



(Inside illumination as option available.)

Biogas Batch Fermentation System

With Automatic Data Logging in Real Time

Maximum precise measurement results

with individually calibrated RITTER MilliGascounters

RITTER Engineering has been successfully working in the field of plastic engineering for 65 years. Among other products RITTER manufactures Gas Flow Meters made of various superior plastics and high grade stainless steel. RITTER meters are used world-wide in research & development laboratories as well as in industry.

The MilliGascounter was developed for the volumetric measurement of the smallest amounts of gas with ultra-low flow rates. These small devices are suitable for measurement of inert, and slightly corrosive biogas, as well as most aggressive gases.

Each MilliGascounter is individually calibrated and supplied with an individual calibration certificate. By PTB calibration of RITTER master meters the traceability to the national primary

standard for each MilliGascounter is given. As a result, maximum measurement accuracy is guaranteed which provides the necessary basis for any research.

In the field of the biogas research the RITTER MilliGascounter became a central component of a system allowing investigation of fermentation processes with up to 16 fermentation bottles in a heating oven at the same time. This RITTER Biogas Batch Fermentation System enables automatic measurement with data acquisition in real time.

±3%
GUARANTEED

Measurement accuracy across the whole flow rate range. With calibration certificate for each MilliGascounter.



National PTB certificates for all Ritter master meters

»Wouldn't it be great to receive multiple results at one time – especially when measuring very small gas volumes in biogas research and development?«

The RITTER Biogas Batch Fermentation System

with automatic data logging in real time

The primary advantage of the RITTER Biogas Batch Fermentation System is the uniform tempering of the entire fermentation bottle inside the heating oven. In contrast to tempering the fermentation bottles in a water bath there will be no uncontrolled cooling of the upper part of the bottles by air and air currents. All temperature deviations can be minimized by e.g. an optional inner glass door of the heating oven for visual inspections.

Features:

- Batches of up to ...
 - 16 Laboratory glass bottles (1 ltr) and 16 RITTER MilliGascounters in heating oven type FD 115 (116 ltr)
 - 8 Laboratory glass bottles (1 ltr) and 8 RITTER MilliGascounters in heating oven type FD 56 (60 ltr)
- Automated data acquisition of gas volume and flow rate from biogas batch fermentation systems through real time data logging with Windows® software »RIGAMO«. (suitable for up to 24 RITTER MilliGascounters)
- Graphical and tabular display, printing and storing of measurement data.
- Export of stored data to Microsoft Excel®.
- Advantage: In contrast to tempering the fermentation bottles in a water bath the entire bottle is heated inside the heating oven. An (uncontrolled) cooling of the upper part of the bottles by air and air currents is eliminated.

It is recommended - especially for anaerobic fermentation tests - to equip the system with the »Inner glass door« option ③. As a result all temperature deviation by opening the outer door is almost completely prevented.

The RITTER Biogas Batch Fermentation System is available as a package for 8 or 16 fermentation bottles.

8x

- **1x Heating oven FD56** with lead-through in heating oven top panel for gas tubing
- **1x Tube distribution frame** for MilliGascounters on top panel of heating oven
- **8x MilliGascounters** MGC-1 PMMA
- **8x Tubing connection** from fermentation bottle to MilliGascounter
- **8x Fermentation Glass Bottle**, 1 ltr GL 80
- **8x Stirring device** for fermentation bottles
- **1x Connection module** for stirring device with Power supply unit for connection module
- **1x Licence** for »RIGAMO«-Software 8-Channel
- **1x Digital Interface Module** (»DIM«) 8-Channel

16x

- **1x Heating oven FD115** with lead-through in heating oven top panel for gas tubing
- **1x Tube distribution frame** for MilliGascounters on top panel of heating oven
- **16x MilliGascounters** MGC-1 PMMA
- **16x Tubing connection** from fermentation bottle to MilliGascounter
- **16x Fermentation Glass Bottle**, 1 ltr GL 80
- **16x Stirring device** for fermentation bottles
- **1x Connection module** for stirring device with Power supply unit for connection module
- **1x Licence** for »RIGAMO«-Software 16-Channel
- **1x Digital Interface Module** (»DIM«) 16-Channel

8x

16x



Ritter
Made in Germany


"Worldwide -
with the precision
of the original!"

Overview of system components

Basic elements

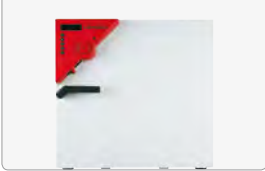
1A

1



1B


1




2

1

1




3



4

1


1



10

8

16



±3%
GUARANTEED

Heating Oven

Type 1A Fa. Binder / Model: FD 115 / Volume 116 ltr

- Suitable for max. 16 fermentation bottles 1 ltr.
- Air circulation by forced convection (fan)
- Temperature range from 5°C above room temperature to 300°C (with option "Inner Glass Door" limited to 100°C)
- DS control with integrated timer 0 to 99 hrs
- Digital temperature setting, increment 0.1°C
- Adjustable ventilation via front control panel and rear exhaust Ø 50 mm
- USB interface for recording of heating oven data

Outside	Dimensions	W 710 mm x D 605 mm x H 735 mm	Weight	54 Kg
Inside	Dimensions	W 530 mm x D 385 mm x H 550 mm		

(Alternatively) Type 1B Fa. Binder / Model: FD 56 / Volume 60 ltr

- Suitable for 8 fermentation bottles 1 ltr

Outside	Dimensions	W 560 mm x D 565 mm x H 625 mm	Weight	39 Kg
Inside	Dimensions	W 420 mm x D 345 mm x H 440 mm		

Lead-through in heating oven top panel for gas tubing

- Diameter 50 mm
- Delivered with silicon plug

Inner Glass Door for Heating Oven FD115 1A und FD 56 1B (Option)

- Visual control of oven content without major temperature loss when opening front door.
- Factory-adjusted limitation of temperature control up to 100°C.

This option is recommended especially for anaerobic fermentation tests because a temperature loss of the fermentation bottles is almost completely prevented when opening the outer door.

Tube distribution frame for MilliGascounters on top panel of heating oven

- Material: Plexiglass PMMA, for max. 16 MGC's with FD115 / 8 MGC's with FD56
- Easy positioning of MilliGascounters 10
- Kink-free tube routing between fermentation bottles and MilliGascounters 10 (and optional CO₂ absorpon bottles)

Top panel for 1A	Dimensions	W 710 mm x D 528 mm x H 90 mm	Weight	4.8 Kg
Top panel for 1B	Dimensions	W 560 mm x D 488 mm x H 90 mm	Weight	3.5 Kg





MilliGascounter MGC-1 PMMA

Type: MGC-1 PMMA / Material: Casing PMMA, measurement cell PVDF

- Measuring range: 1 ml/h to 1 ltr/h
- **Measuring accuracy: ±3% across the whole flow rate range** (better ±1% with »RIGAMO« software 11 by dynamic measurement errors correction)
- **Including individual calibration certificate**
- Volume measurement cell: 3 ml
- Equipment: Digital display, 200 ml packing liquid, 1.5 m connection tube, cleaning tool, syringe and bubble level (1 piece each for up to max. 5 pc.)
- Resolution (= min. measurement increment): 3ml
- Max. operating temperature 60°C
- Max. overpressure: 100 mbar

PMMA / PVDF	Dimensions	ø 96 mm x H 112 mm	Weight	468 g
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Components for Fermentation Process

20		Fermentation Glass Bottle <ul style="list-style-type: none"> Threaded bottle neck with glass thread GL80 for connection of stirring device or gas sensor Additional lateral nozzle GL14 for connection of tubing to MilliGascounter ¹⁰ 2 bottle screw caps Standard sizes 0.5 / 1.0 / 2.0 ltr; different sizes available on request <table> <tr> <td>0.5 ltr</td><td>Dimensions</td><td>ø 101 mm x H 152 mm</td><td>Weight</td><td>325 g</td></tr> <tr> <td>1.0 ltr</td><td>Dimensions</td><td>ø 101 mm x H 222 mm</td><td>Weight</td><td>500 g</td></tr> <tr> <td>2.0 ltr</td><td>Dimensions</td><td>ø 136 mm x H 252 mm</td><td>Weight</td><td>1,000 g</td></tr> </table>	0.5 ltr	Dimensions	ø 101 mm x H 152 mm	Weight	325 g	1.0 ltr	Dimensions	ø 101 mm x H 222 mm	Weight	500 g	2.0 ltr	Dimensions	ø 136 mm x H 252 mm	Weight	1,000 g
0.5 ltr	Dimensions	ø 101 mm x H 152 mm	Weight	325 g													
1.0 ltr	Dimensions	ø 101 mm x H 222 mm	Weight	500 g													
2.0 ltr	Dimensions	ø 136 mm x H 252 mm	Weight	1,000 g													
21		Tubing connection from fermentation bottle to MilliGascounter <ul style="list-style-type: none"> Bottle screw cap, GL14, red, with centric hole Joint straight (hose connection) for bottle screw cap PVC tubing (Rauclair) ø_i 4 mm / ø_o 6 mm, 1,5 m 															
22		Filter 0.45 micron with 2 hose nozzles (Option) <ul style="list-style-type: none"> Hose nozzles for tube ø_i 4 mm / ø_o 6 mm Materials: Housing Acrylic, filter element PTFE, hose nozzles Polypropylene Function: Filtering of particles in gas flow to avoid blockade of micro capillary of MilliGascounter Easy mounting in tubing between fermentation bottle and MilliGascounter ¹⁰ 															
23		Check valve with 2 hose nozzles (Option) <ul style="list-style-type: none"> Hose nozzles for tube ø_i 4 mm / ø_o 6 mm Materials: Housing PC, valve body Silicone, hose nozzles Polypropylene Function: Prevents reverse flow* of ... <ul style="list-style-type: none"> ... packing liquid into fermentation bottle when used with MilliGascounter ... absorption liquid into fermentation bottle when used with CO₂ absorption bottle Easy mounting in tube feeding to MilliGascounter or to CO₂ absorption bottle <p>* Reverse flow may be caused due to an underpressure in the fermentation bottle for example by a decrease of temperature in the bottle</p>															

Components for Stirring of Substrate

Stirring device for fermentation bottles

- With intervalic stirring for better contact among the bacterias and thus better production of methane
- Suitable for fermentation bottles with bottle neck and glass thread GL80
- Step motor 2 Ampere, 15 U/min
- Adapter for glass thread GL80

0.5 ltr	Dimensions $\varnothing_{\text{max.}}$ 60 mm x L 70 mm	Weight ~ 1 kg
1.0 ltr	Dimensions $\varnothing_{\text{max.}}$ 60 mm x L 100 mm	Weight ~ 1 kg
2.0 ltr	Dimensions $\varnothing_{\text{max.}}$ 60 mm x L 115 mm	Weight ~ 1 kg
$\varnothing_{\text{max.}}$ =max. Stirring diameter, L = Length of stirring blade		

Control unit of step motor for stirring device

- Voltage distributor for connection of stirring devices
- Available for connection from 1 up to 16 stirring devices
- Incorporated power-supply unit

1 Connection		Weight 82 g
4 Connections	Dimensions W 115 mm x D 65 mm x H 27 mm	Weight 92 g
8 Connections		Weight 104 g
16 Connections		Weight 129 g

CO₂ Absorption System (Option)

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Complete CO₂ Absorption System with following components:

- 4 / 8 Absorption bottles
- Hanger for absorption bottles
- Indicator for saturation limit of absorption solution

For detailed description see brochure »CO₂ Absorption System«

Components for CO₂ Absorption (Option)

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Absorption Bottle

- CO₂ absorption rate better than 99%**
- Design with dip pipe and PP screw-type hose coupling
- Including tubing to fermentation bottle and to MilliGascounter Ø 4 mm / Ø 6 mm
- Including Check Valve 23
- Volume 250 ml, overall dimensions Ø 70 mm x H 200 mm, weight 290 g

** Systems with gas surface wetting achieve an absorption of 95% to 97% only causing the subsequent measuring error of 3% to 5%

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Hanger for Absorption Bottles

- Suitable for ...

a) 8 Absorption bottles 250 ml, suitable for heating oven FD115 (116 ltr) 1A

... for FD115	Dimensions	W 528 mm	x	D 685 mm	x	H 125 mm	Weight	4.9 kg
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b) 4 Absorption bottles 250 ml, suitable for heating oven FD56 (60 ltr) 1B

... for FD56	Dimensions	W 488 mm	x	D 390 mm	x	H 125 mm	Weight	2.6 kg
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- Material: PVC grey
- Maximum of 2 hangers per heating oven
- Requires »MilliGascounter Tube Distribution Frame« 4

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Absorption solution

- Caustic soda solution (NaOH 3Mol in aqua dest.)
- CO₂ absorption capacity approx. 6 ltr per absorption bottle
- Filling quantity per absorption bottle: 200 ml
- Delivery in bottles of 1 ltr

Please note: Due to transportation restrictions, the absorption solution might have to be purchased locally. Please contact RITTER!

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Indicator for indication of saturation limit

- »Phenolphthalein«, solution 1% in Ethanol (technical), delivered in 1-liter bottles

Components for Condensate Separation (Option)

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Condensate Separator for fermentation bottles

- Flask with inside cooling spiral for water or air cooling
- Gas connection: 2 x hose nozzle D 4 mm for tube Ø 4 mm / Ø 6 mm
- Water connection: 2 x hose nozzle D 4 mm for tube Ø 4 mm / Ø 6 mm

Functional principle: For cooling by water the Condensation Separator is to be connected to a water circulation. If the difference between room and gas temperature is sufficient for condensate formation, the condensation can be done without water cooling.

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Fixture for Condensate Separator

- SS rod with clamp fixture holding the condensate separator
- Easy mounting: The SS rod with clamp fixture is inserted into the »MilliGascounter Tube Distribution Frame«

Components for Data Acquisition in Real Time

90

1
1

±1%



»RIGAMO« Software for data acquisition

Type: RIGAMO-V3.1

- Improves the measurement accuracy of MilliGascounter ¹⁰ from ±3% to better than ±1% across the whole flow rate range by algorithm using individual calibration data
- Software features
 - Windows software (XP / Vista / 7 / 8) for data acquisition of gas volume and flow rate from up to 24 Ritter gas meters to a PC USB port. Attention: Rigamo can be started only once at a time at one PC
 - Graphical and tabular real-time display of acquired data
 - Storing of data
 - Export of stored data to Microsoft Excel
 - Automatic correction of the dynamic measurement error (flow rate dependent) only with MGC ¹⁰).
 - No support of bi-directional recognition of measuring drum rotation with Pulse Generator V4.01
 - »RIGAMO« is designed to run on one PC with only one Digital Input Module ⁹².

Please note the system specifications listed below ***

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Licence for »RIGAMO« Software

Types: 1-/4-/8-/16-/24-Channel licences / Model: USB-Dongle

- Enables data acquisition for a defined amount of gas meters according to the number of licences

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Picture 1: 1-channel-type



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Digital Input/Interface Module (»DIM«)

Types: 1-/4-/8-/16-/24-Channel / Model: Plastic casing

- Pulse acquisition from MilliGascounter ¹⁰ and forwarding to PC
- Input: phone jack socket for connection of MilliGascounter ¹⁰
- Output: USB socket for PC connection
- Data transmission cables to MilliGascounter ¹⁰ L=5m und zum PC L=1m

Picture 2: 16-channel-type



1-channel	Dimensions	W 114 mm	x H 96 mm	x D 78 mm	Weight	183 g
4-channel					Weight	914 g
8-channel					Weight	947 g
16-channel	Dimensions	W 185 mm	x H 182 mm	x D 90 mm	Weight	1,013 g
24-channel					Weight	1,080 g

*** System specifications for the »RIGAMO« Software for data acquisition

- Gas meter with built-in pulse generator (MilliGascounter standard)
- Digital Input Module »DIM« ⁹² (option)
- Licence for requested number of connected gas meters (license dongle ⁹¹)
- Operation system Windows XP / Vista / 7 / 8
- Microsoft Excel® 2003 or higher for data export to Microsoft Excel
- Recommended processor performance: ≥ 1.5 GHz
- Random access memory (RAM): ≥ 500 MB
- 2 free USB ports (1 for data acquisition, 1 for license dongle ⁹¹)
- Monitor 17" (optimised for resolution of 1280x1024 pixel)



Better than ...
±1%
... in combination with
»RIGAMO«
data acquisition
software.

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