

**ModbusRTU**

Sample gas cooler

Series RC 1.1, RC 1.2+

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.

Sample gas coolers with the option for high-purity oxygen (suffix -O2) are specially optimised, with regard to the wetted parts, for use with increased oxygen concentrations. A mandatory special cleaning of the components is carried out to minimise organic and inorganic contamination. The manufacture of the products under controlled cleanliness conditions ensures compliance with the limits based on EIGA Doc 33/18.

Sample gas coolers with the option for high-purity hydrogen (suffix -H2) are specially refined using advanced manufacturing measures, in particular to prevent hydrogen-induced component damage. In addition, the parts in contact with the media are subjected to an additional visual inspection to remove any residual metallic contamination, such as chips and particles. Finally, a leak test is carried out as standard.

For passing of flammable gases, make sure that the parts carrying and/or in contact with the medium are tightly connected.

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 1.1 series was designed specifically for high cooling capacities and high ambient temperatures.

The RC 1.1 with -H2/-O2 heat exchanger series was specially developed for use with high-purity hydrogen and oxygen.

The RC 1.2+ series was designed specifically for the requirements in so-called automated measuring systems (AMS) according to EN 15267-3. The series connection of the heat exchangers will cool in two cycles to minimise wash-out effects.

The compressor coolers are distinguished by two types based on the cooling nests. This classification is reflected in the type designation. 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 1.1	1 heat exchanger (single or double)
H ₂ /O ₂	RC 1.1	1 heat exchanger (single or double)
Washout-optimised gas cooling	RC 1.2+	2 heat exchangers in series

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

- Peristaltic pump for condensate separation
- Filter
- Moisture detector

In addition, we offer different signal outputs:

- Status output
- Analog 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 also prioritised 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 gas path inside the heat exchanger

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

4596	3	1	1	0	X	X	X	X	X	0	X	X	X	0	0	0	0	0	Product characteristic
Power supply																			
1																		115 V AC, 60 Hz	
2																		230 V AC, 50/60 Hz	
Heat exchanger																			
1	1	0																Stainless steel, TS, metric	
1	1	5																Stainless steel, TS-I, US	
1	2	0																Duran glass, TG, metric	
1	2	5																Duran glass, TG, US	
1	3	0																PVDF, TV, metric	
1	3	5																PVDF, TV-I, US fittings	
Condensate drain																			
			0															without condensate drain	
			1															CPsingle with hose nipple, angled	
			3															CPsingle with screw connection, metric/US	
Filter and moisture detector																			
				0	0													without filter, without moisture detector	
				0	1													without filter, 1 moisture detector	
				0	3													Moisture detector in stainless steel adapter	
				3	0													1 filter, without moisture detector	
				3	1													1 filter, 1 moisture detector	
Signal outputs																			
					0													status output only	
					1													Analogue output, 4..20 mA, incl. status output	
					2													Modbus RTU digital output, incl. status output	

1.4.2 Gas cooler with two gas paths inside the heat exchanger

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

4596	3	1	1	0	X	X	X	X	X	0	X	X	X	0	0	0	0	0	Product characteristic
Power supply																			
1																		115 V AC / 60 Hz	
2																		230 V AC, 50/60 Hz	
Heat exchanger																			
2	6	0																Stainless steel, DTS, metric	
2	6	1																Stainless steel, DTS-6 ¹⁾ , metric	
2	6	5																Stainless steel, DTS-I, US	
2	6	6																Stainless steel, DTS-6-I ¹⁾ , US	
2	7	0																Duran glass, DTG, metric	
2	7	5																Duran glass, DTG, US	
2	8	0																PVDF, DTV ¹⁾ , metric	
2	8	5																PVDF, DTV-I ¹⁾ , US	
Condensate drain																			
0																		without condensate drain	
2																		CPdouble with hose nipple, angled	
4																		CPdouble with screw connection, metric/US	
Filter and moisture detector																			
0	0																	without filter, without moisture detector	
0	1																	without filter, 1 moisture detector	
0	2																	without filter, 2 moisture detectors	
0	3																	1 moisture detector in stainless steel adapter	
0	4																	2 moisture detectors in stainless steel adapter	
3	0																	1 filter, without moisture detector	
3	1																	1 filter, 1 moisture detector	
3	2																	1 filter, 2 moisture detectors	
4	0																	2 filters, without moisture detector	
4	1																	2 filters, 1 moisture detector	
4	2																	2 filters, 2 moisture detectors	
Signal outputs																			
0																		status output only	
1																		Analogue output, 4..20 mA, incl. status output	
2																		Modbus RTU digital output, incl. status output	

¹⁾ Condensate outlets only suitable for connecting condensate pumps (CPdouble).

1.4.3 Gas cooler with two heat exchangers in series

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

4596	3	1	2	0	X	X	X	X	X	0	X	X	X	0	0	0	0	0	Product characteristic
																			Power supply
																			115 V AC, 60 Hz
																			230 V AC, 50/60 Hz
																			Heat exchanger
																			1 2 2 Duran glass, STG-2, metric
																			1 2 7 Duran glass, STG-2, US
																			1 3 2 PVDF, STV-2, metric
																			1 3 7 PVDF, STV-2, US
																			Condensate drain
																			0 without condensate drain
																			2 CPdouble with hose nipple, angled
																			4 CPdouble with screw connection, metric/US
																			Filter and moisture detector
																			0 0 without filter, without moisture detector
																			0 1 without filter, 1 moisture detector
																			1 0 1 filter, without moisture detector
																			1 1 1 filter, 1 moisture detector
																			Signal outputs
																			0 status output only
																			1 Analogue output, 4..20 mA, incl. status output
																			2 Modbus RTU digital output, incl. status output

1.4.4 Gas cooler for H₂/O₂ applications

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

4596	3	1	1	0	X	X	X	X	0	0	0	0	X	0	0	0	0	X	Product Characteristics
																			Power supply
																			1 115 V AC, 60 Hz
																			2 230 V AC, 50/60 Hz
																			Heat exchanger
																			1 1 0 -O2 Stainless steel, TS-O2, metric
																			1 1 5 -O2 Stainless steel, TS-I-O2, US
																			1 1 0 -H2 Stainless steel, TS-H2, metric
																			1 1 5 -H2 Stainless steel, TS-I-H2, US
																			2 6 0 -O2 Stainless steel, DTS-O2, metric
																			2 6 5 -O2 Stainless steel, DTS-I-O2, US
																			2 6 0 -H2 Stainless steel, DTS-H2, metric
																			2 6 5 -H2 Stainless steel, DTS-I-H2, US
																			Signal outputs
																			0 status output only
																			1 Analog output, 4..20 mA, incl. status output
																			2 Modbus RTU digital output, incl. status output

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 and modification

The following must be observed during maintenance, repair and modification work:

- Repairs to the equipment may only be performed by Bühler authorised personnel.
- Before carrying out maintenance, repair and modification work, place the device in a safe condition as described for the specific task.
- Only perform the maintenance, repair and modification work described in this operating and installation manual.
- Use only original spare parts.
- Do not install damaged or defective spare parts. Before carrying out any maintenance, repair or modification work, 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.
- When carrying out any maintenance, repair or modification work, the relevant safety and operating regulations of the user country must be observed.

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

Warning: Flammable substances



The device is filled with flammable refrigerant R600a.

- a) Handle with care and choose the installation location carefully.
- 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.

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).

In particular, for gas coolers with stainless steel heat exchangers for O₂ applications (suffix -O2), any contamination of parts in contact with media must be avoided during storage.

4 Installation and connection

4.1 Installation site requirements

The device is designed for indoor use, either wall-mounted or as a benchtop device. The maximum installation altitude is suitable for elevations up to 2000 m.

Wall mounting: The device must be fixed at the designated mounting points. Flange through holes: 4 × Ø 7 mm.

Benchtop device: Ensure that the device is positioned upright and level on a flat, secure surface.

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 is filled with flammable refrigerant R600a.

Sufficient room should be provided around the device to prevent an explosive atmosphere in case of refrigerant leakage. Alternatively, adequate ventilation should be planned to avoid accumulation of refrigerant. National legal regulations must be observed.

Ensure adequate ventilation when installing in enclosed housings, e.g. analyser cabinets. If the convection is inadequate, we recommend aerating the cabinet or installing a fan to lower the inside temperature.

WARNING



Warning: Flammable substances

The device is filled with flammable refrigerant R600a.

- a) Handle with care and choose the installation location carefully.
- 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



Contamination of cleaned components

For sample gas coolers with stainless steel heat exchangers for O₂ applications (suffix -O₂), contamination with oil, grease, dust, particles, lint, hair, etc. must be ruled out for fire protection reasons when working on components that come into contact with media. If necessary, adapt your operational and organisational measures with regard to the work clothing to be used, hygiene regulations, etc. If necessary, move such work to a suitable, cleaner work area.



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.

With the option for high-purity water or oxygen (suffix -H₂/-O₂), the components are each supplied in separate packaging. To prevent soiling, these should only be unpacked shortly before use.

Installation instructions additional type plate -H2:

To ensure traceability of the leakage test of the heat exchanger in H₂ applications, affix the enclosed additional type plate in a suitable place before commissioning. When affixing to the cooler housing, no openings must be closed, and overlapping with other stickers or components is not permitted – minimum distance: 2 mm.

CAUTION**Warning of electrical charge (-H2)**

When affixing to the cooler:
The enclosed additional type plate of the heat exchanger must be affixed to the cooler according to the installation instructions.

4.2.1 Connecting the filter gas connections (optional)

The connection between the heat exchanger outlet and the filter inlet does not have tubing included. The connection G1/4 or NPT 1/4" (filter head marked NPT) for the gas outlet must be carefully and properly connected using a suitable screw connection.

When ordering the cooler with the **option filter without Moisture detector**, a bypass may be connected to the filter head.

The filter head is intended for a G1/4 internal screw thread which is plugged at the factory. To use it, unscrew the plug and screw in a suitable screw connection. Pay attention to leaks.

NOTICE

Installing **filters** limits the maximum approved **operating pressure** in the system!
Operating pressure ≤ 4 bar

4.2.2 Flow adapter connection (optional)

When ordering the cooler with the **option moisture detector without filter**, it will be factory installed inside a flow adapter.

The connection between the heat exchanger outlet and the flow adapter inlet does not have tubing included. The connection G1/4 or NPT 1/4" (flow adapter marked NPT) for the gas inlet/outlet must be carefully and properly connected using a suitable screw connection. Here the direction of flow is not relevant.

4.2.3 Connecting the moisture detector (option)

When ordering the cooler with **moisture detector option**, it will be factory installed inside a flow adapter, or for the **filter option** installed and connected in the filter head.

4.2.4 Peristaltic pump connector (optional)

Coolers ordered with built-in peristaltic pumps already have these installed and wired. Heat exchangers ordered at the same time are already installed and connected to the peristaltic pumps.

NOTICE

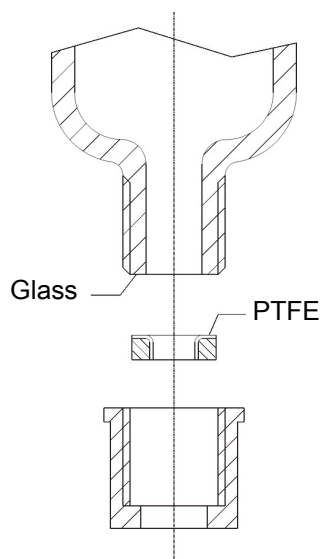
Installing peristaltic **pumps** CPsingle / CPdouble limits the maximum permissible **operating pressure** in the system!
Operating pressure ≤ 1 bar

A peristaltic pump may also be installed away from the cooler. A mounting angle is available for mounting the pump directly below the cooler. Mounts for securing the angle directly to the cooler are designated.

4.2.5 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

4.2.6 Condensate drain connection

Depending on the material, a connecting line consisting of fitting and pipe or hose must be installed between the heat exchanger and condensate drain. For stainless steel, the condensate drain can be suspended directly from the connecting pipe; for hose connections, the condensate drain must be fixed separately with a clamp.

For the high-purity oxygen option, ensure selection of components with suffix -O2.

If the condensate drain type 11 LD V 38 is used for high hydrogen concentrations, the system into which it is installed must be checked for leak-tightness.

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

The DTS-6(-I) and DTV(-I) heat exchangers cannot be operated in conjunction with an automatic condensate drain.

4.2.7 Adapter plate connection

The adapter plate is intended to easily replace the cooler with an existing bore pattern of the predecessor EGK 1/2. It is first inserted from behind with the threaded bolts through the bores of the RC 1.x and locked in place with the included nuts. The cooler with adapter plate can then be fastened to the existing bore pattern.

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.

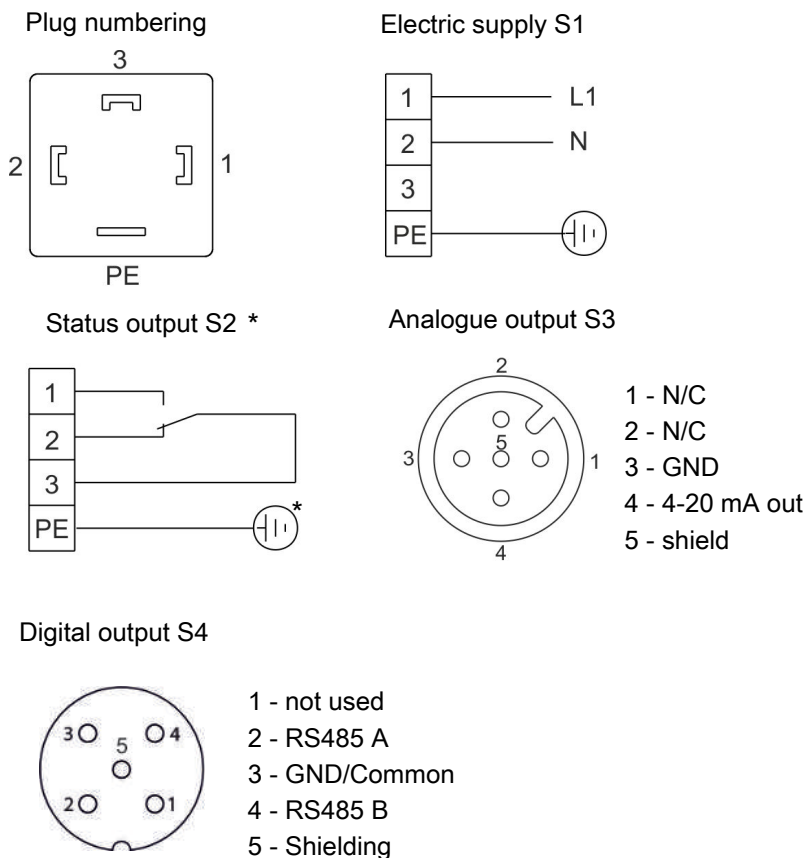


Fig. 1: Cooler connection

* 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	the following device statuses can be indicated via two switching outputs: Contact between 3 and 2 closed (alarm) – No mains voltage and/or actual temperature value outside the set alarm thresholds. – Device in fault condition / pump deactivated. Contact between 3 and 1 closed (ok) – Mains voltage applied + actual temperature value within the set alarm thresholds. with humidity sensor option Contact between 3 and 2 closed (alarm) – Humidity sensor detects residual moisture in the sample gas or cable break: Error message. Contact between 1 and 3 closed (ok) – 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 ($R_{load} < 500 \Omega$)	Signalling of the cooler block temperature $T_{cooler} = -20 \text{ °C} \triangleq (-4 \text{ °F}) \rightarrow 4 \text{ mA}/2 \text{ V}$ $T_{cooler} = 5 \text{ °C} \triangleq (41 \text{ °F}) \rightarrow 9 \text{ mA}/4.5 \text{ V}$ $T_{cooler} = 60 \text{ °C} \triangleq (140 \text{ °F}) \rightarrow 20 \text{ mA}/10 \text{ V}$

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	Modbus RTU (RS-485)	Interface default values Baudrate – Parity – Stop bit: 19200 – Even – 1 Default ID: 10 The bus lines are not internally terminated.

5 Operation and control

NOTICE



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

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.

5.1 Description of functions

The cooler is controlled by a microprocessor. The factory settings of the controller already take into account the different characteristics of the installed heat exchangers.

The programmable display shows the cooling block temperature according to the selected unit of display ($^{\circ}\text{C}/^{\circ}\text{F}$) (factory setting: $^{\circ}\text{C}$). Application-specific settings can easily be made in the menu using the five keys. This not only applies to the target outlet dew point, which can be set from 3°C to 20°C (37°F to 68°F) (factory setting $5^{\circ}\text{C}/41^{\circ}\text{F}$),

but also the warning thresholds for high/low temperature. These are set relative to the configured outlet dew point τ_a .

For the low temperature, a range from $\tau_a -1\text{ K}$ to -3 K (but at least $1^{\circ}\text{C}/34^{\circ}\text{F}$ coolant block temperature) is available; for the high temperature, a range from $\tau_a +1\text{ K}$ to $+7\text{ K}$. The factory settings for both values are 3 K .

Falling below or exceeding the configured warning range (e.g. after switching on) is indicated both by the LED S2 blinking on the display and by the status relay.

The status output can be used, for example, to control the sample gas pump, allowing the gas flow to be enabled only once the permissible cooling range has been reached, or to switch off the pump in the event of a humidity sensor alarm.

The separated condensate can be discharged via connected condensate pumps or attached automatic condensate drains.

Furthermore, fine filters can be used, into which humidity sensors can optionally be integrated.

The glass dome allows the dirt level of the filter element to easily be determined.

The humidity sensor can be easily removed. This may be necessary if, due to a fault, a breakthrough of condensate into the cooler occurs which can no longer be removed by the condensate pump or automatic condensate drain.

5.2 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!)

5.2.1 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.

5.2.2 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.

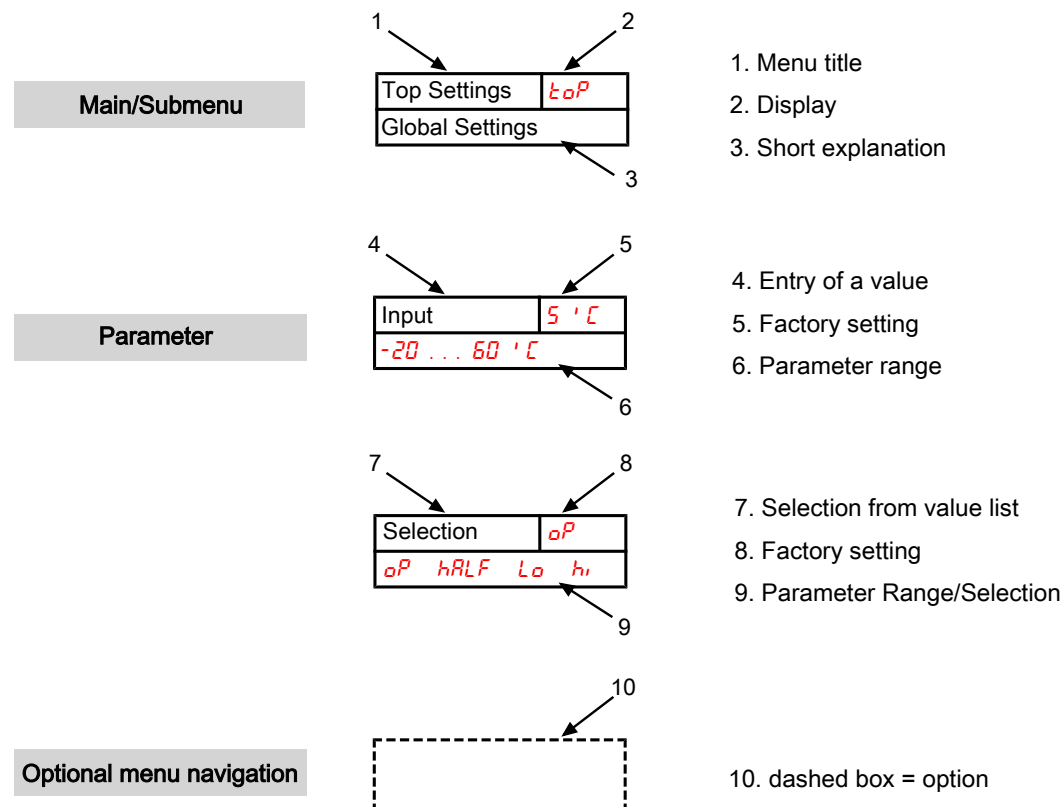
If you forgot the password you can always enter master code 287 to access the menu; the menu will be unlocked.

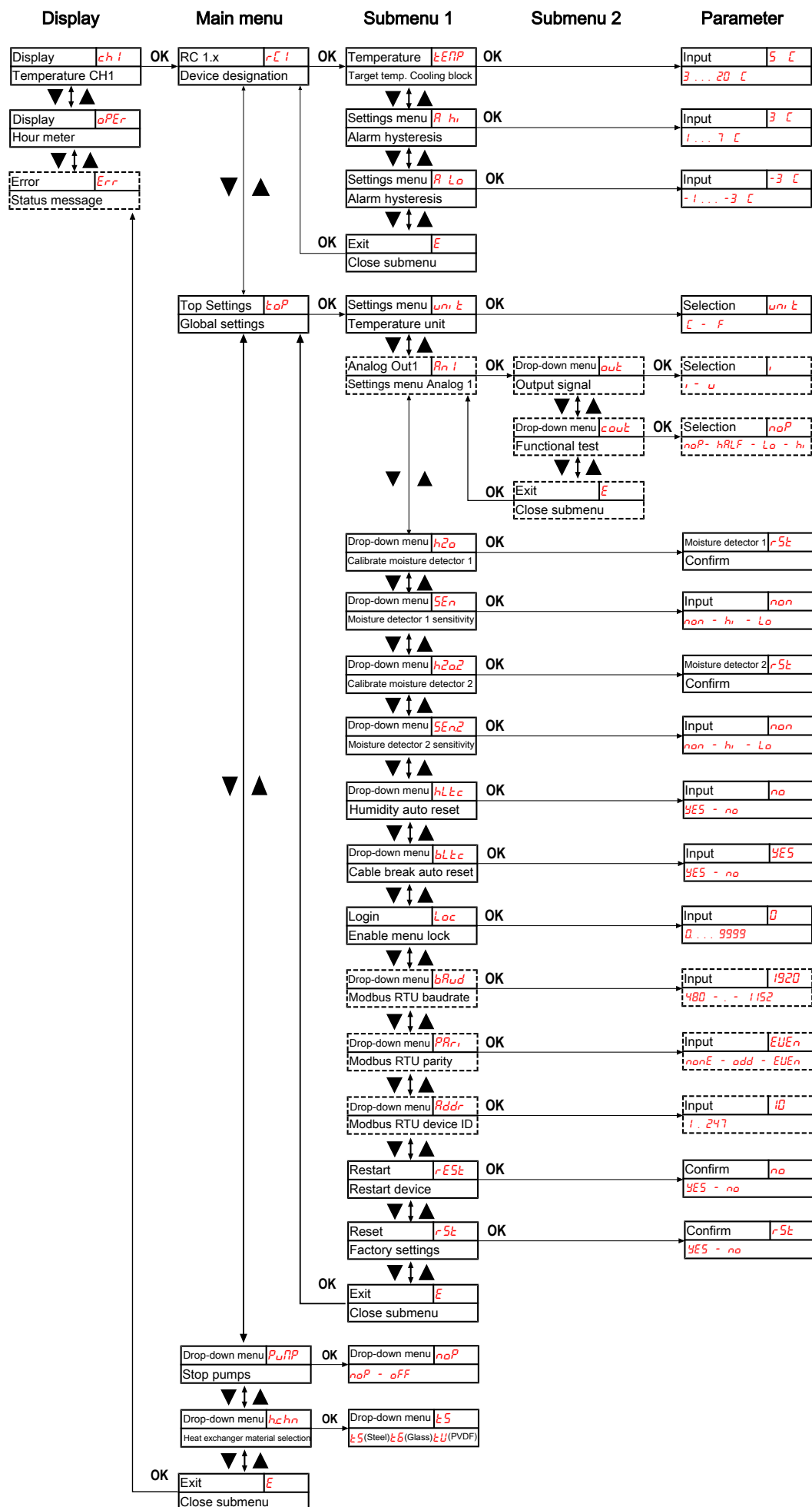
The following image shows an overview of the menu structure.

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.





5.3 Description of menu functions

5.3.1 Display Menu

Block temperature display

Display → *ch i*



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*

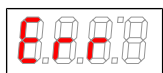


Displays the operating hours of the unit. The runtime cannot be reset and can be output in various display formats. To view/exit the runtime, press the „Enter“ key.

- *yyMM* – display in years and months (default)
- *MM* – display in months
- *WEEK* – 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.

5.3.2 Main menu

Cooler RC 1.x

Display → *rC i*



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

Global setting

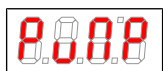
Display → *LoP* (ToP Settings)



This menu is used to configure the global cooler settings.

Peristaltic Pump

Display → *PuMP*



Switching the peristaltic pump on and off.

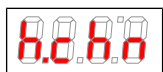
Parameter range: *noP, oFF*

Factory setting: *noP*

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

Heat exchanger material selection

Display → **hchh**



Heat exchanger material selection

Parameter range: **h5** (Steel), **h6** (Glass), **hU** (PVDF)

Factory setting: **h5** (cooler without heat exchanger), or respective material per configuration

Exit main menu

Display → **E**



Selecting this will return you to display mode.

5.3.3 Submenu 1

Setpoint temperature

Display → Cooler → **hEMP**



This setting defines the target cooling block temperature.

Parameter range: 3 °C to 20 °C (37.4 °F to 68 °F)

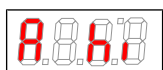
Factory setting: 5 °C (41 °F)

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 → **h 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 → **h 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.

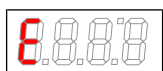
Parameter range: -1 °C to -3 °C (-1.8 °F to -5.4 °F)

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**

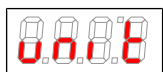


Selecting this will return you to the main menu.

5.3.4 Submenu 1 (global settings)

Temperature unit

Display → *LoP* → *uni t*



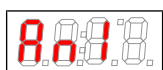
Used to select the temperature display unit.

Parameter range: *C*, *F*

Factory setting: *C*

Analog output

Display → *LoP* → *An 1*

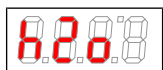


This submenu is used to specify the settings for analog output 1, see chapter Submenu 2 (Analog Output 1)

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

Calibrate moisture detector

Display → *LoP* → *h2o*



If a moisture detector is installed, calibration can now be performed. To do so, the unit must be flushed with dry gas.

Note: Calibration was performed at the factory using ambient air. After replacing the moisture detector a calibration is again required.

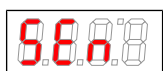
Calibrating the moisture detector will set the menu *SEn* to *h1*.

This menu will be hidden if the menu is locked.

If the unit has multiple moisture detectors built in, they will be numbered in the menu. In this case, *h2o* indicates the first, *h2o2* the second moisture detector. The same applies to setting the sensor sensitivity in menu *SEn*.

Moisture detector sensitivity

Display → *LoP* → *SEn*



If moisture detectors are installed, the sensitivity can be reduced here.

Parameter range: *h1* : high sensitivity
Lo: low sensitivity
non: no moisture detector

Factory setting: *h1*

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

Moisture detector: manual or automatic reset following moisture ingress

Display → *LoP* → *hLtc*

(*hLtc* = humidity latch). The setting applies to all connected moisture detectors.



Specifies whether the moisture ingress message must be reset manually or will automatically be reset after the sensor dries.

Parameter range: *YES*: The status will be indicated until the user restarts the device and the pumps will be disabled.
no: The status message will automatically be cleared/the pumps will be released again once moisture is no longer detected.

Factory setting: *no*

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

Moisture detector: error cleared automatically after cable break

Display → *LoP* → *bLtc*

(*bLtc* = broken wire latch). The setting applies to all connected moisture detectors.



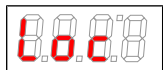
Determines whether the cable break alarm must be reset manually or will automatically clear on valid measuring signal.

Parameter range:	<i>yEs</i> : The status will be indicated until the user restarts the device. Clears the error, and the pumps will be deactivated. <i>no</i> : The error message will disappear. The pumps will be switched on again once the moisture detector is reactivated again.
Factory setting:	<i>yEs</i>
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:	<i>480</i> <i>960</i> <i>1920</i> <i>3840</i> <i>5760</i> <i>1152</i>
Factory setting:	<i>1920</i>
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*

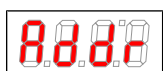
Note: This menu will be hidden if the menu is locked.

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 Ec* 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.

5.3.4.1 Submenu 2 (Analog Output 1)

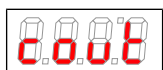
The cooling block temperature of the cooler is output at the analogue output. For devices with the “Digital Output Modbus RTU” option, the menu items for the analogue output are not available.

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
hi	20 mA	10 V
hi	12 mA	6 V
Lo	4 mA	2 V
noP	4 – 20 mA	2 – 10 V

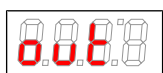
After testing, the signal behaviour must be changed back to normal mode (**noP**).

Display → **LoP** → **An I** → **out**

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** → **An I** → **out**

Select the type of output signal.

Parameter range: **1** Status output 4... 20 mA**2** Status output 2...10 VFactory setting: **1**

Note: Disconnect meter before switching!

This menu item is hidden if the keylock is enabled.

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

Selecting this will return you to submenu 1.

5.3.5 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.

5.4 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.

5.5 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.

5.6 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

5.7 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	20.0	-	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
Moisture detector signal store error	3, 16	9002	R/W	Uint16	2	-	-	1 := No 2 := Yes	-	-
Moisture alarm signal store	3, 16	9003	R/W	Uint16	1	-	-	1 := No 2 := Yes	-	-
Sensitivity moisture detector 1	3, 16	9004	R/W	Uint16	1 (with FF) 2 (without FF)	-	-	0 := Sensitivity low 1 := Sensitivity high 2 := Moisture detector inactive	-	-
Sensitivity moisture detector 2	3, 16	9005	R/W	Uint16	1 (with FF) 2 (without FF)	-	-	0 := Sensitivity low 1 := Sensitivity high 2 := Moisture detector inactive	-	-
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	-	-

Description	FC	Address	Access	Data type	Default	Min	Max	Selection	Resolution	Unit
								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	-
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 := Moisture detector 1 connected Bit 7 := Moisture detector 2 connected	-	-
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 := FF1 moisture alarm Bit 7 := FF2 moisture alarm	-	-
Condition code register 3	3	10003	R	Uint16	0	-	-	Bit 0 := Peristaltic pumps deactivated Bit 1 := Bit 2 := Bit 3 := Bit 4 :=	-	-

Description	FC	Address	Access	Data type	Default	Min	Max	Selection	Resolution	Unit
								Bit 5 := Bit 6 := Gas pump controller deactivated 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 3 - moisture detector 1	3	10007	R	Uint16	0	-	-	Bit 0 := Bit 1 := Bit 2 := Cable break Bit 3 := Bit 4 := Bit 5 := Bit 6 := Bit 7 :=	-	-
Error register 4 – moisture detector 2	3	10008		Uint16	0	-	-	Bit 0 := Bit 1 := Bit 2 := Cable break Bit 3 := Bit 4 := Bit 5 := Bit 6 := Bit 7 :=	-	-
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 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	-	-	-	-	-

Description	FC	Address	Access	Data type	Default	Min	Max	Selection	Resolution	Unit
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 chapter [Safety instructions](#) [> page 7] 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



Warning: Flammable substances

The device is filled with flammable refrigerant R600a.

- a) Handle with care and choose the installation location carefully.
- 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.

However, depending on the cooler model, various options may be included. In this case the following routine maintenance is required:

- **Peristaltic pump option:** Checking hoses (see chapter [Replacement of the hose for the peristaltic condensate pump \(optional\)](#) [> page 41])
- **Filter option:** Checking the filter element (see chapter [Replacing the filter element \(option\)](#) [> page 41])
- **Moisture detector option:** Calibrating the moisture detector (see chapter [Calibration of the moisture detector \(option\)](#) [> page 41])

For the option for ultrapure water or oxygen, only use the explicitly designated replacement parts with the suffix -H2 or -O2.

7 Service and repair

This chapter contains information on troubleshooting and correction should an error occur during operation.

Repairs to the unit must be performed by Bühler authorised personnel.

Please contact our Service Department with any questions:

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

For more information on your custom maintenance and startup services, please visit: <https://www.buehler-technologies.com/service>

If the device is not functioning properly after correcting any malfunctions and switching on the power, it must be inspected by the manufacturer. Please send the equipment inside suitable packaging to:

Bühler Technologies GmbH

- Reparatur/Service -

Harkortstraße 29

40880 Ratingen

Germany

For devices for H_2/O_2 applications, seal the gas and condensate path or return it without any parts in contact with the medium.

Please also attach the completed and signed RMA decontamination statement to the packaging. We will otherwise be unable to process your repair order.

You can find the form in the appendix of these instructions, or simply request it by e-mailing:

service@buehler-technologies.com.

7.1 Troubleshooting

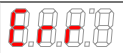
Problem/malfunction	Possible cause	Action
Condensate inside the gas output	– Condensate trap full	– Empty condensate trap
	– Valve inside the automatic condensate drain may be stuck	– Flush in both directions
	– Cooler overload	– Observe limit parameters
	– Hose contaminated or blocked	– Flush in both directions, replace hose for condensate pumps if necessary
Reduced gas flow rate	– Gas circuit clogged	– Remove and clean heat exchanger – if necessary, replace filter element
	– 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
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

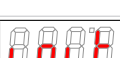
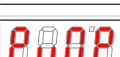
7.1.1 Error Messages in the Display

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	– No voltage – Loose connecting cable – Display failure	– Check the supply cable – Check connections
 D1.02 (permanent)	(The software version for the display will appear). – Not communicating with the controller	– Check connections
 Error	– An error has occurred	– Read the error number as described above
 Error 01	– Controller malfunction	– Clear error (temporary fault) – Disconnect from power for approx. 5 s – Contact service
 Error 03	– Microcontroller fault / MCP2	– Contact service
 Error 04	– EEPROM error	– Contact service
 Error 06	Motor speed signal faulty – Fan connector not connected – Fan blocked	– Check whether the fan is blocked – Check the fan connector contact on the controller board
 Error 22	– Moisture detector 1 cable break	– Check moisture detector line – Check moisture detector
 Error 32	– Moisture detector 2 cable break	– Check moisture detector line – Check moisture detector
 Error 40	– General error temperature sensor 1	– Possible sensor failure
 Error 41	– Low temperature/short-circuit temperature sensor 1	– Check temperature sensor connection
 Error 42	– High temperature/short-circuit temperature sensor 1	– Check temperature sensor connection
 Error 43	– Measurement fluctuation temperature sensor 1	– Check temperature sensor connection
 Error 51	– Low temperature / short-circuit temperature sensor fan control	– Check temperature sensor connection
 Error 52	– Low temperature / cable break temperature sensor fan control	– Check temperature sensor connection
 Error 53	– Measurement fluctuation temperature sensor fan control	– Check temperature sensor connection

Status text	Possible cause	Action
 H2o.1	– Moisture alarm moisture detector 1	– Dry – Check condensate trap
 H2o.2	– Moisture alarm moisture detector 2	– Dry – Check condensate trap
 init	– Initialisation phase	– Wait
 PuMP	– Pumps deactivated	– Reactive pumps via menu
 (Flashing)	– Excess/low temperature	– see chapter "Troubleshooting"

7.2 Carrying out maintenance, repair and modification work

For all work on the device, the general instructions in the chapter Safety instructions must be observed!

For sample gas coolers with stainless steel heat exchangers for **O2 applications (suffix -O2)**, there are special requirements for avoiding contamination when performing maintenance, repairs or modifications:

- Use only cleaned and undamaged tools. We recommend cleaning with a lint-free cleaning cloth, ideally pre-soaked with a mixture of isopropanol and demineralised water for residue-free degreasing.
- Use only cleaned, genuine spare parts (see chapter Spare Parts and Spare parts and accessories for cooler with -H2/-O2 heat exchanger).
- Do not use any parts whose original packaging is damaged.
- The use of compressed air is only permitted if it meets at least class 2 according to ISO 8573-1:2010.

DANGER

Electrical voltage

Electrocution hazard.



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



DANGER

Toxic, corrosive gas/condensate

Sample gas/condensate may be hazardous to health.



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



WARNING

Warning: Flammable substances

The device is filled with flammable refrigerant R600a.



- Handle with care and choose the installation location carefully.
- 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**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.

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.

7.2.1 Opening the housing

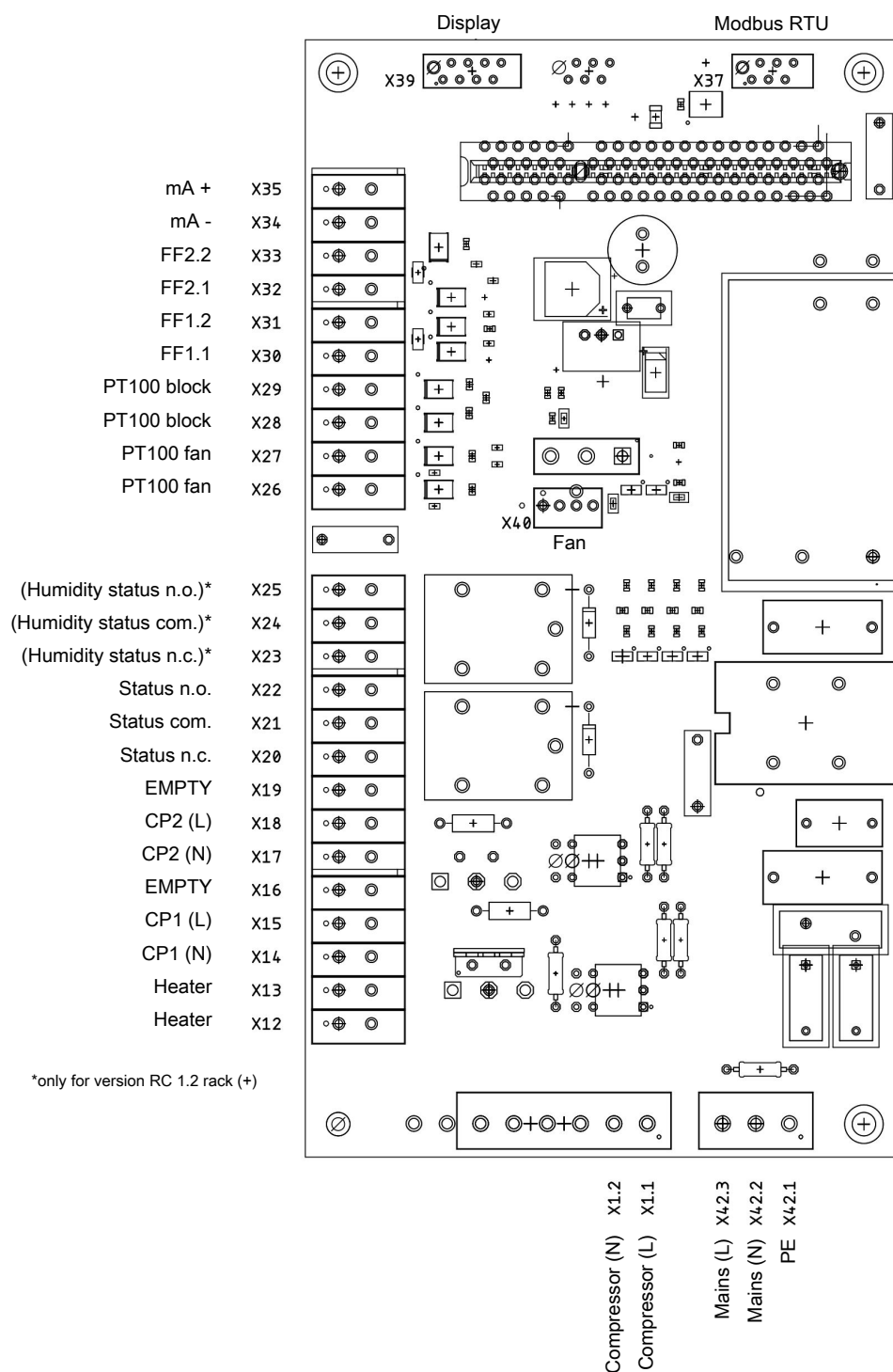
- Shut off the gas supply.
- Switch off the device and disconnect the mains and status plug (disconnect all poles).
- Disconnect the gas connection (only when dismantling the cover).
- The fastening screws for the front panel are located underneath the device. The fastening screws for the cover are located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

7.2.2 Replacing the fan

- Open the device as described in the chapter [Opening the housing](#) [> page 38].
- 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.

7.2.3 Replacing the controller board

- Open the device as described in the chapter Opening the housing.
- The controller board can be removed either directly or together with the drawer. To remove the drawer, loosen the side screw from the outside and the two nuts at the bottom (inside).
- 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.

7.2.4 Replacing the MCP2 microcontroller board

- Open the device as described in the chapter [Opening the housing](#) [> page 38].
- Remove the MCP2 board from the control board.
- Attach the new board.
- Reassemble the device in the reverse order.

7.2.5 Replacing the MCD400 display module

- Open the device as described in the chapter [Opening the housing](#) [> page 38].
- 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.

7.2.6 Cleaning and removal of the heat exchanger

Heat exchangers only need to be replaced or serviced if they are blocked or damaged. If they are clogged, we recommend checking whether this can be avoided in the future by using a filter.

For applications with high-purity oxygen or hydrogen, cleaning in accordance with common application-specific standards or the use of an original replacement heat exchanger is recommended.

To clean or remove the heat exchanger, carry out the following steps:

- Shut off the 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. Recommendation: Start against the direction of the gas flow.
- Coat the cooled outer surface of the heat exchanger with silicone grease.
- Insert the heat exchanger back into the cooling nest with a rotating motion.
- Reconnect the gas supply and condensate drain. The gas inlet is marked red.
- Restore power/gas supply and wait until the device is ready for operation.
- Open the gas supply.

7.2.7 Replacing the peristaltic condensate pump (optional)

- Shut off the gas supply.
- Switch off the device and disconnect the mains plug.
- Remove the front panel from the cooler.
- Loosen the screws on the underside of the mounting bracket.
- Replace the condensate pump.
- Establish the earth connection.
- Push the hoses onto the hose connectors and ensure they are leak-tight. The pumping direction is indicated on the housing.
- Reassemble the device in the reverse order.

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

- Close gas supply.
- Switch off the device via menu.
- Disconnect supply and discharge tube on peristaltic pump (**observe safety notes!**).
- Loosen but do not remove centre knurled nut. Flip down 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.

7.2.9 Replacing the filter element (option)

CAUTION



Gas leakage

The filter should not be dismantled under pressure.
Don't use damaged parts again.

- Shut off the gas supply.
- Pull the bracket while holding the filter glass in place.
- Whilst holding the filter head, move the glass back and forth and carefully remove downward.
- Remove the filter element and insert a new one.
- Check for leaks and replace, if necessary.
- Refit the glass while simultaneously holding the filter head and gently moving it back and forth, attach the bracket and ensure it is securely seated.
- Restore the gas supply.

NOTICE! Observe legal regulations when disposing of filter elements.

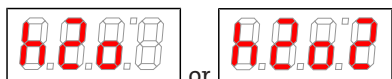
7.2.10 Drying of the moisture detector (option)

The moisture detector must be dried if moisture enters.

- Close the gas supply.
- Switch off and unplug the device.
- Loosen the swivel nut for the moisture detector connection line and disconnect the line.
- Unscrew the moisture detector counter-clockwise and remove.
- Dry moisture detector.
- Reinsert the moisture detector and carefully tighten the screw connection.
- Connect the connection line and tighten the swivel nut.
- Restore the power and gas supply.

7.2.11 Calibration of the moisture detector (option)

- When replacing the moisture detectors, they must be recalibrated.
- Be sure dry gas flows through the cooler.
- Select cooler menu and confirm.



- Select menu item moisture detector.



- The display shows (Reset).
- Confirm the display to calibrate the moisture detectors.

For a detailed overview of menu navigation, refer to chapter "Operation and Control".

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
9100130385	Controller board 10 W 115-230 V
9124040101	Fan 24 V
90214702	Silicone grease 1.5 ml
4011000	Flow adapter type G, PVDF G1/4
40110001	Flow adapter type NPT, PVDF NPT 1/4"
4011005	Flow adapter type G, stainless steel, G1/4
40110051	Flow adapter type NPT, stainless steel, NPT 1/4"
4111100	Moisture detector FF-3-N, without cable
9144050081	Moisture detector connection cable, 300 mm
9144050086	Moisture detector connection cable, 520 mm
44920035012	Hose for condensate pump, Tygon (Norprene), 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 connector and imperial threaded fitting

7.3.1 Spare Parts and Accessories

Item no.	Description
41020050	Filter element F2-L; unit 2 count (for type RC 1.1)
41030050	Filter element F2; unit 5 count (for type RC 1.2+)
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
459600026	Adapter plate EGK 1/2 to RC 1.1 and RC 1.2+
see data sheet 410001	Fine mesh filter AGF-PV-30
see data sheet 450020	Peristaltic condensate pumps CPsingle, CPdouble

7.3.2 Spare parts and accessories for cooler with -H2/-O2 heat exchanger

Item no.	Description
4410001 (see data sheet 450005)	Automatic condensate drain 11 LD V 38 ¹⁾
4410001-O2 (see data sheet 450005)	Automatic condensate drain 11 LD V 38 optimised for oxygen
see data sheet 400016	Stainless steel pipe fittings for high-purity oxygen applications

¹⁾ For use with high hydrogen concentrations max. 1.5 bar overpressure.

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
WEEE
Harkortstr. 29
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 Gas Cooler Technical Data

RC 1.1 (with heat exchanger -H2/-O2)

Gas Cooler Technical Data			
Rated cooling capacity (at 25 °C):	360 kJ/h		
Ambient temperature:	5 °C to 50 °C		
Ready for operation:	after max. 15 minutes		
Gas outlet dew point preset:	5 °C		
adjustable:	3 °C to 20 °C		
Dew point fluctuations static:	± 0.1 K		
in the entire specification range:	± 1.5 K		
IP rating:	IP 20		
Installation:	Table-top or wall mounting		
Housing:	Stainless steel		
Packaging dimensions:	approx. 530 x 400 x 400 mm		
Weight:	approx. 15 kg		
max. altitude:	Altitudes up to 2000 m		
Refrigerant:	R600a (28 g)		
Recommended minimum room: <i>Refrigerant quantity [g] / 8 g/m²</i>	3,5 m ²		
Electrical connection:	Plug per DIN EN 175301-803		
Contamination level:	2		
Overvoltage category:	II		
Electrical data: <i>Available options may result in details that differ from these</i>	Voltage:	230 V	115 V
	Tolerance:	+/-10% at 50 Hz +/-10% at 60 Hz	- +/-10% at 60 Hz
	Typical power input:	414 VA	345 VA
	max. operating current:	1.8 A	3.0 A
	Starting current:	2.3 A	3.6 A
	Protection:	4 A (delayed action)	4 A (delayed action)
Status output switching capacity:	max. 250 V AC, 150 V DC 2 A, 50 VA, potential-free		
Condensate outlet:	For heat exchanger, see table "Heat exchanger overview" For condensate pump, see "Technical Data - Options"		
Parts in contact with media			
Filter:	see "Technical Data - Options"		
Moisture detector:	see "Technical Data - Options"		
Heat exchanger:	see table "Heat Exchanger Overview"		
Peristaltic pump:	see "Technical Data - Options"		
Tubing:	PTFE/FKM (Viton)		

RC 1.1 with heat exchanger -H2/-O2

Gas Cooler Technical Data			
Rated cooling capacity (at 25 °C):	360 kJ/h		
Ambient temperature:	5 °C to 50 °C		
Ready for operation:	after max. 15 minutes		
Gas outlet dew point preset:	5 °C		
adjustable:	3 °C to 20 °C		
Dew point fluctuations static:	± 0.1 K		
in the entire specification range:	± 1.5 K		
IP rating:	IP 20		
Installation:	Table-top or wall mounting		
Housing:	Stainless steel		
Packaging dimensions:	approx. 530 x 400 x 400 mm		
Weight:	approx. 15 kg		
max. altitude:	Altitudes up to 2000 m		
Refrigerant:	R600a (28 g)		
Recommended minimum room: <i>Refrigerant quantity [g] / 8 g/m²</i>	3,5 m ²		
Electrical connection:	Plug per DIN EN 175301-803		
Contamination level:	2		
Overvoltage category:	II		
Electrical data: <i>Available options may result in details that differ from these</i>	Voltage:	230 V	115 V
	Tolerance:	+/-10% at 50 Hz +/-10% at 60 Hz	- +/-10% at 60 Hz
	Typical power input:	414 VA	345 VA
	max. operating current:	1.8 A	3.0 A
	Starting current:	2.3 A	3.6 A
	Protection:	4 A (delayed action)	4 A (delayed action)
Status output switching capacity:	max. 250 V AC, 150 V DC 2 A, 50 VA, potential-free		
Condensate outlet:	For heat exchanger, see table "Heat exchanger overview"		
Parts in contact with media Heat exchanger:	see table "Heat Exchanger Overview"		

RC 1.2+

Gas Cooler Technical Data			
Rated cooling capacity (at 25 °C):	390 kJ/h		
Ambient temperature:	5 °C to 50 °C		
Ready for operation:	after max. 15 minutes		
Gas outlet dew point preset:	5 °C		
adjustable:	3 °C to 20 °C		
Dew point fluctuations static:	± 0.1 K		
in the entire specification range:	± 1.5 K		
IP rating:	IP 20		
Installation:	Table-top or wall mounting		
Housing:	Stainless steel		
Packaging dimensions:	approx. 530 x 400 x 400 mm		
Weight:	approx. 15 kg		
max. altitude:	Altitudes up to 2000 m		
Refrigerant:	R600a (28 g)		
Recommended minimum room: <i>Refrigerant quantity [g] / 8 g/m²</i>	3,5 m ²		
Electrical connection:	Plug per DIN EN 175301-803		
Contamination level:	2		
Overvoltage category:	II		
Electrical data: <i>Available options may result in details that differ from these</i>	Voltage:	230 V	115 V
	Tolerance:	+/-10% at 50 Hz +/-10% at 60 Hz	- +/-10% at 60 Hz
	Typical power input:	414 VA	345 VA
	max. operating current:	1.8 A	3.0 A
	Starting current:	2.3 A	3.6 A
	Protection:	4 A (delayed action)	4 A (delayed action)
Status output switching capacity:	max. 250 V AC, 150 V DC 2 A, 50 VA, potential-free		
Condensate outlet:	Hose nipple Ø5 mm or with screw connection (metric/US)		
Parts in contact with media			
Filter:	see "Technical Data - Options"		
Moisture detector:	see "Technical Data - Options"		
Heat exchanger:	see table "Heat Exchanger Overview"		
Peristaltic pump:	see "Technical Data - Options"		
Tubing:	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 FF-3-N Moisture Detector

Ambient temperature:	3 °C to 50 °C
max. operating pressure with FF-3-N:	2 bar
Weight:	0.04 kg (incl. cable)
Material:	PVDF, PTFE, epoxy resin, stainless steel 1.4571, 1.4576

Technical Data Cpsingle/CPdouble Condensate Pump

Ambient temperature:	0 °C to 60 °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-OEM: 0.47 kg CPdouble-OEM: 0.51 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 40
Materials	
Hose:	Tygon (Norpren)
Connections:	PVDF

AGF-PV-30-F2 Filter Technical Data

Ambient temperature:	3 °C to 100 °C
max. operating pressure with filter:	4 bar
Weight:	0.24 kg
Filter surface:	60 cm ²
Filter fineness:	2 µm
Dead volume:	57 ml
Materials	
Filter:	PVDF, DURAN glass (parts in contact with media)
Seal:	FKM (Viton)
Filter element:	sintered PTFE

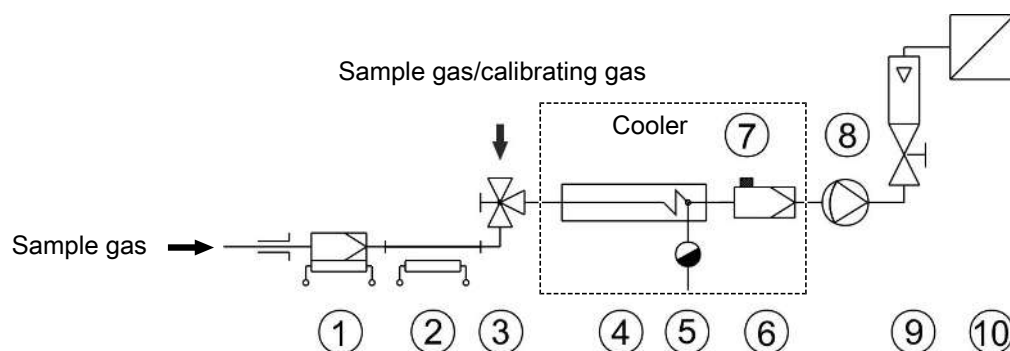
Technical Data Filter AGF-PV-30-F2-L

Ambient temperature:	3 °C to 100 °C
max. operating pressure with filter:	4 bar
Weight:	0.29 kg
Filter surface:	125 cm ²
Filter fineness:	2 µm
Dead volume:	108 ml

Materials

Filter:	PVDF, DURAN glass (parts in contact with media)
Seal:	FKM (Viton)
Filter element:	sintered PTFE

9.3 Diagram typical installation



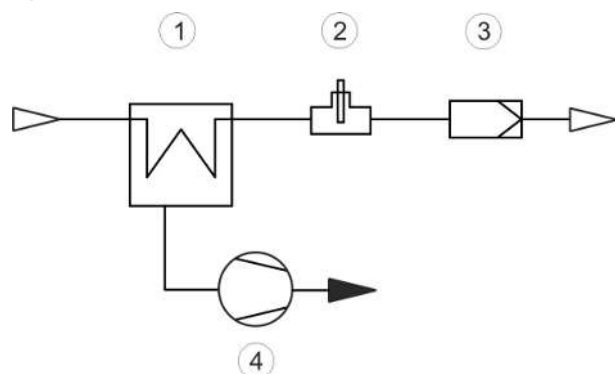
1 Sample gas probe	2 Sample gas line
3 Reversing tap	4 Heat exchanger
5 Automatic condensate drain or peristaltic pump	6 Fine filter
7 Moisture detector	8 Sample gas pump
9 Flow meter	10 Analyser

See data sheets for individual component models and data.

9.4 Cooler flow diagrams

RC 1.1

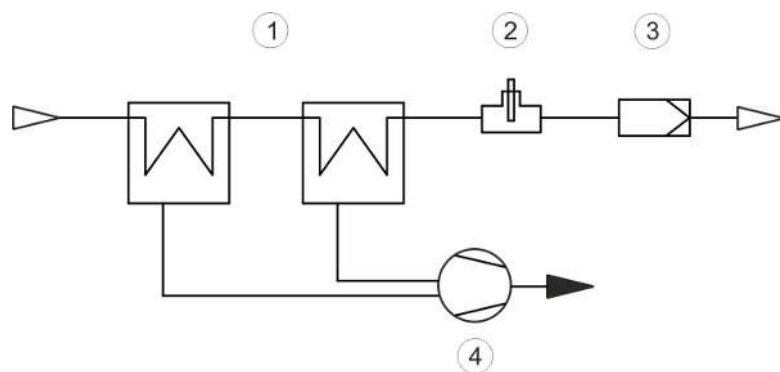
1 gas path:



1 Cooler	2 Moisture detector (option)
3 Filter (optional)	4 Condensate pump (optional)

RC 1.2+

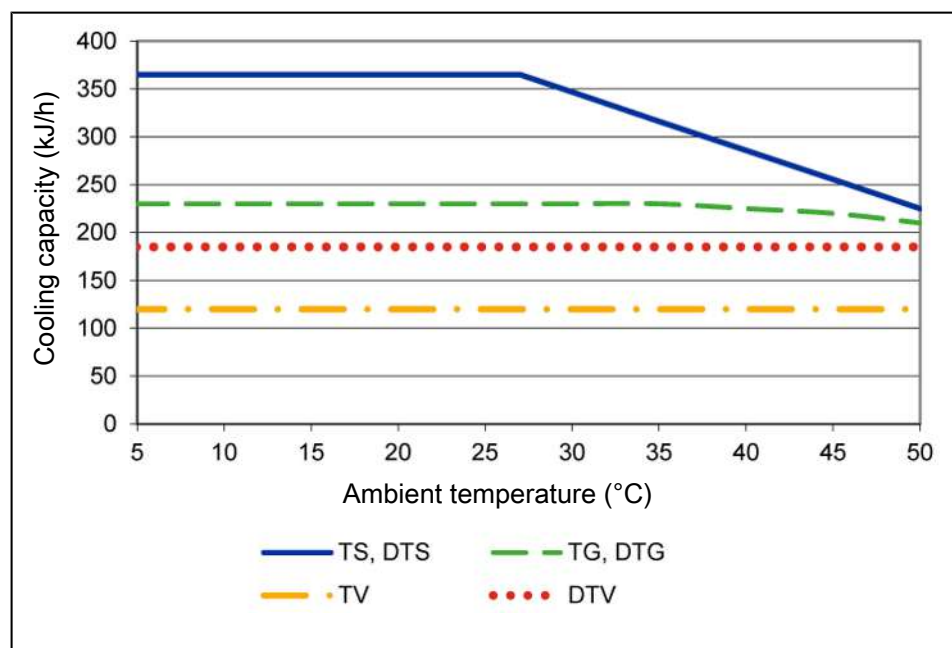
1 in-line gas path:



1 Cooler	2 Moisture detector (option)
3 Filter (optional)	4 Condensate pump (optional)

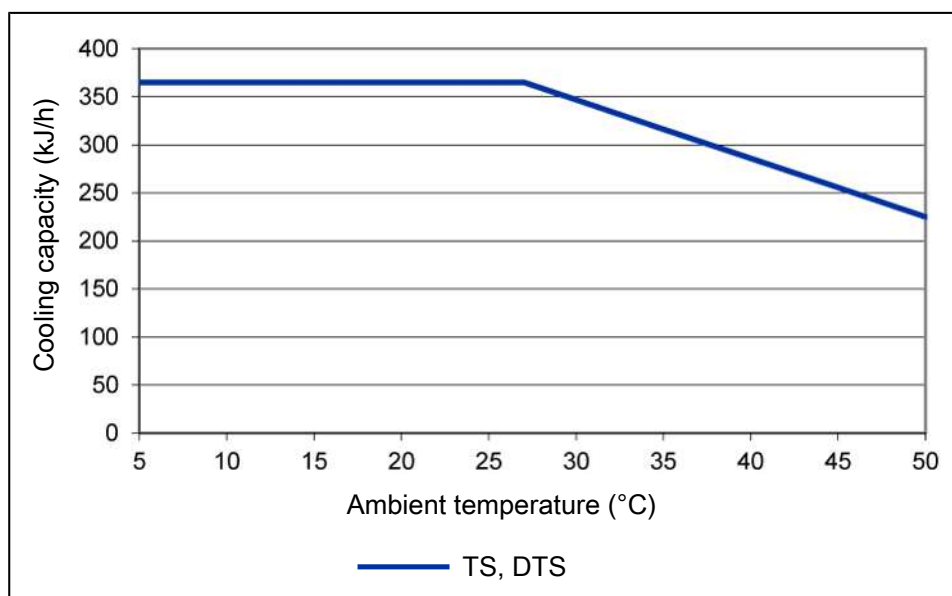
9.5 Performance curves

RC 1.1

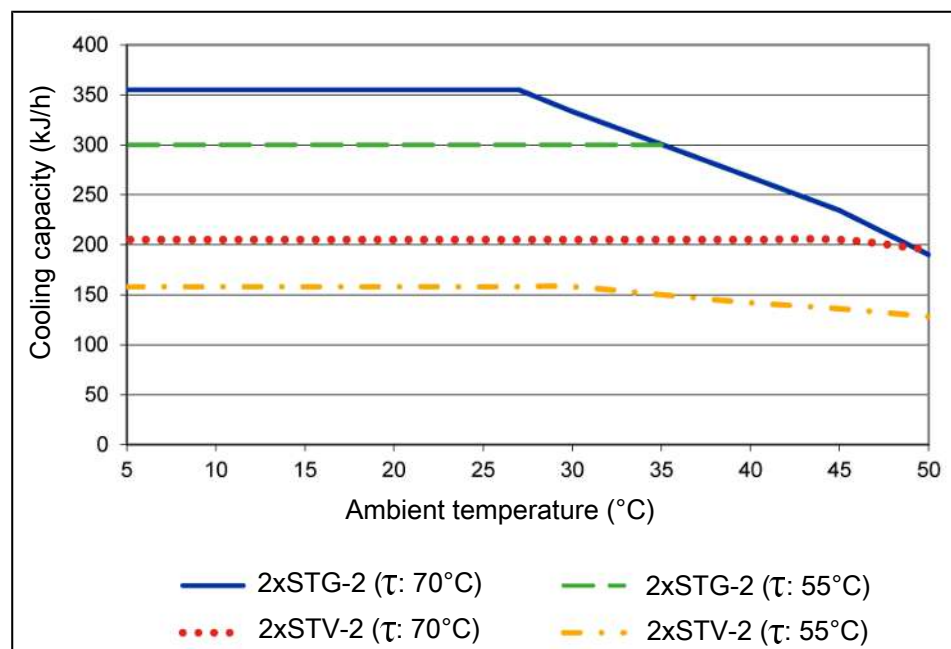


Note: The limit curves for the heat exchangers exchanger apply to a dew point of 65 °C.

RC 1.1 with -H2/-O2 heat exchanger



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

RC 1.2+

Note: The limit curves of the heat exchangers apply to different dew points (τ), see legend.

9.6 Heat exchanger

9.6.1 Heat exchanger description

RC 1.1

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.

RC 1.2+

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 , 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 standard operating point of $\tau_e = 70^\circ\text{C}$ and $\vartheta_G = 110^\circ\text{C}$. 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, with the STG heat exchanger in place of $\tau_e = 70^\circ\text{C}$, $\vartheta_G = 110^\circ\text{C}$ and $v = 320 \text{ NI/h}$ the parameter triple $\tau_e = 50^\circ\text{C}$, $\vartheta_G = 105^\circ\text{C}$ and $v = 420 \text{ NI/h}$ may also be used.

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

9.6.2 Heat exchanger overview

RC 1.1

Heat exchanger	TS TS-I ²⁾	TG TG	TV TV-I ²⁾	DTS (DTS-6 ³⁾) DTS-I (DTS-6-I ³⁾) ²⁾	DTG DTG	DTV ³⁾ DTV-I ^{2) 3)}
Materials in contact with media	Stainless steel	DURAN Glas PTFE	PVDF	Stainless steel	DURAN Glas PTFE	PVDF
Weight	0.9 kg	0.4 kg	0.25 kg	0.9 kg	0.45 kg	0.55 kg
Flow rate $v_{\max}$ ¹⁾	530 L/h	280 L/h	155 L/h	2 x 250 L/h	2 x 140 L/h	2 x 115 L/h
Inlet dew point $\tau_{e,\max}$ ¹⁾	80 °C	80 °C	65 °C	80 °C	65 °C	65 °C
Gas inlet temperature $\vartheta_{G,\max}$ ¹⁾	180 °C	140 °C	140 °C	180 °C	140 °C	140 °C
Max. cooling capacity $Q_{\max}$	450 kJ/h	230 kJ/h	120 kJ/h	450 kJ/h	230 kJ/h	185 kJ/h
Gas pressure $p_{\max}$	160 bar	3 bar	3 bar	25 bar	3 bar	2 bar
Pressure drop Δp ($v=150$ L/h)	8 mbar	8 mbar	8 mbar	5 mbar each	5 mbar each	15 mbar each
Dead volume V_{dead}	69 ml	48 ml	129 ml	28 / 25 ml	28 / 25 ml	21 / 21 ml
Gas connections (metric)	G1/4	GL 14 (6 mm) ⁴⁾	DN 4/6	6 mm tube	GL14 (6 mm) ⁴⁾	DN 4/6
Gas connections (US)	NPT 1/4"	GL 14 (1/4") ⁴⁾	1/4"-1/6"	1/4" tube	GL14 (1/4") ⁴⁾	1/4"-1/6"
Condensate out connection (metric)	G3/8	GL 25 (12 mm) ⁴⁾	G3/8	Tube 10 mm (6 mm)	GL18 (10 mm) ⁴⁾	DN 5/8
Condensate out connection (US)	NPT 3/8"	GL 25 (1/2") ⁴⁾	NPT 3/8"	Tube 3/8" (1/4")	GL18 (3/8") ⁴⁾	3/16"-5/16"

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

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

³⁾ Condensate drain only possible with condensate pump.

⁴⁾ Gasket inside diameter.

RC 1.1 with -H2/-O2 heat exchanger

Heat exchanger	TS-H2/-O2 TS-I-H2/-O2 ²⁾	DTS-H2/-O2 DTS-I-H2/-O2 ²⁾
Materials in contact with media	Stainless steel	Stainless steel
Weight	0,9 kg	0,9 kg
Flow rate $v_{\max}$ ¹⁾	530 l/h	2x 250 l/h
Inlet dew point $\tau_{e,\max}$ ¹⁾	80 °C	80 °C
Gas inlet temperature $\vartheta_{G,\max}$ ¹⁾	180 °C	180 °C
Max. cooling capacity $Q_{\max}$	450 kJ/h	450 kJ/h
Gas pressure $p_{\max}$	1,5 barg (H2) / 15 barg (O2)	1,5 barg (H2) / 15 barg (O2)
Pressure drop Δp ($v=150$ l/h)	8 mbar	5 mbar each
Dead volume V_{dead}	69 ml	28/25 ml
Gas connections (metric)	G1/4	6 mm tube
Gas connections (US)	NPT 1/4"	1/4" tube
Condensate out connection (metric)	G3/8	Tube 10 mm (6 mm)
Condensate out connection (US)	NPT 3/8"	3/8" tube

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

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

RC 1.2+

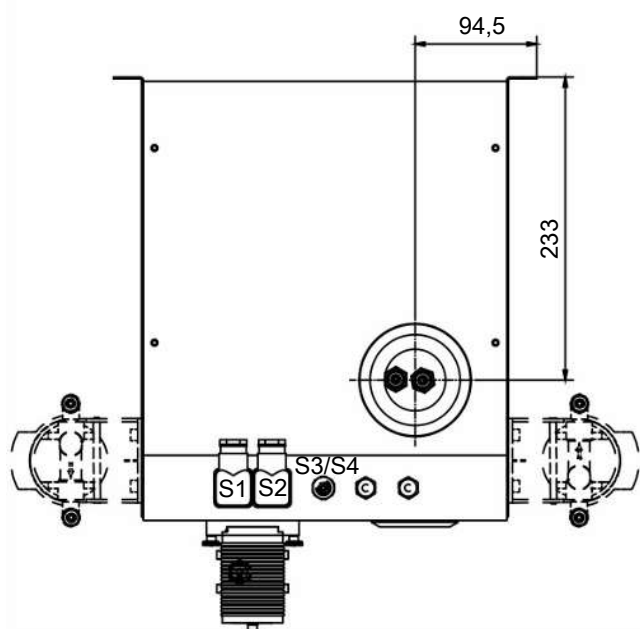
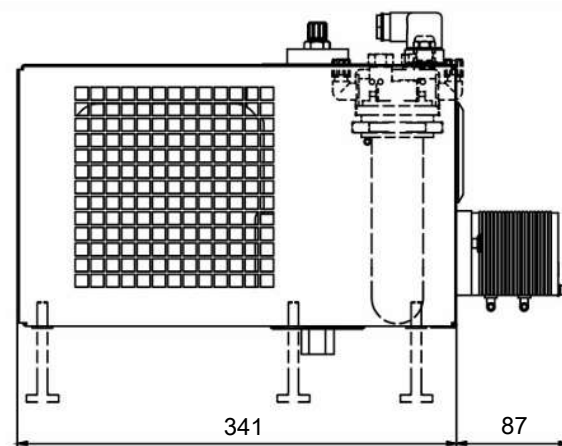
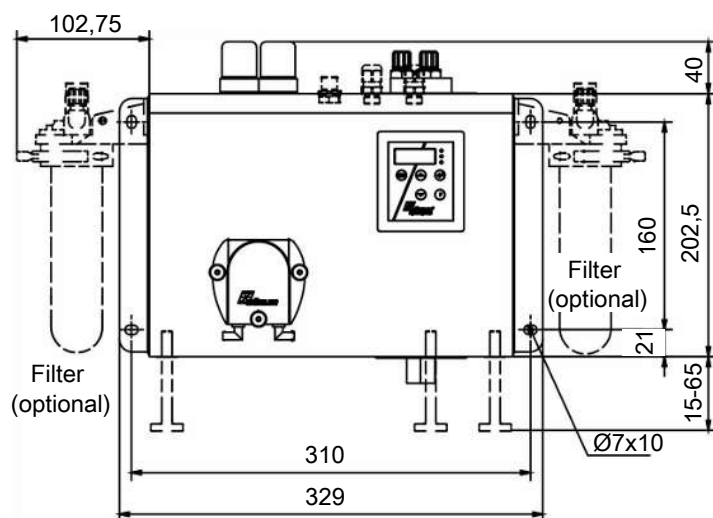
Heat exchanger	2 x STG-2	2 x STV-2
Materials in contact with media	DURAN Glas PTFE	PVDF
Weight	2 x 0.14 kg	2 x 0.11 kg
Flow rate $v_{\max}^{1)}$	320 L/h	300 L/h
Inlet dew point $\tau_{e,\max}^{1)}$	70 °C	70 °C
Gas inlet temperature $\vartheta_{G,\max}^{1)}$	140 °C	140 °C
Gas pressure $p_{\max}$	3 bar	3 bar
Pressure drop Δp ($v=150$ L/h)	2.6 mbar	2.9 mbar
Max. Cooling capacity $Q_{\max}$	345 kJ/h	210 kJ/h
Dead volume V_{dead}	47 ml	41 ml
Gas connections (metric)	GL 14 (6 mm) ²⁾	DN 4/6
Gas connections (US)	GL 14 (1/4") ²⁾	1/4"-1/6"
Condensate out connection (metric)	GL 18 (10 mm) ²⁾	G1/4
Condensate out connection (US)	GL 18 (10 mm) ²⁾	NPT 1/4"

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

²⁾ Gasket inside diameter.

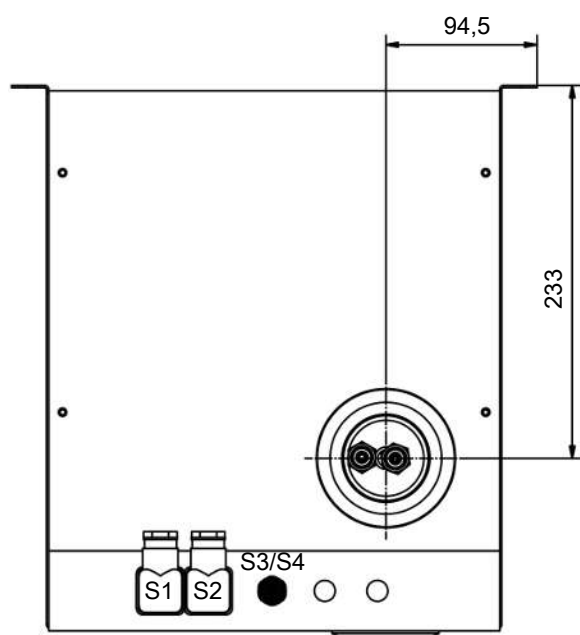
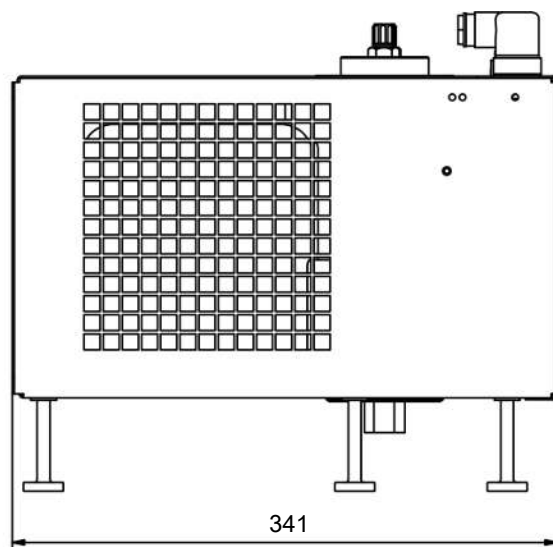
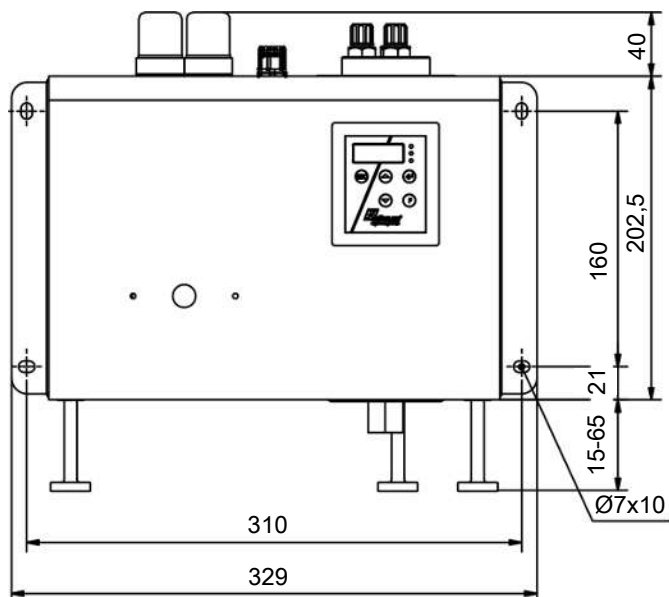
9.7 Dimensions

RC 1.1



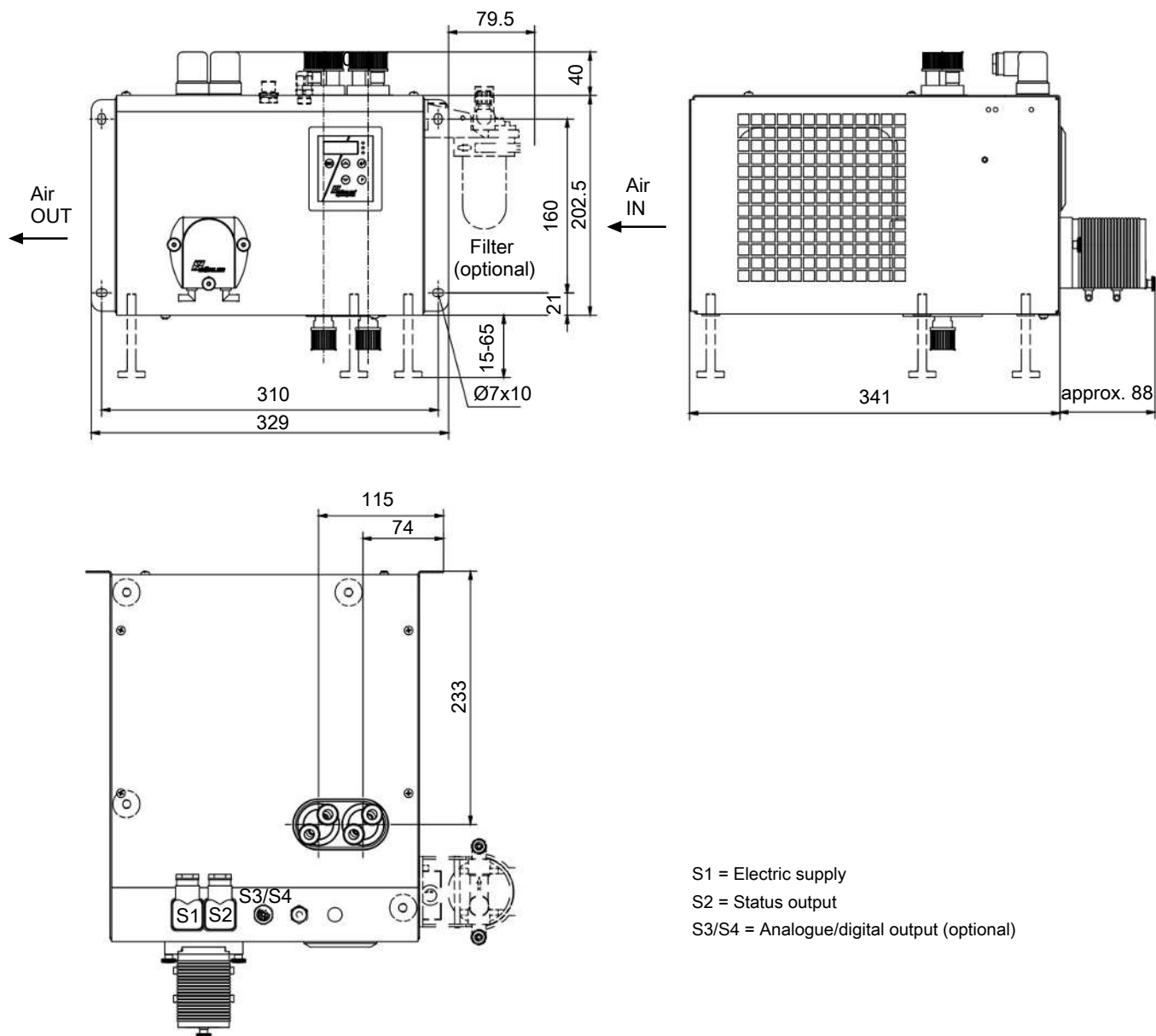
S1 = Electric supply
 S2 = Status output
 S3/S4 = Analogue/digital output (optional)

RC 1.1 with -H2/-O2 heat exchanger



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

RC 1.2+



10 Attached Documents

- Declaration of Conformity KX450021
- O₂declaration (heat exchanger)
- RMA – Decontamination Declaration

EU-Konformitätserklärung
EU-declaration of conformity



Hiermit erklärt Bühler Technologies GmbH,
dass die nachfolgenden Produkte den
wesentlichen Anforderungen der Richtlinie

*Herewith declares Bühler Technologies GmbH
that the following products correspond to the
essential requirements of Directive*

2014/35/EU
(Niederspannungsrichtlinie / low voltage directive)

in ihrer aktuellen Fassung entsprechen.

in its actual version.

Folgende Richtlinie wurde berücksichtigt:

The following directive was regarded:

2014/30/EU (EMV/EMC)

Produkt / products: Kompressor-Messgaskühler / Compressor sample gas cooler
Typ / type: RC 1.1, RC 1.2+
RC 1.2 Rack, RC 1.2+ Rack
Seriennummer / serial number: 45963...

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
Harmonisierungsrechtsvorschriften der Union:

*The object of the declaration described above is in conformity with the relevant Union harmonisation
legislation:*

EN 61326-1:2013

EN 61010-1:2010/A1:2019/AC:2019-04

Die alleinige Verantwortung für die Ausstellung dieser Konformitätserklärung trägt der Hersteller.
This declaration of conformity is issued under the sole responsibility of the manufacturer.

Dokumentationsverantwortlicher für diese Konformitätserklärung ist Herr Stefan Eschweiler mit
Anschrift am Firmensitz.

*The person authorized to compile the technical file is Mr. Stefan Eschweiler located at the company's
address*

Ratingen, den 08.09.2025

Stefan Eschweiler
Geschäftsführer – Managing Director

Frank Pospiech
Geschäftsführer – Managing Director

UK Declaration of Conformity



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

Electrical Equipment Safety Regulations 2016

The following legislation were regarded:

Electromagnetic Compatibility Regulations 2016

Product: Compressor sample gas cooler
Types: RC 1.1
RC 1.2
RC 1.2 Rack
RC 1.2+ Rack

Seriennummer: 45963...
Serial number:

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

The object of the declaration described above is in conformity with the relevant designated standards:

EN 61010-1:2010/A1:2019/AC:2019-04

EN 61326-1:2013

Ratingen in Germany, 03.07.2025



Stefan Eschweiler
Managing Director



Frank Pospiech
Managing Director

O2-Erklärung O2 Declaration

Wärmetauscher für den Einsatz mit
hochreinem Sauerstoff optimiert

*Heat Exchanger optimised for use with
high-purity oxygen*

Applikationen mit Sauerstoff: Partikel-, Öl- und Fettfreiheit

Mit dieser Erklärung bestätigen wir, dass alle medienberührenden Flächen der nachfolgenden Produkte in Anlehnung an die Vorgaben der EIGA Doc 33/18 und des VDA-Band 19 gereinigt und gefertigt sind.

Applications with oxygen: free of particles, oil and grease

With this declaration, we confirm that all surfaces of the following products that come into contact with media have been cleaned and manufactured in accordance with the specifications of EIGA Doc 33/18 and VDA Volume 19.

Produkt / Products	Wärmetauscher / Heat Exchanger	Art-Nr. / Item no.:
Typen / Types:	PTS-O2	4447999-O2
	PTS-I-O2	4448999I-O2
	TS-O2	4510023-O2
	TS-I-O2	4510025I-O2
	DTS-O2	4501026-O2
	DTS-I-O2	4501026I-O2

Ratingen, den 25.04.2024

Bühler Technologies GmbH



Heat exchanger optimized for use with high-purity oxygen

Applications with oxygen: Free from particles, oil and grease



For use with high-purity oxygen, the product requires special cleaning to ensure that it is free from oil and grease, as oxygen is a strong oxidising agent. Under unfavourable conditions, oxygen can cause spontaneous combustion of organic substances such as particles, oils and fats, and generally promotes the combustion of substances. Oils and fats can even react explosively on contact with oxygen. We use special cleaning and production processes to ensure the safe use of our products with high-purity oxygen and to avoid the above-mentioned undesirable reactions.

With this declaration, we confirm that all surfaces of the following products that come into contact with media have been cleaned and manufactured in accordance with the requirements of EIGA Doc 33/18 and VDA Volume 19.

Product:	Heat exchanger	Item no.
Models:	PTS-O2	4447999-O2
	PTS-I-O2	4448999I-O2
	TS-O2	4510023-O2
	TS-I-O2	4510025I-O2
	DTS-O2	4501026-O2
	DTS-I-O2	4501026I-O2

The material used for the “O2” heat exchangers is high-quality stainless steel, which has been tested by Bühler Technologies for its suitability for oxygen applications.

All components in contact with the medium undergo a special cleaning process to reliably remove impurities (such as oil, grease and particles). This process is documented by a comprehensive delivery specification to the service provider and compliance with the limits is verified with regular analyses by an independent, accredited laboratory.

The contamination limits of the surfaces in contact with media are defined as follows (as in EIGA Doc 33/18 Cleaning of Equipment for oxygen service):

	Contamination limits
Non-volatile organic or inorganic impurities:	$\leq 220 \text{ mg/m}^2$ for non-volatile impurities
Particles:	$\leq 22 \text{ particles/m}^2$ between $500 \mu\text{m}$ and $1000 \mu\text{m}$

The component groups of the heat exchangers are cleaned by an external service provider and then manufactured into the end product at Bühler Technologies. After these production steps, the heat exchanger undergoes final cleaning by the service provider before delivery in order to remove any contamination from the production process.

Compliance with the contamination limits is documented by the external service provider by means of factory test certificates (free of oil and grease) and a test report (free of dust and dirt). After cleaning, the heat exchangers are packed in airtight and dustproof packaging and clearly labeled “Cleaned for oxygen service. Do not open until ready for use”.

All described cleaning properties are lost if the product comes into contact with oily or greasy media or is otherwise contaminated from the outside.



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.

