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
- Rated cooling power 47 Btu/h (104 °F version) or 52 Btu/h (122 °F version)
- Power supply 24 V DC
- Heat exchanger made from stainless steel, Duran glass or PVDF
- Dew point adjustable to 37/41/50/59 °F or delta T control
- Signal output 4 - 20 mA or Modbus RTU
- Status display and output
- Optional filter and moisture detector
- Maintenance free
- Low operating noise

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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)

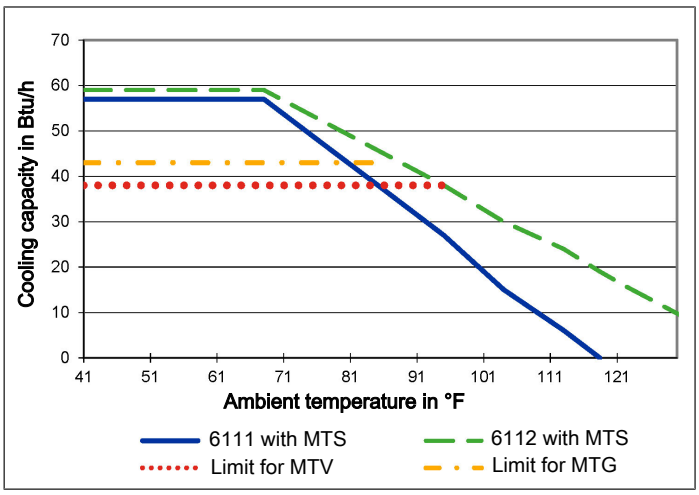
Typically intended for **small systems** designed for sample gas with low dew points and flow rate, providing a **24 V DC power supply**. In this context, typical is sample gas around normal pressure with a dew point of 104 °F, a gas inlet temperature of 158 °F, and an outlet per litre of approx. 1.7 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 τ_e = 104 °F and ϑ_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**

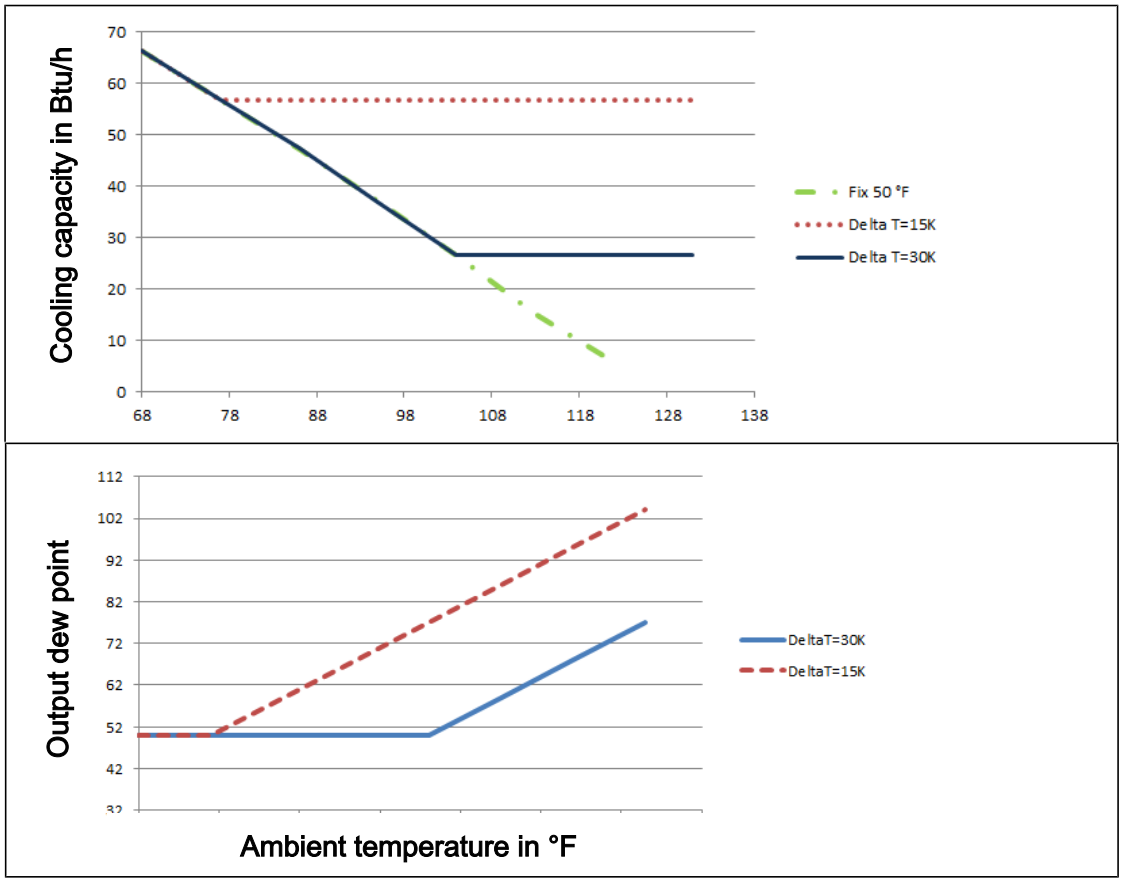
   An outlet dew point of 37, 41, 50 or 59 °F can be set to reach the specified values. Here it's important the ambient temperature is always ABOVE the outlet dew point setting, or condensation may form in the lines after the cooler. So the ambient temperature range is limited.

2. **Delta-T Control**

   Here the electronics measures the ambient temperature an 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	
Rated cooling power (at 41 °F gas outlet dew point):	47 Btu/h (104 °F version) or 52 Btu/h (122 °F version)
Ready for operation:	after max. 10 minutes
Ambient temperature:	41 °F to 131 °F
Gas outlet dew point, preset:	41 °F
Dew point fluctuations static: in the entire specification range:	 ± 0.1 K ± 1.5 K
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 V DC
24 V output:	max. 1 A
Power input:	max. 70 W (plus max. 25 W at 24 V output)
Status output switching capacity:	30 V AC / 60 V DC, 1 A
Electrical connections: *Standard applications*	3-pole terminal block for moisture detector 2x 5-pole terminal block for power supply, status, and options

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
Weight:	0.09 lb (incl. cable)
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
Weight:	0.5 lb
Filter surface:	9.3 in^2
Filter fineness:	2 µm
Dead volume:	3.47 cu. in.
Materials	
Filter:	PVDF, DURAN glass (parts in contact with media)
Seal:	FKM (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 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 T_e = 104 °F and ϑ_G = 158 °F. 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 program.

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]	5 lpm	3.5 lpm	3.2 lpm
Inlet dew point $\tau_{e\,max}$ [1]	149 °F	149 °F	149 °F
Gas inlet temperature $\vartheta_{G,max}$ [1]	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 Δp (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) [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 (5/16)[4]	NPT 1/4"

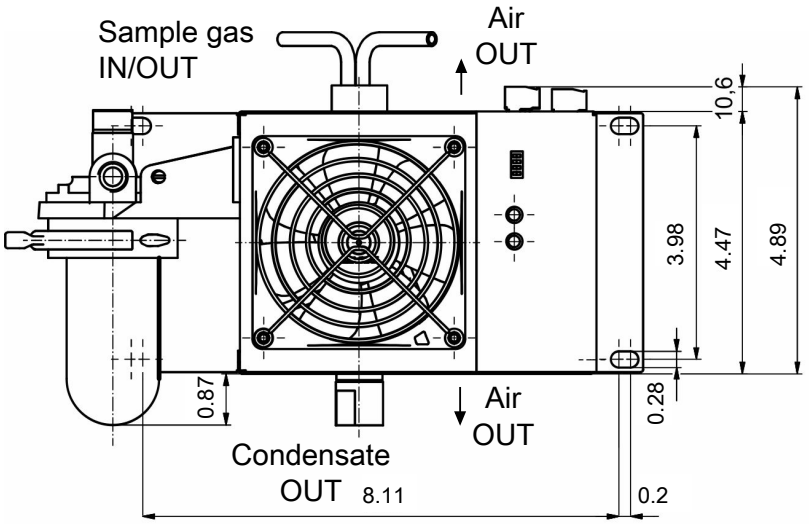
[1] Max. cooling capacity of the cooler must be considered.

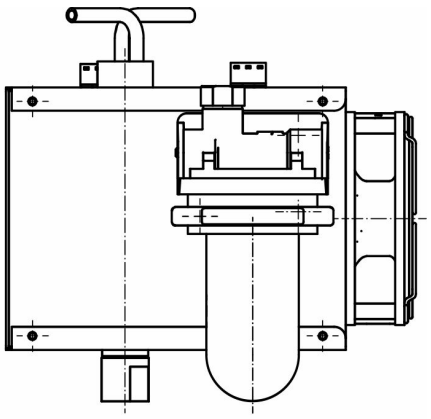
[2] Models marked I have NPT threads or US tubes, respectively.

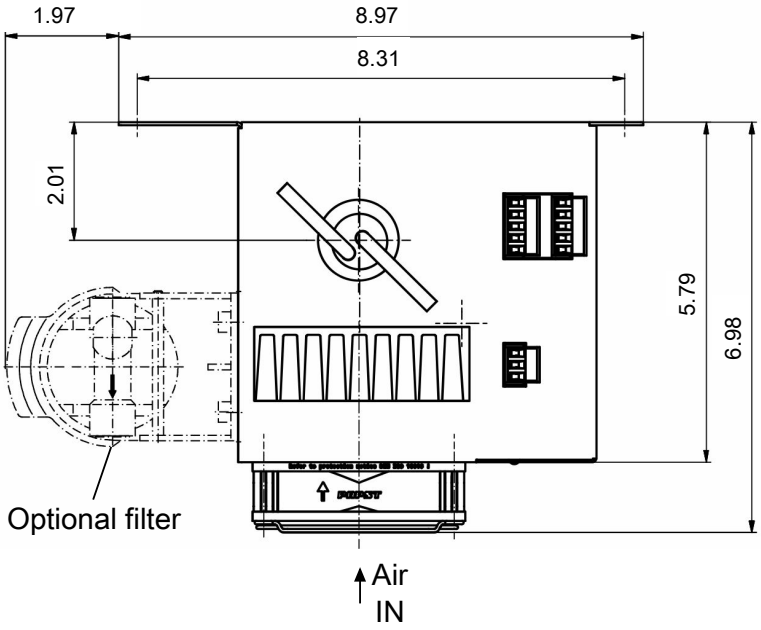
[3] Passive discharge via automatic condensate drains or traps not applicable for MTG heat exchanger. For passive discharge on the MTS and MTV heat exchangers, use a screw connection with a clearance of at least 7 mm (9/32") (see accessories).

[4] Gasket inside diameter

Dimensions (inch)







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
																			Gas cooler models (with 1 heat exchanger)
				1															TC-MINI 6111: moderate ambient temperature 104 °F
				2															TC-MINI 6112: higher ambient temperature 122 °F
																			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

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
9144050143	Modbus RTU connection cable 2 m
9144050144	Modbus RTU connection cable 5 m
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