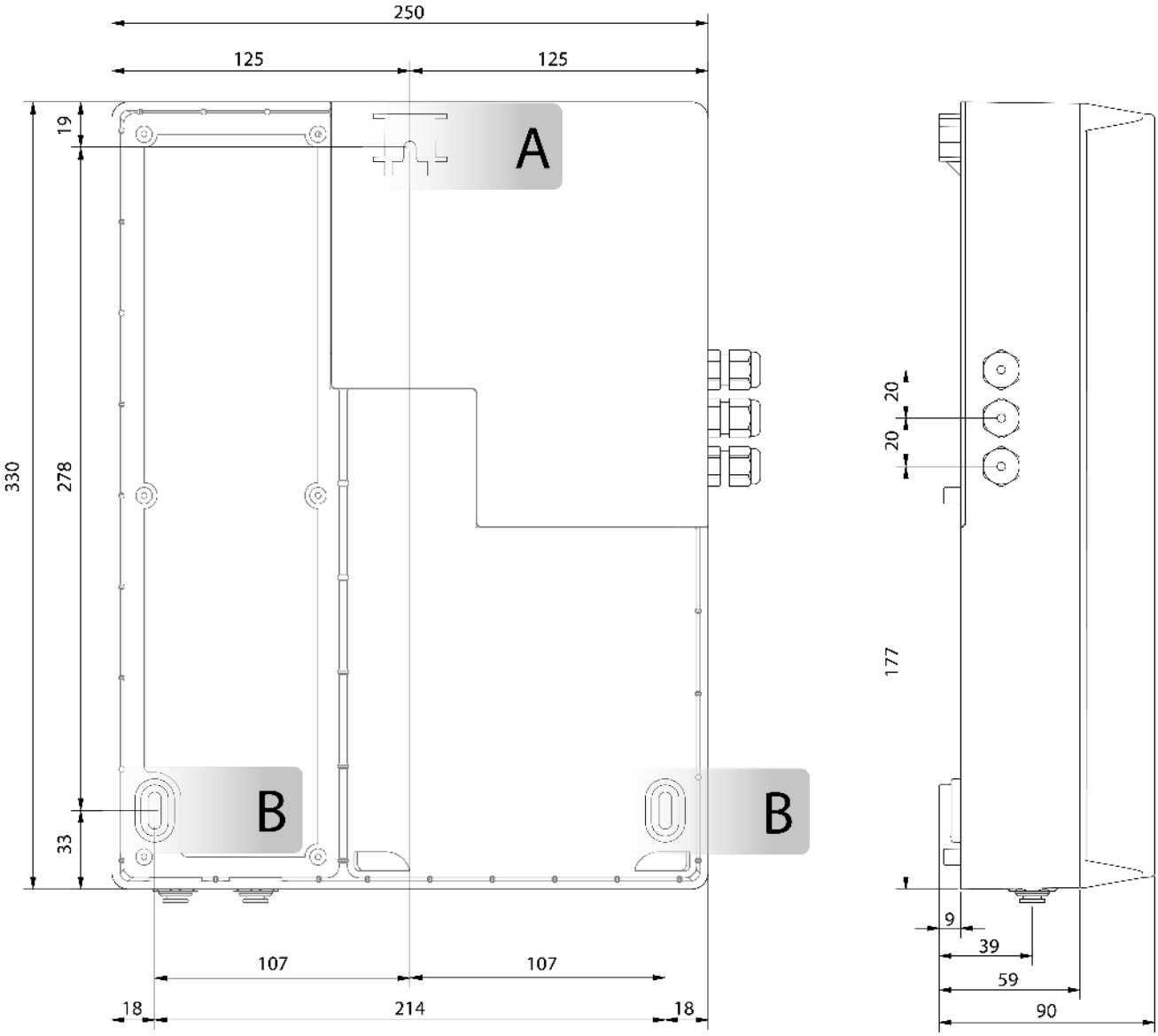


Illustration 2LIMES - rear and side view (figures are in mm)

The appliance is attached to a wall or suitable supporting structure using 3 screws (max. Ø 5 mm).

1. Select a suitable installation location
2. Firstly, pre-assemble a screw (A) on the wall
3. Suspend and align the analyser
4. Finally, attach to the wall from the front using two screws (B)

Tension

Do not install the analyser under dripping pipes.

Wall-mounted junction box (optional)

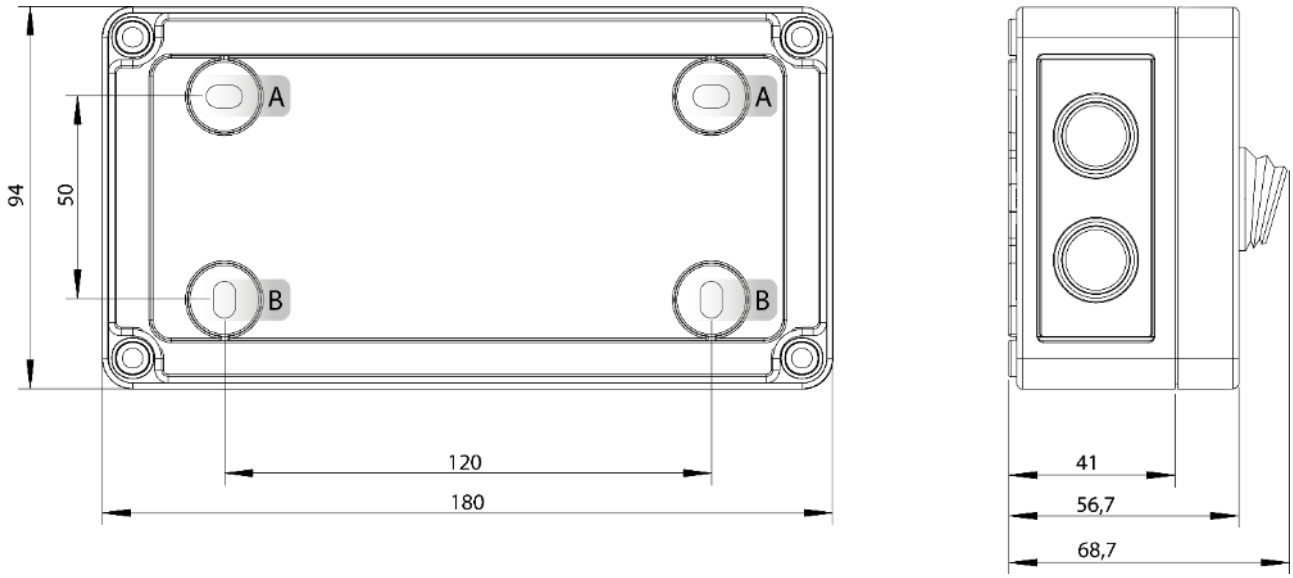


Illustration 3LIMES junction box - front and side view (figures are in mm)

The junction box is attached to a wall or suitable supporting structure using 4 screws (max. Ø 6 mm).

1. Select a suitable installation location
2. Firstly, pre-mount to the wall with two screws (A)
3. Aligning the junction box
4. Finally, fix to the wall with two screws (B)

Tension

Do not install the junction box under dripping pipes.

Connect the supply line to the sample water and the sewer

The connections for the inlet and outlet are designed for flexible plastic hose with an outer diameter of 1/4 inch.

A manual shut-off valve must be provided between the preparation system and the analyser. A suitable valve can be found in the product catalogue or in the spare parts list. When connecting to a drinking water pipe, the installation must be carried out in accordance with EN 1717. The drain must lead into an open channel via a short connection. The drain line must remain unpressurised.

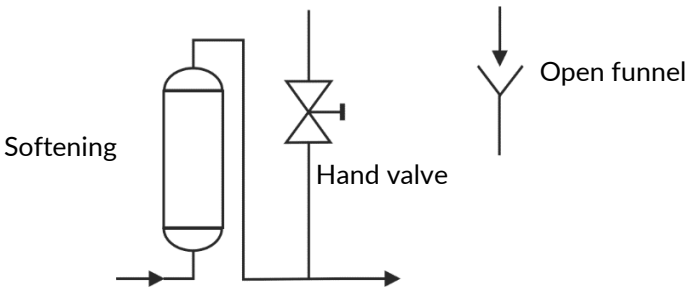


Illustration 4Connection of the water inlet and outlet

Ensure that the inlet and outlet are not interchanged. The inlet is located on the left-hand side of the inlet filter.

Pressure

The inlet pressure of the water sample must be between 0.5 and 5.0 bar.

The recommended inlet pressure of the water sample should be between 1 and 2 bar.

The hose length of the water drain must not be longer than 2 metres and must lead vertically downwards. The system must be able to depressurise freely against atmospheric pressure (no back pressure). The water is drained into an open funnel or drain without pressure.

Device overview

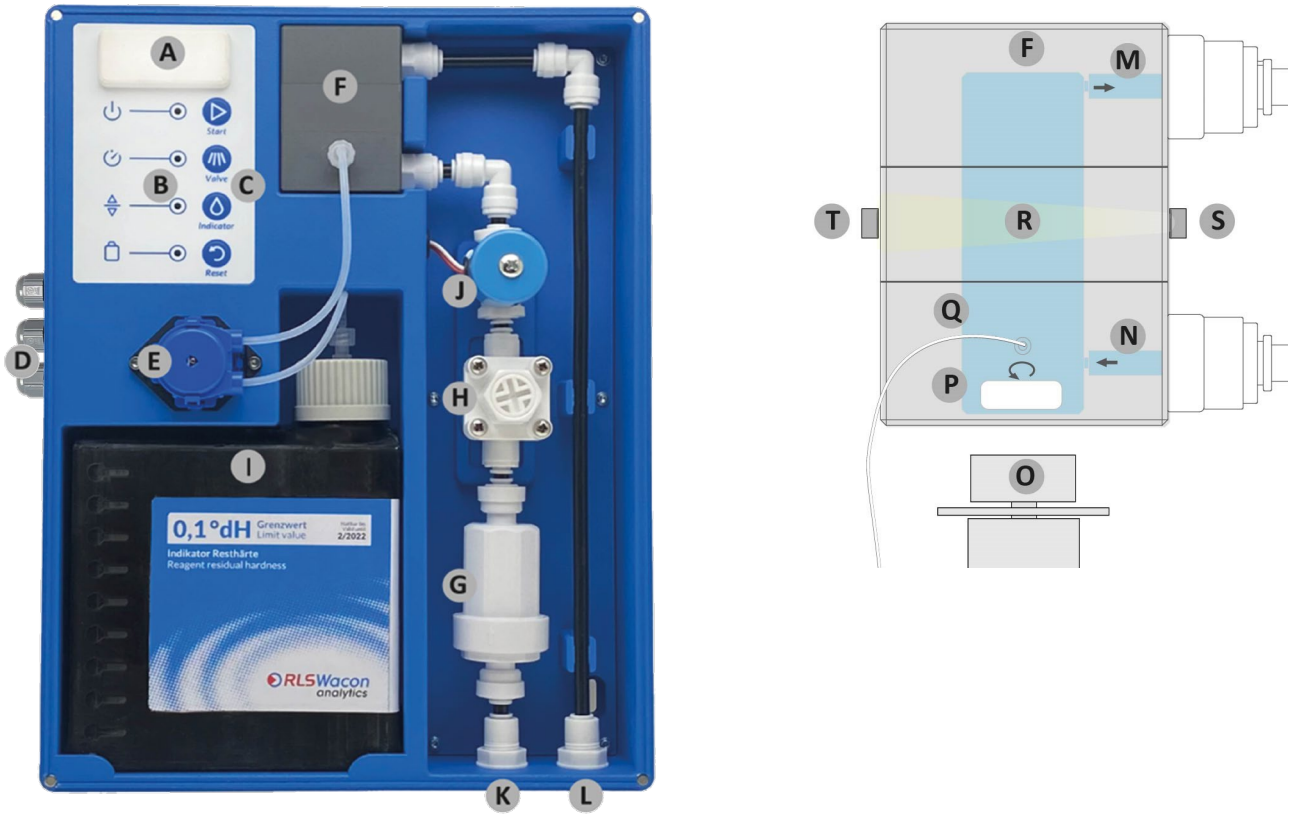


Illustration 5LIMES analyser with indicator bottle installed (left), Schematic representation of the measuring chamber (r.)

Position	Description of the	
A	Control system	
B	LED display	
C	Control buttons	
D	Cable bushing	
E	Dosing pump (peristaltic pump cassette)	
F	Measuring chamber	
G	Filters	
H	Pressure regulator	
I	Indicator bottle 750 ml	
J	Solenoid valve	
K	Water inlet / sample water	Push-in connector for plastic hoses with 1/4 inch outer diameter
L	Water drainage	
M	Measuring chamber drain	
N	Measuring chamber inlet	
In the housing / not visible		
O	Magnetic agitator	
P	Agitator blade	
Q	Injector	
R	Optical measuring section	
S	Actuator board (LED)	
T	RGB sensor	

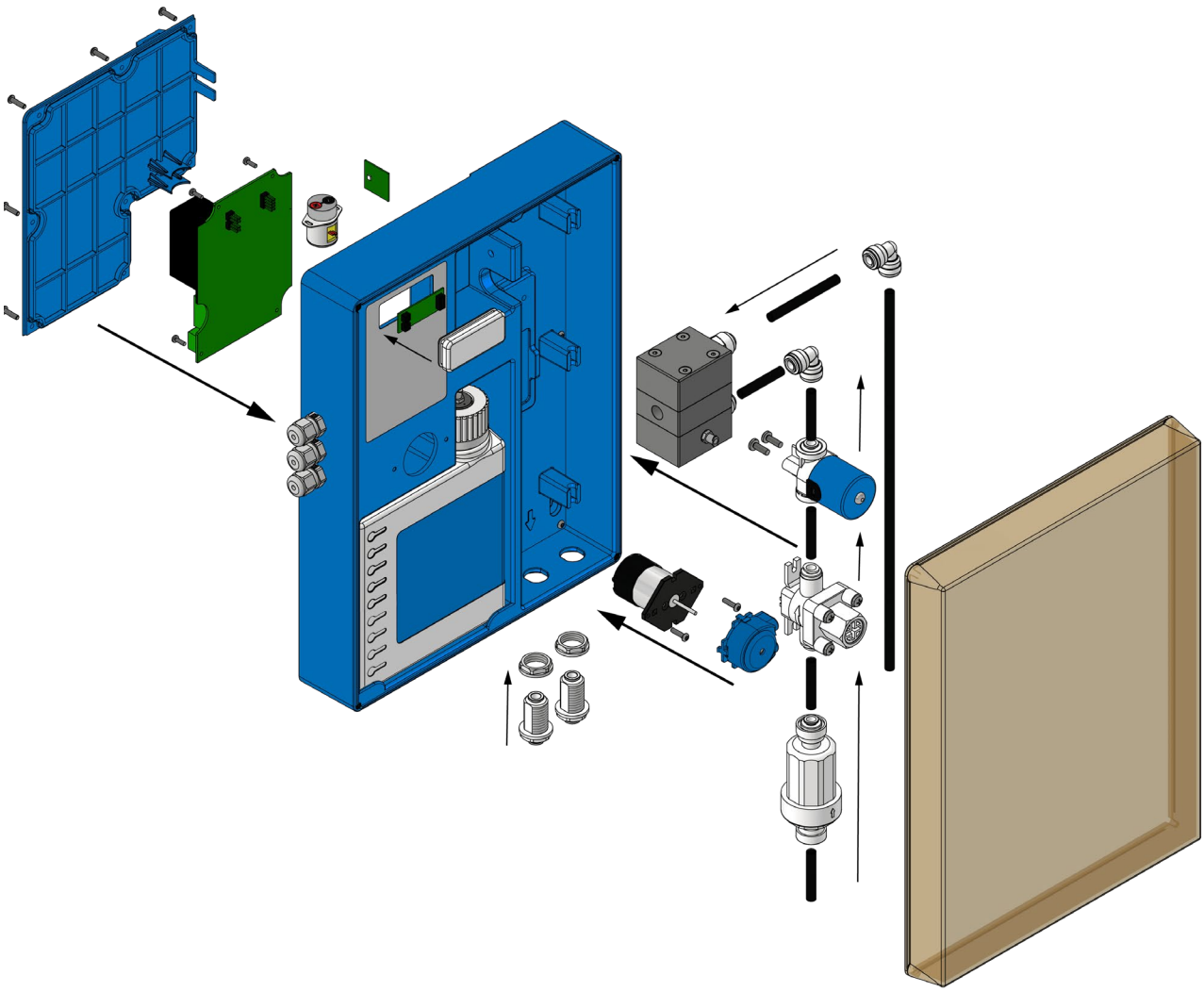


Illustration 6LIMES exploded view - assembling the components

Observe the correct positioning and flow direction when replacing components or carrying out other work on the analyser.

Displays and front panel

There are 4 LEDs on the front of the LIMES analyser to indicate the operating status and 4 buttons for operating the device.

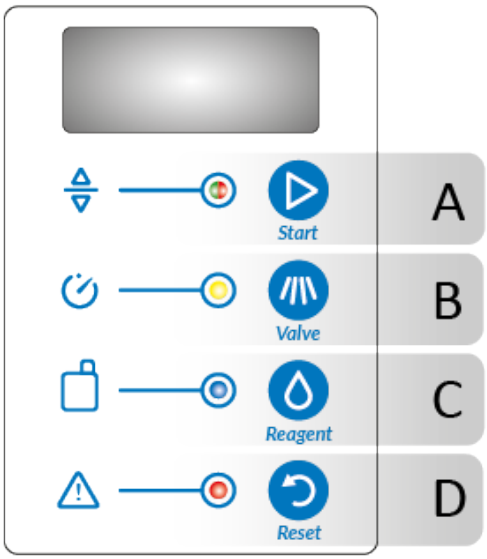


Illustration 7LIMES - Device overview / front foil

The operating status is indicated by the LED display:

LED	Colour	Information
A	Green (two-colour LED)	Below limit value
A	Red (two-colour LED)	Limit value exceeded
B	Yellow	Analysis active
B	Flashing yellow	Input contact open, e.g. through flow monitor
C	Blue	Provide indicator
C	Flashing blue	BoB message
D	Red	Device fault

Further information can be found from page 36 and 47.

Overview of the configuration elements

The LIMESPlus analyser has configuration elements that are located on the plug-in board under the rubber stopper:

- 1 Rotary switch for setting the flush time (A)
- 4 Programme switches for configuring the operating requirements (B)

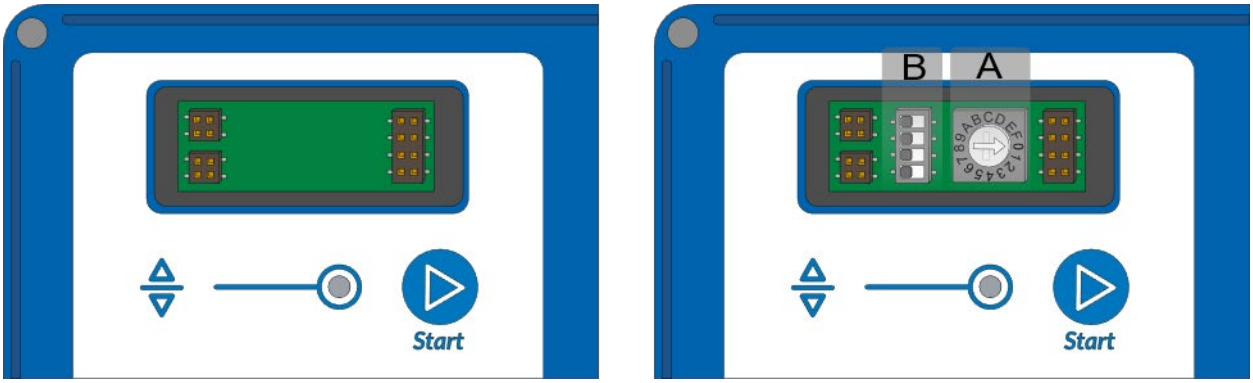


Illustration 8Plug-on board, LIMESBase (l.) and LIMESPlus (r.)

Position	Information
A	Rotary switch for setting the flush time
B	Programme switch for configuring the operating requirements

When upgrading from LIMESBase to LIMESPlus, note the plug-in direction of the plug-in board.

Upgrade Kit from LIMESBase to LIMESPlus

To upgrade a LIMESBase, you need an upgrade kit containing the necessary components (LIMESPlus plug-in board, board extractor, LIMESPlus rubber cap). The LIMESPlus functions are activated by inserting the LIMESPlus plug-in board.

Further information can be found on page 8 and 68.

Overview of the electrical connections (main board):

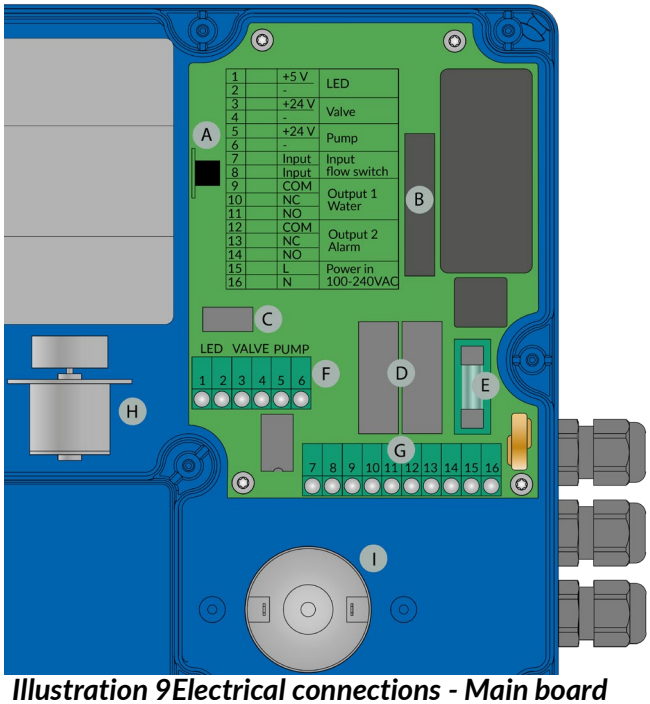


Illustration 9Electrical connections - Main board

Position	Description of the						
A	RGB sensor						
B	Controller						
C	Magnetic agitator connection (H)						
D	2x relay						
E	Microfuse (5 x 20 mm) 400 mA (slow)						
F	Connections:						
	- Actuator board (LED)	**1** (red):	+ 5V	**2** (black):	-		
	- Solenoid valve (Valve)	**3** (red):	+ 24V	**4** (white):	-		
	- Dosing pump (Pump) (I)	**5** (red):	+ 24V	**6** (black):	-		
G	Connections:						
	- Input contact (Input flow switch) Start or stop	**7** (Black 1):		**8** (Black 2):			
	- Relay output 1 (Output 1 Water) Limit value alarm	**9** (white):	COM	**10** (Brown):	NC	**11** (green):	NO
	- Relay output 2 (Output 2 Alarm) Device fault / indicator message BoB	**12** (yellow):	COM	**13** (grey):	NC	**14** (Pink):	NO
	- Power supply (Power in)	**15** (Brown):	L	**16** (blue):	N		
H	Magnetic agitator (connection C)						
I	Dosing pump (connection 5 and 6)						

Electrical installation

The following instructions must be observed when working on the electrical connections:

- Screw-type and plug-in connection terminals are suitable for rigid single-core conductors up to 2.5 mm². Fine-core conductors up to 1.5 mm² can be connected with ferrules, with plastic collars or up to 2.5 mm² without plastic collars. A slotted screwdriver SL with a maximum blade width of 3 mm must be used to loosen a terminal.

- The relevant VDE regulations must be observed for all installation work.

Tension

Before opening the housing, de-energise the appliance and secure it against unintentional restarting.
The installation of a suitable electrical disconnecting device is the responsibility of the system operator.

Tension

The maximum connected load of all loads must not exceed 250 VAC / 2.5 A or 100 VDC / 2.5 A. Provide suitable interference suppression for inductive loads.

Tension

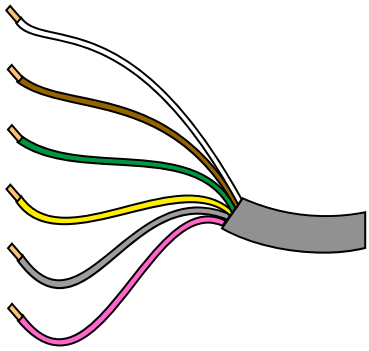
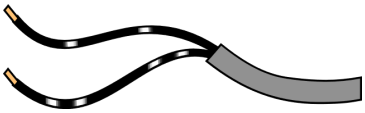
Work on the electrical equipment of the system/machine may only be carried out by a trained electrician!

Electrical installation

Overview of the electrical connections (cables):

The standard scope of delivery (without junction box) includes the LIMES analyser with 3 cables fed out. The cables are 1.75 m long, stripped and the individual wires are fitted with wire end ferrules.

Observe the function and colour coding of the wires during electrical installation.

Function	Name	Colour	Illustration
Power supply (Power in)	L	Brown	
	N	Blue	
Relay output 1 (Output 1 Water) Limit value alarm	COM	White	
	NC	Brown	
	NO	Green	
Relay output 2 (Output 2 Alarm) Device malfunction/ Indicator message BoB	COM	Yellow	
	NC	Grey	
	NO	Pink	
Input contact (Input flow switch) Start or stop	1	Black 1	
	2	Black 2	

Tension

Before opening the housing, de-energise the appliance and secure it against unintentional restarting.
The installation of a suitable electrical isolating device is the responsibility of the system operator.

Tension

The maximum connected load of all loads must not exceed 250 VAC / 2.5 A or 100 VDC / 2.5 A. Provide suitable interference suppression for inductive loads.

Tension

Work on the electrical equipment of the system/machine may only be carried out by a trained electrician!

Overview of the electrical connections (junction box):

The optional connection box for the LIMES analyser ensures easy access to the existing electrical connections and has an on/off switch.

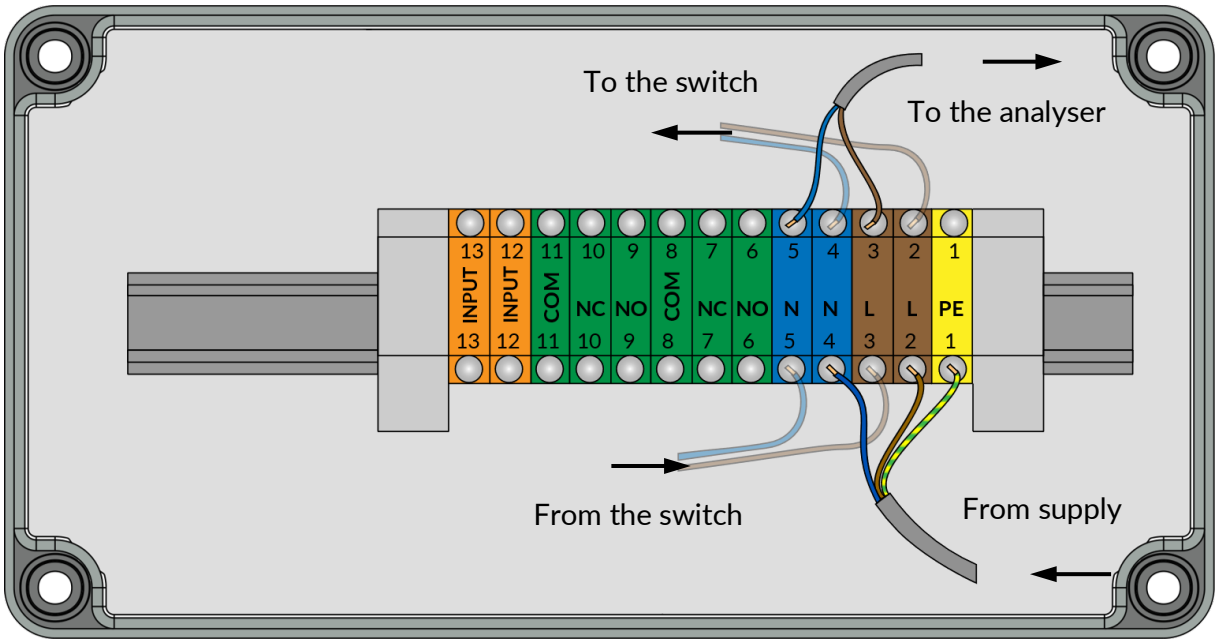


Illustration 10Electrical connections - junction box

Position	Designation	Function
1	PE	
2	L power in	Connection for supply voltage, with wiring for On/off switch on the junction box
3	L power out	Switched supply voltage for the LIMES analyser
4	N power in	Connection for supply voltage, with wiring for On/off switch on the junction box
5	N power out	Switched supply voltage for the LIMES analyser
6	NO	Relay output 2 (device fault or indicator message BoB)
7	NC	
8	COM	
9	NO	Relay output 1 (limit value alarm)
10	NC	
11	COM	
12	Black (1)	Input contact (INPUT, start or stop analysis interval)
13	Black (2)	

A detailed description of all connections can be found on the following pages.

Establishing the supply voltage (with junction box):

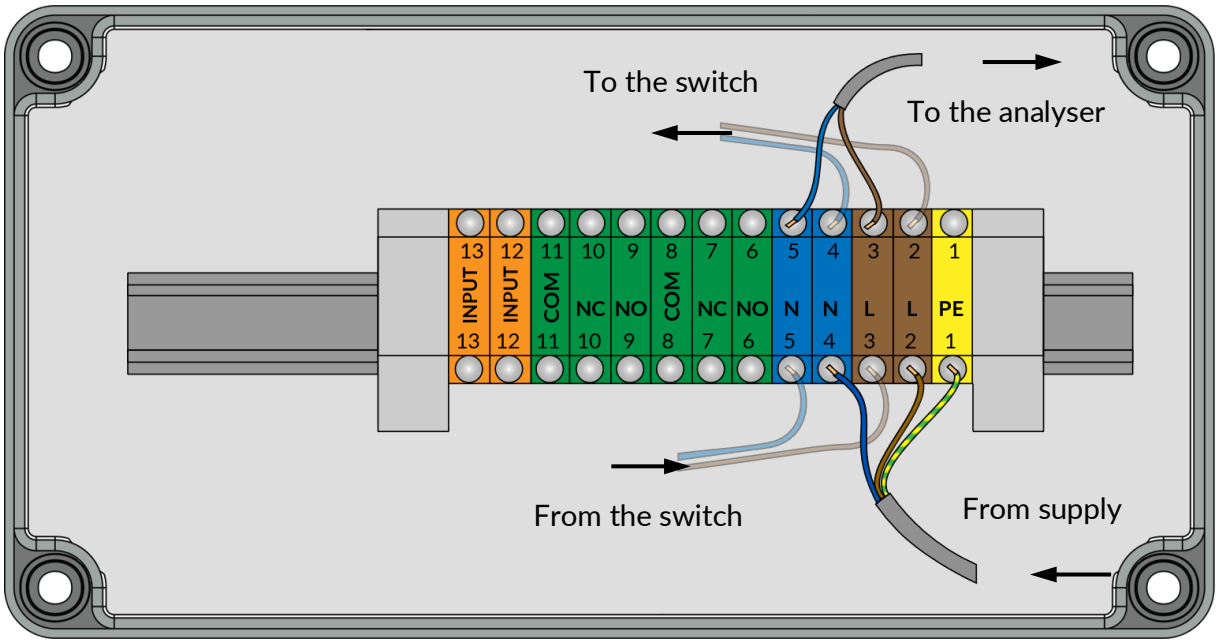


Illustration 11Electrical installation - supply voltage (junction box)

Tension

Work on the electrical equipment of the system/machine may only be carried out by a trained electrician!

To establish the supply voltage, proceed as follows:

1. Insert the de-energised supply cable into the junction box
2. Strip the cable (as well as PE, L and N), use wire end ferrules if necessary
3. Connect PE, L and N as shown in the illustration (marked in red)

Observe the other wiring to and from the appliance switch and to the analyser. Only connect your supply cable to the free terminals provided for this purpose.

Establishing the supply voltage (without junction box):

Designation	Colour
L	Brown
N	Blue

Connect the connection cable to your supply voltage in accordance with the applicable standards and directives.

Connection of the relay outputs

Relay output 1 (limit value alarm)
Terminal 11/10/9 - white, brown, green

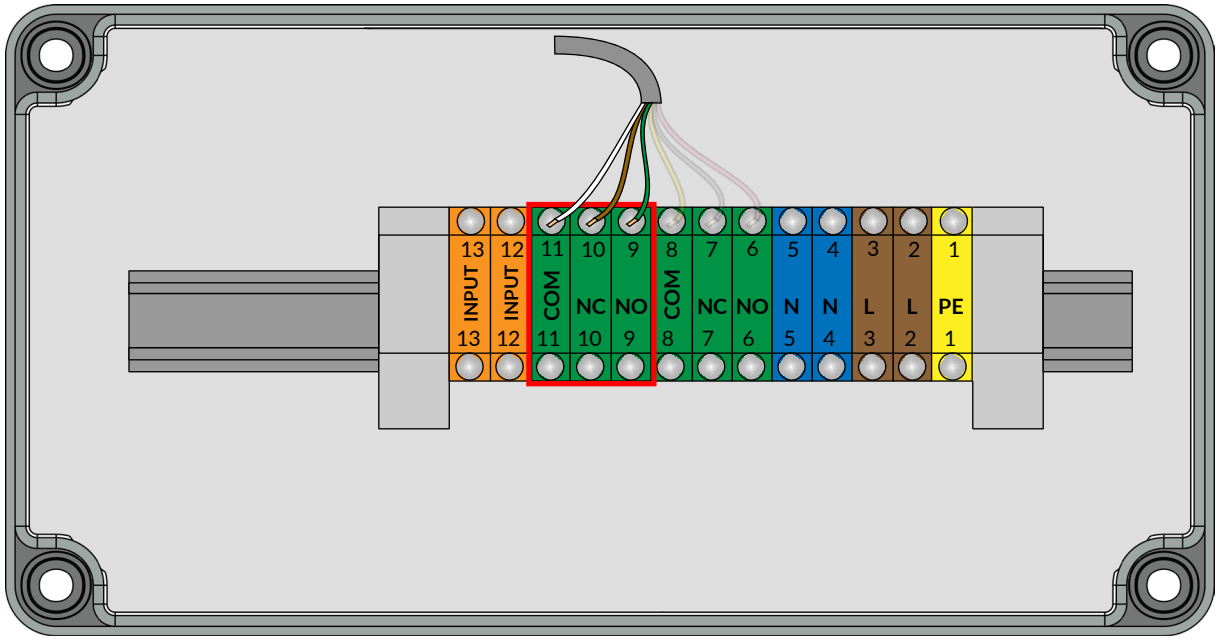


Illustration 12Electrical installation relay output 1 (junction box)

Relay output 1 is energised when a limit value is exceeded and switches the connection from COM to NO. An indicator light or horn can be connected to relay output 1 to signal that a limit value has been exceeded.

If the limit value is exceeded, relay output 1 remains switched in the position (connection from COM to NO) until the measured water hardness is below the limit value again. The limit value is then cancelled again and relay output 1 switches back (connection from COM to NC).

Relay output 2 (device fault or indicator message BoB)
Terminal 8/7/6 - yellow, grey, pink

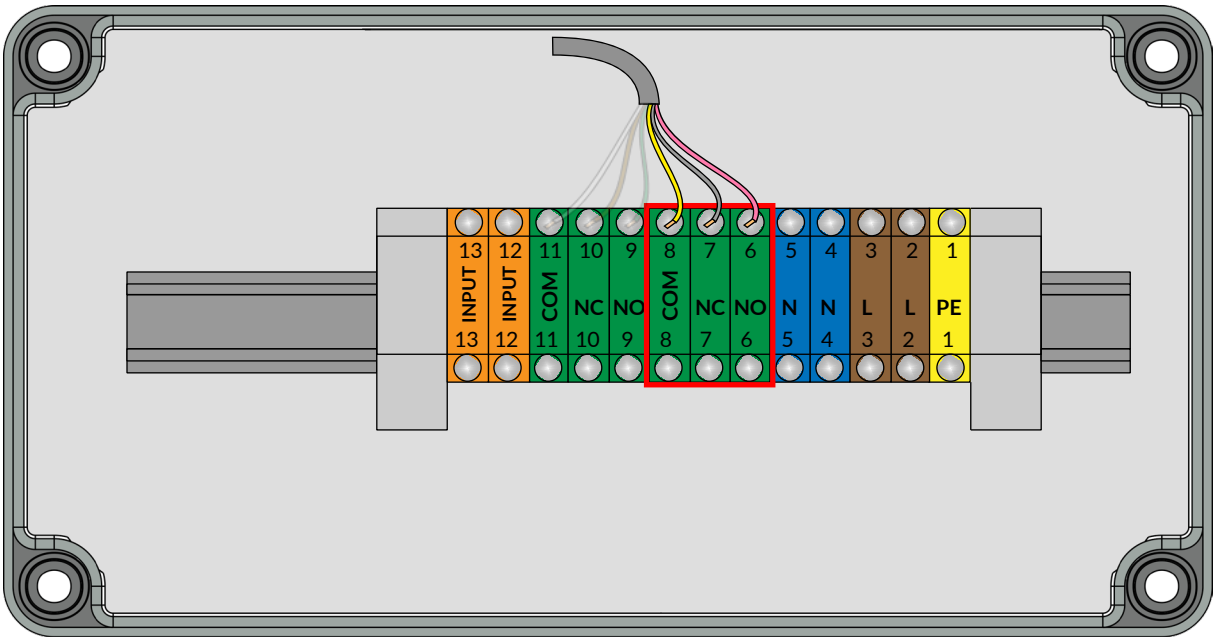


Illustration 13Electrical installation - Relay output 2 (junction box)

Relay output 2 is used to signal device faults or indicator message BoB (low indicator).
If the analyser is in normal operation and there is no fault, relay output 2 is energised and the connection is switched from COM to NO (wire breakage protection). If a fault is detected, relay output 2 drops out and establishes the connection from COM to NC.

Relay 2 is always energised in normal operation:
Connection COM to NO (wire breakage protection)

The following faults are signalled:

- Power failure
  - The analyser is switched off (relay output 2 is de-energised).
- Indicator message
  - The content of the indicator bottle is less than approx. 10 %.
- Zero sample error (insufficient brightness before adding the indicator)
  - The measuring chamber is dirty.
  - The test sample/test water is contaminated or cloudy.
  - The electronics are defective.
- Measurement error (no sufficient difference in the measured value before and after the addition of the indicator)
  - No indicator was dosed.
  - There is no water in the measuring chamber.
  - There was no mixing (agitator blade missing or magnetic agitator is defective).

Input contact connection

Input contact (INPUT, start or stop analysis interval)
Terminal 13/12 - Black 2, Black 1

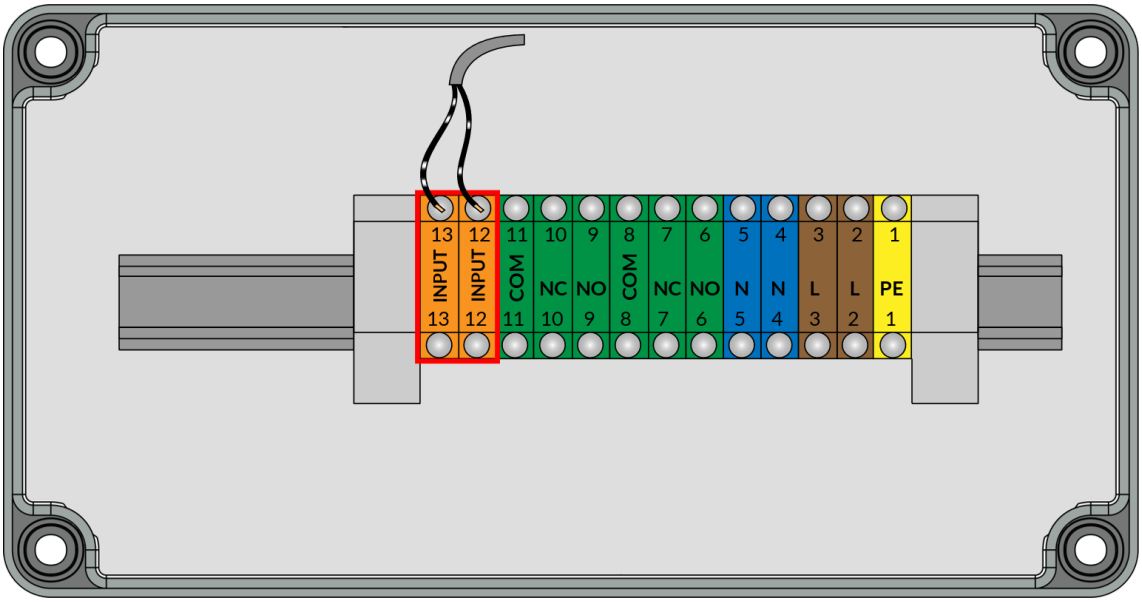


Illustration 14Electrical installation Input contact (junction box)

Potential-free flow monitors, switches or controls can be connected to the input contact to start or pause analyses or to run an analysis interval. No external voltage may be applied to the input contact.

Information regarding the wiring of the input contact can be found on page 34

Information on the function of the input contact depending on the programme switch can be found from page 41

It is recommended to connect the input contact accordingly in order to avoid unnecessary messages when a limit value is exceeded during a regeneration.

Tension

Only connect potential-free switches to the terminals. Connecting an external voltage source can damage the device.

Wiring example 1: Connection to control room (LIMESPlus only)

Attention

- Relay output 1 **energised** when limit value is exceeded **(COM, NO)**
- Relay output 2 for device faults or indicator message BoB **de-energised (COM, NC)**
- Wiring of the input contact (INPUT), see page 34

Marked position for relay 1 and relay 2: appliance de-energised - relay de-energised

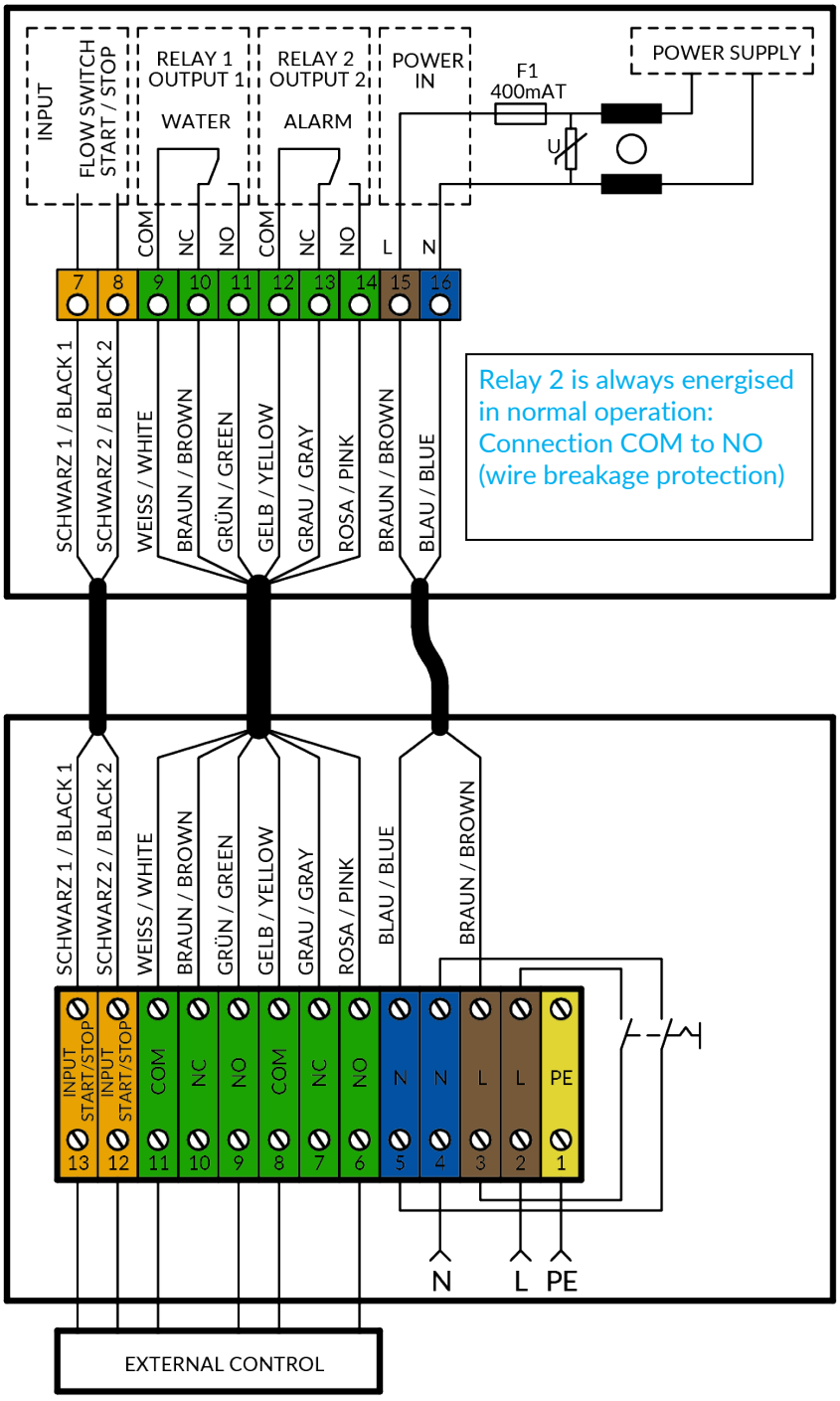


Illustration 15Circuit diagram 1 - LIMESPlus

Wiring example 2:
Connection to a reverse osmosis system (connection potential free switch, LIMESPlus)

Connection to an osmosis system:
Relays 1 and 2 are wired as shown in the circuit diagram. In normal operation, there is continuity between terminals 11 and 6 with this wiring. If a limit value is exceeded or a device fault is detected, relay 1 or 2 switches and continuity between terminals 11 and 6 is interrupted.

Attention

- Relay output 1 **energised** when limit value is exceeded **(COM, NO)**
- Relay output 2 for device faults or indicator message BoB **de-energised (COM, NC)**
- Wiring of the input contact (INPUT), see page 34

Marked position for relay 1 and relay 2: appliance de-energised - relay de-energised

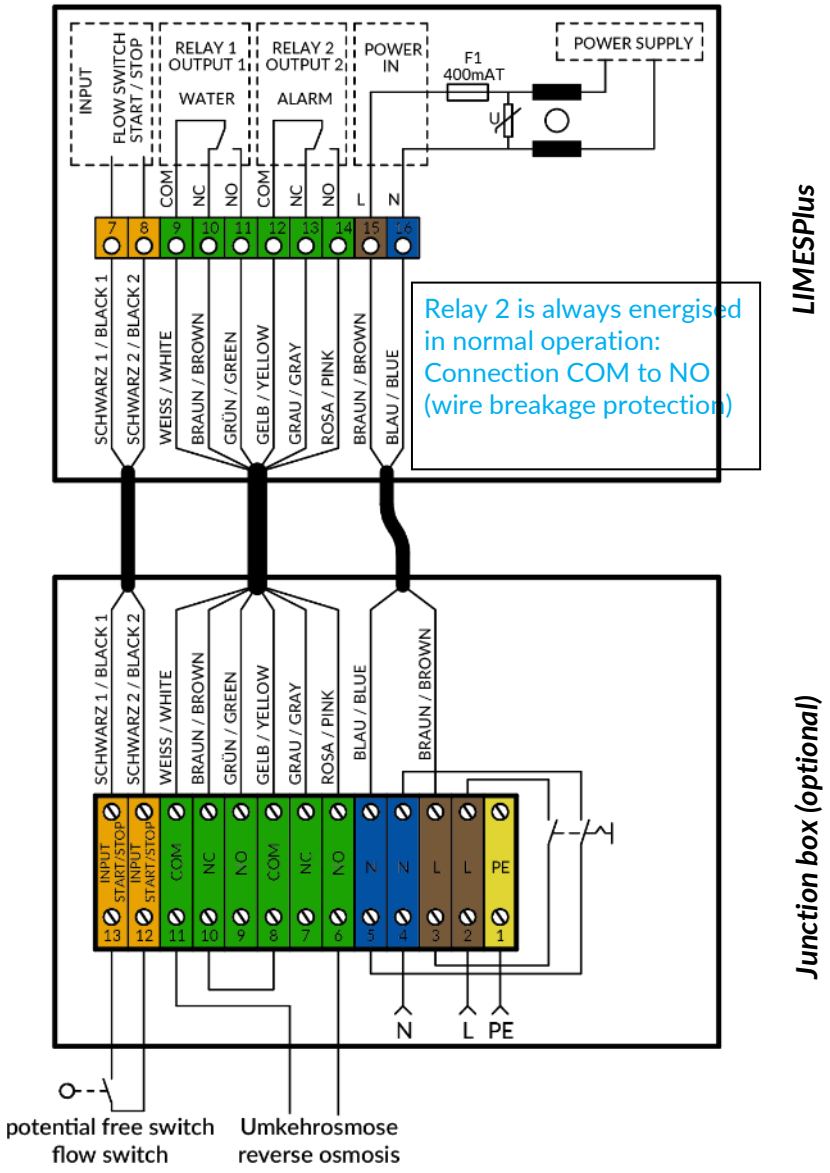


Illustration 16Circuit diagram 2 - LIMESPlus

Wiring example 3: Connection to external control unit (LIMESPlus only)

Attention

- Relay output 1 **energised** when limit value is exceeded **(COM, NO)**
- Relay output 2 for device faults or indicator message BoB **de-energised (COM, NC)**
- Wiring of the input contact (INPUT), see page 34

Marked position for relay 1 and relay 2: appliance de-energised - relay de-energised

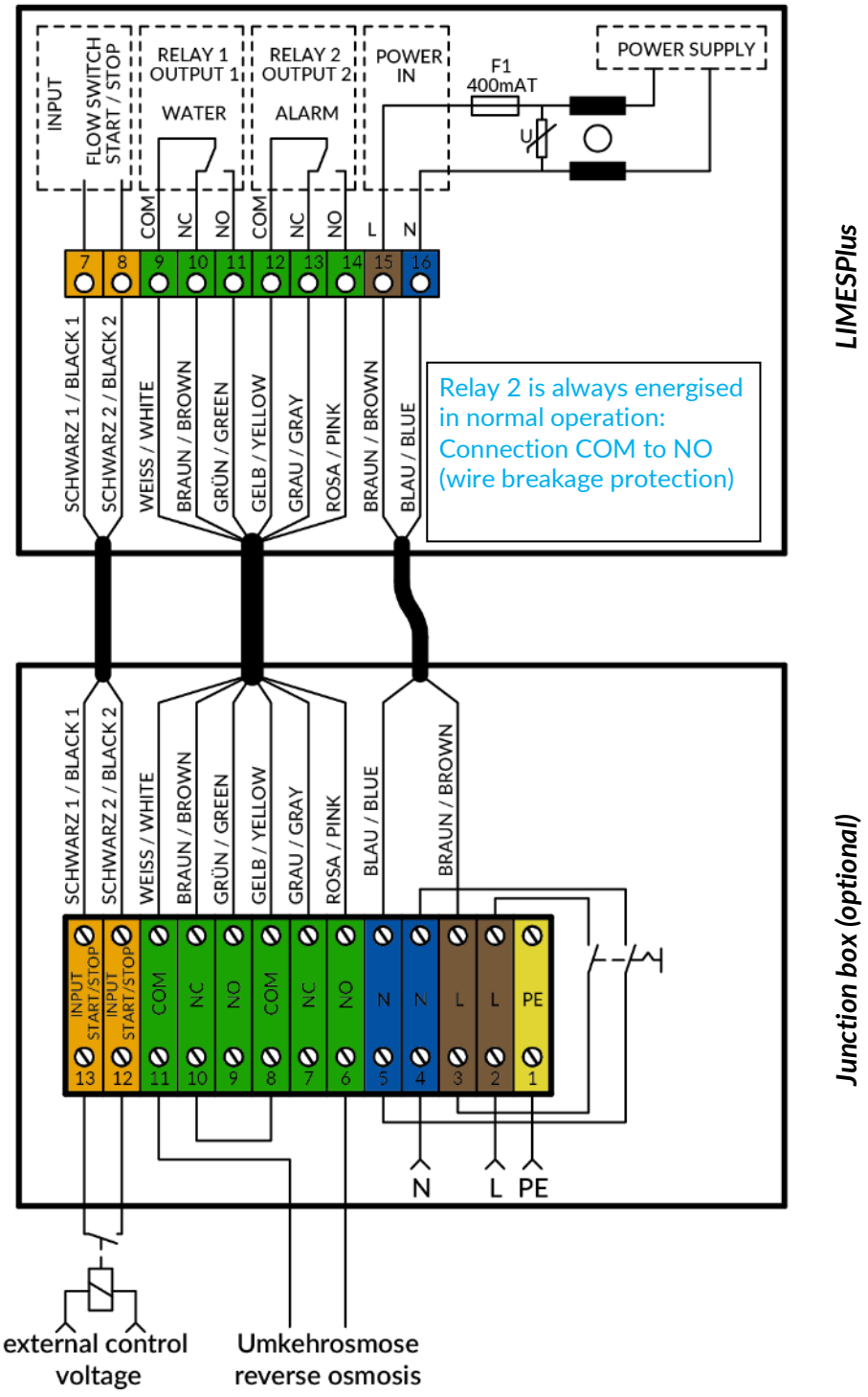


Illustration 17Circuit diagram 3 - LIMESPlus

Wiring example 4 and 5: INPUT input contact (LIMESPlus only)

Potential-free flow monitors, switches or controls can be connected to the input contact to start or pause analyses or to run an analysis interval. No external voltage may be applied to the input contact.

Information on the function of the input contact depending on the programme switch can be found from page 41

It is recommended that the input contact is wired accordingly to avoid unnecessary messages when a limit value is exceeded during a regeneration.

Tension

Only connect potential-free switches to the terminals. Connecting an external voltage source can damage the device.

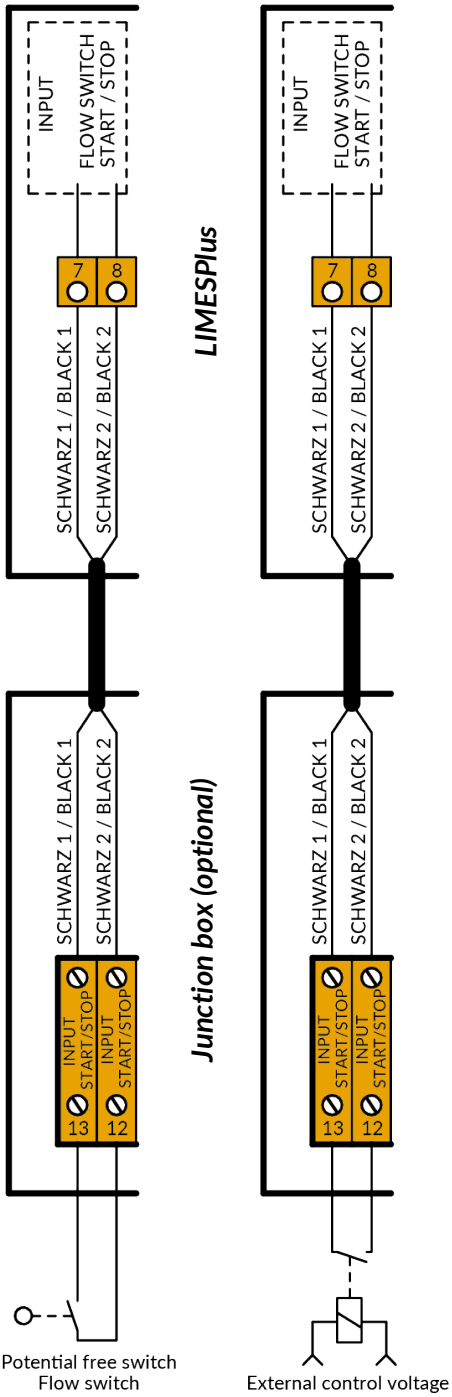


Illustration 18Circuit diagram 4 and 5 - LIMESPlus

Wiring example 6: LIMESBase

Attention

- Relay output 1 **energised** when limit value is exceeded **(COM, NO)**
- Relay output 2 for device faults or indicator message BoB **de-energised (COM, NC)**

The input contact function is not active on the LIMESBase. Controls or switches connected to the input contact do not start or stop analyses. To enable the input contact function, you need an upgrade kit, which you can purchase from us. *Further information can be found on page 8, 22 and 68.*

Marked position for relay 1 and relay 2: appliance de-energised - relay de-energised

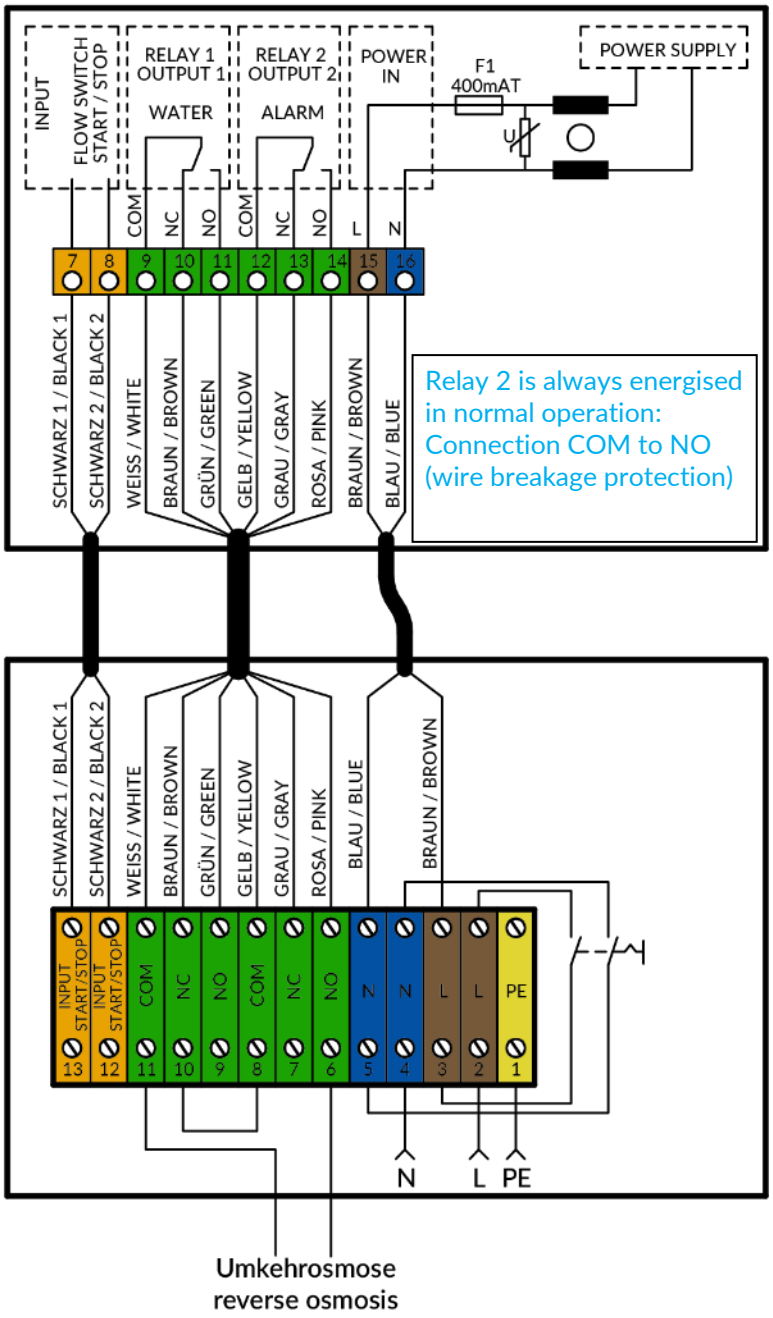


Illustration 19Circuit diagram 6 - LIMESBase

Key functions

Start of analysis

- You can start an analysis manually.
- Once an analysis sequence has been triggered, you can switch to the next analysis step by pressing the START button.
- If an analysis is started manually, any activated relays 1 and 2 are also deleted.

Flushing and filling the measuring chamber

- You can rinse the measuring chamber and the supply line to the measuring chamber outside of an analysis procedure.

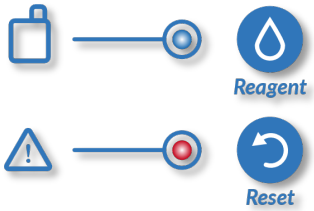
Vent the dosing pump

- You can switch on the indicator pump outside of an analysis procedure, e.g. to vent the hose line during commissioning.
- The agitator runs simultaneously with the indicator pump.

Reset functions

- Delete relay 1 if the limit value is exceeded.
- Delete relay 2 in the event of a device fault or the BoB indicator message.
- You can cancel an analysis procedure with this button.

Reset indicator fill level



- Press and hold the "Reagent" and "Reset" buttons simultaneously for 4 seconds to reset the quantity measurement of the indicator. This is necessary after inserting a new full indicator bottle. The reset is complete when the "Indicator low" (blue) and "Device fault" (red) LEDs light up simultaneously. *Further information on the topic of "Inserting a new indicator bottle" and "Indicator fill level" can be found on page 51 and 53*

The reset may only take place if you have used a full 750 ml indicator bottle.

Functional principle

The LIMES, based on the SYCON series, is an online analyser for the automatic determination of total hardness using the colourimetric limit value method. A colour reaction is generated by adding an indicator to the water sample. Depending on the indicator used, the device evaluates the intensity of the colour. The LIMES monitors the limit value of the water constituent through the colour change of the sample after the addition of the indicator. The limit value is determined by the indicator used.

Analysis procedure

The analysis procedure consists of several steps. The duration of each step depends on the configuration of the device. The first analysis is started automatically 3 minutes after switching on. If the limit value is not reached, the next analyses are carried out at the set analysis interval. The set analysis interval time can only be adhered to if the flushing time is not set longer than the interval time. If the limit value is exceeded, the following measurements are carried out at 8-minute intervals to indicate that the system is ready for use again promptly after regeneration. The analysis takes 3 minutes plus the set flushing time. A control measurement takes place 4 minutes after completion of the initial measurement (initial value suppression). A control measurement (first value suppression) is permanently integrated in the programme sequence of the LIMESBase and LIMESPlus.

Operation with hot sample water

When monitoring hot water, the sample must be cooled to below 40 °C (< 104 °F).

Rinsing the measuring chamber and taking water samples

The inlet solenoid valve opens. The measuring chamber and the supply line are flushed until it is ensured that there is water from the process to be monitored in the measuring chamber. With the LIMESPlus, the flushing time can be adjusted to the length of the inlet pipe.

Measurement of the zero sample

A zero sample is always taken before the actual measurement begins. The zero sample is used to determine influencing disturbance variables such as sample turbidity, contamination of the optics or extraneous light influences and to be able to take them into account for the evaluation of the water sample. The actuator LED lights up during this process. The solenoid valve is open during the zero sample.

Dosing the indicator into the water sample

The solenoid valve on the device is closed and the indicator is dosed into the water sample. The indicator is homogeneously dissolved in the water sample by turning the stirring paddle.

Measurement of the water sample with indicator

In this step, the value is determined from the colour of the water sample. The agitator blade is stopped for this purpose. The actuator board LED lights up and the water sample is analysed immediately. The result of the measurement is displayed on the LEDs on the front of the device. In the event of incorrect values, e.g. missing indicator addition, a device fault is displayed.

Rinsing and cleaning the measuring chamber

The solenoid valve opens, flushing out the coloured water sample. The measuring chamber remains filled with pure process water until the next analysis begins.

Before commissioning

- Ensure that the appliance is securely attached to a wall or suitable suspension.
- Ensure that the water quality meets the specified requirements. If necessary, take suitable measures to improve the inlet water quality (e.g. installation of an activated carbon filter).
- Make sure that a full indicator bottle is inserted.
- Check that the Leur connections of the hose pump cassette are tightly screwed onto the measuring chamber and the bottle.
- Check whether the correct indicator type is used for the application.
- Check that the expiry date of the indicator has not expired.
- Make sure that all water-bearing parts are tight and that the inlet and outlet are connected the right way round.
- Make sure that the water treatment plant to be monitored is in operation and supplies sample water.
- Ensure that the maximum permissible operating pressure on the water supply line is not exceeded. Install a throttle valve if necessary.
- If in doubt, consult a specialist or contact your supplier or the manufacturer.

Ensure that the input and output contacts of the analyser are connected to the water treatment system to be monitored in the desired manner.

Ensure that the electrical connections are correctly installed.
If in doubt, consult a specialist or contact your supplier or the manufacturer.

Tension

Device settings

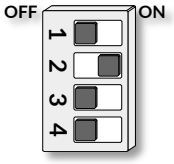
The LIMESPlus analyser is programmed using small slide switches (programme switches SW1 - SW4) and adapted to the operating requirements. (SW = switch/switch)

Tension

De-energise the device and remove the rubber cover from the analyser.

The programme switches are located behind the rubber cover. The 16-stage rotary switch for setting the rinse time and the SW programme switches are located on this circuit board.

Setting	Factory setting	
Rinsing time	Position 6	4 minutes



Setting	Factory setting	
Analysis interval	SW1 OFF SW2 ON	10 minutes
Input contact	SW3 OFF	From
Diagnostic mode	SW4 OFF	From

Tension

Work on electrical connections may only be carried out by authorised specialist personnel in compliance with the locally applicable regulations.

You will need a small screwdriver to operate the rotary switches and to set the programme switch SW (slide switch). Please only use suitable and tested tools to avoid damaging the sensitive components.

Setting the flush duration LIMESPlus

In the LIMESPlus device variant, the rinsing time can be set in the range from 5 seconds to 30 minutes using the "Rinsing time" rotary switch before starting an analysis.

Rinsing time

Position	Time
0	5 sec.
1	10 sec.
2	20 sec.
3	50 sec.
4	90 sec.
5	2 min
6	4 min
7	8 min
8	10 min
9	12 min
A	14 min
B	16 min
C	18 min
D	20 min
E	25 min
F	30 min

Select the flushing duration depending on the length of the supply line to ensure that the water from the softener flushes the supply line and fresh water is analysed.

A long rinsing time also reduces build-up in the measuring chamber.

The local conditions of a system can vary greatly: different pipe cross-sections to the softener, fluctuating pressure conditions due to heavy consumers, etc.

Measure the amount of flushing water at the currently set flushing duration and compare it with the theoretically calculated amount of water based on the pipe cross-sections. Take into account an allowance for the resin bed volume.

This ensures that a representative water sample is always analysed.

We recommend a rinsing time of at least 50 seconds.

Setting the flushing time LIMESBase

The LIMESBase is supplied with a pre-programmed rinsing time of 50 seconds.
An upgrade kit is required to activate the flushing time, which you can purchase from us.

Further information can be found on page 8, 22 and 68

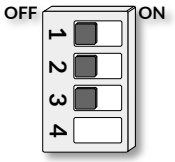
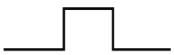
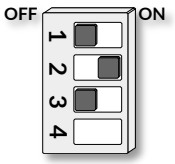
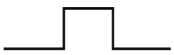
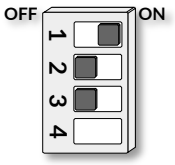
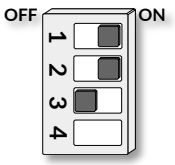
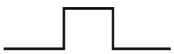
Analysis interval LIMESPlus depending on the input contact INPUT

There are 4 fixed interval times, which are set using the programme switches SW1 and SW2.
The interval time is the time between 2 consecutive analysis starts. If the input contact is open, no analyses are started at the set analysis interval. This input is therefore bridged in the as-delivered state. The jumper or an external switch (e.g. flow monitor) must be connected and closed when water is flowing in order to carry out analyses at the analysis interval.

Symbols used:

INPUT Input contact	Condition	Description of the
	Closed	The input contact is permanently closed
	Open	The input contact is permanently open
	Pulse	Only one analysis is carried out

Setting for the use of a switch or flow monitor
Internal analysis interval time, ***input contact deactivated (SW3 OFF)***

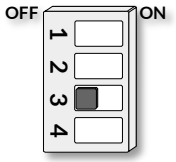
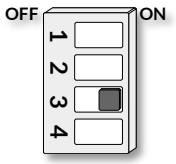
SW programme switch position	INPUT Input contact	Function
		Analyses are carried out **at 5 min intervals**
		Paused: No analyses are performed because the input contact is open
		Only one analysis is performed
		Analyses are carried out **at 10 min intervals**
		Paused: No analyses are performed because the input contact is open
		Only one analysis is performed
		Analyses are carried out **at 20 min intervals**
		Paused: No analyses are performed because the input contact is open
		Only one analysis is performed
		Analyses are carried out **at 30 min intervals**
		Paused: No analyses are performed because the input contact is open
		Only one analysis is performed

Analysis interval LIMESBase

The LIMESBase is supplied with a pre-programmed analysis interval time of 10 minutes. To activate the analysis interval time, you need an upgrade kit, which you can purchase from us.
Further information can be found on page 8, 22 and 68

LIMESPlus input contact (INPUT, start or stop analysis interval)

Different functions can be assigned to the input contact.

Programme switch	SW3	Function
	OFF	• Flow monitor, switch or bridge, internal analysis interval time • No analysis when input contact is open *Further information can be found on page 41*
	ON	• External analysis start depending on the SW1 and SW2 switch position • No analysis with open input contact depending on SW1 and SW2 switch position

Flow monitor

This function is used if analyses are only to be carried out as soon as a water withdrawal takes place. This is particularly useful for intermittent operation, i.e. filling a storage tank at longer intervals or for systems that are only in operation for a few hours a day.
The function is also used if no analyses are required, e.g. during the regeneration of a single-filter system. *Further information can be found on page 41*

External analysis start

The input contact is used in conjunction with a control unit in "external analysis start" operating mode. An analysis is started by pulsing the input contact.

Tension

Please note that the input contact must always be a potential-free switch. Connecting an external voltage source can damage the device.

Instead of a flow monitor, you can also use any other potential-free contact of a timer or a relay (osmosis control, softening control).

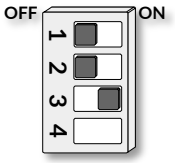
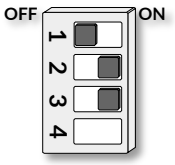
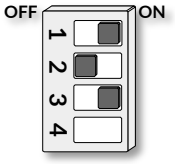
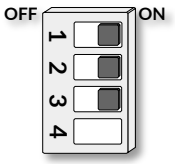
On delivery, the programme switch SW3 = OFF and the input contact is bridged so that the internal analysis interval is active.

If the input contact is permanently bridged while the programme switch SW3 is set to ON, analyses are carried out continuously. The analyses are carried out consecutively. The set internal analysis interval is deactivated.

Symbols used:

INPUT Input contact	Condition	Description of the
	Closed	The input contact is permanently closed
	Open	The input contact is permanently open
	Pulse	Only one analysis is performed

Setting for the use of an external control unit depending on the SW1 and SW2 switch position
External analysis start, ***input contact activated (SW3 ON)***

SW programme switch position	INPUT Input contact	Function
		Analyses are carried out continuously without pauses
		Paused: No analyses are performed because the input contact is open
For pulse operation		Only one analysis is performed
		Analyses are carried out continuously without pauses
		Analyses are carried out **at 10 min intervals**
		Only one analysis is performed
		Analyses are carried out continuously without pauses
		Analyses are carried out **at 20 min intervals**
		Only one analysis is performed
		Analyses are carried out continuously without pauses
		Analyses are carried out **at 30 min intervals**
		Only one analysis is performed

The following examples should make it easier for you to select the right setting:

Example 1: Analyses are to be carried out continuously at a fixed time interval
In this case, the programme switch SW3 = OFF and no flow monitor is connected. Instead, the input contact is fitted with a jumper.

Example 2: Analyses are carried out at a fixed time interval when a flow monitor reports flowing water
The programme switch SW3 is in the OFF position. The flow monitor is connected to the INPUT input contact instead of the jumper. The first analysis after switching on the device takes place after 3 minutes, even if the flow monitor does not report any flowing water. The subsequent analyses only take place if there is flowing water at the set interval. The pausing of the analysis interval by the flow monitor is indicated by the yellow LED flashing. If flowing water is signalled by the flow monitor after a standstill period, an analysis is carried out immediately.

Example 3: The analysis is started by an external controller
To specify the analysis interval via a control unit, the control unit is connected to the input contact using a potential-free switch. The programme switch SW3 is set to the ON position (external analysis start) to start analyses by a switching pulse at the input contact. If the input contact is permanently bridged, analyses are carried out continuously.
Usually, the programme switches SW1 and SW2 are also set to OFF, thus deactivating the internal analysis interval.

Input contact LIMESBase

The input contact function is not active on the LIMESBase. Controls or switches connected to the input contact do not start or stop analyses. To enable the input contact function, you need an upgrade kit, which you can purchase from us.

Further information can be found on page 8, 22 and 68

First value suppression

After a limit value has been exceeded, a reference measurement is carried out every 4 minutes to evaluate the result. This prevents false alarms due to the counter ion effect after a system shutdown.

The LIMESBase and LIMESPlus are factory-fitted with a permanently activated first value suppression.

Trigger conditions for starting an analysis

- Automatically through the set analysis interval
- Manual analysis by pressing the "Start" button
- 3 minutes after switching on the device
- 4 minutes after a limit value has been exceeded
- Switching on a connected flow monitor after system standstill
- Through a connected external control unit

Commissioning

Ensure that the analyser is installed according to the instructions and that the programme switches SW1-SW4 are programmed according to the desired requirements.

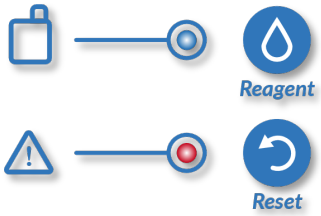
Switching on the device

- Switch on the power supply, e.g. via the optional connection box.
- The calculated fill level of the indicator bottle is displayed for one second. *See page 51.*

After switching on

- The green "Limit value" LED flashes as no measurement has been carried out yet.
- If the input contact is open, the yellow "Input contact open" LED also flashes.

Insert a full indicator bottle and reset the indicator fill level



- Insert a full indicator bottle into the LIMES
- Press and hold the "Reagent" and "Reset" buttons simultaneously until the "Indicator deficiency" (blue) and "Device fault" (red) LEDs light up at the same time
  Further information can be found on page 53

Only reset the fill level if you have inserted a full bottle

Vent the dosing pump

- Press and hold the "Reagent" button for 10 seconds to pump indicator from the newly inserted bottle into the measuring chamber and press the air bubbles out of the tube.
  (During this time, the agitator blade rotates)

Filling the measuring chamber with water

- Press the "Valve" button until the measuring chamber has filled with water.

Start analysis

- Press the START button to start the first analysis.
- An analysis starts with flushing the measuring chamber.

LED displays

Using the 4 LEDs, the LIMES analyser displays information on the operating status and the results of the measurements and provides information on the fill level of the indicator.

The device status is indicated by 4 LEDs on the front of the device.
The following displays can be shown during operation depending on the configuration. The display variants of the blue LED (indicator notes) can appear in combination with the other LEDs depending on the fill level of the indicator bottle.

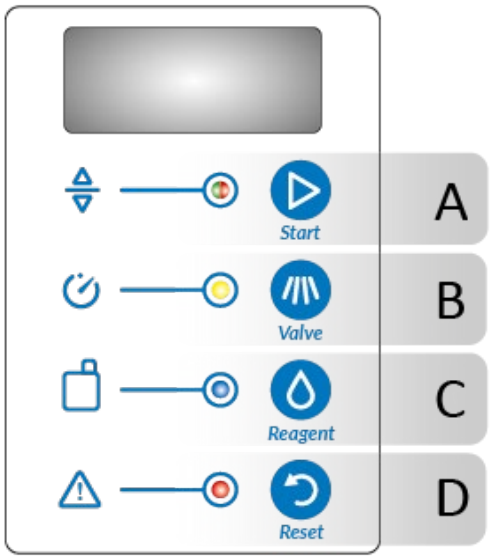
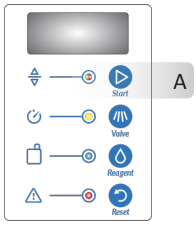


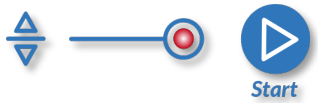
Illustration 20LIMES LED display front / operating front

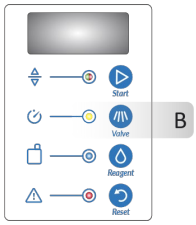
The operating status is indicated by the LED display:

LED	Colour	Information
A	Green (two-colour LED)	Below limit value
A	Red (two-colour LED)	Limit value exceeded
B	Yellow	Analysis active
B	Flashing yellow	Input contact open, e.g. through flow monitor
C	Blue	Provide indicator
C	Flashing blue	BoB message
D	Red	Device fault

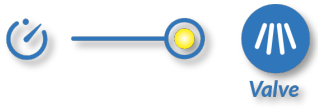


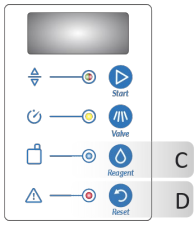
Description of the two-colour red/green LED (A) "Limit value"

LED display (A)	Description of the
Flashing green 	There is no analysis result because the device has just been switched on. **Relay 1 "Limit value" has dropped out. (limit value undershot)**
Glowing green 	The water quality is below the specified limit value. **Relay 1 "Limit value" has dropped out. (limit value undershot)**
Red flashing 	The specified limit value was exceeded. **Relay 1 "Limit value" is energised. (limit value exceeded)** However, the relay 1 position can be cancelled by pressing the "Reset" button, which de-energises the relay but keeps the red LED (A) flashing. The Relay 1 position can be cancelled at the LED combination of LED (A) and LED (D) can be read. See "Description of relay 1 position LED combination LED (A) and LED (D)"
Red-glowing 	The limit value has been exceeded, but relay 1 has not yet been energised (first value suppression - the analysis is repeated in 4 minutes).

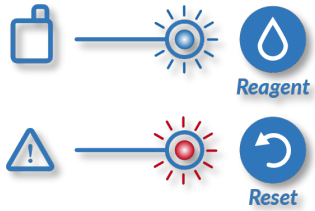
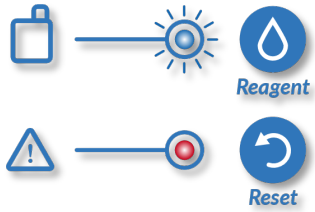


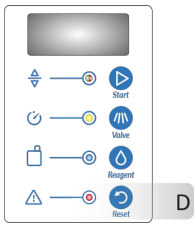
Description of the yellow LED (B) "Analysis active / input contact"

LED display (B)	Description of the
Yellow flashing 	The display flashes, signalling that the analysis interval has expired, but that the analysis start is blocked via the input contact Input (flow monitor function).
Luminous **yellow** 	The indicator lights up permanently, signalling that an analysis has been started.



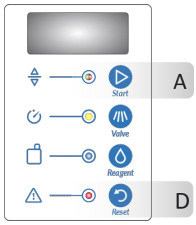
Description of the LED combination LED (C) blue, LED (D) red "Indicator message / BoB message"

LED display (C) and (D)	Description of the
Luminous **blue** 	The indicator lights up permanently, signalling that the indicator supply is less than approx. 30 %. The remaining amount of indicator allows operation for a further 72 hours at the set analysis interval. Prepare a new indicator bottle.
LED (C) Flashing blue **LED (D) Flashing red** 	The BOB alarm is active. The display signals an indicator level that may no longer be sufficient for unattended operation at the set analysis interval (BoB) for 72 hours. **Relay 2 "Device fault / indicator message BoB " has dropped out.** To acknowledge the BoB alarm, press the "Reset" button.
LED (C) Flashing blue **LED (D) Red-illuminating** 	The display signals an indicator level that may no longer be sufficient for unattended operation for 72 hours. The BoB message has already been acknowledged with the "Reset" button. **Relay 2 "Device fault / indicator message BoB " is energised.**

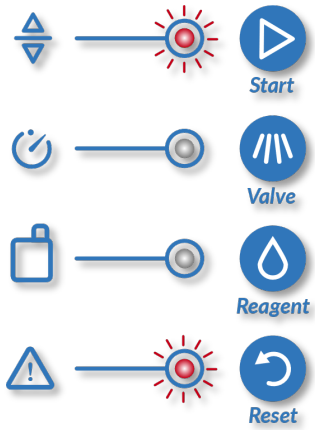
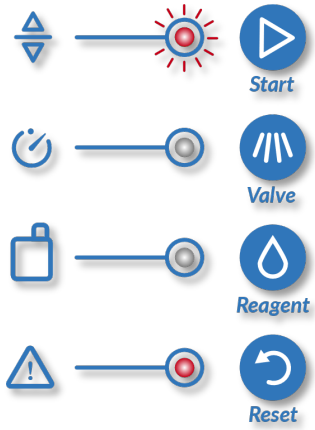


Description of the red LED (D) "Device fault"

LED display (D)	Description of the
Red flashing 	The display signals a device fault: • Faulty zero sample or faulty measurement • All other displays are switched off. To acknowledge the device fault, press the "Reset" button or switch the device off and on again. **Relay 2 "Device fault / indicator message BoB " has dropped out.**

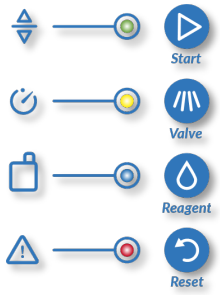
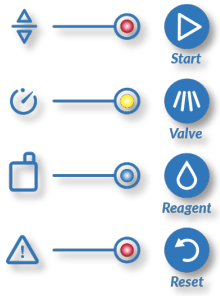
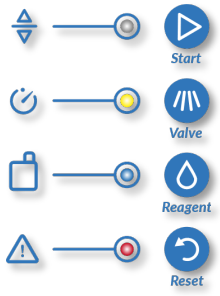
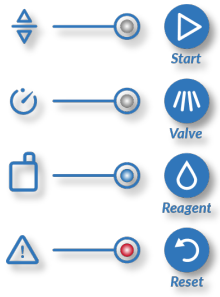
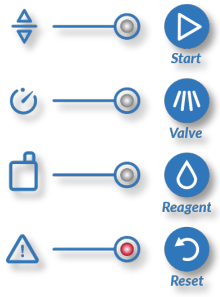


Description of the relay 1 position LED combination LED (A), LED (D) "Limit value exceeded"

LED display (A) and (D)	Description of the
LED (A) Flashing red **LED (D) Flashing red** 	Limit value LED (A) flashing red and simultaneous device fault LED (D) flashing red: Signals that the specified limit value has been exceeded and that relay 1 is energised. **Relay 1 "Limit value" is energised. (limit value exceeded)**
LED (A) Flashing red **LED (D) Red-illuminating** 	Limit value LED (A) flashing red and simultaneous device fault LED (D) illuminated red: Indicates that the specified limit value has been exceeded, but relay 1 has been cancelled by pressing the "Reset" button. **Relay 1 "Limit value" has dropped out.**

LED display Indicator fill level

After switching on the analyser, the calculated fill level is displayed for 1 second:

LED display	Description of the
	**100 %** The LEDs light up: green, yellow, blue, red Immediately after resetting the indicator counter: Up to 10,000 analyses are possible.
	**100 % - 75 %** The LEDs light up: red, yellow, blue, red More than 7500 analyses are possible.
	**75 % - 50 %** The LEDs light up: yellow, blue, red More than 5000 analyses are possible.
	**50 % - 25 %** The LEDs light up: blue, red More than 2500 analyses are possible.
	**25 % - 0 %** The red LED lights up Less than 2500 analyses are possible until the indicator bottle is changed.

Maintenance and service

To ensure long-term and trouble-free operation of the LIMES analyser, it is necessary to clean the measuring chamber and replace wearing parts.

We therefore recommend:

- A weekly visual inspection of the device
- Cleaning the measuring chamber at least every 6 months
- Installation of a maintenance kit after 24 months

Maintenance can be carried out easily. We recommend that maintenance is carried out by a trained specialist. In any case, please observe the following safety instructions.

Ideally, carry out the maintenance work in conjunction with the maintenance of the processing system or during a break in operation.

Before carrying out maintenance, switch off the appliance by pressing the mains switch or disconnecting the supply voltage.

Tension

Depending on the wiring, some terminals may be energised with 230 volts when the mains switch is switched off.
Contact can have serious consequences:

- Danger to life
- Risk of injury
- Damage to the device due to improper handling

No analyses are carried out during maintenance and therefore a possible hardness breakthrough cannot be detected.

Close the inlet valve to the analyser before working on the measuring chamber.

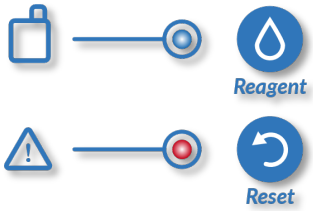
- Splashes of water could destroy the electronics.

Irritating

Ensure that your eyes, skin and clothing do not come into contact with the indicator.

- Follow the instructions in the safety data sheets.
- Suitable protective clothing is required for maintenance work:
  - Workwear
  - Laboratory gloves
  - Eye protection

Inserting a full indicator bottle



1. Open the indicator bottle by unscrewing the cap. Insert the suction lance into the new bottle and tighten the cap.
2. Insert the full indicator bottle into the LIMES.
3. Set the indicator level to 100 %. To do this, press the "Reagent" and "Reset" buttons simultaneously and keep them pressed until the "Indicator low" (blue) and "Device fault" (red) LEDs light up at the same time. *Further information on the topic of "Indicator fill level" can be found on page 51*
4. Now press and hold the "Reagent" button for 10 seconds to pump indicator from the newly inserted bottle into the measuring chamber and press the air bubbles out of the tube.

The indicator bottle is not included with the device.
- Only use original indicator type LHV in the 750 ml bottle.
- Check the shelf life of the indicator used.

Irritating

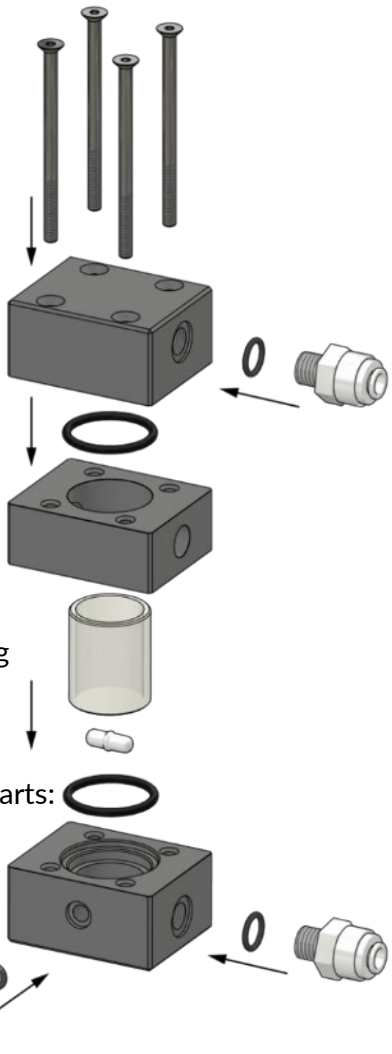
Danger of soiling
When handling the indicator, ensure that your eyes, skin and clothing do not come into contact with the liquid.
- Observe the instructions in the safety data sheets.

We accept no liability for permanent soiling caused by the colourants in the indicator and personal injury resulting from improper handling of the indicator.

We recommend wearing suitable protective clothing when handling the indicator:
- Workwear
- Laboratory gloves
- Eye protection / safety goggles

Install maintenance set / clean measuring chamber

Time: approx. 30 minutes
Material: Maintenance set for LIMES
LIMES Clean cleaning set
Paper towels
Tools: Ring spanner 8 and 16mm,
Allen screwdriver with 2.5mm



Irritating

Ensure that your eyes, skin and clothing do not clothing do not come into contact with the indicator.
Protective clothing required:
Work clothing, laboratory gloves, eye protection

Removal / cleaning:

- Switch off the LIMES
- Connect the manual valve to the LIMES
  (The manual valve must
  be installed by the system operator upstream of
  the LIMES in the supply line)
- Loosen the indicator connection on the measuring chamber
- Remove the measuring chamber from the front of the housing
  (measuring chamber is held in the housing by magnets)
- Loosen the inlet and outlet hoses
  on the measuring chamber
- Then disassemble the measuring chamber into its individual parts:
  - 4x screws A2 M4 x 65
  - 3x measuring chamber components
  - 1x plastic tube (transparent)
  - 2x O-rings 24 x 2.5
  - 2x inlet/outlet screw connection
  - 2x O-rings 9 x 1.6
  - 1x injector
  - 1x O-ring 5.28 x 1.78
  - 1x agitator blade
- Place the three measuring chamber components in the FIT 3000 cleaning fluid for approx. 10 minutes and then clean the parts with the brush
- Then rinse the parts under running water

Assembly: *Only fit new parts from the maintenance set.*

- First insert the transparent plastic tube into the centre section of the measuring chamber and slide a greased O-ring onto the top and bottom of the tube
- Now place the stirring paddle in the lower part of the measuring chamber
- Now place the three measuring chamber components on top of each other and screw them tight with the 4 screws. *Torque 0.6 Nm.*
- Push the O-rings onto the inlet/outlet screw connection and grease them, then screw them into the measuring chamber. *Torque 1 Nm.*
- Push the O-ring onto the injector and grease it, then screw it into the measuring chamber. *Torque 0.2 Nm.*
- Now connect the measuring chamber to the inlet and outlet hose.

- Insert the measuring chamber into the housing
- Place a new hose pump cassette on the motor shaft and connect the hose to the measuring chamber
- Unscrew the suction lance from the bottle adapter and insert a new suction lance
- Connect the suction lance to the hose pump cassette

Commissioning:
After maintenance, indicator must be pumped from the bottle into the measuring chamber and the measuring chamber flushed.

- Now open the manual valve
- Switch on the LIMES
- Press and hold the "Reagent" button until the peristaltic pump pumps bubble-free indicator into the measuring chamber. (Takes about 10 seconds)
- Press and hold the "Valve" button until clear water flows out of the drain hose

Maintenance is now complete.

Change peristaltic pump cash register

To ensure the measuring accuracy of the LIMES analyser, the peristaltic pump cassette should be replaced after 24 months.

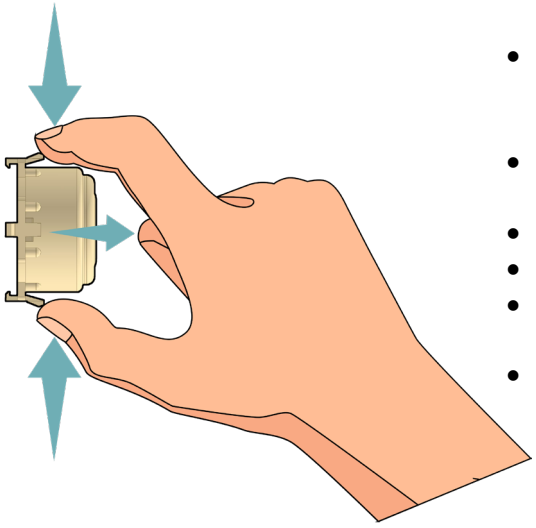


Fig. 21: Changing the hose pump cassette

- Press the locking tabs together with your thumb and index finger and pull the hose pump cassette off the motor shaft.
- Loosen the hose connection to the measuring chamber and indicator bottle by turning the Luer connection.
- If indicator liquid leaks, remove it with a paper towel.
- Fit a new hose pump cassette onto the motor shaft.
- Establish the tube connection to the measuring chamber and indicator bottle by turning the Luer connection.
- Vent the peristaltic pump cassette: Switch on the device and press the "Reagent" button for about 10 seconds until the peristaltic pump pumps bubble-free indicator into the measuring chamber.

You will find a spare parts list from page 65

Irritating

Ensure that your eyes, skin and clothing do not come into contact with the indicator. Follow the instructions in the safety data sheets. Suitable protective clothing is required for maintenance work:

- Workwear
- Laboratory gloves
- Eye protection

Replacement of components

Observe the applicable accident prevention regulations.

Tension

The appliance and the supply line to the appliance must be de-energised and secured against being switched on again.

Irritating

Wear appropriate protective equipment to avoid skin contact with the indicator.

Pressure

Shut off the water supply before starting work.

Replacing the filter / pressure regulator / solenoid valve

Tools required when replacing the solenoid valve:
Torx T10, T20 screwdriver and a phase tester

Preparation:

- Ensure that the inlet is depressurised. (Close the manual valve)
- Loosen the hose connection to the inlet and outlet on the LIMES
- Switch the device on briefly.
- Press and hold the "Valve" button. By opening the solenoid valve, you depressurise the supply line and the measuring chamber empties.
- Hold a small container under the inlet and outlet.
- Switch the device off again.

Only when replacing the filter or pressure regulator:

- Loosen and remove the bulkhead fitting on the inlet and outlet
- Remove the component, filter or pressure regulator to be replaced.
- Install the new component
  (Note the direction of flow, the arrows on the component point in the direction of the measuring chamber)
- Reassemble the appliance and put it back into operation.

Observe the correct flow direction and placement of the components. *See page 19*

Only when replacing the solenoid valve:

- Switch off the power to the LIMES and the connection box!
- Loosen the indicator connection on the measuring chamber and the indicator bottle
- Remove the indicator bottle
- Remove the measuring chamber from the front of the housing
  (measuring chamber is held in the housing by magnets)
- Loosen the inlet and outlet hoses on the measuring chamber
- Remove the analyser from the wall

- Remove the electronics cover on the back of the analyser
- Disconnect the electrical connection of the solenoid valve on the main circuit board
- Detach the solenoid valve from the plastic plate
- Attach a new solenoid valve to the plastic plate
  (Note the direction of flow, the arrow on the component points in the direction of the measuring chamber)
- Guide the electrical connection of the new solenoid valve through the opening provided in the housing
- Connect the new solenoid valve according to the previous assignment on the main circuit board. *See page 23*
- Reassemble the appliance and put it back into operation.

After replacing the solenoid valve, the indicator must be pumped from the bottle into the measuring chamber and the measuring chamber flushed.

- Now open the manual valve
- Switch on the LIMES
- Press and hold the "Reagent" button until the peristaltic pump pumps bubble-free indicator into the measuring chamber. (Takes about 10 seconds)
- Press and hold the "Valve" button until clear water flows out of the drain hose

Observe the electrical connection as shown in the illustration on page 23

Replacing the measuring chamber

Preparation:

- Ensure that the inlet is depressurised. (Close the manual valve)
- Loosen the hose connection to the inlet and outlet on the LIMES
- Switch the device on briefly.
- Press and hold the "Valve" button. By opening the solenoid valve, you depressurise the supply line and the measuring chamber empties.
- Hold a small container under the inlet and outlet.
- Switch the device off again.

Only when replacing the measuring chamber:

- Loosen the indicator connection on the measuring chamber
- Remove the measuring chamber from the front of the housing
  (measuring chamber is held in the housing by magnets)
- Loosen the inlet and outlet hoses on the measuring chamber
- Replace the measuring chamber and reassemble the device

After replacing the measuring chamber, the indicator must be pumped from the bottle into the measuring chamber and the measuring chamber flushed.

- Now open the manual valve and switch on the LIMES
- Press and hold the "Reagent" button until the peristaltic pump pumps bubble-free indicator into the measuring chamber. (Takes about 10 seconds)
- Press and hold the "Valve" button until clear water flows out of the drain hose

Replacing the peristaltic pump motor / agitator drive / actuator board (LED)

Tools required: Torx T10 screwdriver and a phase tester

Do not place the analyser on its front without the housing cover. See page 15.

Preparation:

- Ensure that the inlet is depressurised. (Close the manual valve)
- Loosen the hose connection to the inlet and outlet on the LIMES
- Switch the device on briefly.
- Press and hold the "Valve" button. By opening the solenoid valve, you depressurise the supply line and the measuring chamber empties.
- Hold a small container under the inlet and outlet
- Switch the device off again.
- Switch off the power to the LIMES and the connection box!
- Loosen the indicator connection on the measuring chamber and the indicator bottle
- Remove the indicator bottle
- Remove the analyser from the wall
- Remove the electronics cover on the back of the analyser

Only when replacing the peristaltic pump motor:

- Disconnect the electrical connection on the main circuit board
- Pull the peristaltic pump cassette off the motor shaft
- Loosen the two screws on the front of the device
- Replace the peristaltic pump motor
- Connect the new peristaltic pump motor according to the previous assignment on the main circuit board. *See page 23*
- Reassemble the appliance and put it back into operation.

Only when replacing the agitator drive or actuator board (LED)

- Disconnect the electrical connection on the main circuit board
- Pull or lever out the component
- Replace the component
  (The cables from the body of the agitator motor point towards the housing)
- Connect the component according to the previous assignment on the main circuit board. *See page 23*
- Reassemble the appliance and put it back into operation.

After replacing the components described above, indicator must be pumped from the bottle into the measuring chamber and the measuring chamber flushed.

- Now open the manual valve
- Switch on the LIMES
- Press and hold the "Reagent" button until the peristaltic pump pumps bubble-free indicator into the measuring chamber. (Takes about 10 seconds)
- Press and hold the "Valve" button until clear water flows out of the drain hose

Observe the electrical connection as shown in the illustration on page 23

Diagnostic functions LIMESPlus

The diagnostic programme is used to check the device functions. This is available in the LIMESPlus version.

This test may only be carried out by qualified persons. Please observe the following safety instructions!

Make a note of the positions of the programme switches before the diagnosis and switch all programme switches back to their original position after the diagnostic programme has been carried out.

Use the service booklet to make a note of your settings.

The test must be carried out with the front cover open and the rubber cap removed. All buttons and switches are actuated.

Tension

Please note the following when running the diagnostic programme:

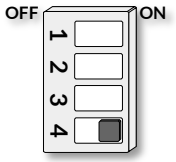
- Depending on the wiring, the cables of relays 1 and 2 that come out of the LIMES may be connected to mains voltage.
- Contact can lead to serious injuries.
- There is a danger to life.
- The appliance can be damaged by improper handling.

Activation of relay 1 and relay 2 can lead to malfunctions.

Pressure

Note that the supply line is pressurised.
Avoid splashing water, which could get into the electronics and destroy them.

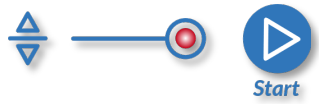
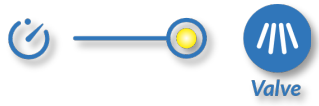
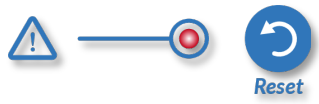
Switch SW4 to the ON position. The diagnostic functions described below can then be called up one after the other. The device is initially in diagnostic step 1.

Programme switch	SW4	Function
	ON	Diagnostic programme

Each time the "Start" button is pressed, the system switches to the next diagnostic step.

Checking the LED displays

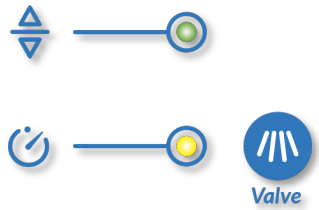
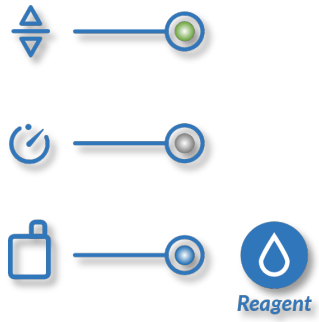
After switching on the device, diagnostic step 1 begins: The LEDs light up one after the other.

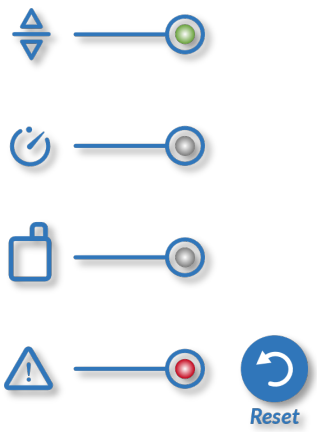
	Limit value undercut
	Limit value exceeded
	Analysis active
	Indicator deficiency
	Device fault

Checking the buttons

After pressing the "Start" button for the first time, the buttons are checked.

By pressing the following buttons, the corresponding LED lights up:

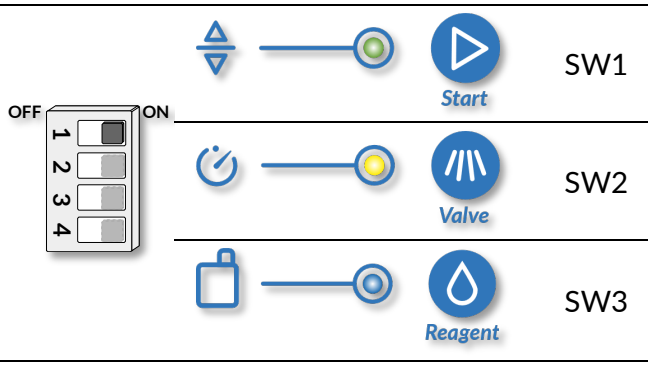
	Valve" button
	Reagent" button



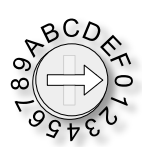
Reset" button

Checking the programme switches

After pressing the "Start" button for the second time, the programme switches are checked. Switch the SW switches to ON and OFF again one after the other; each of the programme switches SW1 - SW3 is assigned a combination of LED displays. (SW4 is not checked as it is already ON for diagnostics)



Check the rotary switch for the "flush duration"

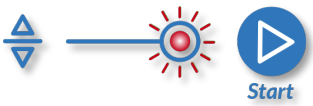


After pressing the "Start" button for the 3rd time, the "Rinse duration" rotary switch is checked.
Turn the switch to the 16 positions from 0 to F one after the other. An LED combination corresponding to the HEX code is displayed in each position.

Rotary switch position

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Start									●	●	●	●	●	●	●	●
Valve					●	●	●	●					●	●	●	●
Reagent			●	●			●	●			●	●			●	●
Reset		●		●		●		●		●		●		●		●

Check relay 1



After pressing the "Start" button for the 4th time, relay 1 is tested.

- The red LED flashes, relay 1 is switched on and off every second.
- Depending on the wiring, check the function of the relay on the connection cables using a continuity tester or a voltmeter.

Check relay 2

After pressing the "Start" button for the 5th time, relay 2 is tested.

- The green LED flashes, relay 2 is switched on and off every second.
- Depending on the wiring, check the function of the relay on the connection cables using a continuity tester or a voltmeter.

Checking the solenoid valve

After pressing the "Start" button for the 6th time, the solenoid valve is tested.

- The yellow LED flashes and the valve is opened and closed every second.

Checking the actuator board LED

After pressing the "Start" button for the 7th time, the white actuator LED is checked.

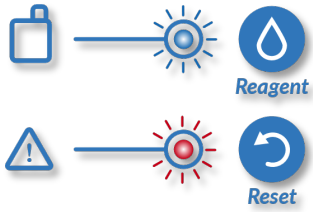
- The blue LED flashes and the measuring LED is switched on and off every second.

Checking the peristaltic pump

After pressing the "Start" button for the 8th time, the peristaltic pump is checked.

- The red LED flashes and the peristaltic pump is switched on and off every second.

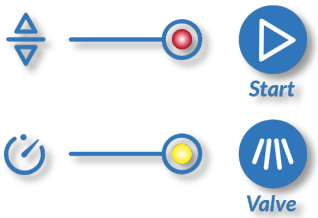
Checking the agitator



After pressing the "Start" button for the 9th time, the agitator is checked.

- The red and blue LEDs flash and the agitator is switched on.

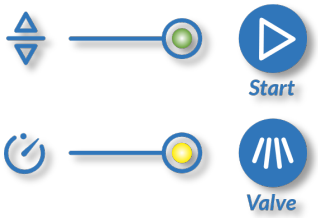
Check start/stop input input contact



After pressing the "Start" button for the 10th time, the input contact is checked.

- The black wires 1 and 2 of the input contact are bridged and opened. The input contact can be checked using the indicator LEDs.

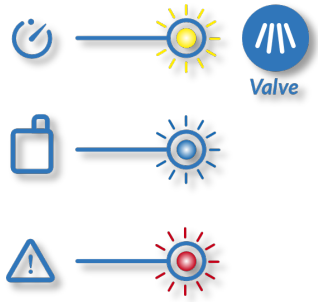
Input contact open



Input contact bridged

Measure the zero value of the water sample

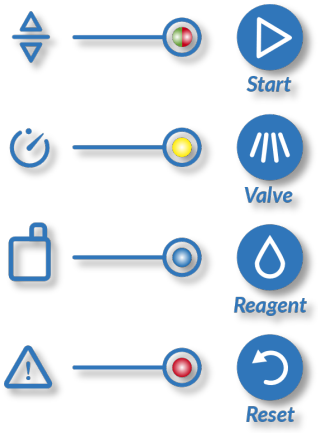
This test step is required to determine the zero value of the sample for the subsequent colour detection test.



After pressing the "Start" button for the 11th time, the zero value of the optical path is measured with a colourless water sample.

- The last 3 LEDs flash.
- The measuring chamber must be filled with clear water to test the measuring section. Press and hold the "Valve" button until the solenoid valve opens and the measuring chamber is flushed.

Testing the colour recognition



After pressing the "Start" button for the 12th time, the colour detection of the optical path is checked.

- The last 3 LEDs light up.

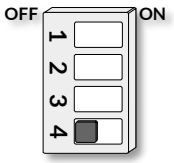
The first LED indicates whether the measured value is above or below the limit value.

- No displayThere is no coloured water sample available
- Green: Measured value below the limit value
- Red: Measured value above the limit value

- You can use the "Reagent" button to dose indicator into the measuring chamber to create a colouration of the sample water
- Depending on the water hardness and the amount of indicator dosed, you will see a colour change, e.g. from red to green for the total hardness.
- The changeover point is not a measure of the water hardness, as an undefined quantity of indicator is dosed.

- The indicator can be flushed out of the measuring chamber using the "Valve" button.

Exit diagnostic programme



After checking the device functions, switch the programme switch SW4 back to the OFF position = analysis mode.

Switch all programme switches back to the original position or to the local operating conditions after the diagnostic programme has been completed.

Diagnostic functions LIMESBase

The LIMESBase does not have a diagnostic programme.
To activate the diagnostic programme, you need an upgrade kit, which you can purchase from us.

Further information can be found on page 8, 22 and 68

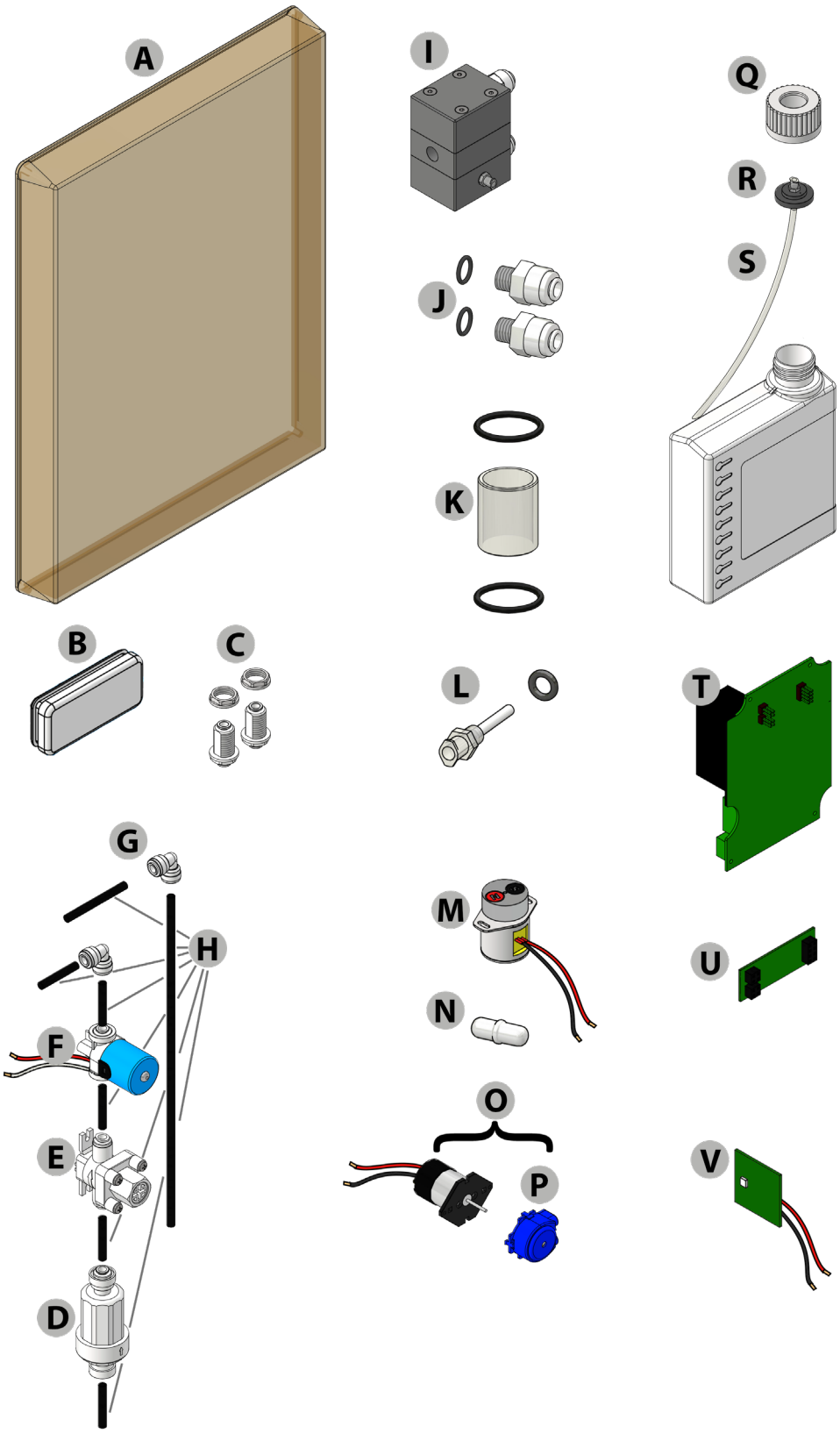


Illustration 22Spare parts LIMES

Spare parts

Position	Article description	Item number
A	Transparent housing cover LIMES	30-035 109
B	Rubber cap LIMESBase	30-035 012
	Rubber cap LIMESPlus	30-035 112
C	Bulkhead fitting white 1/4 inch (2x)	30-093 202
D	Filter LIMES	30-093 218
E	Pressure regulator LIMES	30-093 079
F	Solenoid valve LIMES	30-035 004
G	Angle connection white 1/4 inch (1x)	30-093 216
H	Hose set 1/4 inch	30-035 201
I	Measuring chamber cpl. LIMES	30-035 104
J	Screw-in connection 1/4 inch LIMES incl. O-ring (2x)	30-055 203
K	Measuring chamber tube LIMES incl. O-rings	30-055 204
L	LIMES injector including O-ring	30-035 006
M	Stepper motor with magnet holder cpl. LIMES	30-035 108
N	Agitator blade	33-090 002
O	Peristaltic pump cassette incl. motor cpl. LIMES	30-035 106
P	Hose pump cassette cpl. LIMES	30-035 107
Q	Bottle cap, screw connection GL 32 grey	33-093 060
R	Bottle adapter	33-090 009
S	Suction lance cpl. LIMES	30-035 005
T	LIMES 110/230V mainboard	30-072 004
U	LIMESBase plug-in board incl. mounting tool	30-035 202
	LIMESPlus plug-in board incl. installation tool	30-035 203
V	Actuator board LIMES (LED)	30-090 182

Maintenance kits and accessories

Maintenance set s

The LIMES is largely maintenance-free. A **maintenance set** is available for the analyser. It is recommended that a maintenance set is installed after 24 months.
(Hose pump cassette, hoses and O-rings are replaced)

It is also recommended to clean the measuring chamber regularly, but at least every 6 months. The **LIMES Clean cleaning set** is available for this purpose. It contains all the tools required for cleaning as well as the cleaning fluid **FIT 3000.**

Information on carrying out maintenance can be found from page 52.

Article description	Item number
Maintenance set for LIMES *Contains the following articles:* • 1 x measuring chamber tube LIMES • 2 x O-ring 24 x 2.5 NBR 70 • 2 x O-ring 9 x 1.6 • 1 x LIMES injector • 1 x O-ring 5.28 x 1.78 • 1 x stirring paddle • 1 x hose pump cassette cpl. LIMES • 1 x Suction lance cpl. LIMES	33-030 135
LIMES Clean cleaning set *Contains the following articles:* • 10 x laboratory gloves • 1 x funnel • 1 x FIT 3000 cleaner (1000ml) • 1 x pipette brush • 1 x test tube brush wool head • 1 x container with lid	30-010 920
Cleaner FIT 3000 (1000 ml)	32-089 100

Accessories

Article description	Item number
LIMES junction box	30-035 200
Upgrade Kit from LIMESBase to LIMESPlus *Contains the following articles:* • LIMESPlus plug-in board • Circuit board extractor • Rubber cap LIMESPlus	30-035 205
LIMES connection set *Contains the following articles:* • Reducing nipple stainless steel 1.4408 V4A 1/2 inch to 1/4 inch (conical external thread) • Socket ball valve stainless steel 1.4408 V4A with 1/4 inch (cylindrical internal thread) • Straight screw-in fitting, nickel-plated brass. 1/4 inch (cylindrical external thread with sealing ring), hose connection external diameter 1/4 inch • 5 metre plastic hose outer diameter 1/4 inch 	33-080 701
Stopcock 1/4 inch LIMES Connection size 1/4 inch 	33-000 217

You can find more information about our products on our website www.rls-wacon.de

Indicators

Indicators for monitoring the total hardness

Designation Indicator	Limit value			Item no. 750 ml bottle	Item no. 4 x 750 ml bottles
	°dH	ppm $CaCO_3$	°f		
LHV - 0.1	0,1	1,8	0,18	32-074 135	32-474 135
LHV - 0.5	0,5	9	0,9	32-074 165	32-474 165
LHV - 3.0	3,0	53	5,3	32-074 195	32-474 195
LHV - 7.0	7,0	125	12,5	32-074 210	32-474 210

One bottle of indicator is sufficient for approx. 10,000 limit value analyses.

Interesting facts about the indicators

The measuring device works with single-component indicators for different limit values. The indicators can be stored for 24 months if stored properly (dark and cool).
24 months.

Sample water with temperatures above 40 °C must be cooled before analysing.

Troubleshooting

No LEDs light up on the device after switching on

Cause	Measure
The mains voltage is not connected or not switched on.	Check the power supply / electrical connections. For junction box: Press the on/off switch.
The LIMESBase or LIMESPlus plug-in board behind the rubber cover is missing or incorrectly attached.	Check the plug-in board.
The fuse on the main circuit board is defective.	Check the fuse.

The device is leaking

Cause	Measure
An O-ring is missing on one of the connection plugs of the measuring chamber.	Check the O-rings of the plugs on the measuring chamber.
The water pressure is outside the specification.	Check the water pressure and install a pressure reducer.

No analyses are started

Cause	Measure
The indicator has been used up or the indicator counter has not been reset after changing the bottle.	Check the fill level of the indicator bottle.
The input contact is in "flow monitor" mode and the input contacts are not bridged.	Check whether the input contact is correctly configured and connected.

Error in the zero sample

Cause	Measure
There is no sample water in the measuring chamber	Check the water inlet
The indicator is not cancelled.	Check whether there is an agitator blade in the measuring chamber.
No indicator is dosed.	Check the dosing pump in the diagnostic programme and the plug connectors in the appliance.
The measuring chamber is dirty or the sample water is not draining off	Clean the measuring chamber and check the water inlet and outlet.

Incorrect measured value

Cause	Measure
The indicator is not cancelled.	Check whether there is an agitator blade in the measuring chamber.
No or too little indicator is dosed.	Check the function of the peristaltic pump. Clean the motor shaft with spirit. Replace the peristaltic pump cassette. Check whether the inlet is connected on the left-hand side.
An incorrect indicator has been inserted or the indicator has expired.	Insert a new indicator bottle and reset the level counter.
Water is constantly running through the drain.	Remove foreign objects from the solenoid valve so that it closes properly.
No water runs through the drain.	Check the solenoid valve and upstream shut-off devices.
The sample water contains high concentrations of iron or other chemicals that interfere with the measurement.	Check the water in the system for compliance with the device specification.

Notes

Maintenance and service

Model: **Serial number:**

date	Employees	Remark

Appendix

Setting en

Position - Programme switch					
SW1 / SW2	Analysis interval	Off ☐ / Off 5 min	Off ☐ / On 10 min	On ☐ / Off 20 min	On ☐ / On 30 min
SW3	Input contact	☐ Off	☐On		
SW4	Diagnostic mode	☐Off	☐On		

Position - Rotary switch (flush time)

0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
5 Sec ☐	10 Sec ☐	20 Sec ☐	50 Sec ☐	90 Sec ☐	2 Min ☐	4 Min ☐	8 Min ☐	10 Min ☐	12 Min ☐	14 Min ☐	16 Min ☐	18 Min ☐	20 Min ☐	25 Min ☐	30 Min ☐

	Designation Indicator	Limit value °dH	ppm $CaCO_3$	°f
☐	LHV - 0.1	0,1	1,8	0,18
☐	LHV - 0.5	0,5	9	0,9
☐	LHV - 3	3,0	53	5,3
☐	LHV - 7	7,0	125	12,5

Document changes

Date:	Change:
22.08.2022	Publication of the document
21.09.2022	Improvement
23.01.2023	Disposal instructions revised / changes to LHV-7.0 / front cover
28.11.2023	Note on correct storage of the analyser added (page 15)

RLS Wacon analytics GmbH

EG-KONFORMITÄTSERKLÄRUNG

EC-Declaration of Conformity

Hersteller *Manufacturer*	RLS Wacon analytics GmbH	
Anschrift *Address*	Gropiusstr. 12 D-31137 Hildesheim	
Produktbezeichnung *Product specification*	LIMESBase / LIMESPlus	
Wir erklären in alleiniger Verantwortung, dass das oben bezeichnete Produkt mit folgenden Europäischen Richtlinien übereinstimmt: *We declare that the above product is in conformity with the following directives:*	2014/35/EU	Niederspannungsrichtlinie *Low Voltage Directive*
Angewandte harmonisierte Normen und technische Spezifikationen: *Applied harmonised standards and technical spezifications:*	DIN EN 6100-3-2 DIN EN 6100-3-3 DIN EN 61326-1	
Qualititätssicherung der Produktion angelehnt an: Production Qualitity Assessment according to:	DIN EN ISO 9001:2015	

Hildesheim, 15. 08. 22

Ort, Datum der Ausstellung
Place, date of issue

Dr. Sascha Matern

Name und Unterschrift des Befugten / Dokumentenbevollmächtigter
Name and signature of autorized person / Document manager

Imprint:

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Photo back: Vitali Vidnevski (employee of RLS Wacon analytics GmbH), 2015
Changes and errors excepted

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