Gas Analysis

ModbusRTU

Sample gas cooler

Series TC-MINI

Installation and Operation Instructions

Original instructions

BE440015
05/2024

Bühler Technologies GmbH, Harkortstr. 29, D-40880 Ratingen
Tel. +49 (0) 21 02 / 49 89-0, Fax: +49 (0) 21 02 / 49 89-20
E-Mail: analyse@buehler-technologies.com
Internet: www.buehler-technologies.com

Bühler Technologies GmbH, Harkortstr. 29, D-40880 Ratingen
Tel. +49 (0) 21 02 / 49 89-0, Fax: +49 (0) 21 02 / 49 89-20
Internet: www.buehler-technologies.com
E-Mail: analyse@buehler-technologies.com

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.

Document information
Document No..... BE440015
Version.....05/2024

Contents

1 Introduction

1.1 Intended use

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

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

1.2 Types

The device is delivered with different configurations. The part number given on the type plate informs you about the specific configuration of your device.

1.3 Scope of delivery

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

1.4 Ordering instructions

4496	1	1	1	X	0	4	X	X	X	0	0	X	X	X	0	0	0	0	Product Characteristics
																			Gas cooler models (with 1 heat exchanger)
				1															TC-MINI 6111: moderate ambient temperature 40 °C
				2															TC-MINI 6112: higher ambient temperature 50 °C
																			Certifications
					0														Standard applications – CE
																			Supply voltage
						4													24 V DC
																			Heat exchanger [1]
							1	1	0	0	0								Stainless steel, MTS, metric
							1	1	5	0	0								Stainless steel, MTS-I, US
							1	2	0	0	0								Duran glass, MTG, metric
							1	2	5	0	0								Duran glass, MTG, US
							1	3	0	0	0								PVDF, MTV, metric
							1	3	5	0	0								PVDF, MTV-I, US
							1	6	0	0	0								Stainless steel, angle connector, MTS-WS, metric
							1	6	5	0	0								Stainless steel, angle connector, MTS-I-WS, US
																			Moisture detector/filter
												0	0						without filter, without moisture detector
												0	1						without filter, 1 moisture detector with block
												1	0						1 filter, without moisture detector
												1	1						1 filter with built-in moisture detector
																			Signal outputs
														1	0	0	0	0	Analog output, 4..20 mA, incl. status output
														2	0	0	0	0	Modbus RTU digital output, incl. status output

[1] Moisture detector/filter screw-in fitting and tubes metric or US, accordingly

2 Safety instructions

2.1 Important advice

Operation of the device is only permitted if:

- the product is used under the conditions described in the installation- and operation instruction, the intended application according to the type plate and the intended use. In case of unauthorized modifications done by the user Bühler Technologies GmbH can not be held responsible for any damage,
- when complying with the specifications and markings on the nameplates.
- the performance limits given in the datasheets and in the installation- and operation instruction are obeyed,
- monitoring devices and safety devices are installed properly,
- service and repair is carried out by Bühler Technologies GmbH,
- only original spare parts are used.

This manual is part of the equipment. The manufacturer keeps the right to modify specifications without advanced notice. Keep this manual for later use.

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.

Warning signs

These instructions include the following warnings:

	General warning sign		Unplug from mains
	Warning not to inhale toxic gases		Wear respiratory equipment
	Warning of corrosive substances		Wear a safety mask
	Warning of explosion hazard		Wear gloves
	General mandatory sign		

2.2 General hazard warnings

The equipment must be installed by a professional familiar with the safety requirements and risks.

Be sure to observe the safety regulations and generally applicable rules of technology relevant for the installation site. Prevent malfunctions and avoid personal injuries and property damage.

The operator of the system must ensure:

- Safety notices and operating instructions are available and observed,
- The respective national accident prevention regulations are observed,
- The permissible data and operational conditions are maintained,
- Safety guards are used and mandatory maintenance is performed,
- Legal regulations are observed during disposal,
- compliance with national installation regulations.
- the device is protected from mechanical loads.

Maintenance, Repair

Please note during maintenance and repairs:

- Repairs to the unit must be performed by Bühler authorised personnel.
- Only perform conversion-, maintenance or installation work described in these operating and installation instructions.
- Always use genuine spare parts.
- Do not install damaged or defective spare part. If necessary, visually inspect prior to installation to determine any obvious damage to the spare parts.

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

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 appropriate protective equipment.

DANGER

Potentially explosive atmosphere

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.

3 Transport and storage

Only transport the product inside the original packaging or a suitable alternative.

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

4 Installation and connection

4.1 Installation site requirements

The unit is only intended for wall-mounted use in enclosed areas. Adequate protection from the weather must be provided when used outdoors.

Install the unit leaving enough room below the cooler to discharge the condensate. Leave room above for the gas supply.

Be sure to maintain the approved ambient temperature. Do not obstruct the convection of the cooler. The vents must have enough room to the next obstacle. The distance must especially be a minimum of 10 cm on the air outlet side.

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.

When wall mounting the sample gas cooler, be sure the wall or the cabinet provide adequate weight bearing and stability.

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 V38, AK 20, AK 5.5 OR AK 5.2, 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.

Connecting the condensate drains

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

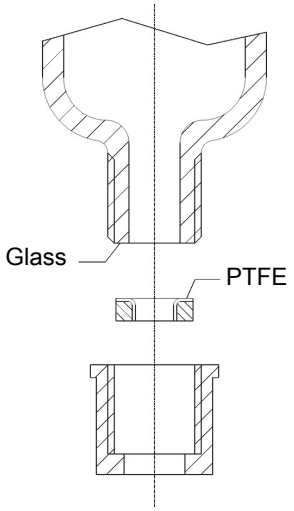
The condensate drain can be mounted directly to the heat exchanger.

Condensate lines must always be installed with a slope and a minimum inside diameter of DN 8/10 (5/16”), with passive discharge via traps or automatic condensate drains. Use screw joints with a minimum inner span of 7 mm, sold separately as accessories. The MTG heat exchanger in glass cannot be operated in conjunction with an automatic condensate drain.

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

4.2.1 Connecting the filter gas connections (optional)

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 ≤ 2 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.

4.3 Electrical connections

NOTICE

The connection must be made by a trained professional.

CAUTION

Wrong mains voltage

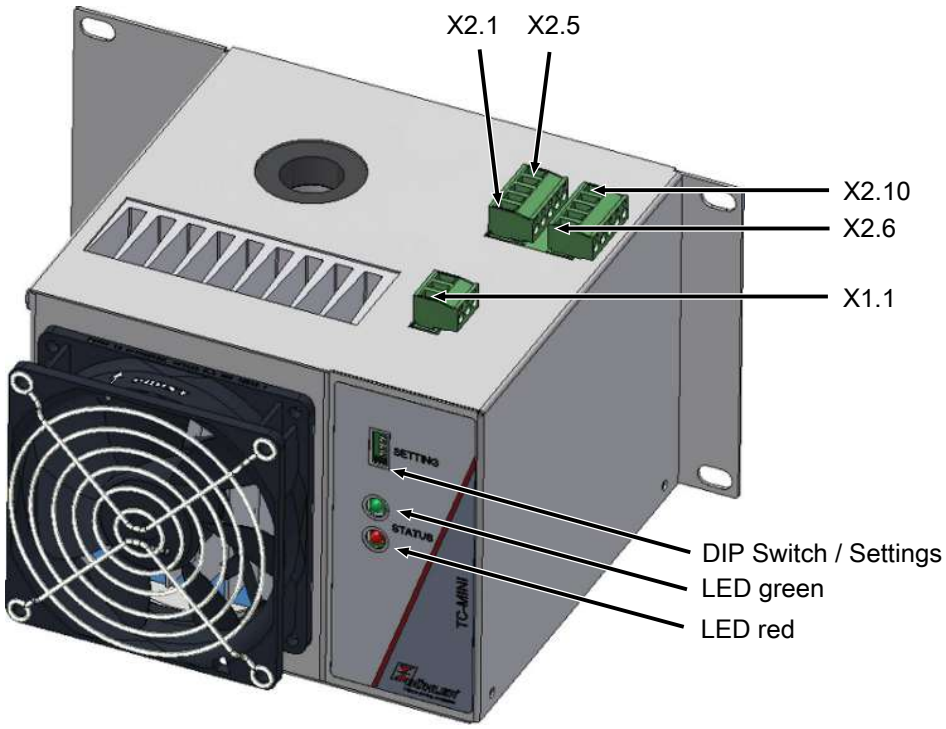
Wrong mains voltage may damage the device.
Regard the correct mains voltage as given on the type plate.

The sample gas cooler features plug-in connectors at the top for connecting the power supply and the status outputs.

The unit features an output for status messages. Please refer to the technical data for ratings.

An alarm is triggered if the temperature of the cooler is outside the specified limits. It does not indicate if the alarm was triggered due to excess temperature or insufficient temperature.

When the moisture detector (optional) is installed, an alarm is activated if the moisture is still present in the prepared sample gas. This is the same alarm output as for the temperature.



Inputs/outputs	Terminal	Function	Description
Moisture detector	X1.1	FF.1 (white)	Moisture detector
	X1.2	FF.2 (brown)	
	X1.3	FE:	Shield for moisture detector inlet
Status	X2.1	Status NC (Alarm)	Alarm/Status
	X2.2	Status COM	Changeover contact, potential-free,
	X2.3	Status NO (ok)	Ratings see technical data
24 V input	X2.4	24 V DC -	Power supply
	X2.5	24 V DC +	
Analog output	X2.6	FE:	Shield for analog output
	X2.7	mA +	Analog output
	X2.8	mA -	4...20 mA, 0 - 80 °C
Digital output	X2.6	FE:	Shield for digital output
	X2.7	Signal A	Communication line for digital interface
	X2.8	Signal B	
24 V output *	X2.9	24 V DC -	Supply for optional add-on units
	X2.10	24 V DC +	maximum current, see technical data

* Add-on units, e.g. a pump, with 24 V supply can be connected to the output, switched via the status output. The 24 V supply must then be configured appropriately (see data sheet).

4.4 Settings

Remarks on outlet dew point

Not all applications require an outlet dew point of 5 °C. In some applications a higher dew point is sufficient. In other applications a stable outlet dew point doesn't matter, it's enough for the gas to be dry, so for the outlet dew point to have an adequate difference in temperature below the ambient temperature.

The advantage of a higher outlet temperature is that at a given ambient temperature the Peltier cooler provides significantly more cooling performance. So on the e.g. TC-MINI version model 6111, at an ambient temperature of 40 °C this means:

Outlet dew point:	5 °C	10 °C	15 °C
Available cooling capacity:	16 kJ/h	28 kJ/h	39 kJ/h

To fully utilize these advantages, the electronics feature several parameter settings:

1. **Adjustable outlet dew point**

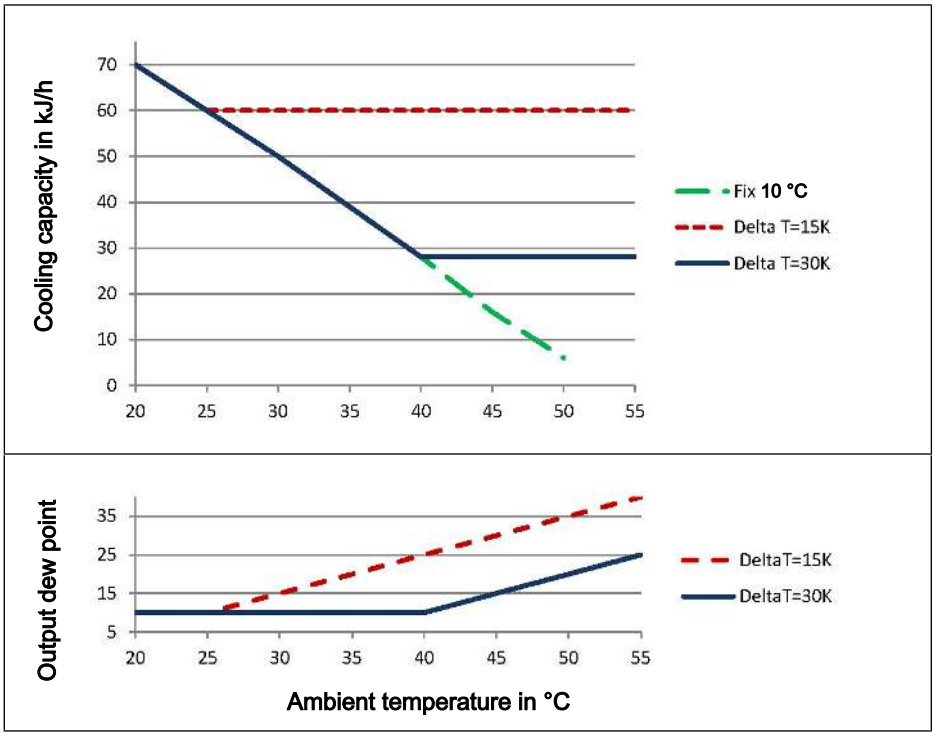
   An outlet dew point of 3, 5, 10 or 15 °C can be set to reach the specified values. Here it's important the ambient temperature is always ABOVE the outlet dew point setting, or condensation may form in the lines after the cooler. So the ambient temperature range is limited.

2. **Delta-T Control**

   Here the electronics measures the ambient temperature an regulates the outlet dew point to a an about 15 °C or 30 °C lower value, but no less than the dew point set under 1. This extends the potential cooling capacity to the limits of the heat exchanger. Here it's important to note the outlet dew point fluctuates along with the ambient temperature and a stable dew point cannot be a prerequisite for the measurement.

   As seen in the following graphics using the TC-MINI 6111 as an example, a difference of 15 °C from the ambient temperature means the focus is on drying the sample gas. The stability of the dew point then takes a backseat to the high performance which can be achieved.

   At a difference of 30 °C, at a set outlet dew point of 10 °C this means the dew point remains stable up to an ambient temperature of approx. 40 °C, and the safe drop is only preferred over the ambient temperature with ambient temperature peaks over 40 °C.



DIP switch

The unit is configured using four DIP switches at the front of the cooler.

1	ON switch
0	OFF switch
SW	Switch, the following numbering of the SWs corresponds with the numbering on the DIP switch.

SW1 / SW2	SW2	SW1	Gas output dew point
	0	0	3 °C
	0	1	5 °C (factory setting)
	1	0	10 °C
	1	1	15 °C

SW3 / SW4	SW3	SW4	Delta-T control/digital interface
	0	0	Gas output dew point, fixed
	0	1	Difference from ambient temperature approx. 15 °C
	1	0	Difference from ambient temperature approx. 30 °C
	1	1	Modbus option active (only with optional Modbus RTU digital output)

Using the Modbus RTU option

On devices with Modbus option, the DIP switches are set so the digital interface is active. With the interface active, it's important the switch settings SW1 and SW2 are not relevant for the cooler function. In this case, the cooler uses the values in the registers.

When disabling the digital interface with the DIP switch, the settings apply based on the DIP switches again. The Modbus registers will not be overwritten.

5 Operation and control

NOTICE

The device must not be operated beyond its specifications.

After switching on the supply voltage the cooler starts to cool the cooling block. When switched off the contact between X2.1 and X2.2 is closed.

The target temperature is factory preset to 5 °C. The alarm limit is defined at +5/-2 K.

(Note deviating defaults with Modbus option enabled, see Modbus register table).

5.1 Status Signal via LEDs and Status Relay

LED green	LED red	Status	Condition internal	FF	Temperature	Description
OFF	OFF	X2.1, X2.2		Unit off		With the cooler switched off, the status output corresponds error status.
ON	OFF	X2.1, X2.3	OK	OK (*)	OK	Normal operation
OFF	Flashing f = 1 Hz	X2.1, X2.2	OK	OK (*)	Error	Overload / temperature outside the target range
OFF	ON	X2.1, X2.2	OK	Error	xxx	Moisture penetration
OFF	Flashing f = 5 Hz	X2.1, X2.2	Error	xxx	xxx	Various possible causes, contact Service.

OK	No error
Error	Error present
xxx	Status not defined
f =...	LED flash frequency
X2.1, X2.2...	Markings on terminals
(*)	Also applies if no moisture detector connected

If the red LED lights up during operation, please refer to chapter ““.Troubleshooting [> page 19]“.

5.2 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.

5.3 Modbus Configuration

The settings below are the defaults; the parameters can be adjusted if the interface is enabled.

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 Modbus frame is always 11 bit, configuring the interface at 0 data bits automatically changes the number of stop bits to 2.

5.4 Modbus Communication

Communication via Modbus RTU is always imitated 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

5.5 Modbus Register

Description	FC	Address	Access	Data type	Default	Min	Max	Selection	Resolution	Unit
Block temperature measurement	3	2000	R	Float	-	-	-	-	0.5	°C
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 := stabilization phase Bit 19 := load limit reached Bit 20 := measurement outside target range Bit 21..31 := not used		
Ambient temperature measurement	3	2004	R	Float	-	-	-	-	0.5	°C
Ambient temperature status	3	2006	R	Uint32	-	-	-	Bit 0 : = error Bit 1..15 := reserved Bit 16 := sensor not calibrated Bit 17 := initialization / measurement invalid Bit 18..31 := not used		
Block temperature setpoint	3, 16	5000	R/W	Float	5.0	3.0	15.0	-	0.5	°C
Positive alarm tolerance setpoint	3, 16	5002	R/W	Float	3.0	1.0	7.0	-	1.0	K
Negative alarm tolerance setpoint	3, 16	5004	R/W	Float	-3.0	-3.0	-1.0	-	1.0	K
Temperature difference Delta-T	3, 16	5008	R/W	Float	-15.0	-30.0	0.0	-	1.0	K
Enable/disable Delta T	3, 16	9001	R/W	Uint16	0	-	-	0 := normal operation 1:= Delta-T control	1	-
Signal store Moisture detector error	3, 16	9002	R/W	Uint16	2	-	-	1 := no 2 := yes	1	-
Signal store Moisture alarm	3, 16	9003	R/W	Uint16	1	-	-	1 := no 2 := yes	1	-
Sensitivity moisture detector 1	3, 16	9004	R/W	Uint16	0 1 (with moisture detector) 2 (without moisture detector)	-	-	0 := sensitivity low 1 := sensitivity high 2 := moisture detector 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	1	-
Modbus Device address selection	3, 16	9011	R/W	Uint16	10	1	247	-	1	-
TEST	3	9990	R	Uint32	12648430	-	-			
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	0xffffffff			
TEST_INT32	3, 16	9996	R/W	Int32	-2766	0x800 00000	0x7fffffff			
TEST_Float	3, 16	9998	R/W	Float	-10.5					
Status register overview	3	10000	R	Uint16	0	-	-	Bit 0 := status information at Register 10001 Bit n := status information at 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 := set temperature range overrun Bit 3 := set temperature range underrun Bit 4 := Bit 5 := Bit 6 := moisture detector connected Bit 7 :=	-	-
Condition code register 2	3	10002	R	Uint16	0	-	-	Bit 0 := Bit 1 := Bit 2 := initialization phase Bit 3 := Delta-T active Bit 4 := Bit 5 := Bit 6 := FF1 moisture alarm Bit 7 :=	-	-
Condition code register 3	3	10003	R	Uint16	0			Bit 0 := Bit 1 := Bit 2 := Bit 3 := Bit 4 :=		

Description	FC	Address	Access	Data type	Default	Min	Max	Selection	Resolution	Unit
								Bit 5 := Bit 6 := Bit 7 :=		
Condition code register 4	3	10004	R	Uint16	0			Bit 0 := Bit 1 := Bit 2 := Bit 3 := Bit 4 := Bit 5 := Bit 6 := Bit 7 :=		
Error register 1	3	10005	R	Uint16	0			Bit 0 := Bit 1 := controller communication error Bit 2 := Bit 3 := controller configuration error Bit 4 := Bit 5 := Bit 6 := Bit 7 := gen. software error		
Error register 2	3	10006	R	Uint16	0			Bit 0 := Bit 1 := Bit 2 := Bit 3 := Bit 4 := Bit 5 := Bit 6 := Bit 7 :=		
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 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 :=		

Description	FC	Address	Access	Data type	Default	Min	Max	Selection	Resolution	Unit
								Bit 5 := Bit 6 := Bit 7 :=		
Error register 6 - PT100.2	3	10010	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 :=		
Utilisation controller 1	3	10017	R	Uint16	-	0	100		10	%
Device run time	3	10100	R	Float	-	0	-		6 min	h
Device restart / device reset	16	11000	W	Uint16	0	-	-	86 := device restart 17:= factory reset		
Reset moisture detector 1	16	11002	W	Uint16	170	-	-	-		

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

The basic version of the cooler requires no special maintenance.

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

Filter option: Check filter element (see chapter Replacing the filter element (option) [> page 21].

During maintenance, remember:

- The equipment must be maintained by a professional familiar with the safety requirements and risks.
- Only perform maintenance work described in these operating and installation instructions.
- Observe the respective safety regulations and operating specifications when performing any type of maintenance.
- Always use genuine spare parts.

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 appropriate protective equipment.

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 further information about our services and customised maintenance visit http://www.buehler-technologies.com/service.

If the equipment 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

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

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

service@buehler-technologies.com.

7.1 Troubleshooting

Problem/malfunction	Possible cause	Action
No LED lights up	– Mains voltage interrupted	– Connect to mains; check the plug is correctly inserted
	– Fuse defective	– Check fuse and replace if necessary
	– LED defective	– Send in cooler
	– Internal error	– Send in cooler
Red LED flashing (f = 1 Hz) Excess temperature Temperature low	– Operating point not yet reached	– Wait (max. 15 min)
	– Cooling output too low despite the cooler running	– Ensure the vents are not covered (heat buildup)
	– Flow rate too high/dew point too high/gas temperature too high	– Maintain limits / install pre-separator
	– Built-in fan stopped	– Check and replace if necessary
	– Controller defective	– Send in cooler
	– Short circuit	– Temperature sensor failure: Send in cooler
	– Broken wire	– Temperature sensor failure: Send in cooler
Red LED flashing (f = 5 Hz)	– Internal error	– Send in cooler
Steady red LED Moisture in sample gas (If the moisture detector was triggered it will then need to be dried)	– Cooler overloaded flow rate too high/dew point/gas temperature too high	– Maintain limits/install pre-separator
	– Cooling output too low despite the cooler running	– Ensure the vents are not covered (heat buildup); maintain limits
	– Condensate trap full	– Empty condensate trap
	– Water entering from water bag	– Observe delivery rate of peristaltic pumps – Install condensate drain with downward slope
	– Cable break in the moisture detector connection line	– Check connection line and plug-in connection
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	– Maintain limits
Reduced gas flow rate	– Gas circuit clogged	– Remove and clean heat exchanger – if necessary, replace filter element
	– Condensate output iced over	– Send in cooler
Modbus communication error	– Bus connection fault	– Check electrical connections
	– Line termination fault	– Check bus line
	– Check bus configuration	– Check/reset configurator

7.2 Safety instructions

- The device must be operated within its specifications.
- All repairs must be carried out by Bühler authorised personnel only.
- Only perform modifications, servicing or mounting described in this manual.
- Only use original spare parts.

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 appropriate protective equipment.

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

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

a) Avoid contact with the skin and eyes.

b) In the event of a leak, do not restart the cooler under any circumstances The cooler must be repaired by the manufacturer.

7.3 Cleaning and removal of the heat exchanger

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

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

7.4 Replacing the fuse of the cooler

- Close the gas supply.
- Switch off and unplug the device.
- Loosen the screws on the cover.
- Carefully remove the cover.
- The fuse is located on the board under a plastic cap. Replace microfuse and put the cap back on. Please note the mains voltage in order to select the correct microfuse.
- Reattach cover. Screw in mounting screws.
- Restore the power and gas supply.

7.5 Replacing the filter element (option)

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

- Close the gas supply.
- Switch off and unplug the device.
- Pull the bracket, holding on to the filter glass.
- 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.
- Whilst holding the filter head, move the glass back and forth and carefully reattach the filter head, attach the bracket, and ensure it is seated securely.
- Restore the power and gas supply.

NOTICE! Please observe legal regulations when disposing of filter elements.

7.6 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.

7.7 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
4011000	Flow adapter type G, PVDF G1/4
4011000I	Flow adapter type NPT, PVDF NPT 1/4"
4111100	Moisture detector FF-3-N, without cable
9144050081	Moisture detector connection cable, 300 mm
9144050082	Moisture detector connection cable, 450 mm
9110000031	Sample gas cooler micro-fuse 24 VDC, 5 x 20 mm, 5 A, delayed action
5530009932	Fan, 24 VDC

7.7.1 Consumables and accessories

Item no.	Description
9112000039	24 V top-hat rail power supply
9112000040	24 V top-hat rail power supply for using the 24 V output
4510008	Automatic condensate drain AK 5.2
4510028	Automatic condensate drain AK 5.5
4410004	Automatic condensate drain AK 20
4410001	Automatic condensate drain 11 LD V 38
41030050	Replacement filter element F2; 2 µm, Unit 5 count
4381045	Screw connection G1/4 - DN 8/12 for passive condensate connection MTS and MTV
4381048	Screw connection NPT 1/4" for passive condensate connection MTS and MTV

8 Disposal

The heat exchanger is charged with 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

Gas Cooler Technical Data	
Ready for operation	after max. 10 minutes
Ambient temperature	5 °C to 55 °C
Gas outlet dew temperature, preset	5 °C
IP rating	IP 20
Housing	Stainless steel, brushed
Packaging dimensions	approx. 235 x 225 x 280 mm (without add-on filter)
Weight incl. heat exchanger	approx. 3.5 kg
Power supply	24 VDC
24 V output	max. 1 A
Power input	max. 70 W (plus max. 25 W at 24 V output)
Status output switching capacity	33 VAC/70 VDC, 1 A
Electrical connections, standard applications	Phoenix plug

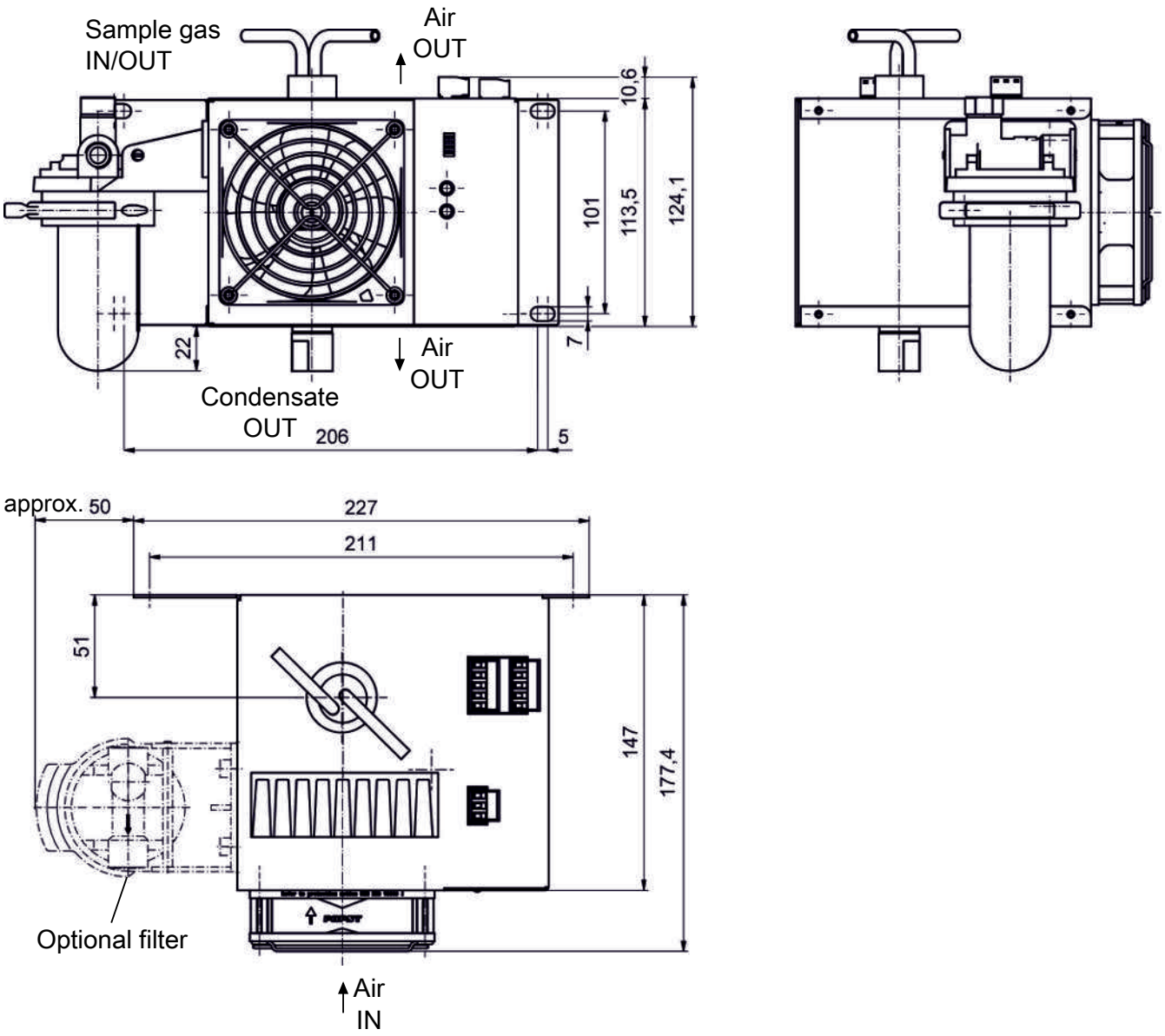
9.2 Technical Data - Options

A moisture detector may be connected to the control. The moisture detector can be mounted to the cooler using a block or by installing it into the optional filter.

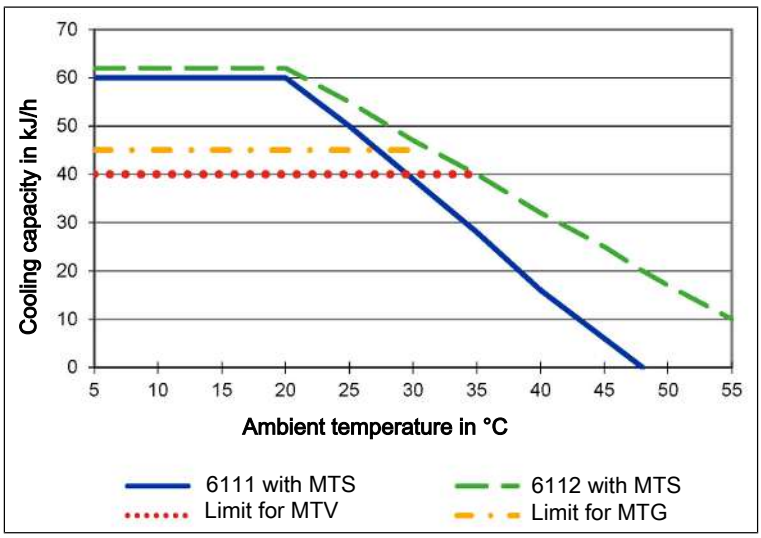
Technical Data FF-3-N Moisture Detector	
Ambient temperature	3 °C to 50 °C
max. operating pressure with FF-3-N	2 bar
Material	PVDF, PTFE, epoxy resin, stainless steel 1.4571, 1.4576

AGF-PV-30-F2 Filter Technical Data	
Ambient temperature	3 °C to 100 °C
max. operating pressure with filter	4 bar
Filter surface	60 cm^2
Filter fineness	2 µm
Dead volume	57 ml
Materials Filter: Seal: Filter element:	 PVDF, Duran glass (parts in contact with media) Viton sintered PTFE

9.3 Dimensions (mm)



9.4 Performance data



A selected outlet dew point of 10 or 15 °C shifts the curves 5 or 10 °C to the right.

The MTV and MTG limits apply to a normal operating point of τ_e = 40 °C and ϑ_G = 70 °C.

9.5 Heat exchanger

9.5.1 Heat exchanger description

The energy content of the sample gas and the required cooling capacity of the gas cooler is determined by three parameters: gas temperature ϑ_G, dew point τ_e (moisture content) and volume flow v. The outlet dew point rises with increasing energy content of the gas. The following limits for the maximum flow are specified for a standard operating point of τ_e = 40 °C and ϑ_G = 70 °C. The maximum flow v_{max} in Nl/h of cooled air indicated, so after moisture has condensed. Values may differ for other dew points and gas inlet temperatures. However, the physical facts are so vast we decided to omit the illustration. Please contact our experts for clarification or refer to our calculation programme.

9.5.2 Heat exchanger overview

Heat exchanger	**MTS** [3] **MTS-I** [2) 3)]	**MTG** [3] **MTG** [3]	**MTV** [3] **MTV-I** [2) 3)]
Materials in contact with media	Stainless steel PVDF	Glass PTFE	PVDF
Flow rate v_{max} [1]	300 Nl/h	210 Nl/h	190 Nl/h
Inlet dew point $\tau_{e\,max}$ [1]	65 °C	65 °C	65 °C
Gas inlet temperature $\vartheta_{G,max}$ [1]	140 °C	140 °C	140 °C
Max. Cooling capacity Q_{max}	95 kJ/h	80 kJ/h	65 kJ/h
Gas pressure p_{max}	25 bar	3 bar	2 bar
Pressure drop Δp (v = 150 L/h)	20 mbar	19 mbar	18 mbar
Dead volume V_{tot}	19 ml	18 ml	17 ml
Gas connections (metric)	6 mm tube	GL14 (6 mm) [4]	DN 4/6
Gas connections (US)	1/4" tube	GL14 (1/4")[4]	1/4"-1/6"
Condensate out connections (metric)	G1/4	GL18 (8 mm) [4]	G1/4
Condensate out connections (US)	NPT 1/4"	GL18 (8 mm) [4]	NPT 1/4"

[1] Max. cooling capacity of the cooler must be considered.

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

[3] Passive discharge via automatic condensate drains or traps not applicable for MTG heat exchanger. For passive discharge on the MTS and MTV heat exchangers, use a screw connection with a clearance of at least 7 mm (see accessories).

[4] Gasket inside diameter

10 Attached documents

– Declaration of conformity: KX 440005
– RMA - Decontamination Statement

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

2014/30/EU
(Elektromagnetische Verträglichkeit / *electromagnetic combability)*

in ihrer aktuellen Fassung entsprechen.

in its actual version.

Produkt / products: Peltier Messgaskühler / *Peltier sample gas cooler*
Typ / type: TC-MINI

Das Betriebsmittel ist für den industriellen Einsatz in Gasanalysesystemen bestimmt und dient zur Aufbereitung des Messgases.
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 61000-4-4:2012

EN 61000-4-5:2013

Zusätzlich wurden berücksichtigt:
In addition, the following standards have been used:

EN 61000-4-3:2006

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

EN 61326:2013

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 17.02.2023

Stefan Eschweiler
Geschäftsführer – *Managing Director*

Frank Pospiech
Geschäftsführer – *Managing Director*

KX 44 0005

Bühler Technologies GmbH, Harkortstr. 29, D-40880 Ratingen,
Tel. +49 (0) 21 02 / 49 89-0, Fax. +49 (0) 21 02 / 49 89-20
Internet: www.buehler-technologies.com

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:

Electromagnetic Compatibility Regulations 2016

Product: Peltier sample gas cooler
Type: TC-MINI

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 61000-4-4:2012

EN 61000-4-5:2013

In addition, the following standards have been used:

EN 61010-1:2010/A1:2019/AC:2019-04
EN 61326:2013

EN 61000-4-3:2006

Ratingen in Germany, 17.02.2023

Stefan Eschweiler
Managing Director

Frank Pospiech
Managing Director

Bühler Technologies GmbH, Harkortstr. 29, D-40880 Ratingen,
Tel. +49 (0) 21 02 / 49 89-0, Fax. +49 (0) 21 02 / 49 89-20
Internet: www.buehler-technologies.com

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	

Ansprechpartner/ Person in charge

Name/ Name	
Abt./ Dept.	
Tel./ Phone	
E-Mail	

Gerät/ Device	
Anzahl/ Quantity	
Auftragsnr./ Order No.	

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

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, Lebensgefahr/ poisonous, risk of death	☐ gesundheitsgefährdend/ harmful to health	☐ gesundheitsschädlich/ health hazard	☐ umweltgefährdend/ 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.

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.

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.

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

Firmenstempel/ Company Sign

Datum/ Date

rechtsverbindliche Unterschrift/ Legally binding signature

Bühler Technologies GmbH, Harkortstr. 29, D-40880 Ratingen
Tel. +49 (0) 21 02 / 49 89-0, Fax: +49 (0) 21 02 / 49 89-20
E-Mail: service@buehler-technologies.com
Internet: www.buehler-technologies.com

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.

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.

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 assembles 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.

Bühler Technologies GmbH, Harkortstr. 29, D-40880 Ratingen
Tel. +49 (0) 21 02 / 49 89-0, Fax: +49 (0) 21 02 / 49 89-20
E-Mail: service@buehler-technologies.com
Internet: www.buehler-technologies.com