



ModbusRTU

Sample gas cooler Series RC 2.4 Rack

Installation and Operation Instructions

Original instructions





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Read this instruction carefully prior to installation and/or use. Pay attention particularly to all advises and safety instructions to prevent injuries. Bühler Technologies can not be held responsible for misusing the product or unreliable function due to unauthorised modifications.

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1 Introduction

1.1 Intended use

This unit is intended for industrial use in gas analysis systems. It's an essential component for conditioning the sample gas to protect the analysis instrument from residual moisture in the sample gas.

Please note the specifications in the data sheet on the specific intended use, existing material combinations, as well as pressure and temperature limits.

1.2 Overview

The RC 2.4 Rack is a compressor sample gas cooler for up to 4 separate gas paths.

The exact item number of the model defined by you is determined by the model code in the ordering information category.

Application	Cooler model	Heat exchanger
Standard	RC 2.4 Rack	1 to 4 heat exchangers

Additional components which every conditioning system should feature can optionally be integrated:

- Peristaltic pump for condensate separation.

In addition, we offer a range of signal outputs:

- Status output,
- Analogue output, 4...20 mA, incl. status output,
- Modbus RTU digital output, incl. status output.

This allows for various configurations of the cooler and its options. Here the approach is to simplify the creation of a complete system in a cost-efficient way using pre-installed components with hoses connected. We further paid attention to easy access to wear parts and consumables.

1.3 Scope of delivery

- Cooler
- Product documentation
- Connection-/mounting accessories (optional)

1.4 Ordering instructions

1.4.1 Gas cooler with one to four heat exchangers

The item number is a code for the configuration of your unit. Please use the following model key:

4596	5	X	4	0	X	X	X	X	X	0	0	0	X	0	0	0	0	0	Product characteristic
Housing type																			
4																			19" housing for wall mounting
5																			19" rack mount housing
Power supply																			
1																			115 V, 60 Hz
2																			230 V, 50 Hz
Gas paths																			
1																			1 gas path
2																			2 gas paths
3																			3 gas paths
4																			4 gas paths
Heat exchanger																			
1 0																			Stainless steel, TS, metric
1 5																			Stainless steel, TS-I, US
2 0																			Duran glass, TG, metric
2 5																			Duran glass, TG, US
3 0																			PVDF, TV, metric
3 5																			PVDF, TV-I, US fittings
Condensate drain ¹⁾																			
0																			without condensate drain
1																			Condensate pump, adapter ²⁾
3																			Condensate pump, screw-in connection ²⁾
Signal outputs																			
0																			status output only
1																			Analogue output, 4..20 mA, incl. status output
2																			Modbus RTU digital output, incl. status output

¹⁾ metric/US depending on chosen heat exchanger.

²⁾ The number of condensate pumps corresponds to the number of gas paths: 1 gas path = CPsingle, 2 gas paths = CPdouble, 3 gas paths = CPdouble + CPsingle, 4 gas paths = 2x CPdouble. With 19" rack-mount housing, the condensate pumps can only be installed externally underneath the device. The required connection accessories are included.

2 Safety instructions

2.1 Important advice

The device may only be operated if:

- the product is used under the conditions described in the operating and installation manual, in accordance with the type label, and for the intended applications; Any unauthorised modifications to the device will void the warranty provided by Bühler Technologies GmbH,
- the information and markings on the type plates are observed,
- the limit values specified in the data sheet and in this operating and installation manual are observed,
- the device is not operated outside its specification,
- monitoring/protective devices are correctly connected,
- Service and repairs not described in these instructions is performed by Bühler Technologies GmbH,
- Using genuine replacement parts.

These operation instructions are a part of the equipment. The manufacturer reserves the right to change performance, specification or design data without prior notice. Keep this manual for future reference.

Signal words for warnings

DANGER	Signal word for an imminent danger with high risk, resulting in severe injuries or death if not avoided.
WARNING	Signal word for a hazardous situation with medium risk, possibly resulting in severe injuries or death if not avoided.
CAUTION	Signal word for a hazardous situation with low risk, resulting in damaged to the device or the property or minor or medium injuries if not avoided.
NOTICE	Signal word for important information to the product.

Warnings

These instructions include the following warnings:

	General warning sign		General mandatory sign
	Voltage warning		Unplug from mains
	Do not inhale toxic gases		Wear respiratory equipment
	Corrosive substances		Wear a safety mask
	Explosion hazard		Wear protective gloves
	Flammable substances		

2.2 General Hazard Warnings

The device may only be installed by qualified specialist personnel who are familiar with the safety requirements and associated risks. In addition, through their professional training, they possess knowledge of the relevant standards and regulations.

Be sure to observe the safety regulations relevant to the installation location and the generally accepted rules of technology. Prevent malfunctions and thereby avoid personal injury and damage to property.

The operator of the system must ensure that:

- Safety instructions and operating manuals are available and observed,
- the respective national accident prevention regulations are observed,
- the permissible data and operational conditions are maintained,
- protective devices are used and the required maintenance is performed,
- the device is disposed of according to the law,
- valid national installation regulations are observed,
- the device is protected against mechanical impact.

Maintenance, Repair

Please note during maintenance and repairs:

- Repairs to the equipment may only be performed by Bühler authorised personnel.
- Due to its high total weight, the device is equipped with handles. These should be used for better handling during assembly, maintenance or repair.
- Before carrying out modification, maintenance or installation work, place the device in a safe condition as described for the specific task.
- Only perform conversion-, maintenance or installation work described in these operating and installation instructions.
- Always use genuine spare parts.
- Do not install damaged or defective spare parts. Before carrying out any maintenance, a visual inspection of the housing and options is required to check the integrity.
- Clean the device only with a damp cloth or with materials-compatible cleaning agents. Ensure that no cleaning agent enters the device.
- This device contains flammable refrigerant. Do not open or damage the cooling circuit. In the event of damage and leaking refrigerant, leave the room and ensure adequate ventilation. Avoid sparks, naked flames and other sources of ignition.

Always observe the applicable safety and operating regulations in the respective country of use when performing any type of maintenance.

DANGER



Use in potentially explosive atmospheres

Explosion hazard if used in hazardous areas.
The device is not suitable for operation in hazardous areas with potentially explosive atmospheres.
Do not expose the device to combustible or explosive gas mixtures.

DANGER



Electrical voltage

Electrocution hazard.

- a) Disconnect the device from power supply.
- b) Make sure that the equipment cannot be reconnected to mains unintentionally.
- c) The device must be opened by trained staff only.
- d) Regard correct mains voltage.



DANGER**Toxic, corrosive gas/condensate**

Sample gas/condensate may be hazardous to health.

- a) If necessary, ensure a safe gas/condensate discharge.
- b) Always disconnect the gas supply when performing maintenance or repairs.
- c) Protect yourself from toxic/corrosive gasses/condensate when performing maintenance. Wear suitable protective equipment.
- d) Do not allow condensate to drip into the housing.

**WARNING****Flammable substances**

The device is filled with flammable refrigerant R600a.

- a) Careful handling and specific choice of installation location and operating conditions. The recommended minimum room must be observed, or other safety measures must be taken.
- b) Do not damage the refrigeration circuit. In the event of damage:
 - ⇒ Keep away from open flames or sources of ignition.
 - ⇒ Ventilate the room for several minutes.
 - ⇒ Switch off the device.
 - ⇒ Contact the manufacturer for repair.
 - ⇒ Do not discharge refrigerant into drains or rooms where there are open flames or sources of ignition.

CAUTION**Hot surface**

Risk of burns

The housing can be up to 60 °C during operation.
Allow the unit to cool down before working on it.

CAUTION**Health hazard if the heat exchanger leaks**

The heat exchanger is charged with glycol-based coolant.
In the event of a heat exchanger leak:

- a) Avoid contact with the skin and eyes.
- b) In the event of a leak, do not restart the cooler under any circumstances. The cooler must be repaired by the manufacturer.

3 Transport and storage

The products should only be transported in their original packaging or a suitable replacement.

Sample gas coolers with flammable refrigerant are marked on their original packaging and must be stored and transported in accordance with national regulations.

When not in use, the equipment must be protected from moisture and heat. It must be stored in a covered, dry and dust-free room at a temperature of -20 °C to 60 °C (-4 °F to 140 °F).

4 Installation and connection

4.1 Installation site requirements

The device is intended for indoor use, either in 19" rack-mount housing or for wall mounting. The maximum installation altitude is suitable for elevations up to 2000 m.

Wall mounting: The device must be fixed at the designated through-holes 4 x \varnothing 7 mm. It must be ensured that the load capacity and stability of the wall and the cabinet are sufficient for the weight of the device.

The device is designed for use with pollution degree 2 and overvoltage category II. When used outdoors, adequate weather protection must be provided.

Install the device, leaving enough room below the cooler to discharge the condensate. There should also be some space above for gas supply connections. During operation, condensate may form and drip off under unfavourable ambient conditions. Ensure that no moisture-sensitive components or devices are positioned beneath the device.

Ensure that the permissible ambient temperature is maintained. Do not obstruct the convection of the cooler. The vents must have enough room to the next obstacle. In particular, on the air outlet side, the distance must be at least 10 cm.

The device contains the flammable refrigerant R600a (isobutane) in a technically permanently sealed refrigerant circuit and was leak-tested at the factory.

Despite the basic, safe design, residual risks should be minimised through appropriate measures with regard to installation location, operation, maintenance, service, repair and disposal (see corresponding chapter). Please observe in particular the warning on flammable substances.

The respective national legal regulations regarding devices with flammable refrigerants apply. The refrigerant quantity can be found in the technical data or directly on the device.

Adequate ventilation must especially be ensured when installing in enclosed housings, e.g. analyser cabinets, to prevent refrigerant accumulation.

This can be done using one of the following measures, for example:

- Ensuring an adequate free air volume (see minimum room volume recommendation) around the device.
- Ensuring natural convection.
- Active ventilation through suitable ventilation equipment (cooler air outlet directly into a free minimum room volume).
- Purging the sealed housing with air or other inert gases.
- Use of a fan to dissipate heat and mix the ambient air.
- Use of an LEL (lower explosion limit) sensor with automatic shutoff.

All measures should be implemented under consideration of applicable national regulations. The operator is responsible for assessing safety.

Recommended minimum room

The recommended minimum room for assembly, startup, maintenance, service, repair and disposal is 4.625 m³ on devices with 230 V supply voltage and 5 m³ on devices with 115 V supply voltage.

The recommended minimum room for operation is 1 m³ on devices with 230 V supply voltage and 1.05 m³ on devices with 115 V supply voltage.

WARNING

Flammable substances

The device is filled with flammable refrigerant R600a.

- a) Careful handling and specific choice of installation location and operating conditions. The recommended minimum room must be observed, or other safety measures must be taken.
- b) Do not damage the refrigeration circuit. In the event of damage:
 - ⇒ Keep away from open flames or sources of ignition.
 - ⇒ Ventilate the room for several minutes.
 - ⇒ Switch off the device.
 - ⇒ Contact the manufacturer for repair.
 - ⇒ Do not discharge refrigerant into drains or rooms where there are open flames or sources of ignition.



4.2 Installation

Run the gas supply to the cooler with a downward slope. The gas inputs are marked in red and additionally labelled "IN".

If a large amount of condensate accumulates, we recommend using a condensate trap with automatic condensate drain. Our condensate drains, 11 LD spec., AK 20 V, or model 165 SS, are suitable.

Glass vessels and automatic condensate drains are available for draining condensate for external mounting below the unit. When using automatic condensate drains, the sample gas pump must be installed upstream of the cooler (pressure operation) to ensure proper function of the condensate drain.

If the sample gas pump is located at the cooler outlet (suction operation), we recommend using glass condensate traps or peristaltic pumps.

4.2.1 Peristaltic pump connector (optional)

A peristaltic pump may also be installed a little away from the cooler. A mounting angle is available for installing up to 4 pumps directly below the cooler. Two M8 rivet nuts in the cooler bottom are designated for mounting the angle.

NOTICE

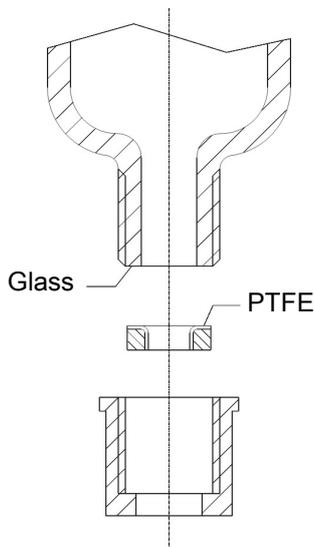


Installing peristaltic **pumps** CPsingle / CPdouble limits the maximum permissible **operating pressure** in the system!
Operating pressure ≤ 1 bar

4.2.2 Connecting the heat exchanger

The gas inputs are marked in red.

On glass heat exchangers the correct position of the seal is important when connecting the gas lines (see image). The seal consists of a silicone ring with a PTFE sleeve. The PTFE side must face the glass thread.



Pay attention to the appropriate spanner size when selecting fittings for stainless steel heat exchangers.

TS/TS-I gas connections: SW 17

TS/TS-I condensate out connections: SW 22

4.2.3 Condensate drain connection

Depending on the material, build a connecting line with fittings and tubing or hose between the heat exchanger and condensate drain. For stainless steel the condensate drain can be suspended directly to the connecting tube, for hoses the condensate drain must be secured separately using a clamp.

Condensate lines must always be installed with a slope and a minimum inside diameter of DN 8/10 (5/16").

4.3 Electrical connections

The operator must install an external separator for the device which is clearly assigned to this device.

This separator

- must be located near the device,
- must be easy for the operator to reach,
- must comply with IEC 60947-1 and IEC 60947-3,
- must separate all live conductors and the status output, and
- must not be attached to the power feed.

The power supply line of the device must be protected according to the specifications in the technical data.

WARNING



Hazardous electrical voltage

The device must be installed by trained staff only.

CAUTION



Wrong mains voltage

Wrong mains voltage may damage the device.
Regard the correct mains voltage as given on the type plate.

WARNING



High voltage

Damage to the device in case of insulation testing
Do not proceed insulation tests with high voltage to the device as a whole!

Insulation test

The device is equipped with extensive EMC protection. If insulation tests are carried out the electronic filter devices will be damaged. All necessary tests have been carried out for all concerned groups of components at the factory (test voltage 1 kV or 1.5 kV respectively, depending on the device).

If you wish to carry out the insulation test by yourself, please test only separate groups of components.

Disconnect the compressor, the fan, the heating or the peristaltic pumps, respectively, and then carry out the insulation tests.

Connection via plug

This device has one EN 175301-803 plug each for the power supply and the status output. If the lead is connected correctly, these cannot be confused. Therefore please be sure to correctly reassemble the plugs after connecting the wires. The following are the pin assignments, with the numbers corresponding to those on the plugs.

The supply line cross-sections must be suitable for the rated current. Use a maximum line cross-section of 1 mm² (AWG 17) and a maximum line cross-section of 1.5 mm² (AWG 16) and a cable diameter of 8–10 mm (0.31–0.39 inches).

For connecting the analogue output or digital interface, shielded signal cables with a maximum length of 30 m (98.4 ft) must be used and connected at both ends.

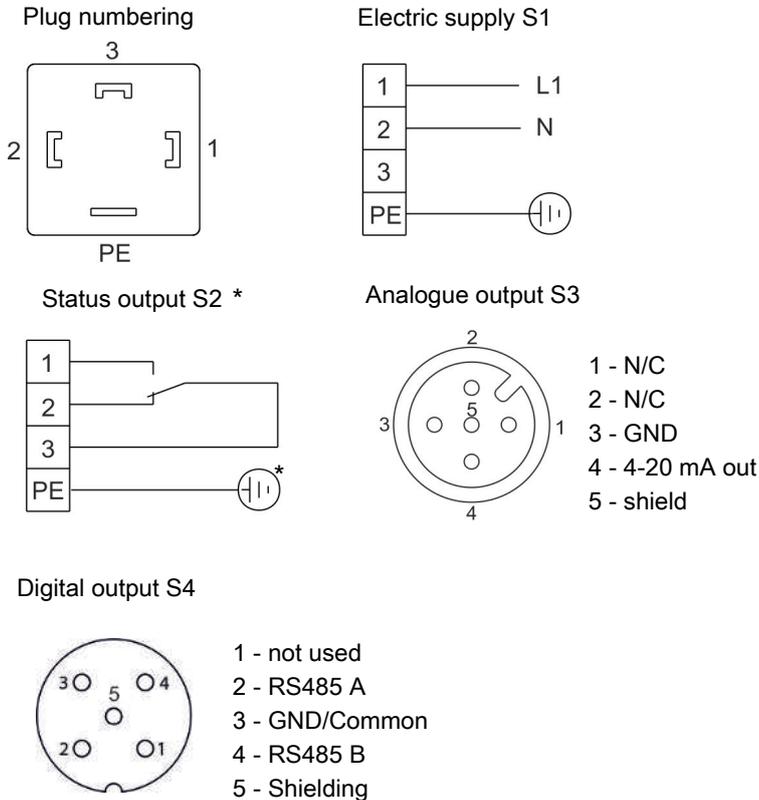


Fig. 1: Cooler connection

* When using the status output with a voltage ≥ 33 V AC or ≥ 70 V DC, the protective earth (PE) must be connected.

The clamping range has a diameter of 8–10 mm (0.31–0.39 inch).

4.4 Signal outputs

The device has various standard and optional signal outputs. Signalling via the display and the status output are always included in the scope of delivery. An analogue or digital output is optional.

4.4.1 Signalling via the display

The front foil contains three LEDs:

Colour	Marking	Function
Red	S2	High/low temperature, device error
Yellow	S1	---
Green	OP	Normal operation

The OP and S2 LEDs indicate the device status in the same way as status output S2.

4.4.2 Status output (terminal S2)

The maximum switching capacity of the status outputs is 250 V AC / 150 V DC, 2 A, 50 VA each.

The status output (S2) indicates when the cooler block temperature is outside the specified limits. No distinction is made as to whether the alarm was triggered by excess temperature or insufficient temperature.

If the “humidity sensor” option is installed, status output S2 will also signal if moisture is still present in the conditioned sample gas or if a cable break is detected. The signalling does not distinguish between humidity sensor 1 or 2.

Function / contact type	Description
internal changeover contact: max. 250 V AC / 150 V DC, 2 A, 50 VA	<p>the following device statuses can be indicated via two switching outputs:</p> <p>Contact between 3 and 2 closed (alarm)</p> <ul style="list-style-type: none"> – No mains voltage and/or actual temperature value outside the set alarm thresholds. – Device in fault condition / pump deactivated. <p>Contact between 3 and 1 closed (ok)</p> <ul style="list-style-type: none"> – Mains voltage applied + actual temperature value within the set alarm thresholds. <p>with humidity sensor option</p> <p>Contact between 3 and 2 closed (alarm)</p> <ul style="list-style-type: none"> – Humidity sensor detects residual moisture in the sample gas or cable break: Error message. <p>Contact between 1 and 3 closed (ok)</p> <ul style="list-style-type: none"> – No residual moisture in the sample gas / no cable break.

4.4.3 Analogue output (connection S3)

If the ‘analogue output’ option (*see type code*) is integrated, the actual value of the cooler block temperature is output via the analogue output as a 4...20 mA signal.

The device menu offers the option to reconfigure the interface from current output to voltage output. The analogue value is then represented as a 2...10 V signal.

The temperature signal can be tapped via the built-in connector (S3) with M12x1 connection. This connector is located next to the connections for the humidity sensors on the top of the cooler.

Function / contact type	Description
4-20 mA analog output ($R_{load} < 500 \Omega$)	<p>Signalling of the cooler block temperature</p> <p>$T_{cooler} = -20 \text{ °C} \triangleq (-4 \text{ °F}) \rightarrow 4 \text{ mA}/2 \text{ V}$</p> <p>$T_{cooler} = 5 \text{ °C} \triangleq (41 \text{ °F}) \rightarrow 9 \text{ mA}/4.5 \text{ V}$</p> <p>$T_{cooler} = 60 \text{ °C} \triangleq (140 \text{ °F}) \rightarrow 20 \text{ mA}/10 \text{ V}$</p>

4.4.4 Digital output (connection S4)

Via this interface, various measurement values and device statuses can be read and the cooler can be parameterised. A detailed description of the interface can be found in the chapter Using the Digital Interface.

Function / contact type	Description
Digital output	<p>Modbus RTU (RS-485)</p> <p>Interface default values</p> <p>Baudrate – Parity – Stop bit:</p> <p>19200 – Even – 1</p> <p>Default ID: 10</p> <p>The bus lines are not internally terminated.</p>

5 Operation and control

NOTICE



The device must not be started or operated outside the specifications!

5.1 Before startup

Before commissioning, the device should be left to stand quietly and upright for at least 1 hour after transport, positioning, or installation.

After switching on the cooler, the display shows the cooling block temperature. The display flashes until the cooling block temperature has reached the setpoint value (\pm adjustable alarm range). The status contact is in the alarm position.

When the set temperature range is reached, the cooling block temperature is displayed continuously and the status contact switches over.

If the display flashes or an error message appears during operation, please refer to the section 'Troubleshooting and Correction'. The performance data and limits can be found in the technical data in the appendix.

5.2 Description of functions

The cooler is controlled by a microprocessor. With the factory preset the control already incorporates the various characteristics of the built-in heat exchangers.

The programmable display shows the block temperature in the selected display unit ($^{\circ}\text{C}$ / $^{\circ}\text{F}$) (factory preset $^{\circ}\text{C}$). Application-specific settings can easily be configured guided by the menu, using the 5 buttons. For one, this applies to the target outlet dew point, which can be set from 3°C to 15°C (37°F to 59°F) (factory preset $5^{\circ}\text{C}/41^{\circ}\text{F}$).

And then the warning thresholds can be adjusted for low and excess temperature. These are set relative to the outlet dew point τ_a setting.

For the low temperature the range is $\tau_a - 1\text{ K}$ to $- 3\text{ K}$ (at a minimum $1^{\circ}\text{C}/34^{\circ}\text{F}$ cooling block temperature), for the excess temperature the range is $\tau_a + 1\text{ K}$ to $+ 7\text{ K}$. The factory presets for both values are 3 K .

The S2 LED and the status relays flashing indicates the conditions are below or above the configured warning range (e.g. after switching on).

The status output can e.g. be used to control the sample gas pump to allow for the gas flow to only be switched on once the permissible cooling range has been reached or shut off the pump in the event of a moisture detector alarm.

The separated condensate can be drained via connected peristaltic pumps or add-on automatic condensate drains.

The moisture detector is easy to remove. This may be required if a condensate enters the cooler due to a malfunction and the peristaltic pump or the automatic condensate drain is unable to remove it.

5.3 Use of menu functions

Brief description of the operating principle:

The unit is operated using 5 keys. Their functions are:

Button	Section	Functions
← or OK	Display	– Switches from the measurement display to the main menu
	Menu	– Selects the menu item displayed
	Enter	– Applies an edited value or a selection
▲	Display	– temporarily switches to the alternative measurement display (if option installed)
	Menu	– Back
	Enter	– Increase value or browse selection – Note: – Press button 1 x = changes parameter / value by one; – Hold button = fast mode (numerical values only) – Display flashes: modified parameter/value – Steady display: original display/value
▼	Display	– temporarily switches to the alternative measurement display (if option installed)
	Menu	– Next
	Enter	– Reduce value or browse selection
ESC	Menu	– Move one level up
	Enter	– Return to menu Changes will not be saved!
F or Func		– Sets a menu to favourite. (Note: The favourite menu will also be activated with the menu locked!)

5.3.1 Lock Menu

Some menus can be locked to prevent inadvertently changing the settings of the unit. This requires setting a code. For information on setting up or disabling the menu lock please refer to "Global Settings" (*tOP*) under menu item *tOP* > *Loc*.

The menu lock is **not** enabled at the time of delivery, all menu items can be accessed.

With the menu locked, only the following menu items will be visible without entering the correct code:

Menu item	Explanation
<i>tOP</i> > <i>uni</i> <i>t</i>	Temperature unit selection (°C or °F).
F or Func.	Accessing the Favourites menu NOTICE! This menu may be one that is normally locked.

5.3.2 Menu navigation overview

When pressing the **OK** button in normal mode, the display will show the prompt *codE* if the menu is locked. Use the **▲** and **▼** buttons to enter the correct code and press **OK**.

If an incorrect code or no code is entered, the menu will not be unlocked and you will not be able to access all menu items.

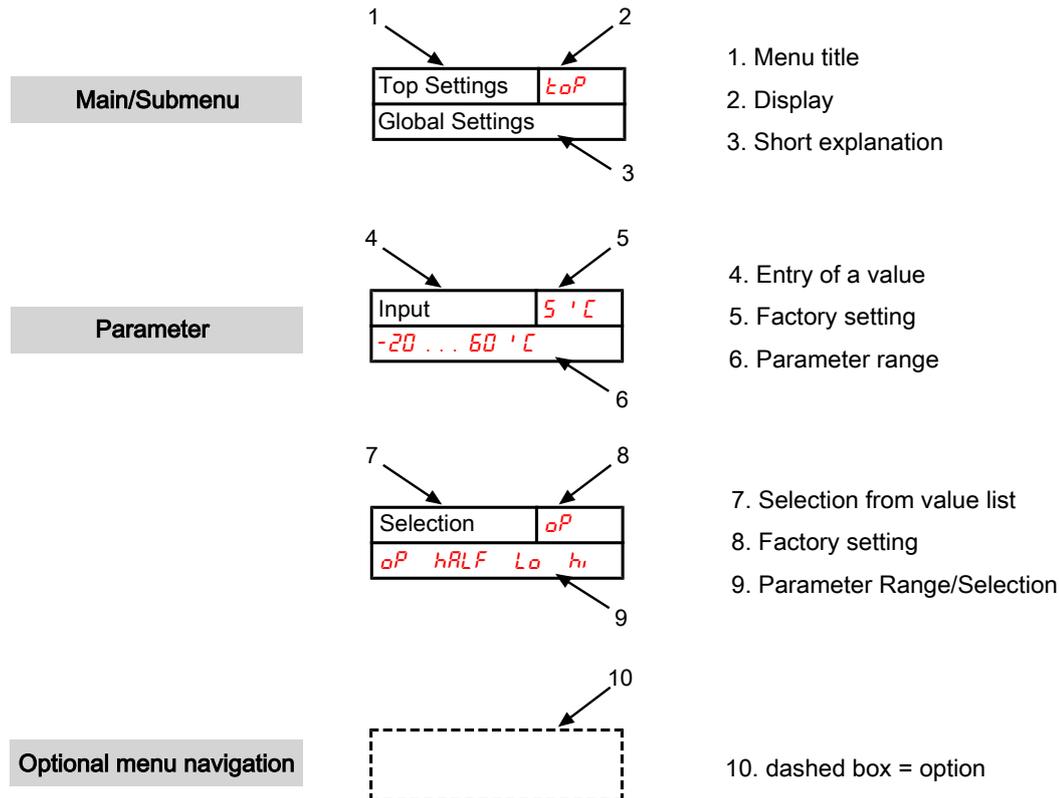
If you forgot the password you can always enter master code 287 to access the menu; the menu will be unlocked.

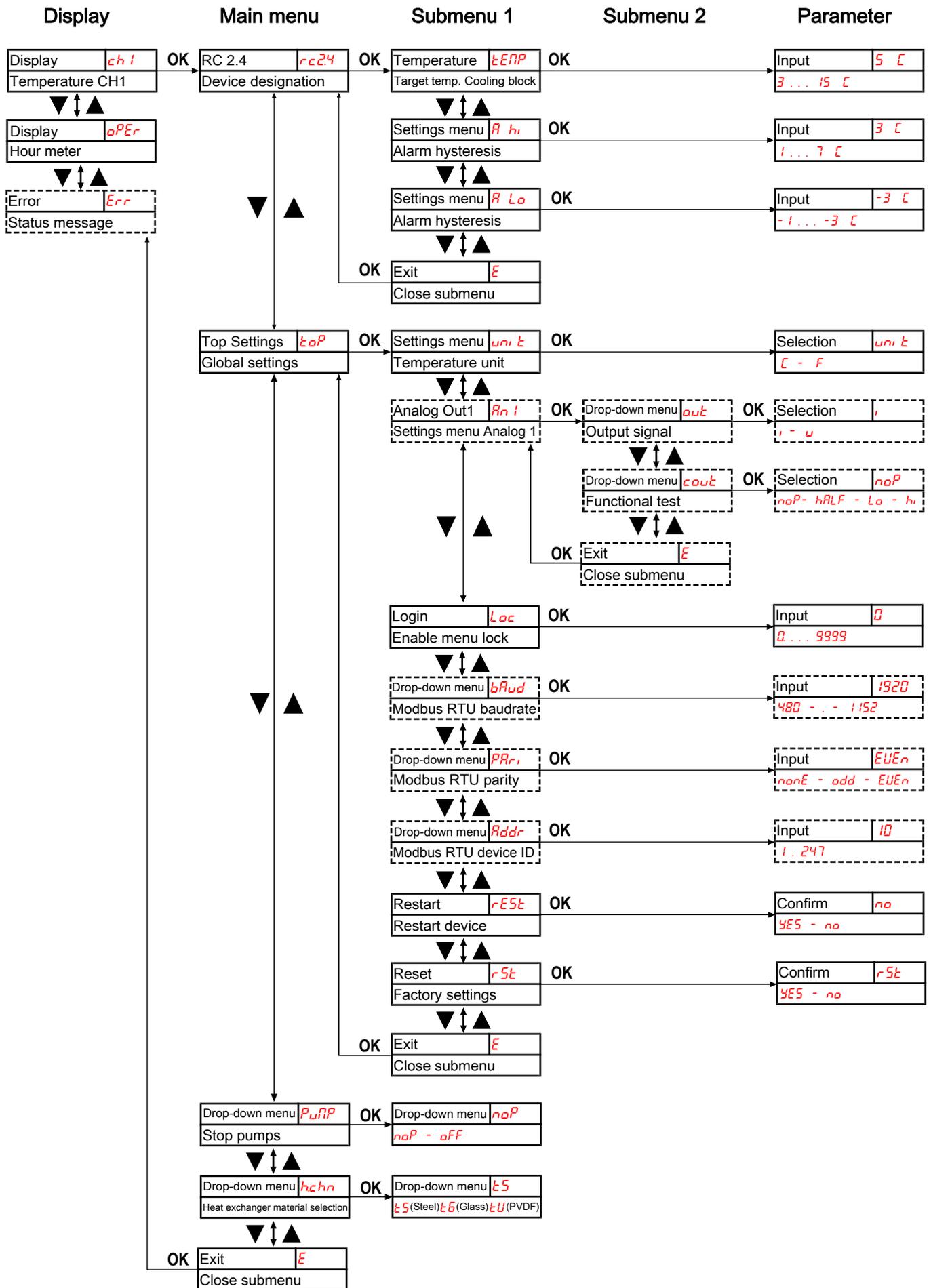
The following image shows an overview of the menu structure.

Items with a dashed frame will only appear with the respective settings or with the respective status messages.

The factory settings and ranges are specified in the overview as well as under the respective menu item. The factory settings apply unless otherwise agreed.

You can cancel entries and menu selections without saving by pressing the **ESC** key.



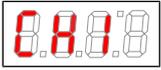


5.4 Description of menu functions

5.4.1 Display Menu

Block temperature display

Display → *chl*



Depending on the device state, the temperature will be displayed as a constant, flashing, or alternating with a status message.

Operating hours /runtime display

Display → *oPEr*

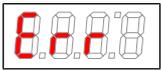


Displays the operating hours of the unit. The runtime cannot be reset and can be output in various display formats. To view/exit the runtime, press the „Enter“ key.

- *yyMn* – display in years and months (default)
- *nMh* – display in months
- *WEEh* – display in weeks
- *dAYS* – display in days
- One month corresponds to 30 days. Press the „F“ key to switch between the display formats. The display will then first show the selected format as short text, then the duration.

Error code display

Display → *Err*



In the event of errors/malfunctions not related to operation, the error code indicates possible causes and solutions.

5.4.2 Main menu

RC 2.4 Rack Cooler

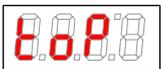
Display → *rc24*



From here, you can access the setpoint adjustment for the cooling block temperature and the tolerance range (alarm threshold).

Global setting

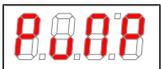
Display → *LoP* (ToP Settings)



This menu is used to configure the global cooler settings.

Peristaltic Pump

Display → *PuRP*



Switching the peristaltic pump on and off.

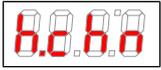
Parameter range: *noP*, *oFF*

Factory setting: *noP*

Note: Status switches, "*PuRP*" flashes.

Heat exchanger material selection

Display → *hchh*



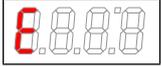
Heat exchanger material selection

Parameter range: *LS* (Steel), *LG* (Glass), *LV* (PVDF)

Factory setting: *LS* (cooler without heat exchanger), or respective material per configuration

Exit main menu

Display → *E*



Selecting this will return you to display mode.

5.4.3 Submenu 1

Setpoint temperature

Display → Cooler → *TEMP*



This setting defines the target cooling block temperature.

Parameter range: 3 °C to 15 °C (37.4 °F to 59 °F)

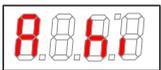
Factory setting: 5 °C (41 °F)

Note: If the temperature is changed, the indicator may blink until the new operating range has been reached.

This menu item is not visible when the key lock is active.

Upper alarm limit

Display → Cooler → *A hi* (Alarm high)



Here you can set the upper threshold for the optical alarm as well as for the status relay. The alarm limit is set relative to the selected cooling block temperature.

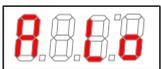
Parameter range: 1 °C to 7 °C (1.8 °F to 12.6 °F)

Factory setting: 3 °C (5.4 °F)

Note: This menu item is not visible when the key lock is active.

Lower alarm limit

Display → Cooler → *A Lo* (Alarm low)



Here you can set the lower threshold for the optical alarm as well as for the status relay. The alarm limit is set relative to the selected cooling block temperature.

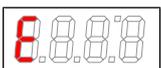
Parameter range: -1 °C to -3 °C (-1.8 °F to -5.4 °F)

Factory setting: -3 °C (-5.4 °F)

Note: This menu item is not visible when the key lock is active.

Exit submenu 1

Display → Submenu → *E*

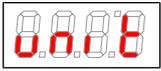


Selecting this will return you to the main menu.

5.4.4 Submenu 1 (global settings)

Temperature unit

Display → *LoP* → *unit*



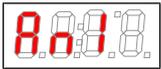
Used to select the temperature display unit.

Parameter range: *C, F*

Factory setting: *C*

Analog output

Display → *LoP* → *An1*



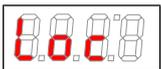
This submenu is used to specify the settings for analog output 1, see chapter Submenu 2 (Analog Output 1)

Note: This menu will be hidden if the menu is locked.

Lock Menu

To protect the menu from unauthorised use, enter a value for the lock code. Menu items can then only be accessed after entering the correct code.

Display → *LoP* → *Loc*



This setting will cancel/enable the menu lock.

Parameter range: 0 to 9999

Factory setting: 0 (keylock cancelled)

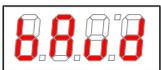
Note: This menu will be hidden if the menu is locked.

Modbus RTU baudrate

The default transfer rate is 19200 bps. This can be configured for the specific application within a defined range. The options are in the display are listed in kbps (19.2 corresponds to 19200 bps). The properties of the digital interface are not affected when re-setting the device to its factory settings!

This menu item is only available on devices with "Digital output Modbus RTU" option.

Display → *LoP* → *bAud*



Determines the transfer rate for the digital interface.

Parameter range: *4.80*
9.60
19.20
38.40
57.60
115.2

Factory setting: *19.20*

Note: This menu will be hidden if the menu is locked.

Modbus RTU parity

The default parity is even/odd, options are odd parity, no parity. The number of stop bits is automatically set based on the respective setting. No parity uses two stop bits, otherwise it is one. The properties of the digital interface are not affected when resetting the device to its factory settings!

This menu item is only available on devices with "Digital output Modbus RTU" option.

Display → *LoP* → *PRr*



This setting restores the factory settings.

Parameter range: *nonE*
odd
EUEn

Factory setting: *EUEn*

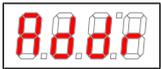
Note: This menu will be hidden if the menu is locked.

Modbus RTU device ID

Selecting the device ID for communication via digital interface. The ID can be any within a defined range, the default is 10. The properties of the digital interface are not affected when resetting the device to its factory settings!

This menu item is only available on devices with "Digital output Modbus RTU" option.

Display → *LoP* → *Addr*



Defines the ID.

Parameter range: *1 247*

Factory setting: *10*

Note: This menu will be hidden if the menu is locked.

Restart

Display → *LoP* → *rESt*

(*rESt* = restart)



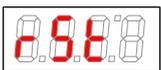
The device will restart, all settings are saved. All error messages will be reset. The moisture detector will be reset, irrespective of the settings in menus *hi Lc* and *hiLo*.

Parameter range: *YES*: Restart. The display will show the software version for the device and returns to measurement display.
no: Exit menu without restarting.

Note: The user settings will be saved.

Factory settings

Display → *LoP* → *rSt*

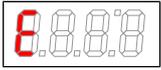


This setting restores the factory settings.

Parameter range: *YES*: factory settings restored.
no: Exit menu without making changes.

Factory setting: *no*

Note: This menu will be hidden if the menu is locked.

Exit submenu 1Display → Submenu → *E*

Selecting this will return you to the main menu.

5.4.4.1 Submenu 2 (Analog Output 1)

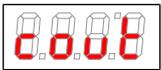
The cooling block temperature of the cooler is output at the analogue output. For devices with the “Digital Output Modbus RTU” option, the menu items for the analogue output are not available.

Signal behaviour

In normal operation (*noP*), the cooling block temperature is output at the measuring point. For test purposes, the constant values *hi*, *Lo* or *hRLF* can be generated. A constant signal is present at the analogue output, the value of which is specified in the table.

Constant	Current output 4 – 20 mA	Voltage output 2 – 10 V
<i>hi</i>	20 mA	10 V
<i>hi</i>	12 mA	6 V
<i>Lo</i>	4 mA	2 V
<i>noP</i>	4 – 20 mA	2 – 10 V

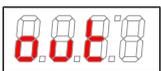
After testing, the signal behaviour must be changed back to normal mode (*noP*).

Display → *LoP* → *Rn I* → *cout*

This setting determines how the analogue output will behave.

Parameter range: *noP* = Operation (normal mode), *hi*, *Lo*, *hRLF*Factory setting: *noP*

Note: This menu will be hidden if the menu is locked.

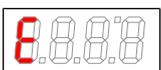
Selection -> Output SignalDisplay → *LoP* → *Rn I* → *out*

Select the type of output signal.

Parameter range: *v* Status output 4... 20 mA
v Status output 2...10 V

Factory setting: *v*

Note: Disconnect meter before switching!
 This menu item is hidden if the keylock is enabled.

Exit Submenu 2Display → *LoP* → *Rn I* → *E*

Selecting this will return you to submenu 1.

5.4.5 Set favourite menu

Use the **F** or **Func** (function) key to set a favourite menu to later open it with just the push of a button.

- Open the menu you wish to set as the favourite. This menu can also be a lockable menu.
- Press the function key for more than 3 sec.
The current menu has been set as the favourite. The display will briefly show the message *Func*.
- Press **ESC** or **E** (Exit) to return to the display.

To now access the favourite menu, press the **F** or **Func** key.

NOTICE! The favourite menu can also be accessed if the menu is locked.

5.5 Using the Digital Interface

The digital interface on this device is a Modbus RTU protocol, which physically communicates via RS485 (2-wire). The cooler therefore takes on the role of the slave in communication.

The Modbus interface enables direct access to process and diagnostic data and parameters during operation.

5.6 Modbus Configuration

The settings listed below correspond to the default settings; with the interface active, the parameters can be adjusted.

Structure of a character:

1 start bit

8 data bits

1 parity bits (configurable)

1 stop bit (*)

Baudrate: 19200 bps (configurable)

Device ID: 10 (configurable)

(*) The length of a character is always 11 bits. If the interface is configured with 0 parity bits, the number of stop bits automatically changes to 2.

5.7 Modbus Communication

Communication via Modbus RTU is always initiated by the master (request). The slave (typically) responds to the request with a response. A Modbus RTU frame for a request/response always has the following structure:

Address field (A)	Function code (FC)	Data	CRC
1 byte	1 byte	1 ... 252 bytes	2 bytes

Register addresses and data are transferred in Big Endian format.

Every register stands for a 16 bit value, with the information represented in various data types. The data type and required function code are assigned to the respective registers in the following tables.

To read/write data types with sizes larger than an individual register, multiple registers must be addressed.

Supported function codes:

Function code (FC)	FC values
Read Holding Registers	3
Write Multiple Registers	16

Data types:

Description	Number of bytes	Number of registers
Float	4	2
Int16	2	1
UInt16	2	1
Int32	4	2
UInt32	4	2

5.8 Modbus Register

Description	FC	Address	Access	Data type	Default	Min	Max	Selection	Resolution	Unit
Cooling block temperature measurement	3	2000	R	Float	-	-	-	-	0.5	°C
Cooling block temperature status	3	2002	R	Uint32	-	-	-	Bit 0 := Error Bit 1..15 := Reserved Bit 16:= Sensor not calibrated Bit 17:= Initialization/measurement invalid Bit 18 := Stabilisation phase Bit 19:= Load limit reached Bit 20:= Measurement outside target range Bit 21..31 := Not used	-	-
Cooling block temperature setpoint	3, 16	5000	R/W	Float	5.0	3.0	15.0	-	0.5	°C
Positive alarm tolerance setpoint	3, 16	5002	R/W	Float	3.0	1.0	7.0	-	1.0	K
Negative alarm tolerance setpoint	3, 16	5004	R/W	Float	-3.0	-3.0	-1.0	-	1.0	K
Display unit selection	3, 16	9006	R/W	Uint16	1	-	-	1 := °C 2 := °F	-	-
Heat exchanger type selection	3, 16	9007	R/W	Uint16	2	-	-	2 := Steel 3 := Glass 4 := PVDF	-	-
De-/activate condensate pump(s)	3, 16	9008	R/W	Uint16	3	-	-	3:= Pump active 4:= Pump inactive	-	-
Modbus Baudrate selection	3, 16	9009	R/W	Uint16	3	-	-	1 := 4800 2 := 9600 3 := 19200 4 := 38400 5 := 57600 6 := 115200	-	-
Modbus Parity selection	3, 16	9010	R/W	Uint16	2	-	-	0 := None 1 := Odd 2 := Even	-	-
Modbus Device address selection	3, 16	9011	R/W	Uint16	10	1	247	-	1	-
Lock menu	3, 16	9012	R/W	Uint16	0	0	9999	-	1	-
TEST	3	9990	R	Uint32	12648430	-	-	-	1	-
TEST_UINT16	3, 16	9992	R/W	Uint16	206	0	65535	-	1	-
TEST_INT16	3, 16	9993	R/W	Int16	-206	-32768	32767	-	1	-
TEST_UINT32	3, 16	9994	R/W	Uint32	2766	0	4294967295	-	1	-
TEST_INT32	3, 16	9996	R/W	Int32	-2766	0x80000000	0x7fffffff	-	1	-

Description	FC	Address	Access	Data type	Default	Min	Max	Selection	Resolution	Unit
TEST_Float	3, 16	9998	R/W	Float	-10.5			-	-	-
Status register overview	3	10000	R	Uint16	0			Bit 0 := Status information register 10001 Bit n := Status information register 10000 + n + 1	-	-
Condition code register 1	3	10001	R	Uint16	0	-	-	Bit 0 := Device status Bit 1 := Device in error status Bit 2 := Target temperature range overrun Bit 3 := Target temperature range underrun Bit 4 := Bit 5 := Bit 6 := Bit 7 :=	-	-
Condition code register 2	3	10002	R	Uint16	0	-	-	Bit 0 := Bit 1 := Bit 2 := Initialization phase Bit 3 := Bit 4 := Bit 5 := Bit 6 := Bit 7 :=	-	-
Condition code register 3	3	10003	R	Uint16	0	-	-	Bit 0 := Peristaltic pumps deactivated Bit 1 := Bit 2 := Bit 3 := Bit 4 := Bit 5 := Bit 6 := Bit 7 :=	-	-
Condition code register 4	3	10004	R	Uint16	0	-	-		-	-
Error register 1	3	10005	R	Uint16	0	-	-	Bit 0 := Display communication error Bit 1 := Controller communication error Bit 2 := Bit 3 := Controller configuration error Bit 4 := EEPROM regulator error Bit 5 := Bit 6 := Bit 7 := Gen. software error	-	-
Error register 2	3	10006	R	Uint16	0	-	-		-	-
Error register 5 - PT100.1	3	10009	R	Uint16	0	-	-	Bit 0 := General error Bit 1 := Short-circuit/temperature low Bit 2 := Cable break/temperature high	-	-

Description	FC	Address	Access	Data type	Default	Min	Max	Selection	Resolution	Unit
								Bit 3 := Measurement fluctuation Bit 4 := Bit 5 := Bit 6 := Bit 7 :=		
Error register 6	3	10010	R	Uint16	0	-	-		-	-
Error register 7	3	10011	R	Uint16	0	-	-	-	-	-
Error register 8	3	10012	R	Uint16	0	-	-	-	-	-
Error register 9	3	10013	R	Uint16	0	-	-	-	-	-
Error register 10	3	10014	R	Uint16	0	-	-	-	-	-
Utilisation controller 1	3	10017	R	Unit16	-	0	100	-	10	%
Device run time	3	10100	R	Float	-	0	-	-	6 min	h
Restart/ reset device	16	11000	W	Unit16	0x00	-	-	86 := Restart device 17:= Factory reset	-	-
Reset moisture detector 1	16	11002	W	Uint16	0xAA	-	-	-	-	-
Reset moisture detector 2	16	11003	W	Uint16	0xAA	-	-	-	-	-

Example:

Register 5000 = 0x1388

Read block temperature set values

	A	FC	Start register HI	Start register LO	No. register HI	No. register LO	CRC	CRC	
Request	0x0A (10)	0x03 (3)	0x13	0x88	0x00 (0)	0x02 (2)	0x41	0xDE	
	A	FC	No. of byte	DATA 3	DATA 2	DATA 1	Data 0	CRC	CRC
Response	0x0A (10)	0x03 (3)	0x04	0x40	0xA0	0x00	0x00	0x55	0x11

6 Maintenance

For all work on the device, the general instructions in the [Safety instructions](#) [> page 5] chapter must be observed!

DANGER

Electrical voltage



Electrocution hazard.

- a) Disconnect the device from power supply.
- b) Make sure that the equipment cannot be reconnected to mains unintentionally.
- c) The device must be opened by trained staff only.
- d) Regard correct mains voltage.



DANGER

Toxic, corrosive gas/condensate



Sample gas/condensate may be hazardous to health.

- a) If necessary, ensure a safe gas/condensate discharge.
- b) Always disconnect the gas supply when performing maintenance or repairs.
- c) Protect yourself from toxic/corrosive gasses/condensate when performing maintenance. Wear suitable protective equipment.
- d) Do not allow condensate to drip into the housing.



WARNING

Flammable substances



The device is filled with flammable refrigerant R600a.

- a) Careful handling and specific choice of installation location and operating conditions. The recommended minimum room must be observed, or other safety measures must be taken.
- b) Do not damage the refrigeration circuit. In the event of damage:
 - ⇒ Keep away from open flames or sources of ignition.
 - ⇒ Ventilate the room for several minutes.
 - ⇒ Switch off the device.
 - ⇒ Contact the manufacturer for repair.
 - ⇒ Do not discharge refrigerant into drains or rooms where there are open flames or sources of ignition.

CAUTION

Hot surface



Risk of burns

The housing can be up to 60 °C during operation.
Allow the unit to cool down before working on it.

CAUTION

Health hazard if the heat exchanger leaks



The heat exchanger is charged with glycol-based coolant.

In the event of a heat exchanger leak:

- a) Avoid contact with the skin and eyes.
- b) In the event of a leak, do not restart the cooler under any circumstances. The cooler must be repaired by the manufacturer.

Depending on the ambient conditions and installation location, ensure that the air inlet and outlet are free from foreign objects. A visual inspection is required at least every 6 months.

When performing any work on the device, it is recommended to ensure a minimum room of 4.625 m³ on devices with 230 V supply voltage and 5 m³ on devices with 115 V supply voltage, or employ other safety measures to avoid any potential ignition sources.

However, it may have different options depending on the cooler model. In this case the following routine maintenance is required:

- **Peristaltic pump option:** Check the hoses (see chapter Replacement of the hose for the peristaltic condensate pump (optional)).

7 Service and repair

If an error occurs during operation, you will find troubleshooting and corrective information in this chapter.

Repairs to the equipment may only be performed by Bühler authorised personnel.

If you have any questions, please contact our service department:

Tel.: +49-(0)2102-498955 or your local representative.

Further information about our individual service solutions for repair, modification and commissioning can be found at <https://www.buehler-technologies.com/service>.

If, after rectifying any faults and switching on the mains voltage, the device does not function correctly, it must be checked by the manufacturer. Please send the equipment inside suitable packaging to:

Bühler Technologies GmbH – BZL

Halle A1 – Aircompark

Halskestr. 24

40880 Ratingen

Germany

Any device with a potential leak must not be sent. Please contact our service team for more information.

In addition, please attach the completed and signed RMA decontamination declaration to the packaging. Otherwise, your repair order cannot be processed. You can find the form in the appendix of these instructions, or simply request it by e-mailing:

service@buehler-technologies.com

7.1 Carrying out maintenance, repair and modification work

For all work on the device, the general instructions in the [Safety instructions](#) [> page 5] chapter must be observed!

When performing any work on the device, it is recommended to ensure a minimum room of 4.625 m³ on devices with 230 V supply voltage and 5 m³ on devices with 115 V supply voltage, or employ other safety measures to avoid any potential ignition sources.

DANGER



Toxic, corrosive gas/condensate

Sample gas/condensate may be hazardous to health.

- a) If necessary, ensure a safe gas/condensate discharge.
- b) Always disconnect the gas supply when performing maintenance or repairs.
- c) Protect yourself from toxic/corrosive gasses/condensate when performing maintenance. Wear suitable protective equipment.
- d) Do not allow condensate to drip into the housing.



DANGER



Electrical voltage

Electrocution hazard.

- a) Disconnect the device from power supply.
- b) Make sure that the equipment cannot be reconnected to mains unintentionally.
- c) The device must be opened by trained staff only.
- d) Regard correct mains voltage.



WARNING**Flammable substances**

The device is filled with flammable refrigerant R600a.

- a) Careful handling and specific choice of installation location and operating conditions. The recommended minimum room must be observed, or other safety measures must be taken.
- b) Do not damage the refrigeration circuit. In the event of damage:
 - ⇒ Keep away from open flames or sources of ignition.
 - ⇒ Ventilate the room for several minutes.
 - ⇒ Switch off the device.
 - ⇒ Contact the manufacturer for repair.
 - ⇒ Do not discharge refrigerant into drains or rooms where there are open flames or sources of ignition.

CAUTION**Hot surface**

Risk of burns

The housing can be up to 60 °C during operation.
Allow the unit to cool down before working on it.

CAUTION**Health hazard if the heat exchanger leaks**

The heat exchanger is charged with glycol-based coolant.
In the event of a heat exchanger leak:

- a) Avoid contact with the skin and eyes.
- b) In the event of a leak, do not restart the cooler under any circumstances. The cooler must be repaired by the manufacturer.

7.1.1 Opening the housing

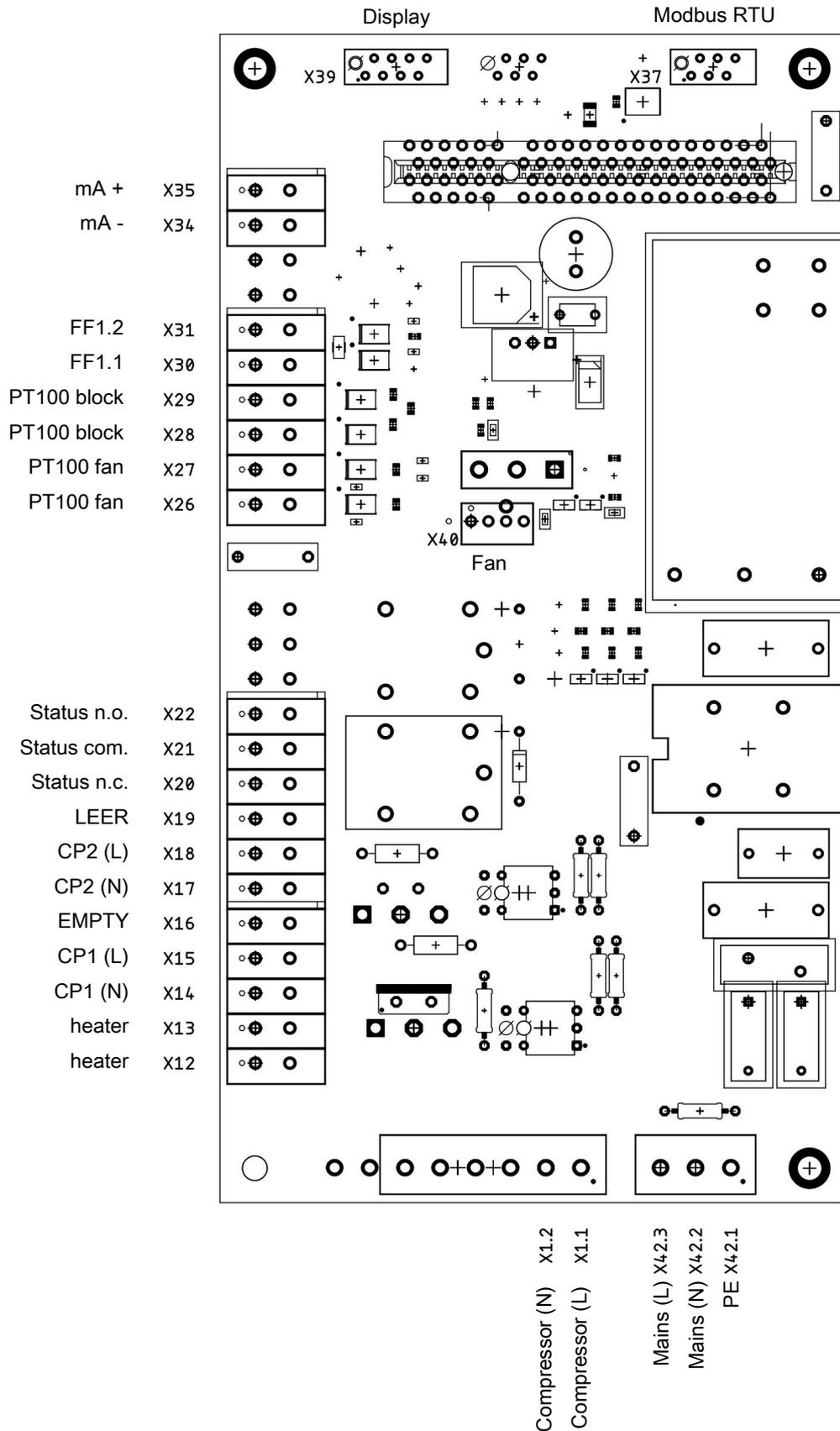
- Shut off the gas supply.
- Switch off the device and disconnect the mains and status plug (disconnect all poles).
- Disconnect the gas connection (only when dismantling the hood).
- Remove the fixing screws. They are located on the front, above and in the area of the electrical connections.
- Remove the hood by pulling the lower end slightly forward and releasing the hooked connection at the top (Caution: The hood contains cable connections from the display module and, optionally, from the condensate pump).
- To close the hood, reassemble the device in the reverse order.

7.1.2 Replacing the fan

- Open the device as described in the chapter [Opening the housing](#) [> page 30].
- Unplug the connector from the controller board.
- Loosen the four fastening screws of the fan.
- Replace the fan and reassemble the device in the reverse order.

7.1.3 Replacing the controller board

- Open the device as described in the chapter [Opening the housing](#) [> page 30].
- Remove all cables, see terminal diagram:



- Loosen the nuts at the corners of the board.
- Replace the board and reassemble the device in the reverse order.

7.1.4 Replacing the MCP2 microcontroller board

- Open the device as described in the chapter [Opening the housing](#) [> page 30].
- Remove the MCP2 board from the control board.
- Attach the new board.
- Reassemble the device in the reverse order.

7.1.5 Replacing the MCD400 display module

- Open the device as described in the chapter [Opening the housing](#) [> page 30].
- Disconnect the flat cable from the display.
- Press out the snap-in frame, if necessary compress the clips, and remove the old display module.
- Insert the new display module and press it flush with the housing.
- Reassemble the device in the reverse order.

7.1.6 Cleaning and removal of the heat exchanger

Heat exchangers only need to be replaced or maintained if clogged or damaged. If they are clogged, we recommend checking if using a filter will avoid future occurrences.

- Close gas supply.
- Switch off device and disconnect all plugs (e.g. status output connector, supply input, etc.).
- Disconnect gas connections and condensate drain.
- Pull the heat exchanger up and out.
- Clean cleaning nest (hole inside the cooler block), as the heat exchangers are installed with silicone grease.
- Flush the heat exchanger until all contaminants have been removed.
- Grease the cooled outside surface external surface with silicone grease.
- Reinsert the heat exchanger into the cooling nest with a rotating movement.
- Reconnect the gas supply and condensate drain. The gas inlet is marked red.
- Restore power/gas supply and wait for unit to be ready for operation.
- Open gas supply.

7.1.7 Replacement of the hose for the peristaltic condensate pump (optional)

- Shut off the gas supply.
- Use the “Peristaltic Pump” device option and switch off the pump via the menu or switch off the device.
- Disconnect supply and discharge tube on peristaltic pump (**observe safety notes (especially about condensate)!**).
- Loosen, but do not remove, the centre-knurled nut. Flip down the screw.
- Pull cover up and off.
- Unplug external connections and remove hose.
- Replace hose (Bühler spare part) and install peristaltic pump in reverse order.
- Restore the power and gas supply.

7.2 Troubleshooting

Problem/malfunction	Possible cause	Action
Condensate inside the gas output	– Condensate trap full	– Empty condensate trap
	– Valve inside the automatic condensate drain may be stuck	– Flush in both directions
	– Cooler overload	– Observe limit parameters
	– Hose contaminated or blocked	– Flush in both directions, replace hose for condensate pumps if necessary
Reduced gas flow rate	– Gas circuit clogged	– Remove and clean heat exchanger
	– Condensate output iced over	– Send in device
Excess temperature	– Operating point not yet reached	– Wait (max. 20 min)
	– Cooling capacity too low, although the cooler is operating	– Ensure ventilation slots are not covered (heat build-up)
		– Operation outside specification (especially ambient temperature)
	– Flow rate too high / Dew point too high / Gas temperature too high	– Observe limit parameters / Install pre-separator if necessary
	– Built-in fan not operating	– Check and replace if necessary
– Faulty refrigerant circuit. Warning! Observe safety instructions	– Contact service	
Temperature low	– Controller failure	– Send in cooler
No cooling	– Compressor does not start	– Compressor (PTC) not sufficiently cooled down. Wait 5 minutes and try again.
	– Increased current consumption of the compressor due to faulty start	
Modbus communication fault	– Bus connection fault	– Check electrical connections
	– Line termination fault	– Check bus line
	– Check bus configuration	– Check/reset configuration

7.2.1 Error messages on the display

If an error occurs, the display will read "Err". Press the "▲" button to show the error number(s).

Error messages will appear until the unit has been restarted or the error is cleared using the "Func" button. It can only be cleared if the cause for the error has been corrected.

Causes / Action: The following is a list of the most common causes and actions for the respective error. If the actions listed do not resolve the problem, please contact Service.

Problem/malfunction	Possible cause	Action
No display	<ul style="list-style-type: none"> No voltage Loose connecting cable Display failure 	<ul style="list-style-type: none"> Check the supply cable Check connections
 D1.02 (permanent)	(The software version for the display will appear). <ul style="list-style-type: none"> Not communicating with the controller 	<ul style="list-style-type: none"> Check connections
 Error	<ul style="list-style-type: none"> An error has occurred 	<ul style="list-style-type: none"> Read the error number as described above
 Error 01	<ul style="list-style-type: none"> Controller malfunction 	<ul style="list-style-type: none"> Clear error (temporary fault) Disconnect from power for approx. 5 s Contact service
 Error 03	<ul style="list-style-type: none"> Microcontroller fault / MCP2 	<ul style="list-style-type: none"> Contact service
 Error 04	<ul style="list-style-type: none"> EEPROM error 	<ul style="list-style-type: none"> Contact service
 Error 06	<ul style="list-style-type: none"> Motor speed signal faulty Fan connector not connected Fan blocked 	<ul style="list-style-type: none"> Check whether the fan is blocked Check the fan connector contact on the controller board
 Error 40	<ul style="list-style-type: none"> General error temperature sensor 1 	<ul style="list-style-type: none"> Possible sensor failure
 Error 41	<ul style="list-style-type: none"> Low temperature/short-circuit temperature sensor 1 	<ul style="list-style-type: none"> Check temperature sensor connection
 Error 42	<ul style="list-style-type: none"> High temperature/short-circuit temperature sensor 1 	<ul style="list-style-type: none"> Check temperature sensor connection
 Error 43	<ul style="list-style-type: none"> Measurement fluctuation temperature sensor 1 	<ul style="list-style-type: none"> Check temperature sensor connection
 Error 51	<ul style="list-style-type: none"> Low temperature / short-circuit temperature sensor fan control 	<ul style="list-style-type: none"> Check temperature sensor connection
 Error 52	<ul style="list-style-type: none"> Low temperature / cable break temperature sensor fan control 	<ul style="list-style-type: none"> Check temperature sensor connection
 Error 53	<ul style="list-style-type: none"> Measurement fluctuation temperature sensor fan control 	<ul style="list-style-type: none"> Check temperature sensor connection
Status text	Possible cause	Action
 init	<ul style="list-style-type: none"> Initialisation phase 	<ul style="list-style-type: none"> Wait
 PuMP	<ul style="list-style-type: none"> Pumps deactivated 	<ul style="list-style-type: none"> Reactive pumps via menu
 (Flashing)	<ul style="list-style-type: none"> Excess/low temperature 	<ul style="list-style-type: none"> see chapter "Troubleshooting"

7.3 Spare parts

Please also specify the model and serial number when ordering parts.

Upgrade and expansion parts can be found in our catalog.

Available spare parts:

Item no.	Description
9100100007	MCD400 display module
9100030265	Modbus RTU interface module
9144050079	Connecting cable controller board display module
9144051038	Modbus RTU interface module connecting cable
9100130380	Microcontroller board MCP2.2
9100131385	Controller board 20 W 115–230 V
91100300039	Circuit breaker
9110000020	3.15 A Microfuse, delayed action
9110000031	5 A Microfuse, delayed action
9124040100	Fan 24 V
90214702	Silicone grease 1.5 ml
44920035012	Condensate pump hose, Tygon (Norprene), angled hose nipple
44920035013	Condensate pump hose, Tygon (Norprene), straight and angled hose nipple
44920035016	Hose for condensate pump, Tygon (Norprene), angled hose nipple and screw connection (metric)
44920035017	Hose for condensate pump, Tygon (Norprene), angled hose nipple and screw connection (US)

7.3.1 Spare Parts and Accessories

Item no.	Description
9144050143	Modbus RTU connection cable 2 m
9144050144	Modbus RTU connection cable 5 m
4410001	Automatic condensate drain 11 LD V 38
4410004	Automatic condensate drain AK 20, PVDF
4410005	Condensate trap GL 1; glass, 0.4 l
4410019	Condensate trap GL 2; glass, 1 l
4570008	Mounting angles for up to 4 peristaltic condensate pumps
see data sheet 450020	Peristaltic condensate pumps CPsingle, CPdouble

8 Disposal

CAUTION! The cooling circuit of the cooler is filled with refrigerant R600a. The heat exchanger contains a glycol-based coolant. The applicable national laws must be observed when disposing of the products. Disposal must not result in a danger to health and environment.

The crossed out wheelie bin symbol on Bühler Technologies GmbH electrical and electronic products indicates special disposal notices within the European Union (EU).



The crossed out wheelie bin symbol indicates the electric and electronic products bearing the symbol must be disposed of separate from household waste. They must be properly disposed of as waste electrical and electronic equipment.

Bühler Technologies GmbH will gladly dispose of your device bearing this mark. Please send your device to the address below for this purpose.

We are obligated by law to protect our employees from hazards posed by contaminated devices. Therefore please understand that we can only dispose of your waste equipment if the device is free from any aggressive, corrosive or other operating fluids dangerous to health or environment. **Please complete the "RMA Form and Decontamination Statement", available on our website, for every waste electrical and electronic equipment. The form must be applied to the packaging so it is visible from the outside.**

Please return waste electrical and electronic equipment to the following address:

Bühler Technologies GmbH – BZL
WEEE
Halle A1 – Aircompark
Halskestr. 24
40880 Ratingen
Germany

Please also observe data protection regulations and remember you are personally responsible for the returned waste equipment not bearing any personal data. Therefore please be sure to delete your personal data before returning your waste equipment.

9 Appendices

9.1 Technical Data

Gas Cooler Technical Data			
Rated cooling capacity (at 25 °C):	860 kJ/h at 230 V 720 kJ/h at 115 V		
Ambient temperature:	5 °C to 45 °C		
Ready for operation:	after max. 15 minutes		
Gas outlet dew point preset:	5 °C		
adjustable:	3 °C to 15 °C		
Dew point fluctuations static:	± 0.2 K		
in the entire specification range:	± 2 K		
Temperature difference between heat exchangers:	< 0.5 K		
IP rating:	IP 20		
Installation:	19" rack mounting housing or wall mounting		
Housing:	Stainless steel		
Packaging dimensions:	approx. 550 x 420 x 340 mm		
Weight:	approx. 26 kg		
max. altitude:	Altitudes up to 2000 m		
Refrigerant, quantity [g]:	R600a 115 V: 40 g 230 V: 37 g		
Electrical connection:	Plug per DIN EN 175301-803		
Contamination level:	2		
Oversvoltage category:	II		
Electrical data: <i>Available options may result in details that differ from these</i>	Supply voltage:	230 V	115 V
	Tolerance:	+/-10%	+/-10%
	Frequency:	50 Hz	60 Hz
	Typical power input:	460 VA	414 VA
	max. operating current:	2 A	3.6 A
	Starting current:	3 A	4.5 A
	Protection (recommendation):	3.15 A (delayed action)	5 A (delayed action)
Status output switching capacity:	max. 250 V AC, 150 V DC 2 A, 50 VA, potential-free		
Gas connections and condensate outlet:	For heat exchanger, see table "Heat exchanger overview" For condensate pump, see "Technical Data - Options"		
Parts in contact with media Heat exchanger: Peristaltic pump: Tubing:	see table "Heat exchanger overview" see "Technical Data - Options" PTFE/FKM (Viton)		

9.2 Technical Data - Options

Analogue Output Technical Data

Signal:	4-20 mA or 2-10 V corresponds to -20 °C to +60 °C cooling block temperature
Connection:	M12x1 connector, DIN EN 61076-2-101

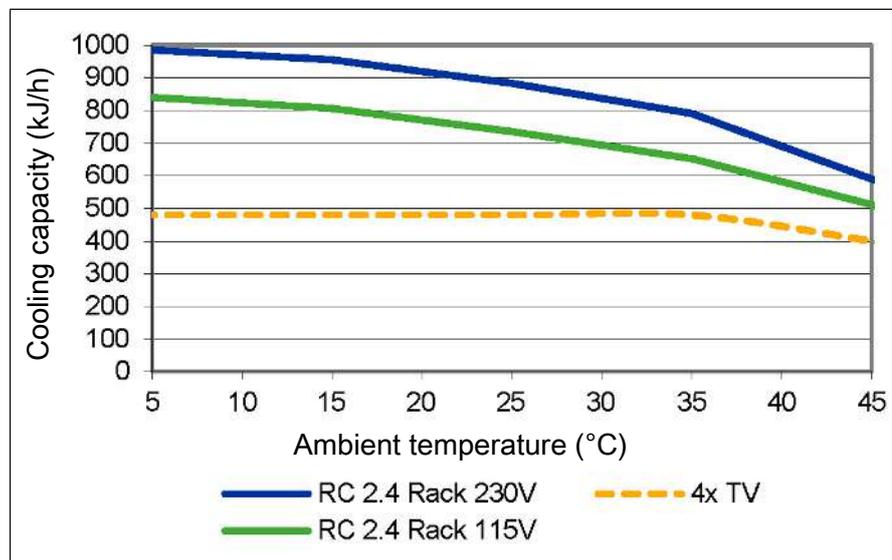
Technical Data, digital output

Signal:	Modbus RTU (RS-485)
Connection:	M12x1 connector, DIN EN 61076-2-101

Technical Data CPsingle/CPdouble Condensate Pump

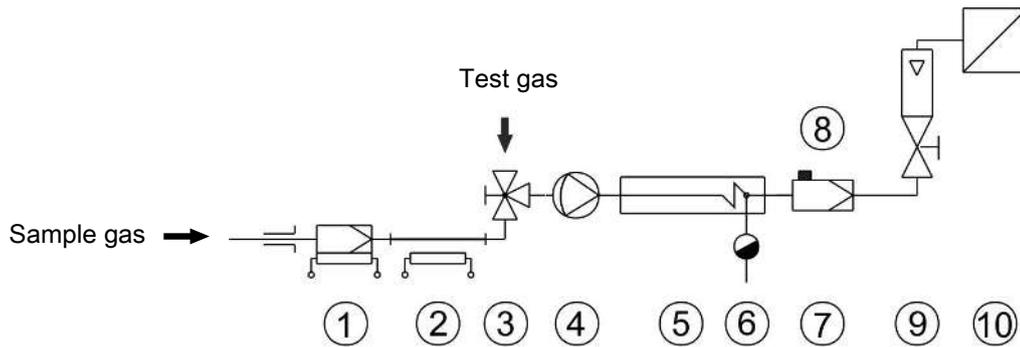
Ambient temperature:	0 °C to 55 °C
Voltage tolerance	± 5%
Flow rate:	0.3 L/h (50 Hz)/0.36 L/h (60 Hz) with standard hose
Inlet vacuum:	max. 0.8 bar
Inlet pressure:	max. 1 bar
Outlet pressure:	1 bar
Weight:	CPsingle-SA: 0.7 kg CPdouble-SA: 0.74 kg
Hose:	4 x 1.6 mm
Condensate outlet:	Hose nipple Ø5 mm Screw connection 4/6 (metric), 1/6"-1/4" (US)
IP rating:	IP 44
Materials	
Hose:	Tygon (Norprene)
Connections:	PVDF

9.3 Performance Data



Note: The limit curves for the heat exchangers exchanger apply to a dew point of 65 °C.

9.4 Diagram typical installation



1 Sample gas probe	2 Sample gas line
3 Reversing tap	4 Sample gas pump
5 Heat exchanger	6 Automatic condensate drain
7 Fine mesh filter	8 Moisture detector
9 Flow meter	10 Analyser

See data sheets for individual component models and data.

9.5 Heat exchanger

9.5.1 Heat exchanger description

The energy content of the sample gas and the required cooling capacity of the gas cooler is determined by three parameters: gas temperature ϑ_G , (inlet) dew point τ_e (moisture content) and volume flow v . The outlet dew point rises with increasing energy content of the gas. The approved energy load from the gas is therefore determined by the tolerated rise in the dew point.

The following limits are specified for a normal standard operating point of $\tau_e = 65^\circ\text{C}$ and $\vartheta_G = 90^\circ\text{C}$. The maximum volume flow v_{max} in NI/h of cooled air is indicated, so after moisture has condensed.

If the values fall below τ_e and ϑ_G , the flow v_{max} may be increased. For example, on the TG heat exchanger the parameter triple $\tau_e = 65^\circ\text{C}$, $\vartheta_G = 90^\circ\text{C}$ and $v = 280\text{ NI/h}$ may also be used in place of $\tau_e = 50^\circ\text{C}$, $\vartheta_G = 80^\circ\text{C}$ and $v = 380\text{ NI/h}$

Please contact our experts for clarification or refer to our design program.

9.5.2 Heat exchanger overview

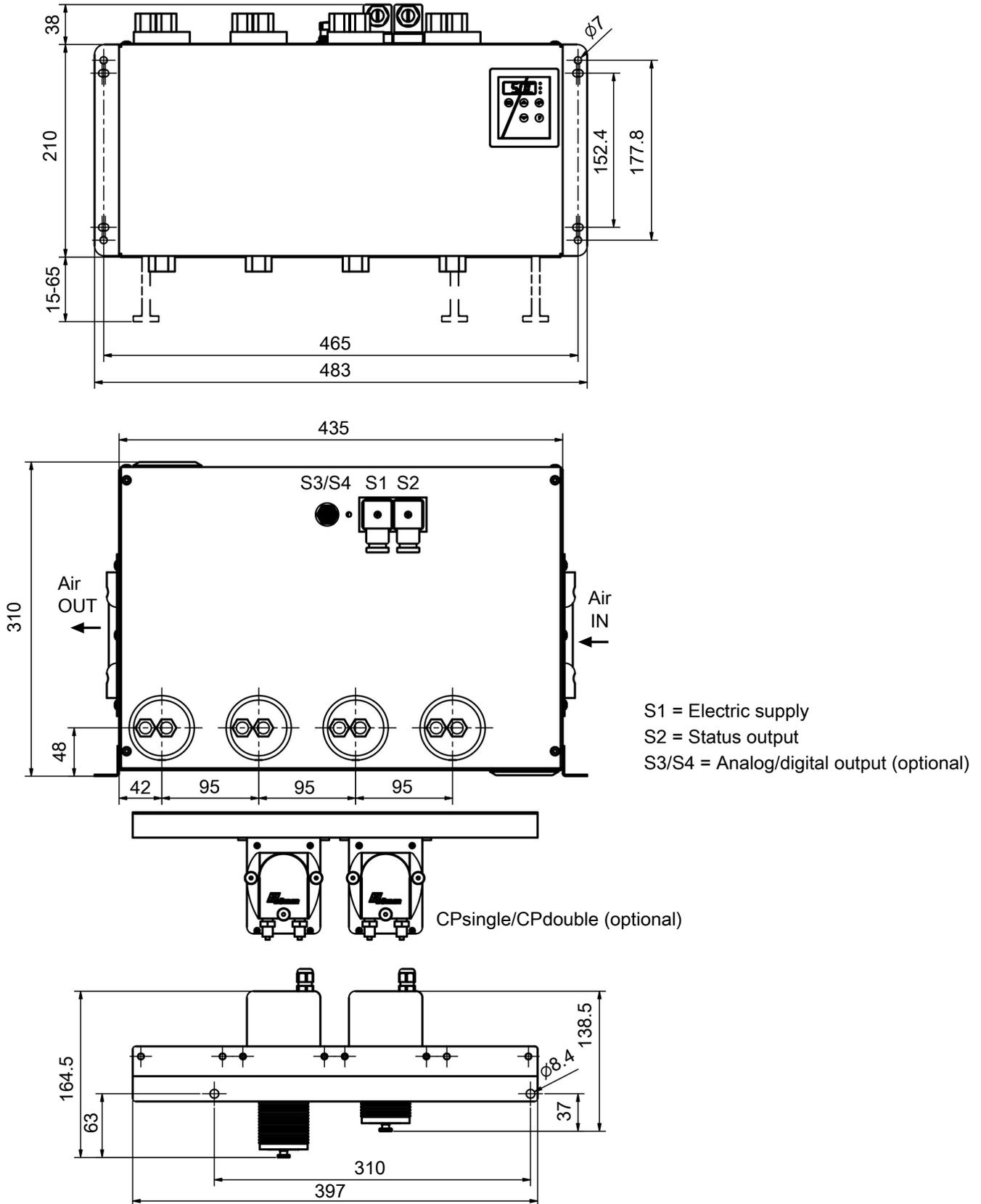
Heat exchanger	TS TS-I ²⁾	TG TG	TV TV-I ²⁾
Materials in contact with media	Stainless steel	DURAN Glas PTFE	PVDF
Weight	0.9 kg	0.4 kg	0.25 kg
Flow rate v_{max} ¹⁾	530 L/h	280 L/h	155 L/h
Inlet dew point $\tau_{e,\text{max}}$ ¹⁾	80 °C	80 °C	65 °C
Gas inlet temperature $\vartheta_{G,\text{max}}$ ¹⁾	180 °C	140 °C	140 °C
Max. cooling capacity Q_{max}	450 kJ/h	230 kJ/h	120 kJ/h
Gas pressure p_{max}	160 bar	3 bar	3 bar
Pressure drop Δp ($v=150\text{ L/h}$)	8 mbar	8 mbar	8 mbar
Dead volume V_{tot}	69 ml	48 ml	129 ml
Gas connections (metric)	G1/4	GL 14 (6 mm) ³⁾	DN 4/6
Gas connections (US)	NPT 1/4"	GL 14 (1/4") ³⁾	1/4"-1/6"
Condensate out connection (metric)	G3/8	GL 25 (12 mm) ³⁾	G3/8
Condensate out connection (US)	NPT 3/8"	GL 25 (1/2") ³⁾	NPT 3/8"

¹⁾ Max. cooling capacity of the cooler must be considered.

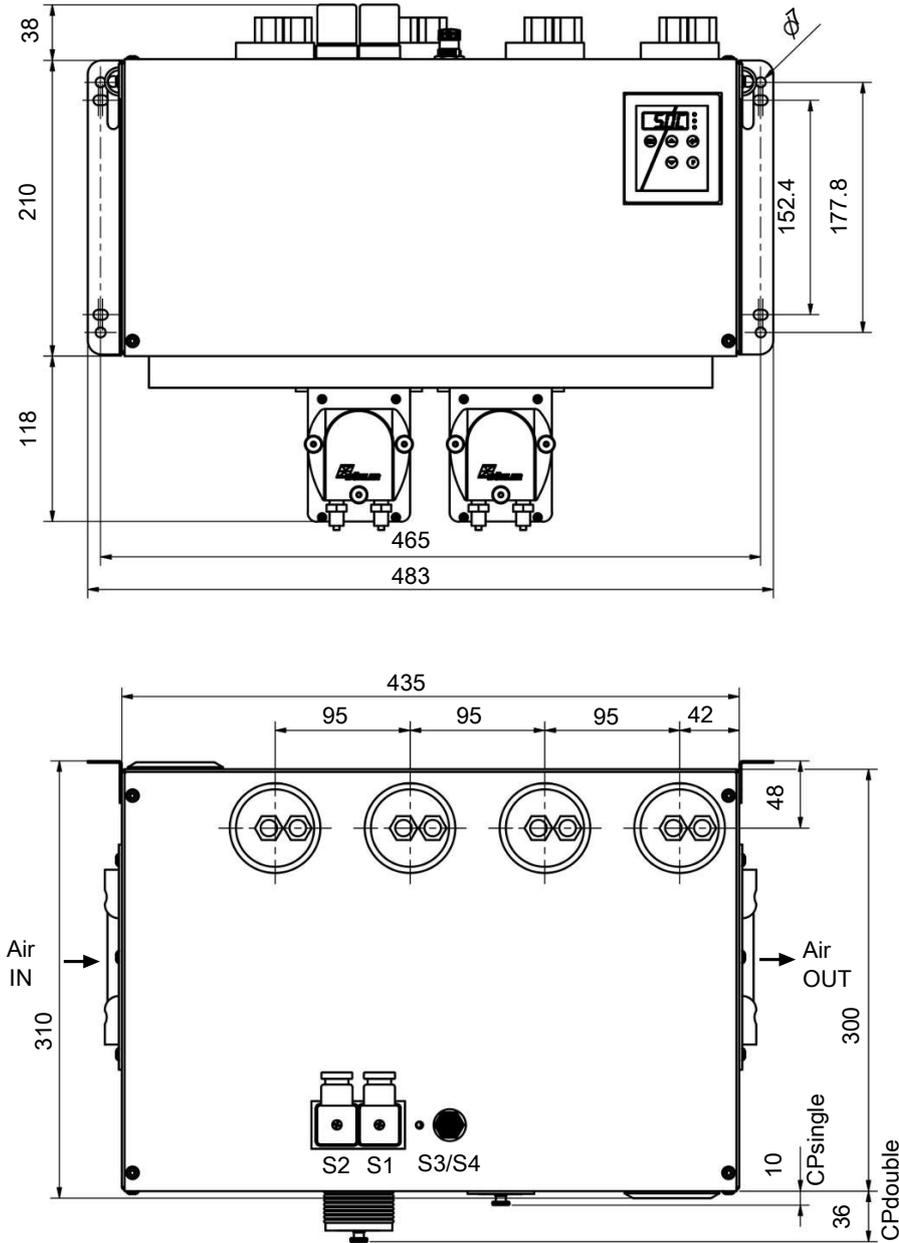
²⁾ Models marked I have NPT threads or US tubes, respectively.

³⁾ Gasket inside diameter

9.6 Dimensions - 19" rack



9.7 Dimensions - 19" housing for wall mounting



- S1 = Electric supply
- S2 = Status output
- S3/S4 = Analog/digital output (optional)

10 Attached documents

- Declaration of Conformity KX450021
- RMA – Decontamination Declaration

EU-Konformitätserklärung **EU Declaration of Conformity**



Hiermit erklärt Bühler Technologies GmbH, dass die nachfolgenden Produkte den wesentlichen Anforderungen der Richtlinie **2014/35/EU (Niederspannungsrichtlinie)** in ihrer aktuellen Fassung entsprechen.
*Bühler Technologies GmbH hereby declares that the following products comply with the essential requirements of Directive **2014/35/EU (Low Voltage Directive)** in its current version.*

Folgende EU-Richtlinien wurden berücksichtigt:
The following EU directives were taken into account:

2014/30/EU (EMV/EMC)

Produkt/product: Kompressor-Messgaskühler / *Compressor sample gas cooler*
Typen/types: RC 1.1, RC 1.2+
RC 1.2 Rack, RC 1.2+ Rack
RC 2.4 Rack
RC 3.1
Serien-Nr./serial number: 45963... / 45965... / 45967...

Das Betriebsmittel dient der Aufbereitung des Messgases, um das Analysengerät vor Restfeuchtigkeit im Messgas zu schützen.
This equipment is used for conditioning the sample gas to protect the analysis instrument from residual moisture in the sample gas.

Das oben beschriebene Produkt der Erklärung erfüllt die einschlägigen EU-Harmonisierungsrechtsvorschriften:
The product described in this declaration complies with the relevant EU harmonisation legislation:

EN 61326-1:2013
EN 61010-1:2010/A1:2019/AC:2019-04
EN IEC 61010-2-011:2021

Die alleinige Verantwortung für die Ausstellung dieser Konformitätserklärung trägt der Hersteller.
The manufacturer bears sole responsibility for issuing this Declaration of Conformity.

Ratingen, 02.03.2026


Frank Pospiech
Geschäftsführer / *Managing Director*



UK Declaration of Conformity

The manufacturer Bühler Technologies GmbH declares, under its sole responsibility, that the product complies with the requirements of the following UK legislation:

Electrical Equipment Safety Regulations 2016

The following legislation was taken into account:

Electromagnetic Compatibility Regulations 2016

Product: Compressor sample gas cooler
Types: RC 1.1, RC 1.2+
RC 1.2 Rack, RC 1.2+ Rack
RC 2.4 Rack
RC 3.1
Serial number: 45963... / 45965... / 45967...

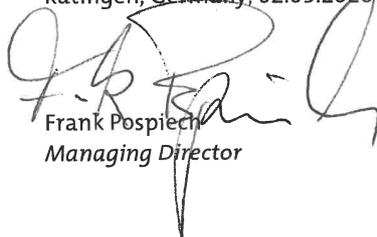
This equipment is used for conditioning the sample gas to protect the analysis instrument from residual moisture in the sample gas.

The product of the declaration described above complies with the relevant harmonised standards:

EN 61326-1:2013
EN IEC 61010-2-011:2021
EN 61010-1:2010/A1:2019/AC:2019-04

The manufacturer bears sole responsibility for this Declaration of Conformity.

Ratingen, Germany, 02.03.2026



Frank Pospiech
Managing Director

Resistance table

Gas Analysis

Formula	Medium	Concentration	Teflon® PTFE	PCTFE	PEEK	PVDF	FEP	FFKM	Viton® FPM	V4A	Glass
CH ₃ COCH ₃	Acetone		1/1	1/3	1/1	3/4	(1)	1/1	4/4	1/1	1/1
C ₆ H ₆	Benzol		1/1	1/3	1/1	1/3	1/1	1/1	3/3	1/1	1/1
Cl ₂	Chlorine	10% wet	1/1	0/0	4/4	2/2	1/1	1/1	3/0	4/4	1/1
Cl ₂	Chlorine	97%	1/0	1/3	4/4	1/1	1/1	1/0	1/1	1/1	1/0
C ₂ H ₆	Ethane		1/0	0/0	1/0	2/0	-	1/0	1/0	2/0	1/0
C ₂ H ₅ OH	Ethanol	50%	1/1	1/3	1/1	1/1	1/1	1/1	2/2	1/0	1/1
C ₂ H ₄	Ethylene		1/0	0/0	0/0	1/0	1/1	1/0	1/0	1/0	1/0
C ₂ H ₂	Ethyne		1/0	0/0	0/0	1/0	1/1	1/0	2/0	1/0	1/0
C ₆ H ₅ C ₂ H ₅	Ethylbenzene		1/0	0/0	0/0	1/1	1/1	1/0	2/0	1/0	1/0
HF	Hydrofluoric acid		1/0	0/0	0/0	2/2	(1)	2/0	4/0	3/4	1/0
CO ₂	Carbon dioxide		1/1	0/0	1/0	1/1	(1)	1/0	1/1	1/1	1/1
CO	Carbon monoxide		1/0	0/0	1/1	1/1	-	1/0	1/0	1/1	1/0
CH ₄	Methane	technically pure	1/1	0/0	1/1	1/0	1/1	1/0	1/1	1/1	1/1
CH ₃ OH	Methanol		1/1	1/1	1/1	1/1	1/1	1/1	3/4	1/1	1/1
CH ₂ Cl ₂	Methylene chloride		1/0	2/0	1/0	1/0	1/1	1/0	3/0	1/1	1/0
H ₃ PO ₄	Phosphoric acid	1–5%	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
H ₃ PO ₄	Phosphoric acid	30%	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
C ₃ H ₈	Propane	gaseous	1/1	0/0	1/0	1/1	1/1	1/0	1/0	1/0	1/1
C ₃ H ₆ O	Propylene oxide		1/0	0/0	0/0	2/4	1/1	2/0	4/0	1/0	1/0
HNO ₃	Nitric acid	1–10%	1/1	1/0	1/1	1/1	1/1	1/0	1/1	1/1	1/1
HNO ₃	Nitric acid	50%	1/1	1/0	3/3	1/1	1/1	1/0	1/0	1/2	1/1
HCl	Hydrochloric acid	1–5%	1/1	1/1	1/0	1/1	1/1	1/1	1/1	2/4	1/1
HCl	Hydrochloric acid	35%	1/1	1/1	1/0	1/1	1/1	1/1	1/2	2/4	1/1
O ₂	Oxygen		1/1	0/0	1/0	1/1	1/1	1/1	1/2	1/1	1/1
SF ₆	Sulphur hexafluoride		1/0	0/0	1/0	0/0	0/0	1/0	2/0	0/0	1/0
H ₂ SO ₄	Sulfuric acid	1–6%	1/1	1/1	2/2	1/1	1/1	1/1	1/1	1/2	1/1
H ₂ S	Hydrogen sulphide		1/1	1/1	0/0	1/1	1/0	1/1	4/4	1/1	1/1
N ₂	Nitrogen		1/1	0/0	1/0	1/1	1/1	1/0	1/1	1/0	1/1
C ₆ H ₅ C ₂ H ₃	Styrene		1/1	0/0	1/0	1/0	1/0	1/0	3/0	1/0	1/1
C ₆ H ₅ CH ₃	Toluol (methylbenzene)		1/1	0/0	1/0	1/1	1/1	1/1	3/3	1/1	1/1
H ₂ O	Water		1/1	0/0	1/1	1/1	1/1	1/1	1/1	1/1	1/1
H ₂	Hydrogen		1/0	1/0	1/0	1/0	(1)	1/0	1/0	1/0	1/0

0 – no information available

1 – durability/suitability very good

2 – durability/suitability good

3 – limited suitability

4 – not suitable

() – estimate

Two values are specified per medium. Left number = value at 20 °C, right number = value at 50 °C.

Source: Bürkle GmbH: List of chemical resistances, <https://www.buerkle.de> [accessed on 12.02.2026].



RMA-Formular und Erklärung über Dekontaminierung

RMA-Form and explanation for decontamination



RMA-Nr./ RMA-No.

Die RMA-Nr. bekommen Sie von Ihrem Ansprechpartner im Vertrieb oder Service. Bei Rücksendung eines Altgeräts zur Entsorgung tragen Sie bitte in das Feld der RMA-Nr. "WEEE" ein./ You may obtain the RMA number from your sales or service representative. When returning an old appliance for disposal, please enter "WEEE" in the RMA number box.

Zu diesem Rücksendeschein gehört eine Dekontaminierungserklärung. Die gesetzlichen Vorschriften schreiben vor, dass Sie uns diese Dekontaminierungserklärung ausgefüllt und unterschrieben zurücksenden müssen. Bitte füllen Sie auch diese im Sinne der Gesundheit unserer Mitarbeiter vollständig aus./ This return form includes a decontamination statement. The law requires you to submit this completed and signed decontamination statement to us. Please complete the entire form, also in the interest of our employee health.

Firma/ Company

Firma/ Company

Straße/ Street

PLZ, Ort/ Zip, City

Land/ Country

Gerät/ Device

Anzahl/ Quantity

Auftragsnr./ Order No.

Ansprechpartner/ Person in charge

Name/ Name

Abt./ Dept.

Tel./ Phone

E-Mail

Serien-Nr./ Serial No.

Artikel-Nr./ Item No.

Grund der Rücksendung/ Reason for return

- Kalibrierung/ Calibration Modifikation/ Modification
 Reklamation/ Claim Reparatur/ Repair
 Elektroaltgerät/ Waste Electrical & Electronic Equipment (WEEE)
 andere/ other

bitte spezifizieren/ please specify

Handelt es sich bei dem Gerät um ein sogenanntes Bühler O2-Ready Produkt (Artikelnummer endet mit „-O2“)?/ Is the device a Bühler O2-Ready product (item number ending with "-O2")?

- Nein/ No Ja/ Yes

Ist das Gerät möglicherweise kontaminiert?/ Could the equipment be contaminated?

- Nein, da das Gerät nicht mit gesundheitsgefährdenden Stoffen betrieben wurde./ No, because the device was not operated with hazardous substances.
 Nein, da das Gerät ordnungsgemäß gereinigt und dekontaminiert wurde./ No, because the device has been properly cleaned and decontaminated.
 Ja, kontaminiert mit:/ Yes, contaminated with:



explosiv/
explosive



entzündlich/
flammable



brandfördernd/
oxidizing



komprimierte
Gase/
compressed
gases



ätzend/
caustic



giftig, Lebensge-
fahr/
poisonous, risk of
death



gesundheitsge-
fährdend/
harmful to health



gesund-
heitsschädlich/
health hazard



umweltge-
fährdend/
environmental
hazard

Bitte Sicherheitsdatenblatt beilegen!/ Please enclose safety data sheet!

Das Gerät wurde gespült mit:/ The equipment was purged with:

Diese Erklärung wurde korrekt und vollständig ausgefüllt und von einer dazu befugten Person unterschrieben. Der Versand der (dekontaminierten) Geräte und Komponenten erfolgt gemäß den gesetzlichen Bestimmungen.

Falls die Ware nicht gereinigt, also kontaminiert bei uns eintrifft, muss die Firma Bühler sich vorbehalten, diese durch einen externen Dienstleister reinigen zu lassen und Ihnen dies in Rechnung zu stellen.

Firmenstempel/ Company Sign

This declaration has been filled out correctly and completely, and signed by an authorized person. The dispatch of the (decontaminated) devices and components takes place according to the legal regulations.

Should the goods not arrive clean, but contaminated, Bühler reserves the right, to commission an external service provider to clean the goods and invoice it to your account.

Datum/ Date

rechtsverbindliche Unterschrift/ Legally binding signature



Vermeiden von Veränderung und Beschädigung der einzusendenden Baugruppe

Die Analyse defekter Baugruppen ist ein wesentlicher Bestandteil der Qualitätssicherung der Firma Bühler Technologies GmbH. Um eine aussagekräftige Analyse zu gewährleisten muss die Ware möglichst unverändert untersucht werden. Es dürfen keine Veränderungen oder weitere Beschädigungen auftreten, die Ursachen verdecken oder eine Analyse unmöglich machen.

Vermeidung von Kontaminationen bei Produkten für hochreine Sauerstoffapplikationen (O2-Ready)

Handelt es sich bei dem Gerät um ein sogenanntes Bühler O2-Ready Produkt (Artikelnummer endet mit „-O2“), so ist dafür zu sorgen, dass es vom Ausbau des Artikels bis zur Anlieferung bei Firma Bühler zu keiner Kontamination medienberührender Teile kommt. Verschießen Sie Öffnungen und verpacken Sie das Gerät in ein luftdichtes Behältnis. Kennzeichnen Sie die Ware deutlich, insbesondere durch Angabe der vollständigen Artikelnummer (.....-O2) auf der ersten Seite dieses Formulars. Hierdurch wird sichergestellt, dass es auch unsererseits zu keiner unnötigen Kontamination kommt.

Umgang mit elektrostatisch sensiblen Baugruppen

Bei elektronischen Baugruppen kann es sich um elektrostatisch sensible Baugruppen handeln. Es ist darauf zu achten, diese Baugruppen ESD-gerecht zu behandeln. Nach Möglichkeit sollten die Baugruppen an einem ESD-gerechten Arbeitsplatz getauscht werden. Ist dies nicht möglich sollten ESD-gerechte Maßnahmen beim Austausch getroffen werden. Der Transport darf nur in ESD-gerechten Behältnissen durchgeführt werden. Die Verpackung der Baugruppen muss ESD-konform sein. Verwenden Sie nach Möglichkeit die Verpackung des Ersatzteils oder wählen Sie selber eine ESD-gerechte Verpackung.

Einbau von Ersatzteilen

Beachten Sie beim Einbau des Ersatzteils die gleichen Vorgaben wie oben beschrieben. Achten Sie auf die ordnungsgemäße Montage des Bauteils und aller Komponenten. Versetzen Sie vor der Inbetriebnahme die Verkabelung wieder in den ursprünglichen Zustand. Fragen Sie im Zweifel beim Hersteller nach weiteren Informationen.

Einsenden von Elektroaltgeräten zur Entsorgung

Wollen Sie ein von Bühler Technologies GmbH stammendes Elektroprodukt zur fachgerechten Entsorgung einsenden, dann tragen Sie bitte in das Feld der RMA-Nr. „WEEE“ ein. Legen Sie dem Altgerät die vollständig ausgefüllte Dekontaminierungserklärung für den Transport von außen sichtbar bei. Weitere Informationen zur Entsorgung von Elektroaltgeräten finden Sie auf der Webseite unseres Unternehmens.

Avoiding alterations and damage to the components to be returned

Analysing defective assemblies is an essential part of quality assurance at Bühler Technologies GmbH. To ensure conclusive analysis the goods must be inspected unaltered, if possible. Modifications or other damages which may hide the cause or render it impossible to analyse are prohibited.

Avoidance of contamination in products for high-purity oxygen applications (O2-Ready)

If the device is a Bühler O2-Ready product (item number ending with "-O2"), it must be ensured that there is no contamination of parts in contact with the medium from the time the item is removed until it is delivered to Bühler. Seal openings and pack the device in an airtight container. Mark the goods clearly, in particular by stating the full item number (.....-O2) on the first page of this form. This ensures that there is no unnecessary contamination on our part either.

Handling electrostatically conductive components

Electronic assemblies may be sensitive to static electricity. Be sure to handle these assemblies in an ESD-safe manner. Where possible, the assemblies should be replaced in an ESD-safe location. If unable to do so, take ESD-safe precautions when replacing these. Must be transported in ESD-safe containers. The packaging of the assemblies must be ESD-safe. If possible, use the packaging of the spare part or use ESD-safe packaging.

Fitting of spare parts

Observe the above specifications when installing the spare part. Ensure the part and all components are properly installed. Return the cables to the original state before putting into service. When in doubt, contact the manufacturer for additional information.

Returning old electrical appliances for disposal

If you wish to return an electrical product from Bühler Technologies GmbH for proper disposal, please enter "WEEE" in the RMA number box. Please attach the fully completed decontamination declaration form for transport to the old appliance so that it is visible from the outside. You can find more information on the disposal of old electrical appliances on our company's website.

