



ModbusRTU

## Sample gas cooler TC-MINI

Many gas analysis processes require extracting sample gas from the process. This also extracts process-related contamination such as particles or moisture. These can impact the measurement results or damage the measuring cells. The sample gas must therefore be conditioned before entering the analyser. The sample gas cooler reduces the gas temperature to below the dew point for this purpose, causing moisture to drop out, which is then discharged as condensate.

In addition to the status output to monitor the sample gas cooler function, we offer an optional 4 – 20 mA analog output or digital interface. The process control can access the process and diagnostic data via the Modbus RTU interface as well as configure the device settings.

The small size of the TC-MINI sample gas cooler is particularly suited for installation in portable or compact gas conditioning systems. Despite the small size, it has a high nominal rating and is therefore also suitable for use in warm climates.

Peltier cooler with 1 heat exchanger

Version for ambient temperatures up to 122 °F

Nominal capacity 52 Btu/h (at 41 °F output dew point)

Power supply 24 V DC

Heat exchanger made from stainless steel, Duran glass or PVDF

Dew point 37/41/50/59 °F or Delta-T control setting

Signal output 4 - 20 mA or Modbus RTU

Status display and output

Optional filter and moisture detector

Maintenance free

Low operating noise



## Description and Overview

The TC-MINI series has two standard models which may have additional options added.

### Standard

TC-MINI 6111	moderate ambient temperature (up to approx. 104 °F)
TC-MINI 6112	higher ambient temperature (up to approx. 122 °F)

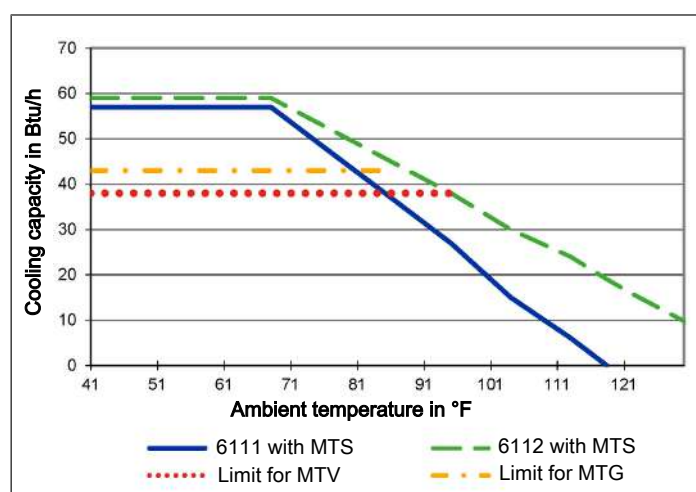
Typically intended for **small systems** designed for sample gas with low dew points and flow rate, providing a **24 V DC power supply**. In this context, typical is sample gas around normal pressure with a dew point of 104 °F, a gas inlet temperature of 158 °F, and an outlet per litre of approx. 1.7 lpm. This more or less corresponds to a cooling capacity of 22 Btu/h. Of course gasses with other parameters can also be cooled.

The cooler is **controlled** by a **microprocessor**. Flashing LEDs and the status relays indicate the conditions are below or above the configured warning range (e.g. after switching on).

The **status output** can e.g. be used to control the sample gas pump to allow for the gas flow to only be switched on once the permissible cooling range has been reached.

Connecting a **moisture detector** allows for the control to be expanded to monitoring condensate penetration.

### Performance data



A selected outlet dew point of 50 °F or 59 °F shifts the curves 41 °F or 50 °F to the right.

The MTV and MTG limits apply to a normal operating point of  $\tau_e = 104$  °F and  $\vartheta_G = 158$  °F.

### Outlet dew point

#### Remarks on outlet dew point

Not all applications require an outlet dew point of 41 °F. 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 104 °F this means:

Outlet dew point:	41 °F	50 °F	59 °F
Available cooling capacity:	15 Btu/h	27 Btu/h	37 Btu/h

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

#### 1. Adjustable outlet dew point

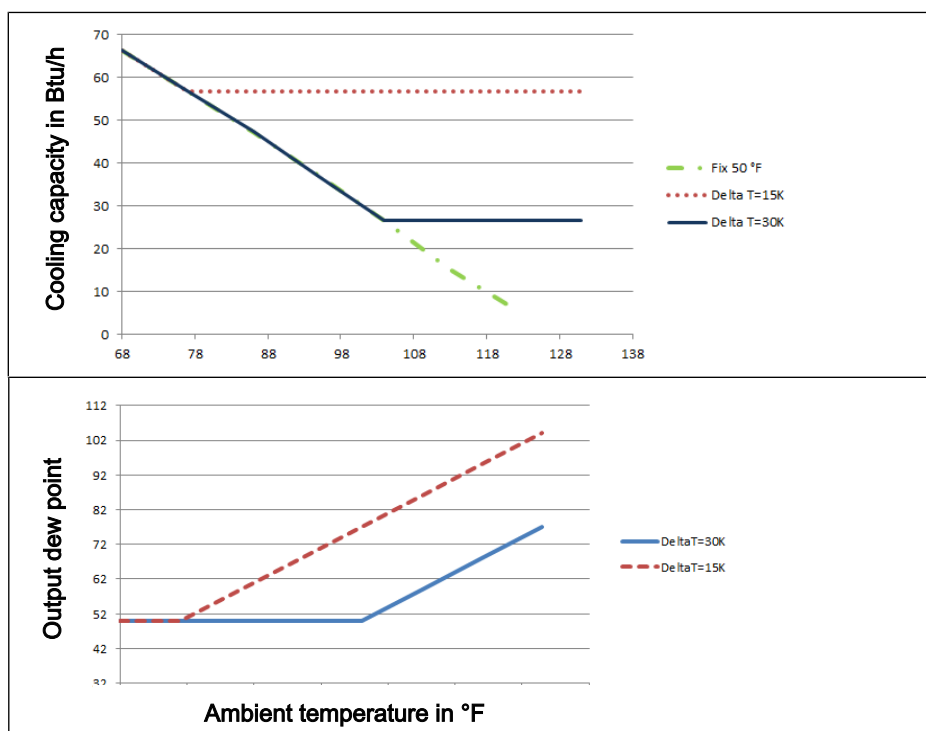
An outlet dew point of 37, 41, 50 or 59 °F can be set to reach the specified values. Here it's important the ambient temperature is always **ABOVE** the outlet dew point setting, or condensation may form in the lines after the cooler. So the ambient temperature range is limited.

#### 2. Delta-T Control

Here the electronics measures the ambient temperature and regulates the outlet dew point to a an about 15 K or 30 K 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 K 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 K, at a set outlet dew point of 50 °F this means the dew point remains stable up to an ambient temperature of approx. 104 °F, and the safe drop is only preferred over the ambient temperature with ambient temperature peaks over 104 °F.



## Gas cooler technical data

### Gas Cooler Technical Data

Ready for operation	after max. 10 minutes
Ambient temperature	41 °F to 131 °F
Gas outlet dew temperature, preset	41 °F
IP rating	IP 20
Housing	Stainless steel, brushed
Packaging dimensions	approx. 9.3 x 8.9 x 11 in (without add-on filter)
Weight incl. heat exchanger	approx. 7.7 lb
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

## 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	37 °F to 122 °F
max. operating pressure with FF-3-N	29 psi
Material	PVDF, PTFE, epoxy resin, stainless steel 1.4571, 1.4576

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

Ambient temperature	37 °F to 212 °F
max. operating pressure with filter	58 psi
Filter surface	9.3 in <sup>2</sup>
Filter fineness	2 µm
Dead volume	3.47 cu. in.
Materials	
Filter:	PVDF, Duran glass (parts in contact with media)
Seal:	Viton
Filter element:	sintered PTFE

## Digital Interface Description

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.

## 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  $\vartheta_c$ , dew point  $\tau_e$  (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  $T_e = 104$  °F and  $\vartheta_c = 158$  °F. The maximum flow  $v_{max}$  in NI/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 program.

## Heat exchanger overview

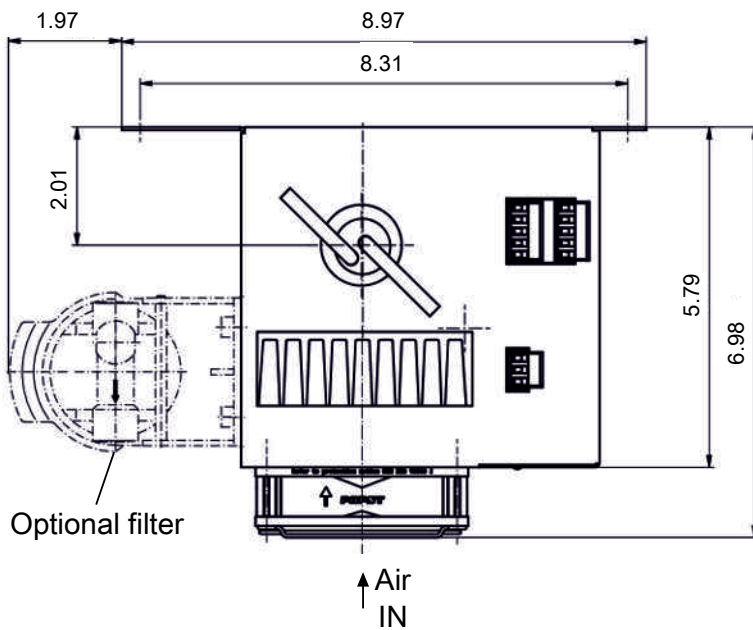
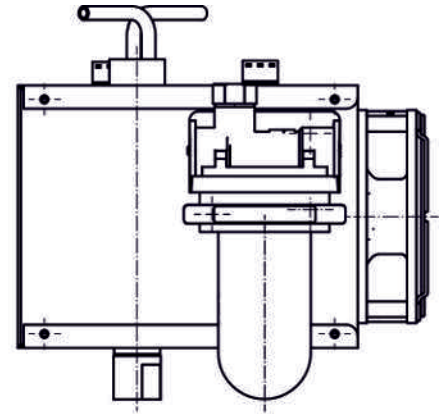
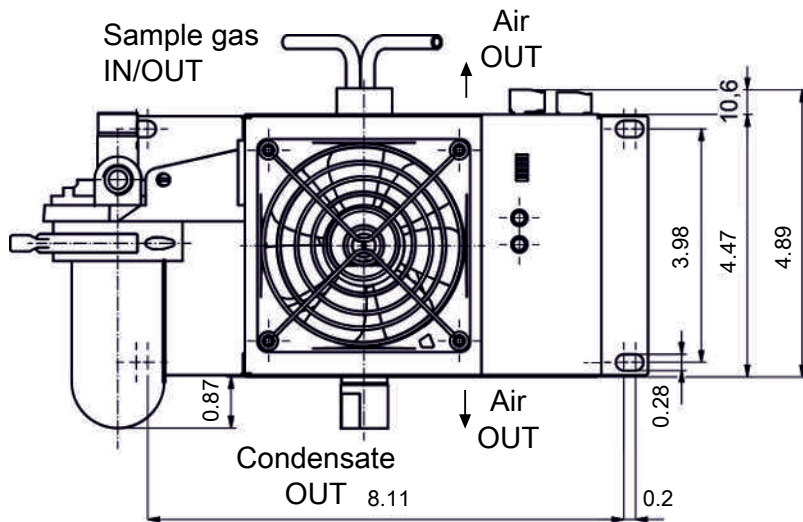
Heat exchanger	MTS <sup>3)</sup> MTS-I <sup>2) 3)</sup>	MTG <sup>3)</sup> MTG <sup>3)</sup>	MTV <sup>3)</sup> MTV-I <sup>2) 3)</sup>
Materials in contact with media	Stainless steel PVDF	Glass PTFE	PVDF
Flow rate $v_{max}$ <sup>1)</sup>	5 lpm	3.5 lpm	3.2 lpm
Inlet dew point $\tau_{e,max}$ <sup>1)</sup>	149 °F	149 °F	149 °F
Gas inlet temperature $\vartheta_{G,max}$ <sup>1)</sup>	284 °F	284 °F	284 °F
Max. Cooling capacity $Q_{max}$	90 Btu/h	76 Btu/h	62 Btu/h
Gas pressure $p_{max}$	363 psi	44 psi	29 psi
Pressure drop $\Delta p$ ( $v = 2.5$ lpm)	0.29 psi	0.28 psi	0.26 psi
Dead volume $V_{tot}$	1.2 cu. in.	1.1 cu. in.	1 cu. in.
Gas connections (metric)	6 mm tube	GL14 (6 mm) <sup>4)</sup>	DN 4/6
Gas connections (US)	1/4" tube	GL14 (1/4") <sup>4)</sup>	1/4"-1/6"
Condensate out connections (metric)	G1/4	GL18 (8 mm) <sup>4)</sup>	G1/4
Condensate out connections (US)	NPT 1/4"	GL18 (5/16") <sup>4)</sup>	NPT 1/4"

<sup>1)</sup> Max. cooling capacity of the cooler must be considered.

<sup>2)</sup> Models marked I have NPT threads or US tubes, respectively.

<sup>3)</sup> 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 (9/32") (see accessories).

<sup>4)</sup> Gasket inside diameter



## Ordering instructions

## Gas cooler

4496	1	1	1	X	0	4	X	X	X	0	0	X	X	X	0	0	0	0	Product Characteristics	
<b>Gas cooler models (with 1 heat exchanger)</b>																				
1				TC-MINI 6111: moderate ambient temperature 104 °F																
2				TC-MINI 6112: higher ambient temperature 122 °F																
<b>Certifications</b>																				
0				Standard applications – CE																
<b>Supply voltage</b>																				
4				24 V DC																
<b>Heat exchanger <sup>1)</sup></b>																				
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
<b>Moisture detector/filter</b>																				
				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
<b>Signal outputs</b>																				
				1				0				0				0				Analog output, 4..20 mA, incl. status output
				2				0				0				0				Modbus RTU digital output, incl. status output

<sup>1)</sup> Moisture detector/filter screw-in fitting and tubes metric or US, accordingly

## 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