Gas monitoring
Water monitoring

GfG AG
Gesellschaft für Gerätebau
Im Gassacher 6
CH-8122 Binz
Tel. +41/ 44 982 12 90
Fax +41/ 44 982 12 91
E-mail: info@gfg.ch
Internet: www.gfg.ch

MiniCal III
Operation Manual

Cooling Water Fitting

W12052III-DD

Content

For your safety

Like any piece of complex equipment, the GfG MiniCal III will do the job designed to do only, if it is used and serviced in accordance with the manufacturer's instructions. This manual must be carefully read by all individuals who have or will have the responsibility for using and servicing this product.
The warranties made by GfG with respect to the product are voided, if the product is not used and serviced in accordance with the instructions in this manual. Please protect yourself and your employees by following them. The above does not alter statements regarding GfG's warranties and conditions of sale and delivery.

Application

The MiniCal III was specially developed for detecting ammonia leakages in cooling circuits. For operations in closed water or brine circuits the fitting W12052.III/DD is available, which is applicable for a pressure range of 1 .. 6 bar (optionally 10 bar with high pressure pump) and a temperature range of 0 to +50°C (other temperatures on request).
The cooling water fitting is to be mounted according to the conditions mentioned below. Adhere strictly to the mounting position and to the distances to other system components.

General description

2-stop valves/ball valves integrated in the cooling circuit allow a partial flow through the fitting to protect the system from air inclusions and soil.
The coolant passes a particle filter before entering the measuring chamber and warms up. After measuring the coolant drops into an overflow tank which is controlled by a float switch contact. The float switch contact turns on a HD pump, which pumps the coolant back into the circuit. For safety reasons the pump is equipped with a non-return valve.

For accurate measuring a permanent coolant exchange within the fitting is absolutely necessary.

The flow through the fitting depends on the pressure (resp. pressure fluctuation) of the system. To adapt the system to the conditions at site the flow is adjusted by magnetic valve during installation. This affects the temperature of the medium in the measuring chamber, where the temperature should be at least 0°C.

The cooling water fitting is applicable for medium temperatures of 0°C to +50°C in the circuit. The coolant warms up on the way to the measuring chamber, high flow causes just a little warming/cooling of the medium.

The medium passes a particle filter, to protect the measuring electrodes from solids. The flow through the fitting depends on the pressure (resp. pressure fluctuation) of the system. To adapt the system to the conditions at site the flow is adjusted by a magnetic valve during installation.

The measuring medium flows into an overflow tank, which is equipped with a float switch. The float switch activates a HD pump, which pumps the coolant back to the cooling circuit. The monitoring of the flow is controlled by 2 parameters, the pump cycle and the pump duration. These parameters are sufficient to detect all failures, like pump malfunction, faulty float switch or reduced flow. Alarms are given by means of a 4-20mA output. The pump is equipped with a non-return valve.

Detection principle

The measuring principle is based on ion-selective resp. gas sensitive detection of ammonium resp. ammonia. The selection of the ion-selective ammonium or the gas sensitive ammonia electrode depends on the coolant and pH-value.
During installation the electrolyte in the electrode must be adapted to the relevant cooling medium. The electrolyte and the ion-sensitive resp. gas sensitive membrane must be replaced at least annually during servicing.
The selective measurement allows the detection of lowest ammonia concentrations (detection limit 1.0 ppm) for quick and reliable recognition of leakages in the cooling system to prevent hazards for people, environment and equipment.

Important:
For accurate measuring results protect the electrodes from drying. The coolant temperature in the measuring chamber should have a temperature of at least 0°C, as otherwise the electrode might be damaged.

To detect an ammonia leakage a permanent exchange of the coolant in the measuring chamber is absolutely necessary. The flow is adjusted with a needle valve and monitored by means of the pump function.

Water circuits

Ammonia is water-soluble and creates a balance with ammonium in water.

$NH_4^+ + OH^- \leftrightarrow NH_3 + H_2O$

Depending on the pH-value the balance shifts to one side or the other and requires the use of either an ion-selective ammonium or a gas sensitive ammonia (NH_3) electrode.

The measuring can be affected by admittance of corrosion inhibitor, biozides and other additions. A clarification before ordering is necessary.

Brine circuits

In brine/water mixtures ammonia is not soluble and occurs as gas, so that a gas sensitive ammonia electrode is necessary.

During installation the electrodes will be adapted to the relevant cooling medium with special electrolytes. For proper functioning a clarification of the used coolants and circuit additions is necessary before ordering.

Electrodes

Our service technicians will install and calibrate the electrodes during installation.

Prevent tighten the electrodes with tools because of breaking hazards. Tightening only by hand.

Only mechanically correct electrodes have to be installed. Faulty electrodes might damage the measuring system.

For accurate measuring results protect the electrodes from drying.

During installation the electrodes will be adapted to the relevant cooling medium with special electrolytes. For proper functioning a clarification of the used coolants and circuit additions is necessary before ordering.

Mounting

	Mounting and servicing the cooling water fitting are only allowed, if the shut-off valves are closed or if the conduit is empty and unpressurized. During the mounting process always keep the shut-off valves closed until the system is put into operation by GfG staff or by an authorized service person. Failure to comply with the above might result in damaging or destroying the electronics in the controller!
	The fitting must always be installed on the pump pressure side! (Pressure range: 1-6 bar / Temperature range: 0°C - +50°C)

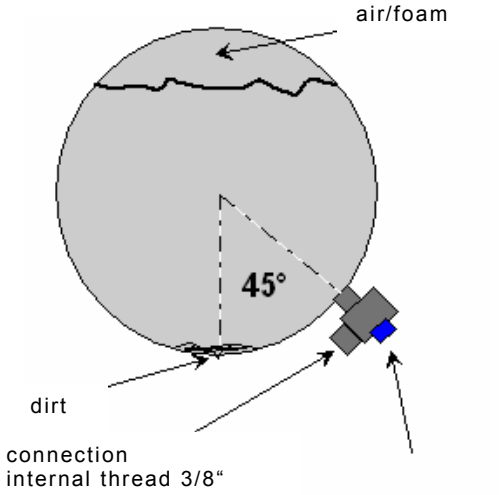
The fitting W12052III - DD is not suitable for mounting outside, the temperature of the ambient air should be between +5 and +50°C.

After putting into operation make sure that the measurement chamber is permanently filled with the medium, as otherwise system malfunction and false measurement values may occur, and the electrode(s) may be damaged. If necessary, chose a different site for the cooling water fitting, e.g. at a siphon. Probably a different fitting, e.g. the float fitting (Type W12201) or the immersion fitting (Type W12111) is more suitable.

The refrigeration plant manufacturer is responsible for the positioning of the fittings. Installation must always be done behind the “consumer” (condenser, heater, etc.) The cooling water fitting should be mounted at the lower conduits, to allow easy access for operation, service and maintenance and to avoid permanent air inclusions!

For proper measurement make sure that the cooling water fitting is always mounted in **horizontal** position. Should this be impossible for certain reasons, contact GfG first.

Stop valve / ball valve for constant volume sampling

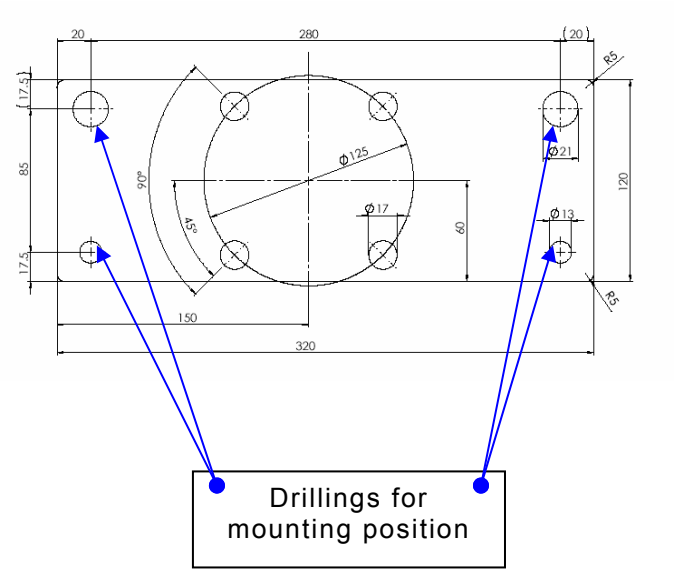


2 cut-off cocks / ball cocks, 3/8“ internal thread, allow a partial flow of the medium through the fitting. The stop valves / ball valves are not part of the delivery and have to be planned at site. The cut-off cocks / ball cocks should be mounted in an angle of approx. 45°, to protect the system from air inclusion and soil. These stop valves have to be kept closed until installation by GfG technicians.

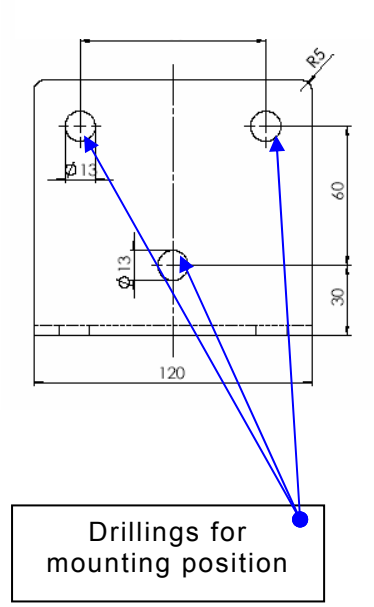
Mounting

The fitting is mounted on a base plate, which can be mounted in different positions. In combination with the mounting angle the fitting can be wall mounted.

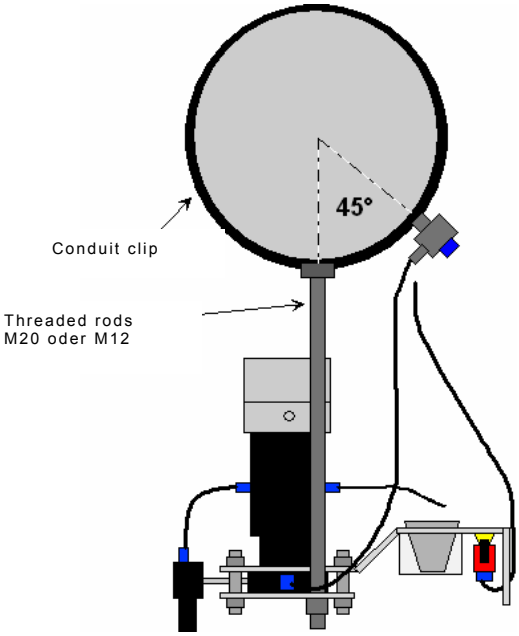
Base plate

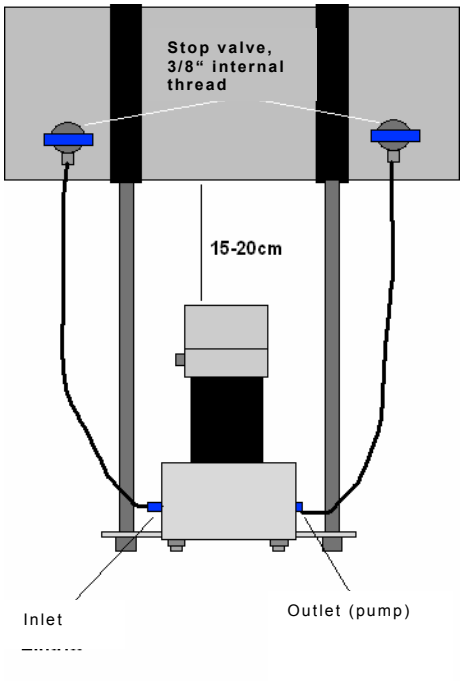


Mounting angle



Mounting at horizontal conduits

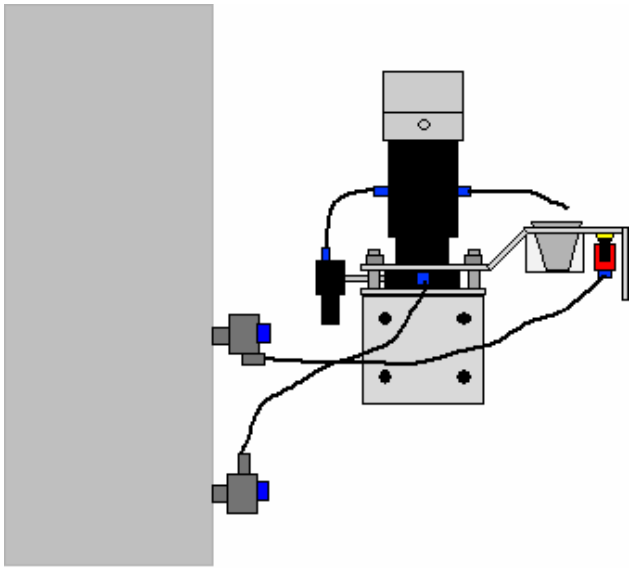




To enable a quick medium exchange, the hoses from the conduit to the fitting should be kept as short as possible. For safety reasons the fitting is equipped with a non-return valve. For stability and easy access for service the distance between fitting and conduit should be between 15 and 20 cm. For quick service and maintenance the fitting must be accessible easily.

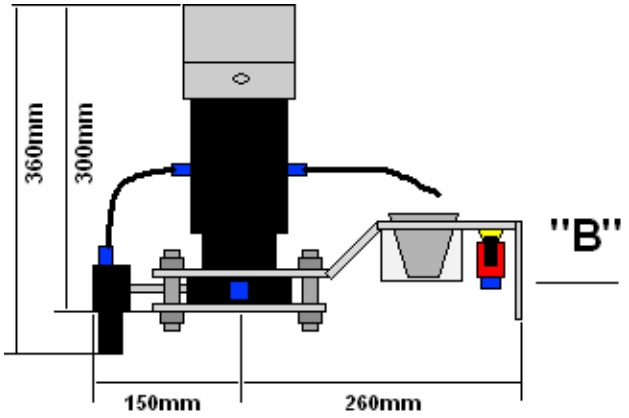
Mounting at vertical circuits with wall mounting

The hoses between cut-off cock/ball cock and the fitting should be kept as short as possible for a quick medium exchange. For mountings at vertical conduits it is necessary to mount to pressurized site (pump pressure site). Air inclusions can cause failures in measurement and flow alarms. The circuit must not be drained completely!

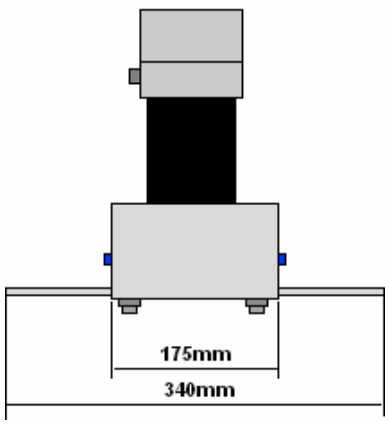


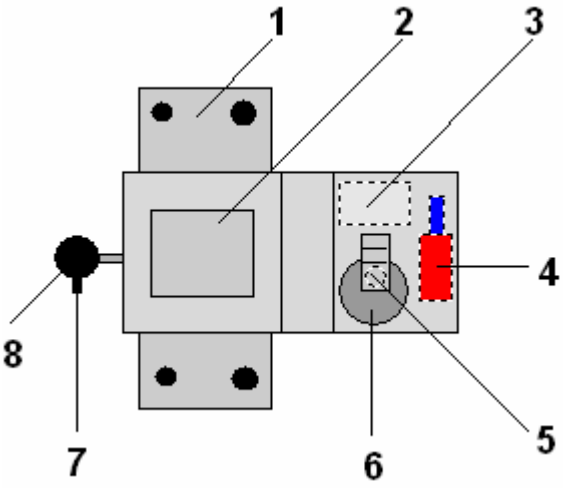
Dimensions

Art. No. W12052III-DD



View „B“



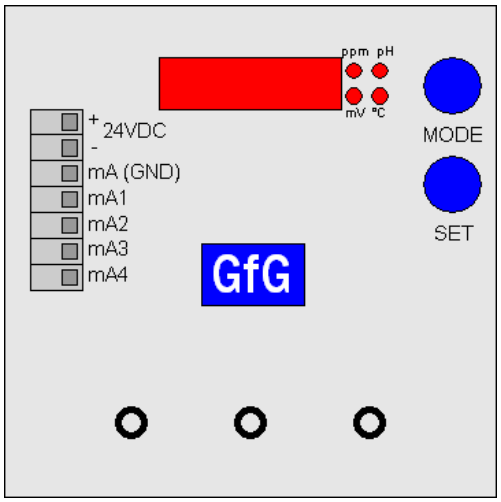


1. Base plate
2. CrNi-steel housing (incl. electronics)
3. Connection box pump
4. Re-circulation pump
5. Float switch
6. Overflow tank
7. Micro valve
8. Particle filter

Electrical connections

The MiniCal III must always be operated on the indicated supply voltage only. The supply voltage is 24 VDC (+-20%). The MiniCal III can be connected either directly to a voltage supply or to a GfG controller for e.g. GMA011 or 160. For the power supply and the 4-20 mA signal a shielded 5-core flexible cable (TD) 1mm^2 is necessary. The mA output shielding has to be grounded at the switch cabinet and at the controller housing of the MiniCal III. The recirculation pump must be separately supplied with 230VAC over a flexible cable (TD) 3 x 1.5mm^2.

Controller



Connection Box Pump

Supply 24VDC +/- 20%
Max. current consumption at 24VDC: 55 mA

Analog current outputs 4-20mA
mA (GND): - signal ground (mA1/2)
mA1: + signal 4 – 20mA concentration display corresponding to the set detection range.
If only one analog output is evaluated, the pump alarm also refers to mA1
(see annex analog outputs)

mA2: + signal 4 – 20mA monitoring pump control
20mA = pump control o.k.
12mA = warning for low flow
4mA = alarm pump control

max. load for current outputs 100 Ohm

Cable to be used:
Flexible, 5-core 1.00 mm^2, shielded
The shield is to be grounded in the switch cabinet
and at the electronics casing of the fitting

Analog Outputs

The controller generally has two 4-20 mA outputs. It is possible to evaluate the measuring signal and the pump alarm separately by a mA output (mA1 + mA2). Both alarms can also be evaluated by one mA output (mA1). Our service technicians take care of the programming during installation.

	Monitoring and evaluating of a pump alarm is absolutely necessary! Warning for loss of medium and interruption of the flow required for the measurement!

Using 2 mA Outputs

The mA output **„mA1“** shows the NH_3/NH_4^+ concentration (0-100 ppm) in 4-20 mA range.

The pump monitoring will be evaluated with following mA output **“mA2”** values:

Analog signal	**MiniCal display**
20 mA = Pump control o.k.	current NH_3/NH_4^+ concentration
12 mA = Warning flow	alternating PALF/current NH_3/NH_4^+ concentration
4 mA = Alarm pump control	alternating PALP/current NH_3/NH_4^+ concentration

The **display** shows the current NH_3/NH_4^+ concentration value. During alarm it reads alternating the concentration and warning.

Using 1 mA Output

The mA output **„mA1“** shows the NH_3/NH_4^+ concentration (0-100 ppm) in 4-20 mA range.
The pump monitoring releases 2 warnings (see pump cycle), for which the value of the mA signal is programmed and complies to the simulation value (see testing mode) 1 resp. 2.

Normally following values will be programmed:

Analog signal	**MiniCal display**
20 mA = Pump control o.k.	current NH_3/NH_4^+ concentration
7.2 mA = Warning flow	alternating PALF/current NH_3/NH_4^+ concentration
10.4 mA = Alarm pump control	alternating PALP/current NH_3/NH_4^+ concentration

The **MiniCal display** shows the **current** value of the **NH_3/NH_4^+ concentration**. The operator has to check the digital display at site for the prevailing fault.

Example 1:
- Pre-alarm: Concentration 20 ppm = 7.2 mA on SPS
- Pump alarm: = 7.2 mA on SPS

➔ *Notification on PLC "NH_3 / NH_4^+ – Pre-alarm" or "Pump alarm"*

- MiniCal display: 0 ppm **+ PALF** ➔ Pump alarm
- MiniCal display of 20 ppm and more ➔ Pre-alarm by ammonia concentration

Example 2:
- Alarm: Concentration 40 ppm = 10.4 mA on SPS
- Alarm pump control: = 10.4 mA on SPS

➔ *Notification on PLC „NH_3 / NH_4^+ – Alarm"or „Alarm pump control"*

- MiniCal display 0 ppm **+ PALP** ➔ Alarm of pump control
- MiniCal display of 40 ppm and more ➔ High alarm by ammonia concentration

Should the concentration exceed the value of the pump alarm, the concentration value will be taken over as a main signal.

PLC programming

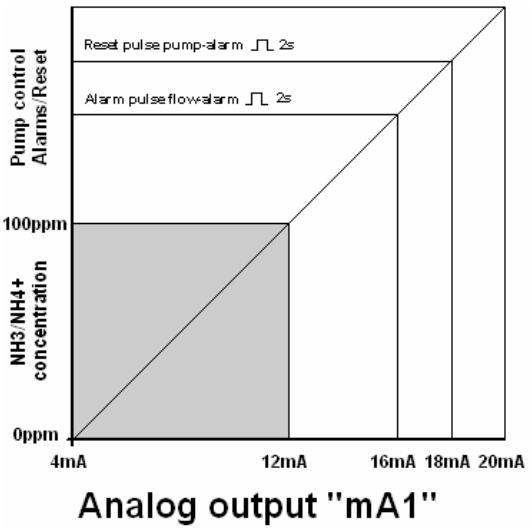
To create a clear difference between "measuring signal of the NH_3/NH_4^+ concentration" and "monitoring pump control", the 4-20 mA analog signal at mA1 output can be separated into 2 ranges.
This requires a corresponding programming of the PLC.

Measuring signal NH_3/NH_4^+ concentration 0…100ppm→ 4 – 12 mA
Monitoring pump control warning → 13 – 20 mA

During flow alarm and pump control alarm the MiniCall III sends a single pulse of 2s duration through the analog output "mA1" to the PLC. The value of the mA signal is programmable in the range 13-20 mA (1 mA steps) both for "flow alarm" PALF and for "pump control alarm" PALP.

Reset
The warning „flow alarm" (PALF) and „pump control alarm" (PALP) have to be reset at the MiniCal controller, keep the "SET" key pressed (approx. 3s) A reset causes the MiniCal III to send another pulse vof 2s to the SPS. The value of this pulse is also programmable in the range 13 – 20 mA (1 mA steps).

Example



Flow monitoring

The fitting has to be mounted at the pump pressure side. The conduit must always be pressurized. The pressure range is 1 to 6 bar.

Flow malfunctions caused by pressure fluctuations or falling below minimum pressure of 1 bar have to be eliminated by the user.

The medium has to fill the overflow tank at least every 240 minutes complete. This has to be regarded while programming the magnetic. Typically the magnetic valve opens every 15 or 20 minutes for 0.5 - 5 seconds, depending on the system pressure. The setting should be performed at minimum system pressure to prevent flow alarm.

For unpressurized systems other fittings are more suitable, e.g. the immersion fitting (type W12111) or the flow fitting (type W12201)

Soil can also cause flow malfunctions, for fault clearance the filter will be controlled or exchanged (see picture).

Open filter housing and exchange filter.

GfG and its partners offer an annually maintenance for the MiniCal system including inspection of the filter. Nevertheless flow malfunctions caused by filter pollutions or air inclusions during shut down of the cooling system have to be eliminated by the user as described above.

The monitoring of the flow is controlled by 2 parameters, the pump cycle and the pump duration. Alarms are given by means of a 4-20 mA signal. For alarm evaluation 3 variances are available, explained below.

Pump cycle

The pump cycle is adjusted during installation. If the pump does not turn on after max. 480 min. an alarm will be released. The MiniCal display alternating shows the current NH_3/NH_4^+ concentration and **PALF** (pump alarm: flow)
After max. 720 min. a pump control alarm will be released. The MiniCal display alternating shows the current NH_3/NH_4^+ concentration and **PALP** (pump alarm: pump).

The flow or pump control alarm can have following causes:

Cause	**Fault clearance**
Particle filter clogged	Replace
No flow to MiniCal	Leakage in cooling system?
	Cut-off valves open?
	Eliminate pressure drop in cooling system
	Afterwards flow control at MiniCal
Float switch faulty	Service by GfG
Pump control faulty	Service by GfG
Pump faulty	Service by GfG

Pump duration

The microprocessor monitors the adjusted pump duration. Exceeding the max. pump duration the alarm “pump control” will be released, that affects on the analogue output mA1 or mA2. Alternating the MiniCal displays the current NH_3/NH_4^+ concentration and the alarm **PALP**.

Exceedings of adjusted pump durations can have following causes:

Cause	**Fault clearance**
Float switch jams or faulty	Cure fault or service by GfG
Pump control faulty	Service by GfG
Pump faulty	Service by GfG

	Pump alarms monitoring and evaluation is absolutely necessary! Warning for coolant loss and faults in necessary flow for measuring!

Test mode

By holding the „MODE“-button the user enters the „testing mode“. From there the different subprograms can be visited by brief pressing the “MODE”-button. During testing mode the mA outputs stay online.

Only exceptions are the programs „A1:xx“ and „A2:xx“, in which the mA output will be set on the pre-programmed simulation values e.g. for testing the transmission to the controller. By pressing the „SET“-button these values will be simulated.

Usually following simulation values are programmed:
„A1:xx“: 20 % - 7.2 mA
„A2:xx“: 40% - 10.4 mA

If “function pump control” is programmed that pump alarms affect on the analog output “mA2”, the subprograms “t120” and “t30” of the testing mode can simulate these values by pressing the “SET” key.
Subprogram „t120“ → flow alarm → 12mA on analog output „mA2“
Subprogram „t 30“ → pump control alarm→ 4mA on analog output „mA2“

If the „function pump control“ is programmed on PAL3 (pump alarms affect on analog output „mA1“ (PAL2), allows to simulate the testing mode ti simulate these alarms resp. by pressing the “SET” key in subprograms “Pd16”, “PA16” and “PC18” (duration of pulse = duration of pressing).

Program „Pd16“ → flow alarm → relevant amplitude analog output „mA1“
Program „PA16“ → pump control alarm→ relevant amplitude analog output „mA1“
Program „PC18“ → Reset alarms → relevant amplitude analog output „mA1“

After 2 min the controller automatically returns to measuring mode, if no modification was made. “Testing mode” can also be left manually by pressing the “MODE”-button for a longer period.

Display mode

The controller can display 2 different values:

ppm	displays measured NH_3/NH_4^+ concentration in ppm
mV	displays the actual electrode mV signal

By holding the “SET”-button the display turns to “mV”. Pressing the “SET”-button briefly again, the displayed value changes between “mV” and “ppm”.

ppm ⇒⇒ mV ⇒ ppm ⇒ mV ⇒ ppm …..

Reference measurement

If NH_3/NH_4^+ concentration warning is released, the Merck-Test can give information about the value of the NH_3/NH_4^+ concentration.

1.08024.0001 ammonium test 0,2-5 mg/l (ppm)
(Method: colorimetric, indophenol blue)

1.10024.0001 ammonium test 10-400 mg/l (ppm)
(Method: analytical test stripes)

Both testing sets are scheduled for ammonium concentration in water. In water cycles the test can be used as described in the testing description.

For coolant being brine (glycolic mixture or similar), the sample will be diluted before testing in a relation of 1/5 to 1/10. In cooling brines ammonia occurs as gas. Ammonia particularly dissolves during dilution and will be transformed into ammonium. That enables a measurement. These values are sufficient for an ammonia detection, but not applicable as an absolute concentration measurement

In general: The predetermined times in the operation manual are to be adhered to exactly, because they affect on the accuracy of the test.

Maintenance

We recommend maintaining every ½ year. Please ask for a favourable offer about our service contracts.

Technical Data

Type:	MiniCal III – Cooling water fitting W12052.III/DD (Art.-no. 3200007)
Detection principle:	Ion-selective resp. gas sensitive detection
Detection range:	0 .. 100 ppm ammonium resp. ammonia
Output:	2x 4.. 20 mA, indirect coupled, load max. 100 Ohm
Power supply:	Controller: 24 V DC (+/- 20%) Pump: 230 V AC
Current consumption:	Controller: 55 mA Pump: 0,3A
Controller housing:	material stainless steel
Cable:	Shielded cable 5 core, 1.00 mm²
Pressure range:	1 .. 6 bar optional: 1 .. 10 bar
Temperature range:	0°C .. +50°C
Parts in contact with medium:	POM
Weight:	app. 6 kg

GfG Gesellschaft für Gerätebau AG
Im Gassacher 6, 8122 Binz
Telephon: +41 (0) 44 982 12 90
Telefax: +41 (0) 44 982 12 91
E-Mail: info@gfg.ch
Internet: www.gfg.ch