GAS METERS

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Fig.: TG 05 Model 5 with “Totalizing Roller Counter”

TG 1 PP
Model 7
(Fig. with LED Counter resettable

RITTER drum-type gas meters are universally applicable for measuring the volume of flowing gases and are particularly effective when measurements demand the highest precision**.**

RITTER™ gas meters are manufactured out of 5 different excellent materials: Polyvinyl Chloride (PVC), Polypropylene (PP), Polyvinylide Fluoride (PVDF), PE-el (polyethylene electrically conductive) or refined stainless steel 1.4571 (316 Ti). Thus, the user is able to measure even highly aggressive gases with laboratory accuracy.

For rugged, industrial applications, robust models with a stainless steel casing and plastic drum (four different materials) are available.

The desired measurement range can be selected from among 8 sizes (types) extending as a whole from 1 Ltr/h to 18,000 Ltr/h at a gas temperature ranging from -10°C to +80°C. The solidly manufactured casing of the standard meters is designed to withstand a maximum overpressure of 50 mbar (plastic casings) or 500 mbar (stainless steel casings); meters for higher pressure ranges up to 35 bars are available.

TG 1 – 35 bar
(Fig. with Pulse Generator ex-version

The measurement of **RITTER** drum-type gas meters works on the principle of displacement. The gas flow causes a rotation of the measuring drum within a packing fluid (usual: water or low viscous oil). The measuring drum compulsorily measures the gas volume by periodically filling and emptying the rigid measuring chambers.
Fastidious production methods and calibration enable a measuring accuracy of ± 0.2 % at standard flow rate and approx. ± 0.5% over the whole measuring range.

TG 50 PP
Model 6
(Fig. with "Resettable Roller Counter")

The **direct** measurement of volume is the major advantage and the superiority of volumetric Gas Meters (like Drum-type Gas Meters) over other measurement principles, which determine gas volume using secondary measurands such as speed, heat capacity, hot-wire resistance or similar. That means that the condition and the composition of the gas do not influence the measurement accuracy.

Correcting factors which take into account gas type, temperature, humidity etc are therefore **not necessary**. It should be noted that with other, non-volumetric measurements the accuracy given for that measurement can only be achieved if the correcting factors for the actual gas condition or gas mixture are <u>exactly</u> known.

Standard Equipment:

- 4-Chamber Measuring Drum
- Magnetic Coupling (between the measuring drum and counting mechanism)
- 8-digit Totalizing Roller Counter
- large, one-Needle dial
- Filling-level Indicator (for setting the Packing Liquid level)
- Manometer/Thermometer Supports
- Viton sealing
- Level and Levelling Feet.

Performance Data:

- Measurement accuracy:
  ± 0.2% at standard flow rate (exact value is stated in individual Calibration Certificate),
  approx ± 0.5% across the measurement range
- Maximum gas inlet pressure (overpressure):
  50 mbar with plastic casings
  500 mbar (0.05 MPa) with stainless steel casings
- Flow rate (measuring range) and meter indication:

Type	Flow Rate			Indication	
	Minimum [ltr/h]	Maximum [ltr/h]	Standard [ltr/h]	Min. Dial Division [ltr]	Maximum Value [ltr]
TG 05	1	60	50	0.002	9,999,999.9
TG 1	2	120	100	0.01	99,999,999
TG 3	6	360	300	0.02	99,999,999
TG 5	10	600	500	0.02	99,999,999
TG 10	20	1,200	1,000	0.1	99,999,999
TG 20	40	4,000	3,200	0.2	999,999,990
TG 25	50	7,000	5,000	0.1	999,999,990
TG 50	100	18,000	10,000	0.5	999,999,990

Available Models (materials of construction)**:**

Casing	Measuring drum	Model
PVC-transparent	PVC-grey	**5**
PP-grey	PP-grey	**6**
PVDF	PVDF	**7**
PE-el	PE-el	**8**
1.4571 (316 Ti)	PVC-grey	**1**
1.4571 (316 Ti)	PE-el	**2**
1.4571 (316 Ti)	PP-grey	**3**
1.4571 (316 Ti)	PVDF	**4**

Legend:		
PVC	=	Polyvinyl chloride
PP	=	Polypropylene
PVDF	=	Polyvinylide fluoride
PE-el	=	Polyethylene-electrically conductive
1.4571	=	316 Ti
	=	Refined stainless steel
Viton	=	Fluorine rubber

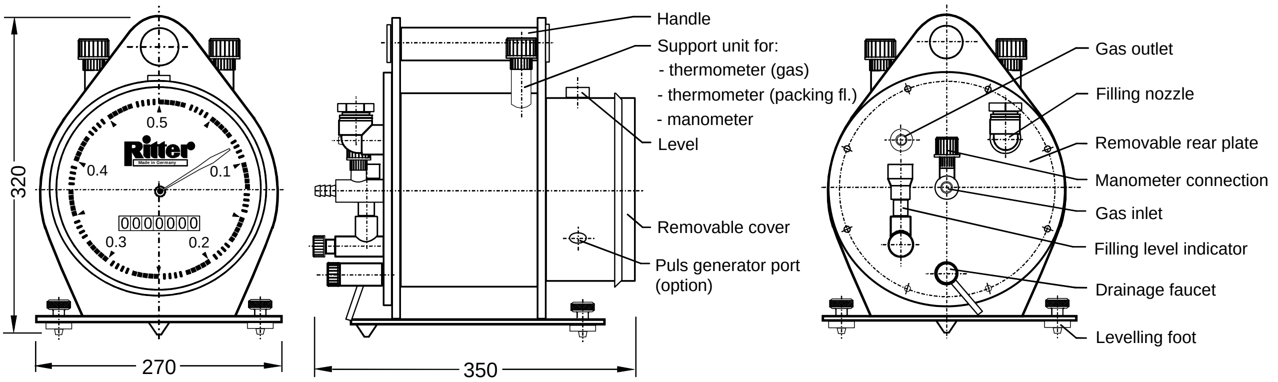
For chemical resistance properties please contact **RITTER**.
Both the casings out of plastic and stainless steel are welded.

Accessories: Data acquisition software "Rigamo"
Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Manometer, range 10 mbar differential pressure
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

Pulse Generator (for connection of Electronic Display Unit or Computer)
- Standard Version
- Ex-proof Version

High Precision Liquid Level Indicator ("HPLI")
LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)



Performance Data:

Minimum flow Q_{min}	1	ltr/h	**Maximum gas inlet pressure**	**50**	**mbar**
Standard flow Q_{stand}	50	ltr/h	Minimum differential pressure [1)]	0.4	mbar
Maximum flow Q_{max}	60	ltr/h	Packing liquid quantity, approx	2.5	ltr
Measurement accuracy			Minimum dial division	0.002	ltr
at standard flow	± 0.2	%	Maximum indication value [2)]	9,999,999.9	ltr
Measurement accuracy			Connection gas in/outlet	Hose barb	
across measuring range	± 0.5	%	Hose barb outside diameter	16	mm
Measuring drum volume	0.5	ltr/Rev.			

[1)] Differential pressure (= pressure loss) gas inlet ⇒ gas outlet

[2)] Standard Totalizing Roller Counter

Models (materials):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
5	PVC-transparent	PVC-grey	4.0	40
6	PP-grey	PP-grey	3.0	80
7	PVDF	PVDF	5.0	80
8	PE-el	PE-el	3.0	60

• **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

4-Chamber Measuring Drum	Manometer/Thermometer Supports
Magnetic Coupling	Viton Sealing
Totalizing Roller Counter (8-digit)	Level, Levelling Feet

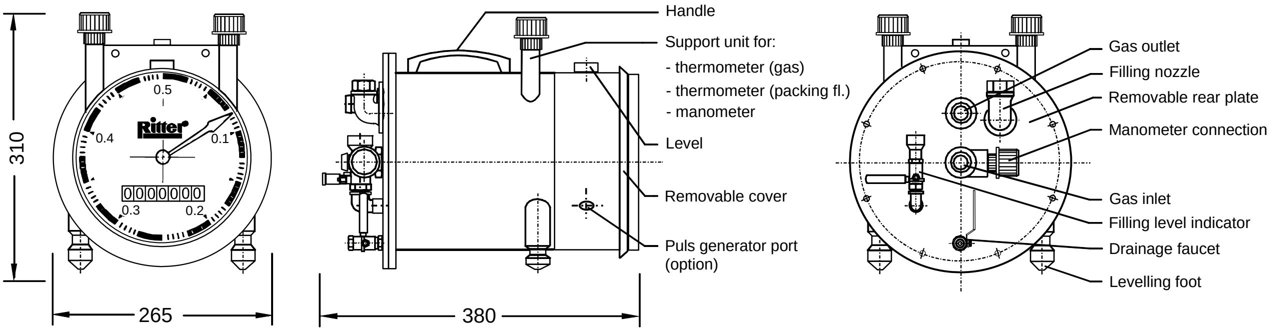
Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Manometer, range 10 mbar differential pressure
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 7-digit + 1 decimal (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)
High Precision Liquid Level Indicator (HPLI)

Ritter Made in Germany	**DRUM-TYPE GAS METERS** **Data Sheet** **Type: TG 05 Mod. 1-4**	**01.06** V 3.2 Rev. 02/2011



Performance Data:

Minimum flow Q_{min}	1	ltr/h	**Maximum gas inlet pressure**	**500**	**Mbar**
Standard flow Q_{stand}	50	ltr/h	Minimum differential pressure [1)]	0.4	Mbar
Maximum flow Q_{max}	60	ltr/h	Packing liquid quantity, approx.	3.5	ltr
Measurement accuracy			Minimum dial division	0.002	Ltr
at standard flow	± 0.2	%	Maximum indication value [2)]	9,999,999.9	ltr
Measurement accuracy			Connection gas in/outlet	Hose barb	
across measuring range	± 0.5	%	Hose barb outside diameter	17	mm
Measuring drum volume	0.5	ltr/Rev.			

[1)] Differential pressure (= pressure loss) gas inlet ⇒ gas outlet [2)] Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
1	Stainless steel	PVC-grey	8.3	40
2	Stainless Steel	PE-el	8.2	60
3	Stainless steel	PP-grey	8.2	80
4	Stainless steel	PVDF	8.5	80

- **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

4-Chamber Measuring Drum	Manometer/Thermometer Supports
Magnetic Coupling	Viton Sealing
Totalizing Roller Counter (8-digit)	Level, Levelling Feet

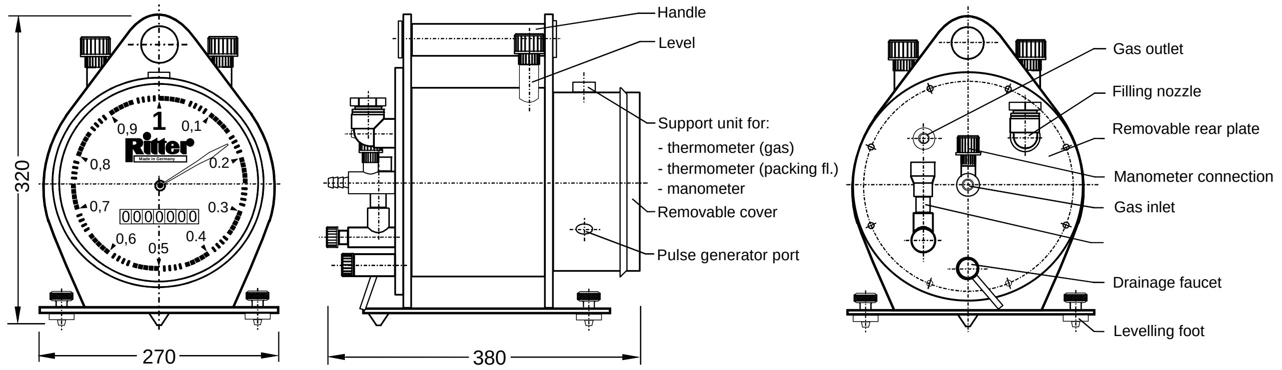
Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Manometer, range 10 mbar differential pressure
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 7-digit + 1 decimal (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)
High Precision Liquid Level Indicator (HPLI)

Subject to alterations



Performance Data:

Minimum flow Q_{min}	2 ltr/h		**Maximum gas inlet pressure**	**50**	**mbar**
Standard flow Q_{stand}	100 ltr/h		Minimum differential pressure [1]	0.2	mbar
Maximum flow Q_{max}	120 ltr/h		Packing liquid quantity, approx.	3.0	Ltr
Measurement accuracy			Minimum dial division	0.01	ltr
at standard flow	± 0.2 %		Maximum indication value [2]	99,999,999	ltr
Measurement accuracy			Connection gas in/outlet	Hose barb	
across measuring range	± 0.5 %		Hose barb outside diameter	16	mm
Measuring drum volume	1.0 ltr/Rev.				

[1] Differential pressure (= pressure loss) gas inlet ⇒ gas outlet

[2] Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
5	PVC-transparent	PVC-grey	4.3	40
6	PP-grey	PP-grey	3.1	80
7	PVDF	PVDF	5.1	80
8	PE-el	PE-el	3.1	60

- **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

4-Chamber Measuring Drum	Manometer/Thermometer Supports
Magnetic Coupling	Viton Sealing
Totalizing Roller Counter (8-digit)	Level, Levelling Feet

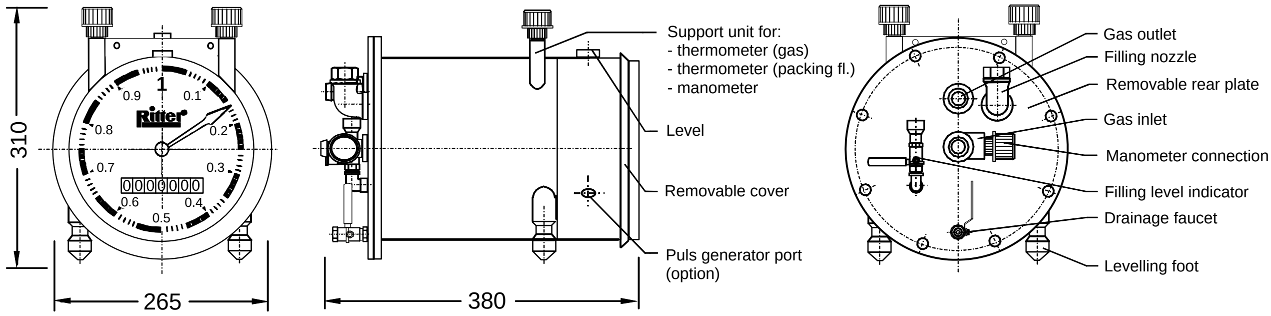
Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Manometer, range 10 mbar differential pressure
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)
High Precision Liquid Level Indicator (HPLI)

Ritter Made in Germany	**DRUM-TYPE GAS METERS** **Data Sheet** **Type: TG 1 Mod. 1-4**	**01.8** V 3.2 Rev. 02/2011



Performance Data:

Minimum flow Q_{min}	2	ltr/h	**Maximum gas inlet pressure**	**500**	**mbar**
Standard flow Q_{stand}	100	ltr/h	Minimum differential pressure [1)]	0.2	mbar
Maximum flow Q_{max}	120	ltr/h	Packing liquid quantity, approx.	3.5	Ltr
Measurement accuracy			Minimum dial division	0.01	ltr
at standard flow	± 0.2	%	Maximum indication value [2)]	99,999,999	ltr
Measurement accuracy			Connection gas in/outlet	Hose barb	
across measuring range	± 0.5	%	Hose barb outside diameter	17	mm
Measuring drum volume	1.0	ltr/Rev.			

[1)]Differential pressure (= pressure loss) gas inlet ⇒ gas outlet [2)]Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
1	Stainless steel	PVC-grey	8.5	40
2	Stainless Steel	PE-el	8.3	60
3	Stainless steel	PP-grey	8.3	80
4	Stainless steel	PVDF	8.9	80

• **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

4-Chamber Measuring Drum	Manometer/Thermometer Supports
Magnetic Coupling	Viton Sealing
Totalizing Roller Counter (8-digit)	Level, Levelling Feet

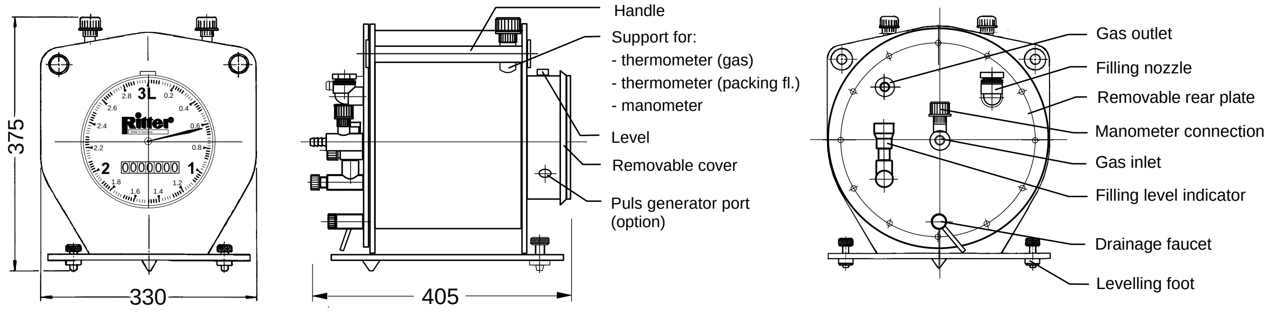
Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Manometer, range 10 mbar differential pressure
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)
High Precision Liquid Level Indicator (HPLI)

Ritter Made in Germany	**DRUM-TYPE GAS METERS** **Data Sheet** **Type: TG 3 Mod. 5-8**	**01.9** V 2.1 Rev. 02/2011



Performance Data:

Minimum flow Q_{min}	6	ltr/h	**Maximum gas inlet pressure**	**50**	**mbar**
Standard flow Q_{stand}	300	ltr/h	Minimum differential pressure [1)]	0.2	mbar
Maximum flow Q_{max}	360	ltr/h	Packing liquid quantity, approx.	5.8	Ltr
Measurement accuracy			Minimum dial division	0.02	ltr
at standard flow	± 0.2	%	Maximum indication value [2)]	99,999,999	ltr
Measurement accuracy			Connection gas in/outlet	Hose barb	
across measuring range	± 0.5	%	Hose barb outside diameter	16	mm
Measuring drum volume	3.0	ltr/Rev.			

[1)]Differential pressure (= pressure loss) gas inlet ⇒ gas outlet [2)]Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
5	PVC-transparent	PVC-grey	6.3	40
6	PP-grey	PP-grey	4.5	80
7	PVDF	PVDF	8.1	80
8	PE-el	PE-el	4.5	60

• **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

4-Chamber Measuring Drum	Manometer/Thermometer Supports
Magnetic Coupling	Viton Sealing
Totalizing Roller Counter (8-digit)	Level, Levelling Feet

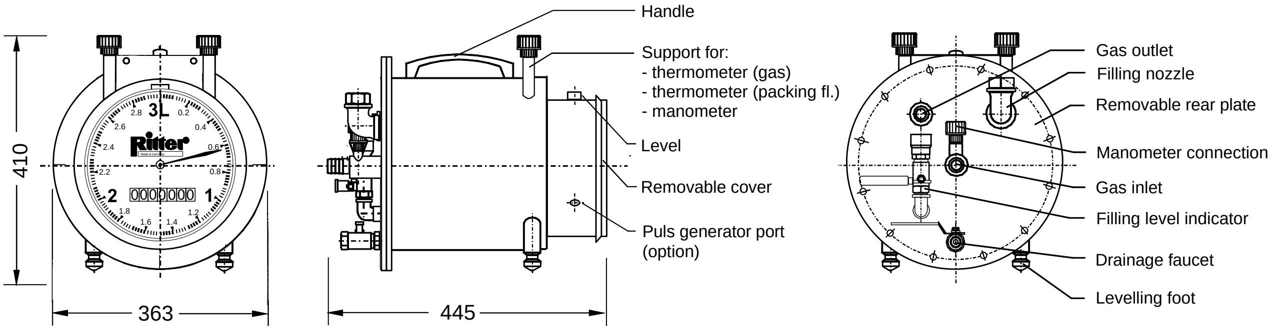
Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Manometer, range 10 mbar differential pressure
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)
High Precision Liquid Level Indicator (HPLI)

Ritter Made in Germany	**DRUM-TYPE GAS METERS** **Data Sheet** **Type: TG 3 Mod. 1-4**	**01.10** V 3.3 Rev. 02/2011



Performance Data:

Minimum flow Q_{min}	6	ltr/h	**Maximum gas inlet pressure**	**500**	**mbar**
Standard flow Q_{stand}	300	ltr/h	Minimum differential pressure [1)]	0.2	mbar
Maximum flow Q_{max}	360	ltr/h	Packing liquid quantity, approx.	11	Ltr
Measurement accuracy			Minimum dial division	0.02	ltr
at standard flow	± 0.2	%	Maximum indication value [2)]	99,999,999	ltr
Measurement accuracy			Connection gas in/outlet	Hose barb	
across measuring range	± 0.5	%	Hose barb outside diameter	17	mm
Measuring drum volume	3.0	ltr/Rev.			

[1)]Differential pressure (= pressure loss) gas inlet ⇒ gas outlet [2)]Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
1	Stainless steel	PVC-grey	15.8	40
2	Stainless Steel	PE-el	15.7	60
3	Stainless steel	PP-grey	15.7	80
4	Stainless steel	PVDF	16.2	80

• **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

4-Chamber Measuring Drum	Manometer/Thermometer Supports
Magnetic Coupling	Viton Sealing
Totalizing Roller Counter (8-digit)	Level, Levelling Feet

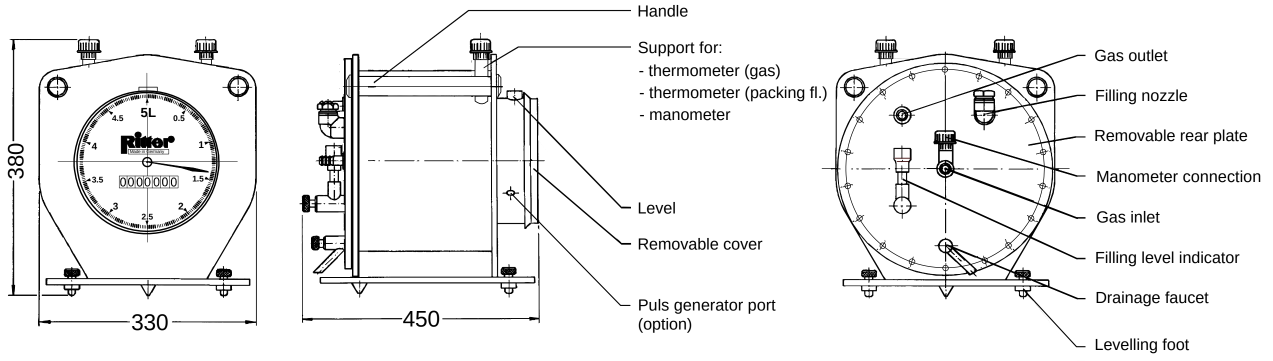
Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Manometer, range 10 mbar differential pressure
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

<u>Built-in Options:</u>

LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)
High Precision Liquid Level Indicator (HPLI)

Ritter Made in Germany	**DRUM-TYPE GAS METERS** **Data Sheet** **Type: TG 5 Mod. 5-8**	**01.11** V 2.2 Rev. 02/2011



Performance Data:

Minimum flow Q_{min}	10	ltr/h	**Maximum gas inlet pressure**	**50**	**mbar**
Standard flow Q_{stand}	500	ltr/h	Minimum differential pressure [1)]	0.2	mbar
Maximum flow Q_{max}	600	ltr/h	Packing liquid quantity, approx.	8.5	Ltr
Measurement accuracy			Minimum dial division	0.02	ltr
at standard flow	± 0.2	%	Maximum indication value [2)]	99,999,999	ltr
Measurement accuracy			Connection gas in/outlet	Hose barb	
across measuring range	± 0.5	%	Hose barb outside diameter	16	mm
Measuring drum volume	5.0	ltr/Rev.			

[1)]Differential pressure (= pressure loss) gas inlet ⇒ gas outlet [2)]Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
5	PVC-transparent	PVC-grey	7.1	40
6	PP-grey	PP-grey	4.9	80
7	PVDF	PVDF	9.2	80
8	PE-el	PE-el	4.9	60

- **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

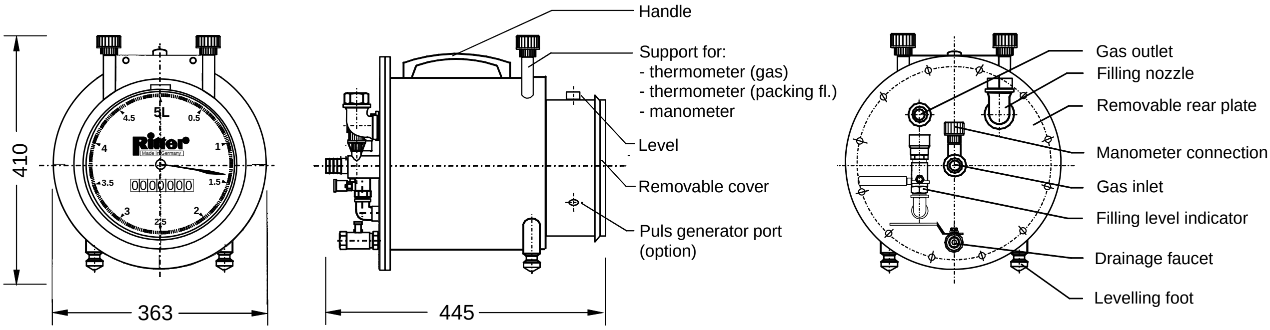
4-Chamber Measuring Drum	Manometer/Thermometer Supports
Magnetic Coupling	Viton Sealing
Totalizing Roller Counter (8-digit)	Level, Levelling Feet

Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Manometer, range 10 mbar differential pressure
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

<u>Built-in Options:</u>

LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)
High Precision Liquid Level Indicator (HPLI)



Performance Data:

Minimum flow Q_{min}	10	ltr/h	**Maximum gas inlet pressure**	**500**	**mbar**
Standard flow Q_{stand}	500	ltr/h	Minimum differential pressure [1)]	0.2	mbar
Maximum flow Q_{max}	600	ltr/h	Packing liquid quantity, approx.	11	Ltr
Measurement accuracy			Minimum dial division	0.02	ltr
at standard flow	± 0.2	%	Maximum indication value [2)]	99,999,999	ltr
Measurement accuracy			Connection gas in/outlet	Hose barb	
across measuring range	± 0.5	%	Hose barb outside diameter	17	mm
Measuring drum volume	5.0	ltr/Rev.			

[1)]Differential pressure (= pressure loss) gas inlet ⇒ gas outlet

[2)]Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
1	Stainless steel	PVC-grey	15.0	40
2	Stainless Steel	PE-el	14.8	60
3	Stainless steel	PP-grey	14.8	80
4	Stainless steel	PVDF	15.2	80

• **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

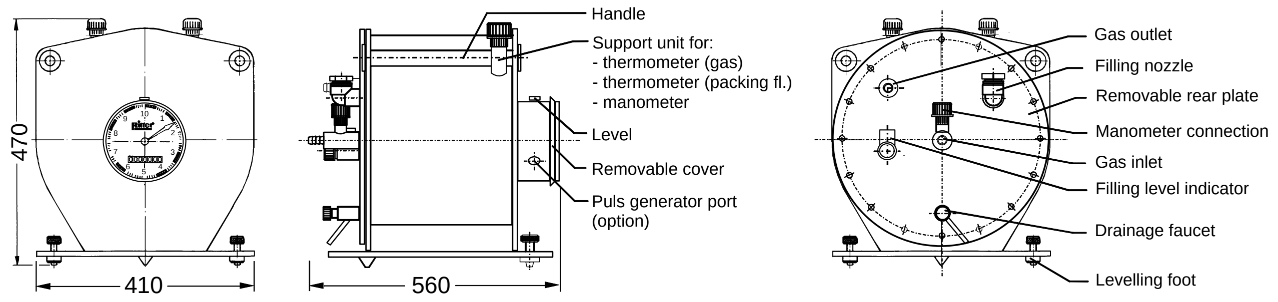
4-Chamber Measuring Drum	Manometer/Thermometer Supports
Magnetic Coupling	Viton Sealing
Totalizing Roller Counter (8-digit)	Level, Levelling Feet

Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Manometer, range 10 mbar differential pressure
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)
High Precision Liquid Level Indicator (HPLI)



Performance Data:

Minimum flow Q_{min}	20	ltr/h	**Maximum gas inlet pressure**	**50**	**mbar**
Standard flow Q_{stand}	1,000	ltr/h	Minimum differential pressure [1)]	0.1	mbar
Maximum flow Q_{max}	1,200	ltr/h	Packing liquid quantity, approx.	15.5	Ltr
Measurement accuracy			Minimum dial division	0.1	ltr
at standard flow	± 0.2	%	Maximum indication value [2)]	99,999,999	ltr
Measurement accuracy			Connection gas in/outlet	Hose barb	
across measuring range	± 0.5	%	Hose barb outside diameter	25	mm
Measuring drum volume	10.0	ltr/Rev.			

[1)]Differential pressure (= pressure loss) gas inlet ⇒ gas outlet

[2)]Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
5	PVC-transparent	PVC-grey	10.6	40
6	PP-grey	PP-grey	7.8	80
7	PVDF	PVDF	13.6	80
8	PE-el	PE-el	7.8	60

- **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

4-Chamber Measuring Drum	Manometer/Thermometer Supports
Magnetic Coupling	Viton Sealing
Totalizing Roller Counter (8-digit)	Level, Levelling Feet

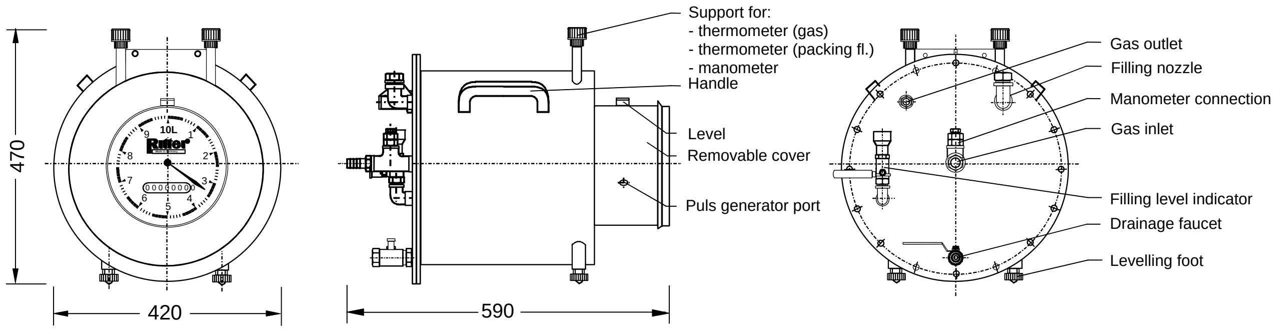
Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Manometer, range 10 mbar differential pressure
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)
High Precision Liquid Level Indicator (HPLI)

Ritter Made in Germany	**DRUM-TYPE GAS METERS** **Data Sheet** **Type: TG 10 Mod. 1-4**	**01.14** V 3.3 Rev. 02/2011



Performance Data:

Minimum flow Q_{min}	20	ltr/h	**Maximum gas inlet pressure**	**500**	**mbar**
Standard flow Q_{stand}	1,000	ltr/h	Minimum differential pressure [1]	0.1	mbar
Maximum flow Q_{max}	1,200	ltr/h	Packing liquid quantity, approx.	21	Ltr
Measurement accuracy			Minimum dial division	0.1	ltr
at standard flow	± 0.2	%	Maximum indication value [2]	99,999,999	ltr
Measurement accuracy			Connection gas in/outlet	Hose barb	
across measuring range	± 0.5	%	Hose barb outside diameter	25	mm
Measuring drum volume	10.0	ltr/Rev.			

[1] Differential pressure (= pressure loss) gas inlet ⇒ gas outlet   [2] Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
1	Stainless steel	PVC-grey	25.6	40
2	Stainless Steel	PE-el	25.2	60
3	Stainless steel	PP-grey	25.2	80
4	Stainless steel	PVDF	25.8	80

• **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

4-Chamber Measuring Drum	Manometer/Thermometer Supports
Magnetic Coupling	Viton Sealing
Totalizing Roller Counter (8-digit)	Level, Levelling Feet

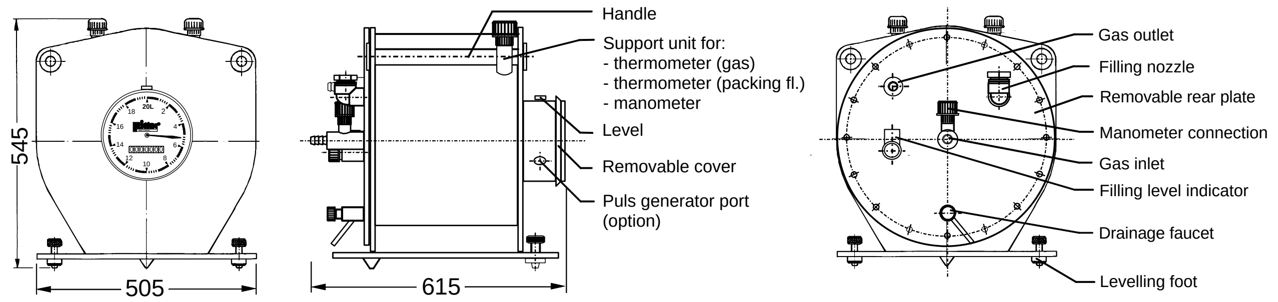
Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Manometer, range 10 mbar differential pressure
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)
High Precision Liquid Level Indicator (HPLI)

Subject to alterations



Performance Data:

Minimum flow Q_{min}	40 ltr/h		**Maximum gas inlet pressure**	**50**	**mbar**
Standard flow Q_{stand}	3,200 ltr/h		Minimum differential pressure[1)]	0.1	mbar
Maximum flow Q_{max}	4,000 ltr/h		Packing liquid quantity, approx.	28.5	Ltr
Measurement accuracy			Minimum dial division	0.2	ltr
at standard flow	± 0.2 %		Maximum indication value [2)]	999,999.990	ltr
Measurement accuracy			Connection gas in/outlet	Hose barb	
across measuring range	± 0.5 %		Hose barb outside diameter	25	mm
Measuring drum volume	20.0 ltr/Rev.				

[1)]Differential pressure (= pressure loss) gas inlet ⇒ gas outlet   [2)]Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
5	PVC-transparent	PVC-grey	18.0	40
6	PP-grey	PP-grey	13.4	80
7	PVDF	PVDF	23.2	80
8	PE-el	PE-el	13.4	60

- **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

4-Chamber Measuring Drum	Manometer/Thermometer Supports
Magnetic Coupling	Viton Sealing
Totalizing Roller Counter, 9 digits, last digit (unit) = 0	Level, Levelling Feet

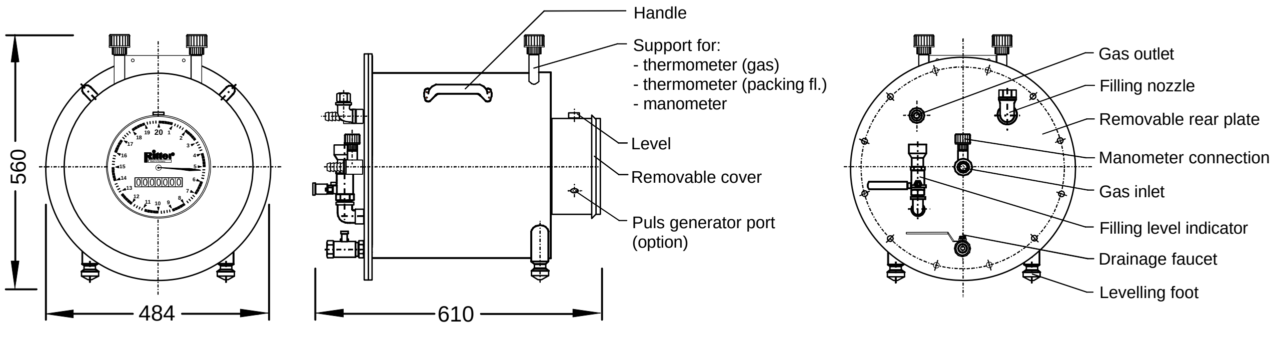
Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Manometer, range 10 mbar differential pressure
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)
High Precision Liquid Level Indicator (HPLI)

DRUM-TYPE GAS METERS
Data Sheet
Type: TG 20 Mod. 1-4



Performance Data:

Minimum flow Q_{min}	40	ltr/h	**Maximum gas inlet pressure**	**500**	**mbar**
Standard flow Q_{stand}	3,200	ltr/h	Minimum differential pressure[1)]	0.1	mbar
Maximum flow Q_{max}	4,000	ltr/h	Packing liquid quantity, approx.	30	Ltr
Measurement accuracy			Minimum dial division	0.2	ltr
at standard flow	± 0.2	%	Maximum indication value [2)]	999,999.990	ltr
Measurement accuracy			Connection gas in/outlet	Hose barb	
across measuring range	± 0.5	%	Hose barb outside diameter	25	mm
Measuring drum volume	20.0	ltr/Rev.			

[1)]Differential pressure (= pressure loss) gas inlet ⇒ gas outlet

[2)]Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
1	Stainless steel	PVC-grey	32.5	40
2	Stainless Steel	PE-el	32.1	60
3	Stainless steel	PP-grey	32.1	80
4	Stainless steel	PVDF	33.3	80

- **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

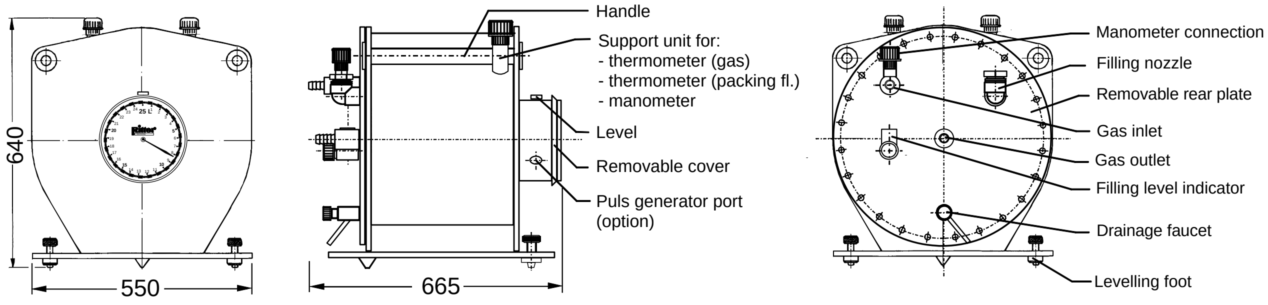
4-Chamber Measuring Drum	Manometer/Thermometer Supports
Magnetic Coupling	Viton Sealing
Totalizing Roller Counter, 9 digits, last digit (unit) = 0	Level, Levelling Feet

Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Manometer, range 10 mbar differential pressure
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)
High Precision Liquid Level Indicator (HPLI)



Performance Data:

Minimum flow Q_{min}	50	ltr/h	**Maximum gas inlet pressure**	**50**	**mbar**
Standard flow Q_{stand}	5,000	ltr/h	Minimum differential pressure[1)]	0.1	mbar
Maximum flow Q_{max}	7,000	ltr/h	Packing liquid quantity, approx.	42	Ltr
Measurement accuracy			Minimum dial division	0.1	ltr
at standard flow	± 0.2	%	Maximum indication value [2)]	999,999,990	ltr
Measurement accuracy			Connection gas in/outlet	Hose barb	
across measuring range	± 0.5	%	Hose barb outside diameter	32	mm
Measuring drum volume	25	ltr/Rev.			

[1)]Differential pressure (= pressure loss) gas inlet ⇒ gas outlet

[2)]Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
5	PVC-transparent	PVC-grey	26.7	40
6	PP-grey	PP-grey	19.4	80
7	PVDF	PVDF	34.5	80
8	PE-el	PE-el	19.4	60

• **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

5-Chamber Measuring Drum	Manometer/Thermometer Supports
Magnetic Coupling	Viton Sealing
Totalizing Roller Counter, 9 digits, last digit (unit) = 0	Level, Levelling Feet

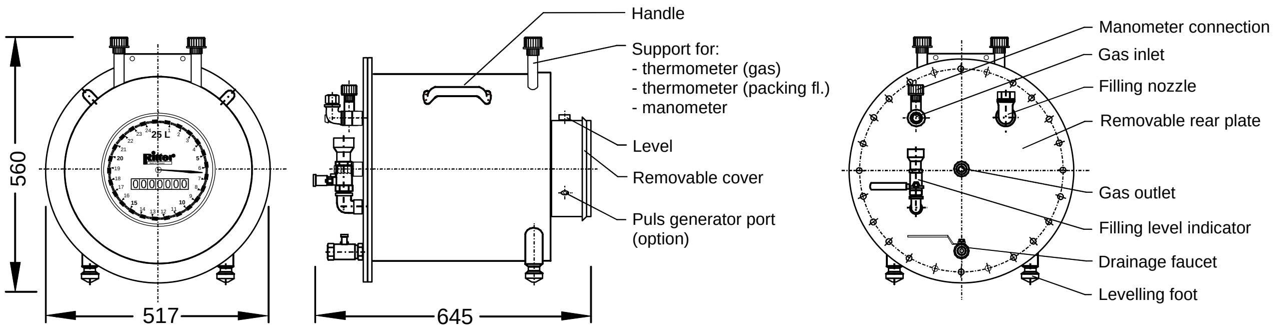
Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Manometer, range 10 mbar differential pressure
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)
High Precision Liquid Level Indicator (HPLI)

Ritter Made in Germany	**DRUM-TYPE GAS METERS** **Data Sheet** **Type: TG 25 Mod. 1-4**	**01.18** V 3.1 Rev. 02/2011



Performance Data:

Minimum flow Q_{min}	50	ltr/h	**Maximum gas inlet pressure**	**500**	**mbar**
Standard flow Q_{stand}	5,000	ltr/h	Minimum differential pressure[1)]	0.1	mbar
Maximum flow Q_{max}	7,000	ltr/h	Packing liquid quantity, approx.	39	Ltr
Measurement accuracy			Minimum dial division	0.1	ltr
at standard flow	± 0.2	%	Maximum indication value [2)]	999,999,990	ltr
Measurement accuracy			Connection gas in/outlet	Hose barb	
across measuring range	± 0.5	%	Hose barb outside diameter	25	mm
Measuring drum volume	25	ltr/Rev.			

[1)]Differential pressure (= pressure loss) gas inlet ⇒ gas outlet [2)]Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
1	Stainless steel	PVC-grey	38.0	40
2	Stainless Steel	PE-el	37.6	60
3	Stainless steel	PP-grey	37.6	80
4	Stainless steel	PVDF	38.8	80

- **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

5-Chamber Measuring Drum	Manometer/Thermometer Supports
Magnetic Coupling	Viton Sealing
Totalizing Roller Counter, 9 digits, last digit (unit) = 0	Level, Levelling Feet

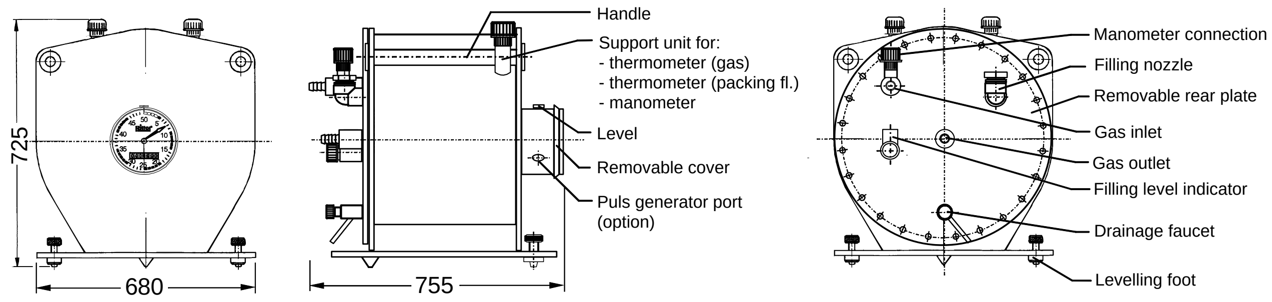
Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Manometer, range 10 mbar differential pressure
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)
High Precision Liquid Level Indicator (HPLI)

Subject to alterations



Performance Data:

Minimum flow Q_{min}	100	ltr/h	**Maximum gas inlet pressure**	**50**	**mbar**
Standard flow Q_{stand}	10,000	ltr/h	Minimum differential pressure[1)]	0.1	mbar
Maximum flow Q_{max}	18,000	ltr/h	Packing liquid quantity, approx.	91	Ltr
Measurement accuracy			Minimum dial division	0.5	ltr
at standard flow	± 0.2	%	Maximum indication value [2)]	999,999,990	ltr
Measurement accuracy			Connection gas in/outlet	Hose barb	
across measuring range	± 0.5	%	Hose barb outside diameter	40	mm
Measuring drum volume	50.0	ltr/Rev.			

[1)]Differential pressure (= pressure loss) gas inlet ⇒ gas outlet   [2)]Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
5	PVC-transparent	PVC-grey	57.0	40
6	PP-grey	PP-grey	32.0	80
7	PVDF	PVDF	73.3	80
8	PE-el	PE-el	40.7	60

- **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

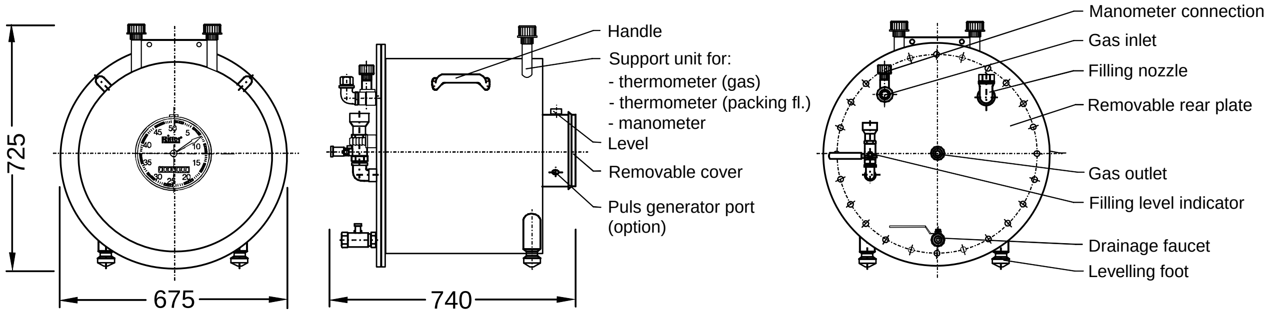
4-Chamber Measuring Drum	Manometer/Thermometer Supports
Magnetic Coupling	Viton Sealing
Totalizing Roller Counter, 9 digits, last digit (unit) = 0	Level, Levelling Feet

Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Manometer, range 10 mbar differential pressure
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)
High Precision Liquid Level Indicator (HPLI)



Performance Data:

Minimum flow Q_{min}	100	ltr/h	**Maximum gas inlet pressure**	**500**	**mbar**
Standard flow Q_{stand}	10,000	ltr/h	Minimum differential pressure[1)]	0.1	mbar
Maximum flow Q_{max}	18,000	ltr/h	Packing liquid quantity, approx.	88	Ltr
Measurement accuracy			Minimum dial division	0.5	ltr
at standard flow	± 0.2	%	Maximum indication value [2)]	999,999,990	ltr
Measurement accuracy			Connection gas in/outlet	Hose barb	
across measuring range	± 0.5	%	Hose barb outside diameter	40	mm
Measuring drum volume	50.0	ltr/Rev.			

[1)]Differential pressure (= pressure loss) gas inlet ⇒ gas outlet [2)]Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
1	Stainless steel	PVC-grey	65.5	40
2	Stainless Steel	PE-el	64.5	60
3	Stainless steel	PP-grey	64.5	80
4	Stainless steel	PVDF	68.7	80

- **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

4-Chamber Measuring Drum	Manometer/Thermometer Supports
Magnetic Coupling	Viton Sealing
Totalizing Roller Counter, 9 digits, last digit (unit) = 0	Level, Levelling Feet

Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Manometer, range 10 mbar differential pressure
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)
High Precision Liquid Level Indicator (HPLI)

DRUM-TYPE GAS METERS

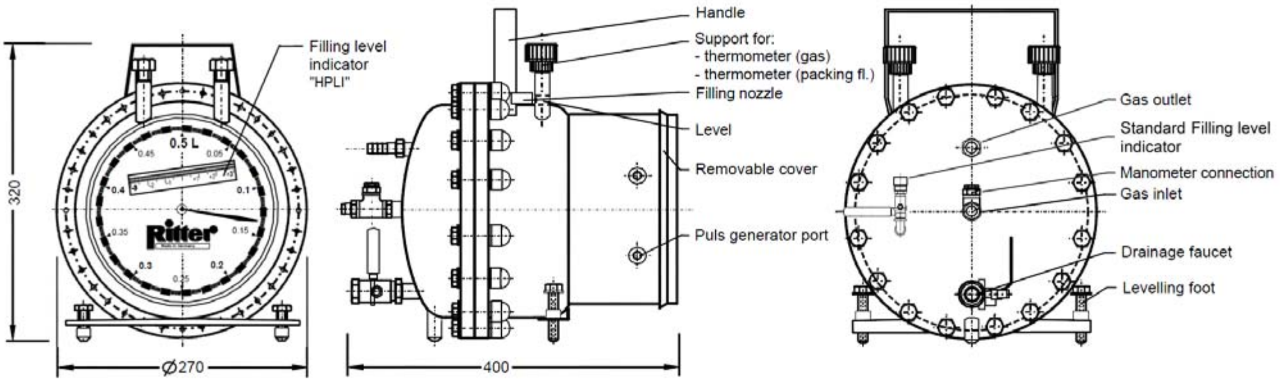
Data Sheet

Type: TG 05 Mod. 1-4 – 6 bars

01.21

V 1.2

Rev. 07/2013



Performance Data:

Minimum flow Q_{min}	1	ltr/h	**Maximum gas inlet pressure**	**6**	**bars**
Standard flow Q_{stand}	50	ltr/h	Minimum differential pressure [1)]	0.2	mbar
Maximum flow Q_{max}	60	ltr/h	Packing liquid quantity, approx.	4.0	Ltr
Measurement accuracy			Minimum dial division	0.002	ltr
at standard flow	± 0.2	%	Maximum indication value [2)]	9,999,999.9	ltr
across flow rate range	± 0.5	%	Connection gas in/outlet	Hose barb	
Measuring drum volume	0.5	ltr/Rev.	Hose barb diameter (external)	11	mm

[1)]Differential pressure (= pressure loss) gas inlet ⇒ gas outlet [2)]Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
1	Stainless steel	PVC-grey	14.3	40
2	Stainless steel	PE-el	14.1	60
3	Stainless steel	PP-grey	14.1	80
4	Stainless steel	PVDF	14.0	80

- **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

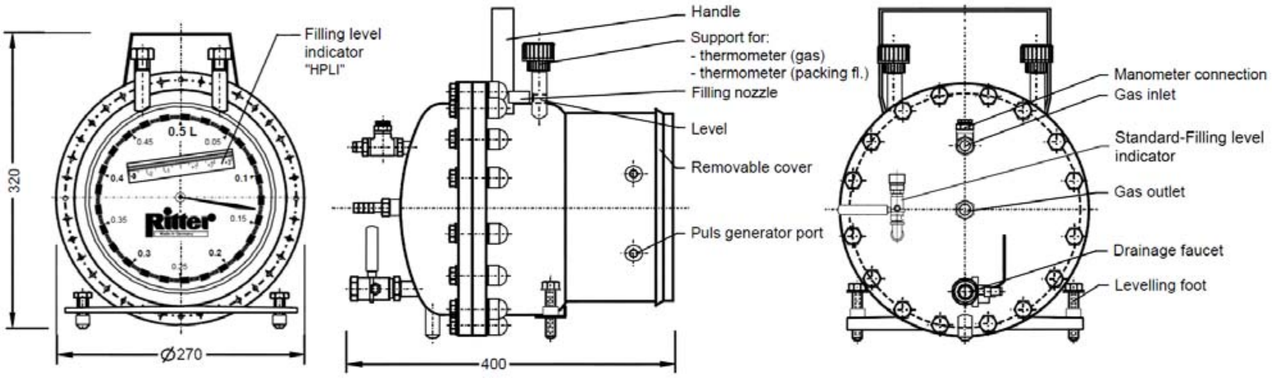
High Precision Liquid Level Indicator (HPLI)	Manometer/Thermometer Supports
4-Chamber Measuring Drum	Viton Sealing
Magnetic Coupling	Level, Levelling Feet
Totalizing Roller Counter (8 digits)	

Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)



Performance Data:

Minimum flow Q_{min}	1	ltr/h	**Maximum gas inlet pressure**	**6**	**bars**
Standard flow Q_{stand}	50	ltr/h	Minimum differential pressure [1)]	0.2	mbar
Maximum flow Q_{max}	60	ltr/h	Packing liquid quantity, approx.	4.0	Ltr
Measurement accuracy			Minimum dial division	0.002	ltr
at standard flow	± 0.2	%	Maximum indication value [2)]	9,999,999.9	ltr
across flow rate range	± 0.5	%	Connection gas in/outlet	Hose barb	
Measuring drum volume	0.5	ltr/Rev.	Hose barb diameter (external)	11	mm

[1)]Differential pressure (= pressure loss) gas inlet ⇒ gas outlet
[2)]Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
1	Stainless steel	PVC-grey	14.0	40
2	Stainless steel	PE-el	13.9	60
3	Stainless steel	PP-grey	13.9	80
4	Stainless steel	PVDF	14.2	80

• **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

High Precision Liquid Level Indicator (HPLI)	Manometer/Thermometer Supports
4-Chamber Measuring Drum	Viton Sealing
Magnetic Coupling	Level, Levelling Feet
Totalizing Roller Counter (8 digits)	

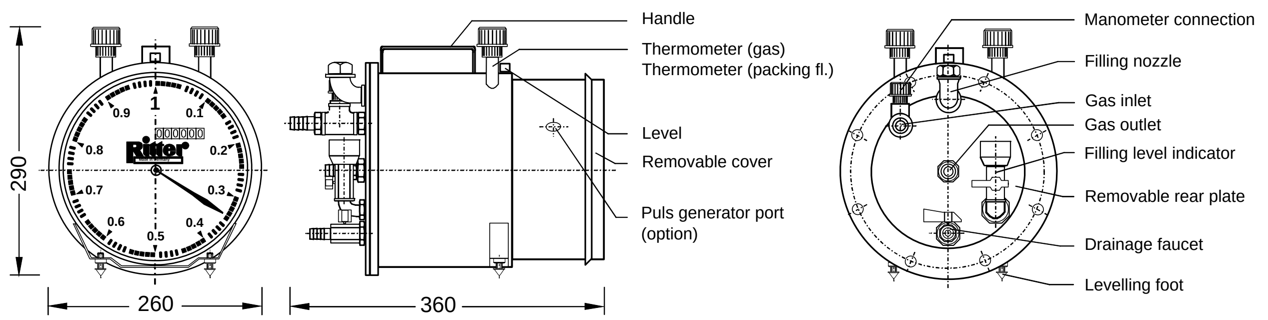
Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)
High Precision Liquid Level Indicator (HPLI)

Ritter Made in Germany	**DRUM-TYPE GAS METERS** **Data Sheet** Type: TG 1 Mod. 1-4 / 1 bar	**01.23** V 1.0 Rev. 02/2011



Performance Data:

Minimum flow Q_{min}	2	ltr/h	**Maximum gas inlet pressure**	**1**	**bar**
Standard flow Q_{stand}	100	ltr/h	Minimum differential pressure[1)]	0.2	mbar
Maximum flow Q_{max}	120	ltr/h	Packing liquid quantity, approx.	3.0	Ltr
Measurement accuracy			Measurement accuracy	± 0.2	%
at standard flow	± 0.2	%	Maximum indication value [2)]	99,999,999	ltr
across flow rate range	± 0.5	%	Connection gas in/outlet	Hose barb	
Measuring drum volume	1.0	ltr/Rev.	Hose barb diameter (external)	12	mm

[1)]Differential pressure (= pressure loss) gas inlet ⇒ gas outlet

[2)]Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
1	Stainless steel	PVC-grey	8.5	40
2	Stainless Steel	PE-el	8.3	60
3	Stainless steel	PP-grey	8.3	80
4	Stainless steel	PVDF	8.9	80

• **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

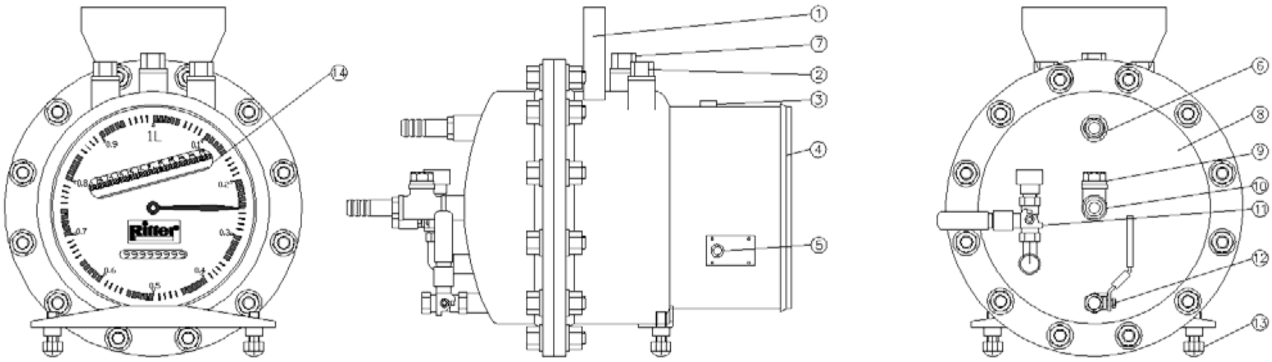
4-Chamber Measuring Drum	Manometer/Thermometer Supports
Magnetic Coupling	Viton Sealing
Totalizing Roller Counter (8 digits)	Level, Levelling Feet

Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

<u>Built-in Options:</u>

LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)
High Precision Liquid Level Indicator (HPLI)



1 Handle
2 Support for gas & packing fluid thermometer
3 Level
4 Removable cover
5 Pulse generator port (option)
6 Gas outlet
7 Filling nozzle
8 Removable rear plate
9 Manometer connection
10 Gas inlet
11 Standard Level indicator
12 Drainage faucet
13 Levelling foot
14 High precision level indicator "HPLI"

Performance Data:

Minimum flow Q_{min}	2	ltr/h	**Maximum gas inlet pressure**	**6**	**bar**
Standard flow Q_{stand}	100	ltr/h	Minimum differential pressure[1)]	0.2	mbar
Maximum flow Q_{max}	120	ltr/h	Packing liquid quantity, approx.	4.5	Ltr
Measurement accuracy			Minimum dial division	0.01	ltr
at standard flow	± 0.2	%	Maximum indication value [2)]	99,999,999	ltr
across flow rate range	± 0.5	%	Connection gas in/outlet	NPT ¼" female	
Measuring drum volume	1.0	ltr/Rev.			

[1)]Differential pressure (= pressure loss) gas inlet ⇒ gas outlet
[2)]Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
1	Stainless steel	PVC-grey	14.0	40
2	Stainless Steel	PE-el	13.9	60
3	Stainless steel	PP-grey	13.9	80
4	Stainless steel	PVDF	14.2	80

- **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

High Precision Liquid Level Indicator (HPLI)	Manometer/Thermometer Supports
4-Chamber Measuring Drum	Viton Sealing
Magnetic Coupling	Level, Levelling Feet
Totalizing Roller Counter (8 digits)	

Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

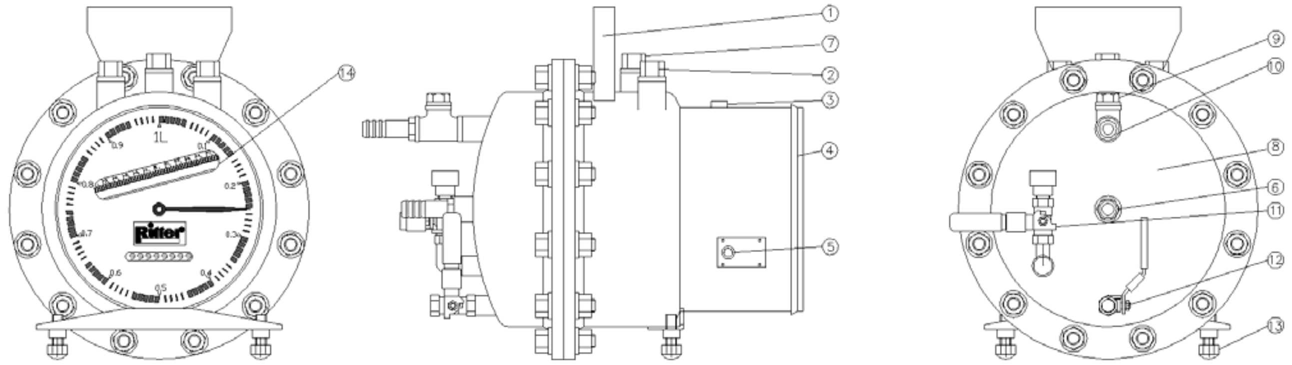
Built-in Options:

LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)

Subject to alterations

DRUM-TYPE GAS METERS
Data Sheet
Type: TG 1-ER Mod. 1-4 / 6 bar

01.25
V 1.2
Rev. 07/2013



1 Handle 2 Support for gas & packing fluid thermometer 3 Level	4 Removable cover 5 Pulse generator port (option) 6 Gas outlet	7 Filling nozzle 8 Removable rear plate 9 Manometer connection	10 Gas inlet 11 Standard Level indicator 12 Drainage faucet	13 Levelling foot 14 High precision level indicator "HPLI"

Performance Data:

Minimum flow Q_{min}	2	ltr/h	**Maximum gas inlet pressure**	**6**	**bar**
Standard flow Q_{stand}	200	ltr/h	Minimum differential pressure[1)]	0.2	mbar
Maximum flow Q_{max}	250	ltr/h	Packing liquid quantity, approx.	4.0	Ltr
Measurement accuracy			Minimum dial division	0.01	ltr
at standard flow	± 0.2	%	Maximum indication value [2)]	99,999,999	ltr
across flow rate range	± 0.5	%	Connection gas in/outlet	NPT ¼" female	
Measuring drum volume	1.0	ltr/Rev.			

[1)]Differential pressure (= pressure loss) gas inlet ⇒ gas outlet
[2)]Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
1	Stainless steel	PVC-grey	14.0	40
2	Stainless Steel	PE-el	13.9	60
3	Stainless steel	PP-grey	13.9	80
4	Stainless steel	PVDF	14.2	80

• **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

High Precision Liquid Level Indicator (HPLI)	Manometer/Thermometer Supports
4-Chamber Measuring Drum	Viton Sealing
Magnetic Coupling	Level, Levelling Feet
Totalizing Roller Counter (8 digits)	

Accessories:

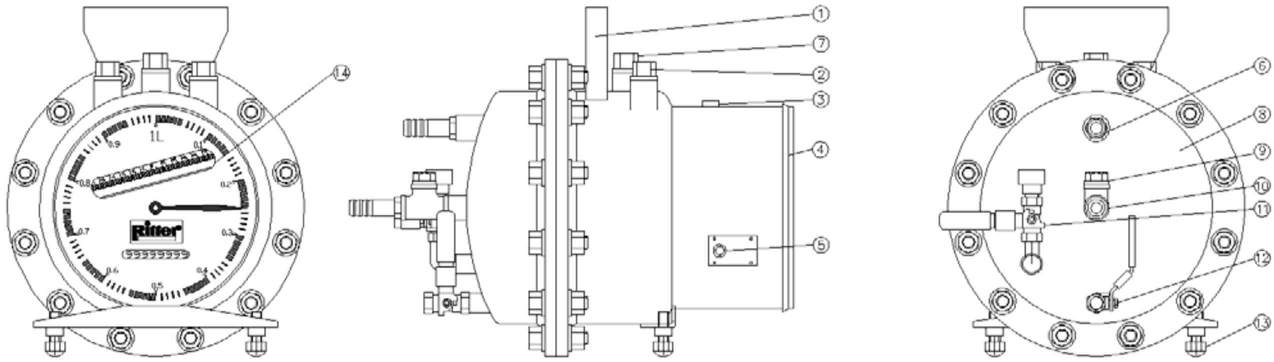
Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)

Subject to alterations

Ritter Made in Germany	**DRUM-TYPE GAS METERS** **Data Sheet** Type: TG 1 Mod. 1-4 / 10 bar	**01.26** V 1.2 Rev. 07/2013



1 Handle
2 Support for gas & packing fluid thermometer
3 Level
4 Removable cover
5 Pulse generator port (option)
6 Gas outlet
7 Filling nozzle
8 Removable rear plate
9 Manometer connection
10 Gas inlet
11 Standard Level indicator
12 Drainage faucet
13 Levelling foot
14 High precision level indicator "HPLI"

Performance Data:

Minimum flow Q_{min}	2	ltr/h	**Maximum gas inlet pressure**	**10**	**bar**
Standard flow Q_{stand}	100	ltr/h	Minimum differential pressure[1)]	0.2	mbar
Maximum flow Q_{max}	120	ltr/h	Packing liquid quantity, approx.	4.0	Ltr
Measurement accuracy			Minimum dial division	0.01	ltr
at standard flow	± 0.2	%	Maximum indication value [2)]	99,999,999	ltr
across flow rate range	± 0.5	%	Connection gas in/outlet	NPT ¼" female	
Measuring drum volume	1.0	ltr/Rev.			

[1)]Differential pressure (= pressure loss) gas inlet ⇒ gas outlet [2)]Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
1	Stainless steel	PVC-grey	14.3	40
2	Stainless Steel	PE-el	14.1	60
3	Stainless steel	PP-grey	14.1	80
4	Stainless steel	PVDF	14.7	80

• **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

High Precision Liquid Level Indicator (HPLI)	Manometer/Thermometer Supports
4-Chamber Measuring Drum	Viton Sealing
Magnetic Coupling	Level, Levelling Feet
Totalizing Roller Counter (8 digits)	

Accessories:

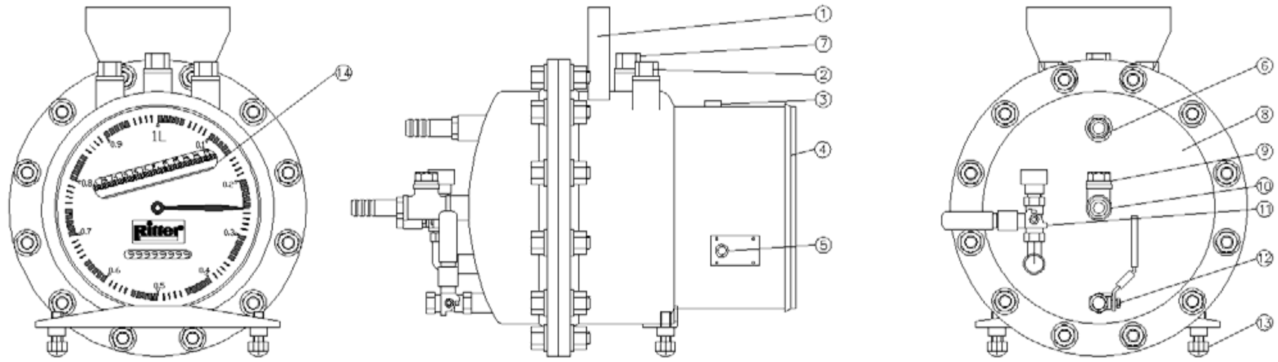
Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)

DRUM-TYPE GAS METERS
Data Sheet
Type: TG 1 Mod. 1-4 / 16 bar

01.27
V 1.2
Rev. 07/2013



1 Handle
2 Support for gas & packing fluid thermometer
3 Level
4 Removable cover
5 Pulse generator port (option)
6 Gas outlet
7 Filling nozzle
8 Removable rear plate
9 Manometer connection
10 Gas inlet
11 Standard Level indicator
12 Drainage faucet
13 Levelling foot
14 High precision level indicator "HPLI"

Performance Data:

Minimum flow Q_{min}	2	ltr/h	**Maximum gas inlet pressure**	**16**	**bar**
Standard flow Q_{stand}	100	ltr/h	Minimum differential pressure[1)]	0.2	mbar
Maximum flow Q_{max}	120	ltr/h	Packing liquid quantity, approx.	4.0	Ltr
Measurement accuracy			Minimum dial division	0.01	ltr
at standard flow	± 0.2	%	Maximum indication value [2)]	99,999,999	ltr
across flow rate range	± 0.5	%	Connection gas in/outlet	NPT ¼" female	
Measuring drum volume	1.0	ltr/Rev.			

[1)]Differential pressure (= pressure loss) gas inlet ⇒ gas outlet
[2)]Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
1	Stainless steel	PVC-grey	14.3	40
2	Stainless Steel	PE-el	14.1	60
3	Stainless steel	PP-grey	14.1	80
4	Stainless steel	PVDF	14.7	80

• **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

High Precision Liquid Level Indicator (HPLI)	Manometer/Thermometer Supports
4-Chamber Measuring Drum	Viton Sealing
Magnetic Coupling	Level, Levelling Feet
Totalizing Roller Counter (8 digits)	

Accessories:

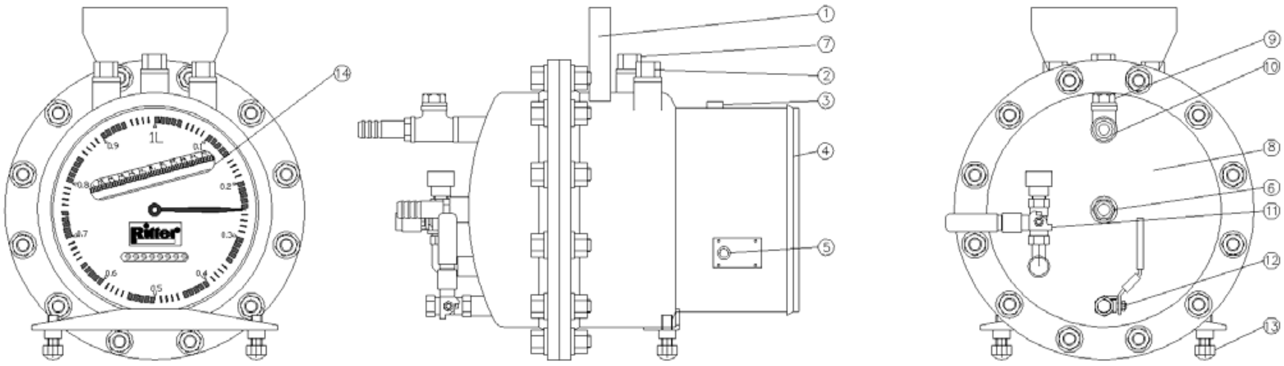
Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

<u>Built-in Options:</u>

LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)

Subject to alterations

Ritter Made in Germany	**DRUM-TYPE GAS METERS** **Data Sheet** Type: TG 1-ER Mod. 1-4 / 16 bar	**01.28** V 1.2 Rev. 07/2013



1 Handle
2 Support for gas & packing fluid thermometer
3 Level
4 Removable cover
5 Pulse generator port (option)
6 Gas outlet
7 Filling nozzle
8 Removable rear plate
9 Manometer connection
10 Gas inlet
11 Standard Level indicator
12 Drainage faucet
13 Levelling foot
14 High precision level indicator "HPLI"

Performance Data:

Minimum flow Q_{min}	2	ltr/h	**Maximum gas inlet pressure**	**16**	**bar**
Standard flow Q_{stand}	200	ltr/h	Minimum differential pressure[1)]	0.2	mbar
Maximum flow Q_{max}	250	ltr/h	Packing liquid quantity, approx.	4.0	Ltr
Measurement accuracy			Minimum dial division	0.01	ltr
at standard flow	± 0.2	%	Maximum indication value [2)]	99,999,999	ltr
across flow rate range	± 0.5	%	Connection gas in/outlet	NPT ¼" female	
Measuring drum volume	1.0	ltr/Rev.			

[1)]Differential pressure (= pressure loss) gas inlet ⇒ gas outlet [2)]Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
1	Stainless steel	PVC-grey	14.3	40
2	Stainless Steel	PE-el	14.1	60
3	Stainless steel	PP-grey	14.1	80
4	Stainless steel	PVDF	14.7	80

- **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

High Precision Liquid Level Indicator (HPLI)	Manometer/Thermometer Supports
4-Chamber Measuring Drum	Viton Sealing
Magnetic Coupling	Level, Levelling Feet
Totalizing Roller Counter (8 digits)	

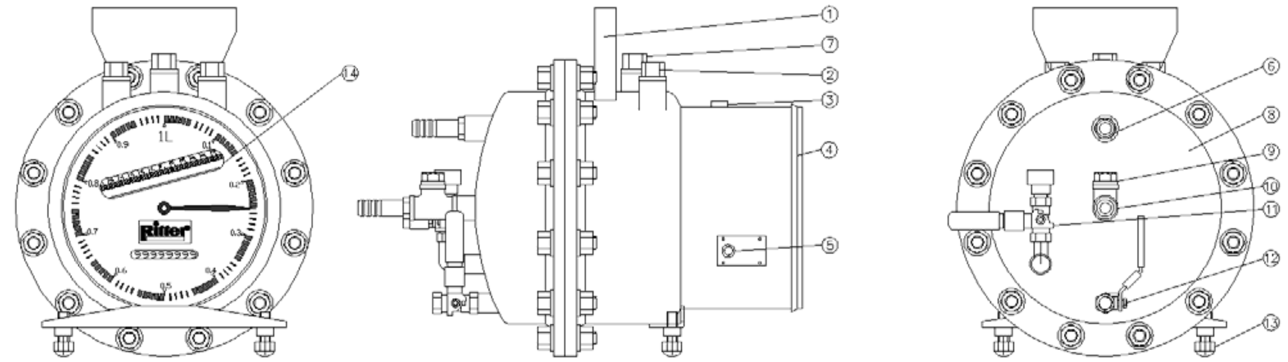
Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)

Ritter Made in Germany	**DRUM-TYPE GAS METERS** **Data Sheet** Type: TG 1 Mod. 1-4 / 35 bar	**01.29** V 1.2 Rev. 07/2013



1 Handle
2 Support for gas & packing fluid thermometer
3 Level
4 Removable cover
5 Pulse generator port (option)
6 Gas outlet
7 Filling nozzle
8 Removable rear plate
9 Manometer connection
10 Gas inlet
11 Standard Level indicator
12 Drainage faucet
13 Levelling foot
14 High precision level indicator "HPLI"

Performance Data:

Minimum flow Q_{min}	2	ltr/h	**Maximum gas inlet pressure**	**35**	**Bar**
Standard flow Q_{stand}	100	ltr/h	Minimum differential pressure[1)]	0.2	Mbar
Maximum flow Q_{max}	120	ltr/h	Packing liquid quantity, approx.	4.0	Ltr
Measurement accuracy			Minimum dial division	0.01	Ltr
at standard flow	± 0.2	%	Maximum indication value [2)]	99,999,999	Ltr
across flow rate range	± 0.5	%	Connection gas in/outlet	NPT ¼" female	
Measuring drum volume	1.0	ltr/Rev.			

[1)]Differential pressure (= pressure loss) gas inlet ⇒ gas outlet [2)]Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
1	Stainless steel	PVC-grey	18.3	40
2	Stainless Steel	PE-el	18.1	60
3	Stainless steel	PP-grey	18.1	80
4	Stainless steel	PVDF	18.7	80

• **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

High Precision Liquid Level Indicator (HPLI)	Manometer/Thermometer Supports
4-Chamber Measuring Drum	Viton Sealing
Magnetic Coupling	Level, Levelling Feet
Totalizing Roller Counter (8 digits)	

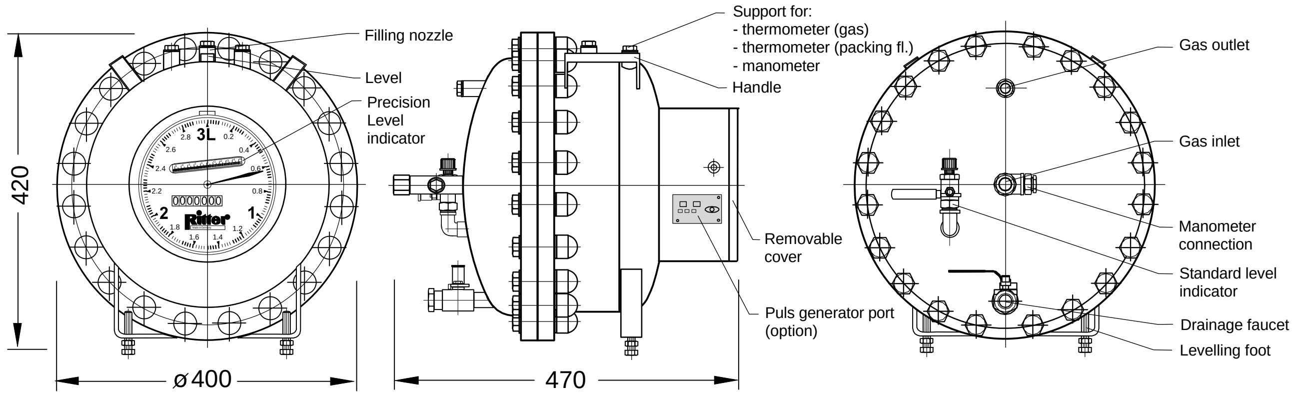
Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)

Subject to alterations



Performance Data:

Minimum flow Q_{min}	10	ltr/h	**Maximum gas inlet pressure**	**6**	**bar**
Standard flow Q_{stand}	500	ltr/h	Minimum differential pressure[1)]	0.2	mbar
Maximum flow Q_{max}	600	ltr/h	Packing liquid quantity, approx.	11.0	Ltr
Measurement accuracy			Minimum dial division	0.02	ltr
at standard flow	± 0.2	%	Maximum indication value [2)]	99,999,999	ltr
Measurement accuracy			Connection gas in/outlet	Hose barb	
across measuring range	± 0.5	%	Hose barb diameter (external)	15	mm
Measuring drum volume	5.0	ltr/Rev.			

[1)]Differential pressure (= pressure loss) gas inlet ⇒ gas outlet [2)]Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
1	Stainless steel	PVC-grey	27.7	40
2	Stainless Steel	PE-el	27.5	60
3	Stainless steel	PP-grey	27.5	80
4	Stainless steel	PVDF	28.1	80

• **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

High Precision Liquid Level Indicator (HPLI)	Manometer/Thermometer Supports
4-Chamber Measuring Drum	Viton Sealing
Magnetic Coupling	Level, Levelling Feet
Totalizing Roller Counter (8 digits)	

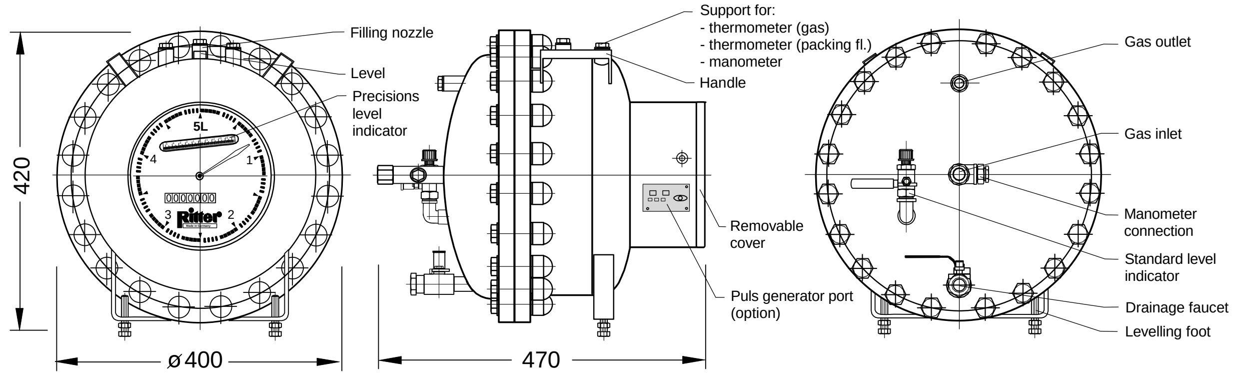
Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)
High Precision Liquid Level Indicator (HPLI)

DRUM-TYPE GAS METERS Data Sheet Type: TG 5 Mod. 1-4 / 6 bar	01.31 V 1.0 Rev. 02/2011



Performance Data:

Minimum flow Q_{min}	10	ltr/h	**Maximum gas inlet pressure**	**6**	**bar**
Standard flow Q_{stand}	500	ltr/h	Minimum differential pressure[1)]	0.2	mbar
Maximum flow Q_{max}	600	ltr/h	Minimum dial division	0.02	ltr
Measurement accuracy	± 0.2	%	Maximum indication value [2)]	99,999,999	ltr
Packing liquid quantity, approx.	12	Ltr	Connection gas in/outlet	Hose barb	
Measuring drum volume	5.0	ltr/Rev.	Hose barb diameter (external)	15	mm

[1)]Differential pressure (= pressure loss) gas inlet ⇒ gas outlet [2)]Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
1	Stainless steel	PVC-grey	31.1	40
2	Stainless Steel	PE-el	30.9	60
3	Stainless steel	PP-grey	30.9	80
4	Stainless steel	PVDF	31.5	80

• **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

High Precision Liquid Level Indicator (HPLI)	Manometer/Thermometer Supports
4-Chamber Measuring Drum	Viton Sealing
Magnetic Coupling	Level, Levelling Feet
Totalizing Roller Counter (8 digits)	

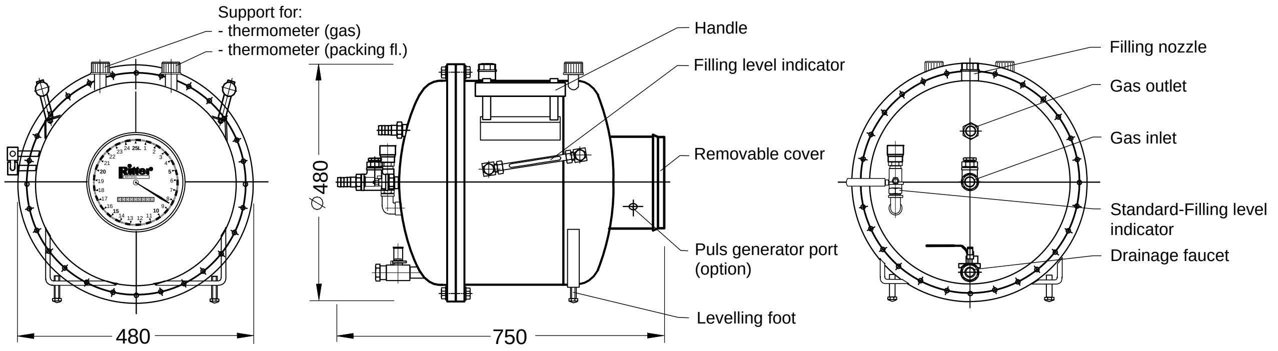
Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:
LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)

Subject to alterations

Ritter Made in Germany	**DRUM-TYPE GAS METERS** **Data Sheet** Type: TG 20 Mod. 1-4 6 bar	**01.32** V 1.0 Rev. 02/2011



Performance Data:

Minimum flow Q_{min}	40	ltr/h	**Maximum gas inlet pressure**	**6**	**bar**
Standard flow Q_{stand}	3,200	ltr/h	Minimum differential pressure[1)]	0.1	mbar
Maximum flow Q_{max}	4,000	ltr/h	Minimum dial division	0.2	ltr
Measurement accuracy	± 0.2	%	Maximum indication value [2)]	999,999,990	ltr
Packing liquid quantity, approx.	35	Ltr	Connection gas in/outlet	Hose barb	
Measuring drum volume	20.0	ltr/Rev.	Hose barb diameter (ext./int.)	25/18	mm

[1)]Differential pressure (= pressure loss) gas inlet ⇒ gas outlet

[2)]Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
1	Stainless steel	PVC-grey	45.0	40
2	Stainless steel	PE-el	44.5	60
3	Stainless steel	PP-grey	44.5	80
4	Stainless steel	PVDF	46.6	80

• **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

High Precision Liquid Level Indicator (HPLI)	Manometer/Thermometer Supports
4-Chamber Measuring Drum	Viton Sealing
Magnetic Coupling	Level, Levelling Feet
Totalizing Roller Counter, 9 digits, last digit (unit) = 0	

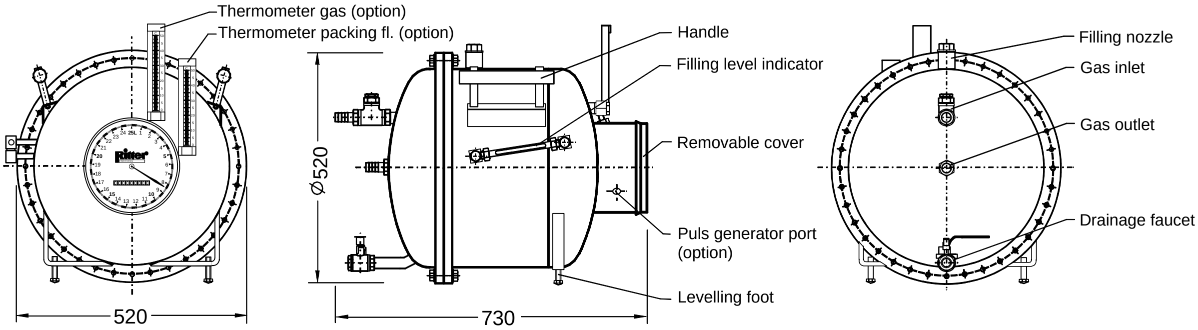
Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Manometer, range 0…6 bar differential pressure
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)
Data acquisition software „Rigamo“, single- & multi-channel versions (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)

Subject to alterations



Performance Data:

Minimum flow Q_{min}	50	ltr/h	**Maximum gas inlet pressure**	**6**	**bar**
Standard flow Q_{stand}	5,000	ltr/h	Minimum differential pressure[1)]	0.1	mbar
Maximum flow Q_{max}	7,000	ltr/h	Minimum dial division	0.2	ltr
Measurement accuracy	± 0.2	%	Maximum indication value [2)]	999,999,990	ltr
Packing liquid quantity, approx.	42	Ltr	Connection gas in/outlet	Hose barb	
Measuring drum volume	25.0	ltr/Rev.	Hose barb diameter (ext./int.)	25/18	mm

[1)]Differential pressure (= pressure loss) gas inlet ⇒ gas outlet
[2)]Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
1	Stainless steel	PVC-grey	53.0	40
2	Stainless Steel	PE-el	52.5	60
3	Stainless steel	PP-grey	52.5	80
4	Stainless steel	PVDF	54.6	80

- **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

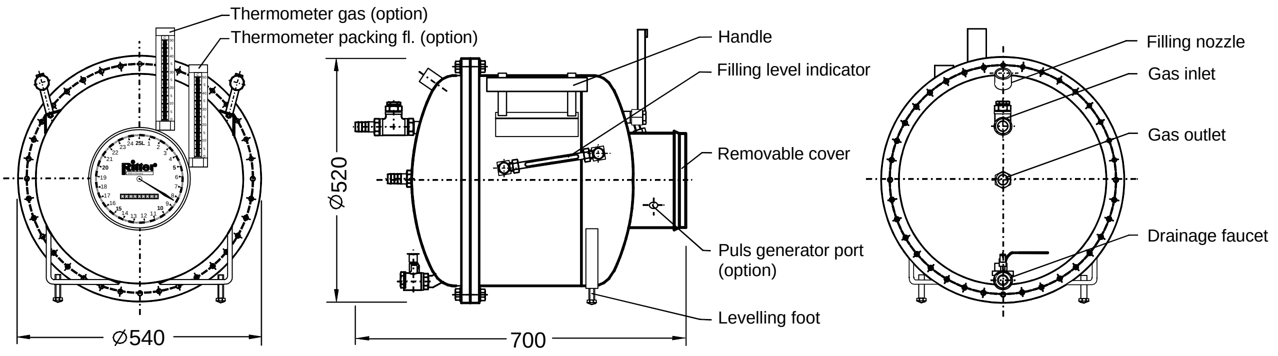
High Precision Liquid Level Indicator (HPLI)
5-Chamber Measuring Drum
Magnetic Coupling
Totalizing Roller Counter, 9 digits, last digit (unit) = 0
Manometer/Thermometer Supports
Viton Sealing
Level, Levelling Feet

Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Manometer, range 0…6 bar differential pressure
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:
LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)

Subject to alterations



Performance Data:

Minimum flow Q_{min}	50	ltr/h	**Maximum gas inlet pressure**	**10**	**bar**
Standard flow Q_{stand}	5,000	ltr/h	Minimum differential pressure[1)]	0.1	mbar
Maximum flow Q_{max}	7,000	ltr/h	Minimum dial division	0.2	ltr
Measurement accuracy	± 0.2	%	Maximum indication value [2)]	999,999,990	ltr
Packing liquid quantity, approx.	46	Ltr	Connection gas in/outlet	Hose barb	
Measuring drum volume	25.0	ltr/Rev.	Hose barb diameter (ext./int.))	25/18	mm

[1)]Differential pressure (= pressure loss) gas inlet ⇒ gas outlet [2)]Standard Totalizing Roller Counter

Models (materials of construction):

Model	Casing	Measuring drum	Weight (kg) (without packing liquid)	Max. constant use temperature °Celsius
1	Stainless steel	PVC-grey	53.0	40
2	Stainless Steel	PE-el	52.5	60
3	Stainless steel	PP-grey	52.5	80
4	Stainless steel	PVDF	54.6	80

• **Caution** Before and after measurements with **oxygen** purge the meter with an inert gas to avoid the danger of **explosion**.

For chemical resistance properties please contact **RITTER**.

Standard Equipment:

High Precision Liquid Level Indicator (HPLI)	Manometer/Thermometer Supports
5-Chamber Measuring Drum	Viton Sealing
Magnetic Coupling	Level, Levelling Feet
Totalizing Roller Counter, 9 digits, last digit (unit) = 0	

Accessories:

Thermometer (gas), range 0° to +60°C
Thermometer (packing liquid), range 0° to +60°C
Manometer, range 10 bar differential pressure
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)

Table of Contents

1. Packing Liquid

1.1. General

By all means, the meter must be filled with the very same packing liquid which the meter was calibrated with! Otherwise major measurement errors will occur!

The Gas Meter (which is shipped dry) must be approximately half-filled with a suitable so-called "Packing Liquid" before first use. The measuring drum which rotates in this packing liquid forms the actual measuring unit in conjunction with the liquid.

The packing liquid has two functions: Firstly, it seals off the active measuring chamber (= measuring chamber inside the measuring drum which is being filled with gas) and secondly, the level of the packing liquid inside the measuring chamber defines the volume of the measuring chamber. The latter function is the basis for calibration of the gas meter's measurement accuracy which is performed at the factory. Because of this, the measurement accuracy is directly dependent on the packing liquid level and so an incorrectly set level at time of installation is bound to cause incorrect measurements (see 2.3).

1.2. The mutual influence of packing liquid and gas

Irrespective of the chosen packing liquid, the packing liquid and the flowing gas inevitably affect each other with respect to **evaporation** and **dissolving**:

1) Absorption of evaporated particles of the packing liquid by the gas,

2) Dissolving of the gas in the packing liquid up to the saturation limit.

Generally valid figures and limit values for the mutual influence of gas and packing liquid cannot be stated, because they depend to a very great extent on the particular gas and its state. For example, when water is used as a packing liquid, a dry, warm gas absorbs significantly more evaporated water particles than a moist, cold gas.

The solubility of gases in the packing liquid also varies greatly: for example, the solubility in "Autin-B" White Oil (mentioned below) of nitrogen is 6 %, air 7 to 8 %, oxygen 12 %, carbon dioxide 90 % (volume % at 20 °C). The gas can, of course, only dissolve in the packing liquid up to the saturation limit. A measuring error caused by solubility can be avoided if the gas can dissolve in the packing liquid up to the saturation limit during test operation before the experiments are subsequently carried out.

1.3. Selection of packing liquid

The criterion for choosing a packing fluid should be that any mutual influence between the packing fluid and the flowing gas should be as small as possible, or that the effects can be ignored. In most cases, water can be used as the packing fluid. No special requirements for the water are necessary - that means that normal clean tap water can be used.

When water is not suitable to be used as the packing fluid, oils or synthetic fluids can be used. Generally speaking, a thin-bodied fluid (ideal: viscosity of water) with a low vapour pressure (ideal: <0.1 mbar/hPa) should be selected. A thin-bodied fluid causes a small friction resistance of the rotating measuring drum only, and hereby a small pressure difference between gas inlet and outlet of the meter. This, in return, results in a better (more flat) calibration curve. A low vapour pressure reduces the (unavoidable) evaporation of the packing liquid. Hereby a better long term stability of the packing liquid level is obtained and thus more stable measuring results.

RITTER recommends, and can supply, the following alternatives:

- „**Ondina 909**“ or „**Autin-B**“. These oils are paraffinic White Oils. They are colourless, clear and odourless.
- **“Silox”**, a silicone oil belonging to the group of polydimethyl siloxane. It is colourless and clear with a weak odour.
- "***CalRiX***", which is a completely synthetic fluid on a fluorine base. It is almost totally inert, even to the most aggressive gases. It can also be used without difficulty under the most demanding and critical application situations. Further advantages of ***CalRiX*** are: low evaporation rate; a viscosity similar to that of water; 1.8 times the density of water and very low surface tension, which result in a more even rotation of the measuring drum; dry gases remain dry.

2. Installation

2.1. High-Pressure Gas Meters (> 1bar)

Before performing the initial set-up please read the general instructions in Point 4 and continue installation with point 2.2.

2.2. Positioning

Place the drum-type gas meter onto a solid, vibration-free support. Align the gas meter precisely horizontally by means of the integrated level (at top of casing) and the levelling feet.

2.3. Filling with the packing liquid

It is essential to use the very same packing liquid which the gas meter was calibrated with. This packing liquid is stated at the calibration certificate as well as at the calibration label at the gas meter.

Using a different packing liquid other than that used with the calibration will cause a significant measuring error!

Standard-Gas Meters:

- TG 01: Remove the screwed cap of the High Precision Packing Liquid Level Indicator ”HPLI“ on the outer end of the glass tube by unscrewing it (please refer to the Data Sheet ”HPLI“ as well). Open the filling nozzle located at the rear plate by turning the sealing screw anti-clockwise until it is unscrewed. Pour the packing liquid into the gas meter through the filling nozzle.
- TG 05 – TG 50: Open the filling-level indicator located at the rear plate by turning the sealing screw 2 or 3 times anti-clockwise. Please pay attention, that the screw is not unscrewed out of the thread. Open the filling nozzle located at the rear plate by turning the sealing screw anti-clockwise until it is unscrewed. Pour the packing liquid into the gas meter through the filling nozzle.

High-pressure Gas Meters: Loosen and remove the sealing screw of the filling nozzle (hexagonal screw). Pour the selected Packing Liquid into the Gas Meter via the filling nozzle. After setting the Packing Liquid level correctly as described in Point 2.4, replace the sealing screw and firmly tighten it with a spanner.

2.4. Quantity of packing liquid (Adjusting the packing liquid level)

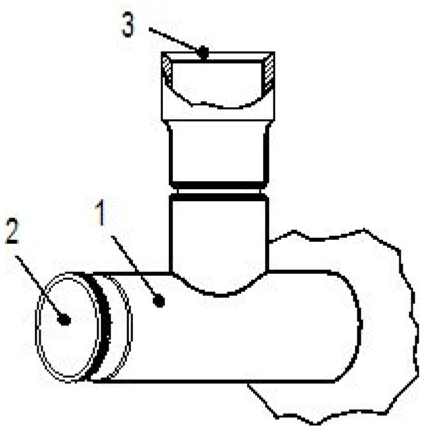
The amount of packing liquid depends on the gas meter size (type) and on the individual setting for each unit. The approximate quantity is shown in the data sheet enclosed with every gas meter. This quantity does not take into account individual differences based on the calibration performed in the factory.

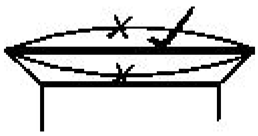
Fine adjustment of the packing liquid level is of greatest significance to the measurement accuracy, **since the measurement accuracy/display depends directly on the packing liquid level and reacts very sensitively to an incorrectly set level!**

The correct packing liquid level is set as follows:

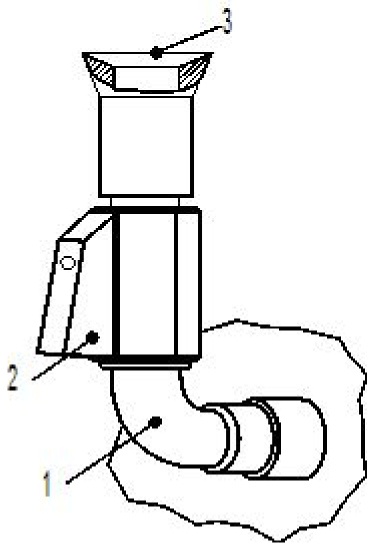
- For Gas Meters with the High Precision Packing Liquid Level Indicator (HPLI): please refer to the HPLI Data Sheet.
- For Gas Meters with the standard Packing Liquid Level Indicator (located at the rear plate of the Meter):

When the filling-level indicator (1) is opened by turning the sealing screw (2) with Plastic Meters (or stop cock (2) with Stainless Steel Meters), the rising pipe of the level indicator is connected to the packing liquid in the gas meter housing in accordance with the communicating pipes principle. When the level in the gas meter housing rises as a result of topping-up with packing liquid, the level in the level indicator rises in the same way. The correct packing liquid level is reached when the surface of the liquid column in the level indicator is flush with the upper edge of the level indicator (3) and forms neither a dome nor an indent (see middle picture below).





Stainless Steel Meters ⇒



Plastic Meters ⇑

The liquid column can be read off (if water is used as the packing liquid) more easily by reducing the surface tension by adding a drop of detergent. If too much packing liquid has been added, it comes over the level indicator causing the level to adjust itself to a certain extent. Any resulting liquid dome at the upper edge of the level indicator must, however, be remedied by draining off liquid via the drainage nozzles.

A small tip for checking the packing liquid level following an extended downtime of the gas meter: Following an extended downtime, the liquid in the level indicator is mostly evaporated, whereas it is not in the inside of the (closed) housing. If the level indicator's screw plug is now opened, the packing liquid flows out of the housing into the level indicator. Even if the packing liquid level was previously correct inside the housing, packing liquid must now be added and the level re-adjusted. This can be avoided by filling the level indicator with packing liquid **before** the screw plug is opened (neither dome nor indent). If the level does not change **after** the screw plug is opened, the packing liquid level was and still is correct.

2.5. After filling and adjustment of the packing liquid

- TG 01: Replace the screwed cap on the outer end of the sloping tube of the HPLI. Close the filling nozzle by turning the sealing screws clockwise.
- TG 05 – TG 50: Close the filling-level indicator and filling nozzle by turning the respective sealing screws clockwise
- When the Meter is equipped with the HPLI (standard with the TG01)
  When closed, the HPLI can indicate a slightly lower filling level than it did after correct filling of the Meter. This can also occur during operation. This is system-related and does not indicate any error.. The given correct filling level will only be indicated when the Meter is not in operation and simultaneously, when the HPLI is open and not connected to the gas supply so that it is pressure-free.

2.6. Grounding of Gas Meters made out of electrically conductive material (PE-el)

Gas Meters with a casing and/or measuring drum made out of electrically conductive material (PE-el) must be grounded in order to discharge a potential static charge.

To do so the feeder clamp at a flange screw of the meter's rear plate must be connected to ground (earth).

2.7. Connection of gas pipe

Connect the gas pipe to the inlet nozzle marked "gas-inlet" at the rear plate. Allow the meter to perform one or two revolutions in order to remove any possible air bubbles within the measuring drum. Then disconnect the gas pipe again and repeat the steps in paragraphs 2.3 and 2.4.

2.8. Moving of the filled meter

If the Gas Meter has to be moved after having been filled (for example carried into another room), it must be kept in a horizontal position. This is to avoid Packing Liquid getting into the Gas Inlet. If this occurs, the Gas Meter should be tipped 90° forwards (the dial face would then point to the floor). The Packing Liquid can then flow out of the Gas Inlet again (and back into the Meter).

3. Measurement

3.1. Initial set-up

- Type TG 01

  In order to keep the mechanical resistance as low as possible, the TG01 is equipped as Standard with a Pulse Generator instead of with a mechanical counter. There is therefore no display of measured volume at the Gas Meter. Instead, the TG01 is equipped as standard with a pulse generator, from which the signals (= pulses) can be transferred either direct to a Electronic Display Unit EDU 32 FP (recommended) or to a user-specific data logging system which can further process the voltage signals. The EDU 32 FP displays volume and calculates flow rate.

  In order for the pulses to be transmitted, the Output socket of the Pulse Generator (located at the 8 o'clock position on side of the Pulse Generator casing) must be connected via the accompanying cable (2 x 5-pin DIN-plugs) to the Electronic Display Unit EDU 32 FP. The EDU 32 FP must be turned on and programmed for use with the Gas Meter type TG 01 (please see the EDU 32 FP Operating Instructions, chapter 6).

  The Gas Meter is then ready for Operation.

- Type TG 05 – TG 50:

  For ease of reading at the end of measurement, the large Needle of the dial plate can be set manually to zero prior to each measurement. In the case of units with a totalizing roller-type counter (standard version), the counter reading must be noted. On the version with a resettable roller-type counter (optional), the counter can be set to zero with the reset button. The Needles can be set manually to zero on units with a totalizing Needle-type counter (optional).

  The Gas Meter is then ready for Operation.

3.2. Check: Liquid level

Prior to each subsequent measurement, the fluid level must again be checked in accordance with paragraphs 2.3 and 2.4.

3.3. Check: Performance data

When taking measurements, pay attention to the performance data of the respective gas meter (refer to the attached data sheet). **The maximum pressure load is 50 mbar** for the standard drum-type gas meters made out of plastic and **500 mbar** with meters with a stainless steel casing!

3.4. Measurements with oxygen

The mixture of some gases with oxygen may cause an explosion. Therefore, before and after measuring with oxygen, ensure that no gas used in the previous measurement is still within the measuring drum or the inside of the housing. To exclude this danger of explosion, the gas meter has to be purged with an inert gas (e.g. nitrogen or any noble gas). The purging can be performed by operating the gas meter with an inert gas for at least five revolutions of the measuring drum (= five revolutions of the large Needle on the dial plate).

4. High-Pressure Gas Meters(> 1bar)

- The Gas Meters may only be used within the Over-Pressure and Temperature operating limits listed on the Meter label and in the Data Sheet.
- If the Gas Meter is placed in an elevated position, for example on a stand or similar, it must be firmly secured so that it cannot move or slip. This is to avoid personal injury or property damage due to the Meter falling. The feet of the Meter should be secured with tension clamps, screws or similar.
- The Gas Meters do not have an Over-Pressure Safety Valve installed. In order to completely avoid exceeding the admissible operating pressure (listed on the Meter label and in the Data Sheet), an Over-Pressure Safety Valve must be installed in the connected gas pipes.
- In the event of Gas Meter disassembly, the Gas Meter must be pressure-free before disassembly begins.
- Only original parts should be used to rebuild the Gas Meter if it has been disassembled.
- Disassembly of the Meter, i.e. removal & replacement of the measuring drum, can alter the calibration results (please refer to Point 5.2).

5. Maintenance

5.1. General

All Ritter drum-type gas meters are maintenance-free.

Furthermore, no leakage from the gas meter casing can occur by use of a magnetic coupling between measuring drum and counter mechanism.

5.2. Cleaning of casing and measuring drum from sediments

When the measured gas carries particles, these particles will be scrubbed by the packing liquid and the rotation of the measuring drum during the measuring process. Thus, sediments may build-up at the bottom of the casing and inside of the measuring drum over the time. In order to clean the casing and measuring drum from these sediments, the casing should be flushed from time to time.

For doing this, the casing must be drained through the drainage faucet. Refill with clean water and add any detergent (if appropriate: dishwashing detergent) which does not attack the meter material. Repeat draining and refilling until no sediments are visible while draining the meter.

If the gas meter size is small enough, it is favourably to hold the meter “face down” and to shake the meter slightly when coming to the end of the draining process. Thus, potential sediments at the inside of the measuring drum are scrubbed in the best possible way.

5.3. Disassembly of the rear plate

The rear plate of the housing can be removed in order to allow the gas meter housing to be cleaned from the inside if required. When removing the plate, it is essential to ensure that the support secured onto the inner face of the housing rear plate and which engages in the measuring drum is not broken off and that the measuring drum is not damaged by this support.

However, after opening the gas meter housing and removing the measuring drum, it must be borne in mind that following refitting the measuring drum will very probably no longer be in exactly the same position as it was during calibration at the factory. This could result in a different calibration result.

We therefore recommend that you send your gas meter to the works for inspection, cleaning and recalibration if the measuring drum becomes dirty and in the event of measuring inaccuracies or other operational faults.

5.4. Trouble shooting

In the unlikely event of problems with the function of the meter, please contact your national distributor or the Ritter Company. In order to be able to be of assistance, we kindly ask you to check the following items and to collect the requested data **prior to your contact**:

a) Serial number of the meter.

b) Is the packing liquid level set correctly?

c) What is the gas flow rate at which the problem occurs?

d) What is the gas inlet pressure at this flow rate?

e) What is the spread of the gas inlet pressure (min./max. pressure) at this flow rate?

f) Is the gas meter outlet nozzle free to atmosphere?

g) What is the approx. gas temperature?

Especially the data according to (d) and (e) are valuable information to find the reason for the problem(s).

1. General

Ondina 909 is a medical mineral White Oil, paraffinic, aromatic-free. It is colourless, clear and odourless.

2. Application

Ondina 909 can be used in all **RITTER** Drum-type Gas Meters. As opposed to water as a Packing Fluid, Ondina 909can be used under 0°C as well. It also has a lower evaporation rate. Because of this, the Packing Liquid level remains stable over a longer period of time. This leads to an improvement in the repeatability of measurement results, and in a reduction in the required frequency of Packing Liquid level monitoring.

The use of Ondina 909 is further recommended when the gas should remain dry or when the gas reacts with water.

Not appropriate for chlorine gas.

3. Advantages

- Use under 0°C
- less evaporation than water due to its lower vapour pressure, resulting in greater stability of the Packing Fluid level and in more consistent measurement result
- the gas remains dry
- in general, a lower chemical reactivity with water

4. Solubility (in ml/ml at 1 bar, 20°C)

Hydrogen	0,07
Nitrogen	0,08
Carbon Monoxide	0,09
Air	0,10
Argon	0,15
Oxygen	0,16
Methane	0,30
Carbon Dioxide	1,20
Ethane	2,80
Ethylene	2,80
Acetylene	4,00
Propylene	14,00
Propane	19,00
Butane	40,00

5. Properties

Viscosity:	20	°C	6.2	cSt (=mm²/sec)
	40	°C	3.8	cSt
Density:	15	°C	0.825	g/ml
Vapour pressure:	20	°C	< 0.01	mbar
Pour point:	-9	°C		
Flashpoint:	125	°C		
Appearance:	Colourless, clear. odourless fluid			

1. General

Autin-B is a Paraffin Oil (white oil) without Polyolefin. It is colourless, clear and odourless.

2. Application

Autin-B can be used in all RITTER Drum-type Gas Meters. As opposed to water as a Packing Fluid, Autin-B can be used under 0°C as well. It also has a lower evaporation rate. Because of this, the Packing Liquid level remains stable over a longer period of time. This leads to an improvement in the repeatability of measurement results and in a reduction in the required frequency of Packing Liquid level monitoring.

The use of Autin-B is further recommended when the gas should remain dry or when the gas reacts with water.

Not appropriate for chlorine gas.

3. Advantages

- Use under 0°C
- less evaporation than water due to its lower vapour pressure, resulting in greater stability of the Packing Fluid level and in more consistent measurement result
- the gas remains dry
- in general, a lower chemical reactivity with water

4. Solubility (Bunsen* coefficient at 1013 mbar, 20°C)

Air	0.07-0.08
Ammonia	0.18
Carbon Dioxide	0.90
Nitrogen	0.06
Oxygen	0.12

* Bunsen coefficient (N ml/ml): volume of gas, reduced to Normal condition (1013 mbar, 0°C), dissolved in the volume unit of fluid.

5. Properties

Viscosity:	20	°C	37.0	cSt (=mm²/sec)
	40	°C	16.0	cSt
	100	°C	3.6	cSt
Density:	15	°C	0.85	g/ml
Vapour pressure:	20	°C	< 0.1	mbar
	50	°C	< 0.1	mbar
	100	°C	0.1	mbar
Boiling range:	335-410	°C		
Pour point:	-24	°C		
Flashpoint:	>150	°C		
Appearance:	Colourless, clear. odourless fluid			

1. General

Silox is a silicone oil belonging to the group of polydimethyl siloxane. It is colourless and clear with a weak odour.

2. Application

Silox can be used in all **RITTER** Drum-type Gas Meters. As opposed to water as a Packing Fluid, Silox can be used under 0°C. It also has a lower evaporation rate in combination with a viscosity similar to water. Because of this, the Packing Liquid level remains stable over a longer period of time. This leads to an improvement in the repeatability of measurement results, and in a reduction in the required frequency of Packing Liquid level monitoring.

The use of Silox is further recommended when the gas should remain dry or when the gas reacts with water.

Not suitable for wet chlorine gas.

3. Advantages

- Use under 0°C (down to -40°C)
- less evaporation than water due to its lower vapour pressure, resulting in greater stability of the Packing Fluid level and in more consistent measurement result
- the gas remains dry
- in general, a lower chemical reactivity than water

4. Properties

Chemical name:	cyclic polydimethyl siloxane			
Viscosity:	20	°C	4	cSt (=mm^2/sec=mPa.sec
	25	°C	4	cSt
Density:	15	°C	0.96	g/ml
	25	°C	0.95	g/ml
	50	°C	0.93	g/ml
Vapour pressure:	20	°C	0.16	mbar (=hPa)
	50	°C	38	mbar
Boiling Point:	205	°C		
Pour point:	-40	°C		
Flash point:	76	°C		
Ignition temperature:	450	°C		
Appearance:	clear, colourless fluid with a weak odour			

1. General

CalRiX is a completely synthetic fluid on a fluorine base. It is of low molecular weight, colourless, clear and odourless.

More detailed information about the chemical composition and molecular structure of this fluid can be obtained upon request.

2. Application

CalRiX can be used with all Ritter Drum-type Gas Meters (Wet-type Gas Meters). Because CalRiX is completely inert to most gases including oxygen, it can be used as a Packing Fluid when water or paraffin oil are not suitable. For example, when the gas needs to remain dry, and when the gas is highly reactive to water or paraffin oil. It is appropriate for use with such gases as:

Butane
Carbon Dioxide
Carbon Tetrafluoride
Carbon Tetrachloride
Chlorine
Deuterium
Fluorine
Helium
Hydrogen chloride
Hydrogen Fluoride
Methane
Nitrogen trichloride
Nitrogen trifluoride NF_3
Oxygen
Phosphine
Propane
Silane
Sulphur Hexafluoride

3. Advantages

- Extremely resistant even against highly aggressive gases because of CalRiX's fluorine base,
- less evaporation than water due to its lower vapour pressure, resulting in greater stability of the Packing Fluid level and in more consistent measurement result,
- very smooth rotation of the measuring drum in the Gas Meter because of CalRiX's high density and low surface tension,.

4. Properties

Viscosity:	-20	°C	11.7	cSt (=mm²/sec)
	20	°C	2.7	cSt
	25	°C	2.4	cSt
	100	°C	0.7	cSt
Density:	20	°C	1.80	g/ml
	100	°C	1.64	g/ml
Vapour pressure:	20	°C	0.4	mbar
	100	°C	30.8	mbar
	120	°C	65.6	mbar
Working Temp. Range:	-20	°C	to 190	°C
Boiling Point:	200	°C		
Pour point:	-85	°C		
Solubility of Water:	14	ppm		
Solubility of Air:	26	cm^3 gas per 100 cm^3 liquid		
Volatility:	34.4	% in 22 hours at 66°C		
Appearance:	Clear, odourless, colourless fluid			

5. Solubility of Gases (Bunsen coefficient at room temperature)

Butane	8.5
Boron Trichloride	13.1
Boron Trifluoride	0.22
Carbon Dioxide	1.2
Carbon Tetrachloride	52.6
Carbon Tetrafluoride	0.68
CFC 114	14.9
CFC 12	4.25
CFC 133a	13.9
CFC 134a	4.7
CFC 21	13.1
CFC 22	4.86
Chlorine	3.19
Deuterium	0.10
Esafluoroethane	2.12
Fluorine	0.20
Helium	0.08
Hydrochloric acid	0.806
Hydrogen	0.10
Methane	0.17
Nitrogen	0.19
Nitrogen Trichloride	0.83
Nitrogen Trifluoride approx.	0.9
Oxygen	0.29
Phosphine	0.67
Propane	3.8
Silane	0.36
Sulphur Hexafluoride	3.5

The Bunsen coefficient [N ml/ml] is the volume of gas, reduced to Normal condition (1013 mbar, 0°C), dissolved in the volume unit of fluid.

Fig.: BG 6
with Pulse Generator V3.2 and Totalizing Roller Counter

Bellows-type gas meters are applicable for measuring the volume of flowing inert and dry gases and are particularly effective at high gas flows.

Please note that gases containing aggressive components may reduce the life span of bellows-type gas meters, if the casing of the measuring unit (tinplate), the valve/control elements (polyamide) or the bellows (nitrile rubber, Perbunan®) should be attacked. For more details regarding the materials used which are in contact with the gas, please refer to data sheet 02.02.

The desired measurement range can be selected from among 6 magnitudes (types) extending together as a whole from 40 ltr/h to 160 m^3/h at a gas temperature ranging from -20° to +50° Celsius. The solidly soldered casing on the standard model is designed to withstand a maximum overpressure of 50 to 500 mbar depending on the meter type.

The measurement of **RITTER** bellows-type gas meters works on the principle of displacement. The gas meters employ a twin-chamber measuring unit with a deformable bellow within each chamber. Thus, a compulsory measurement of the gas flow is possible by periodically filling and emptying these chambers.

The design of the measuring chamber is such that the measuring volume per cycle of the bellows is constant. Among other advantages, this design of the measuring unit enables a measurement accuracy of +/- 2% .

BG 10
(Fig. with "Adding Roller Counter")

BG 40
(Fig. with "Adding Roller Counter")

The major advantage and the superiority of volumetric Gas Meter (like Bellows-type Gas Meters) over other measurement principles, which determine gas volume using secondary measurable variables such as speed, heat capacity, hot-wire resistance or similar, is that the volume is **directly** measured. That means that the condition and the composition of the gas has no influence on the measurement accuracy.

Correcting factors which take into account gas type, temperature, humidity etc are therefore **not necessary**. It should be noted that with other, non-volumetric measurement processes, the measurement accuracy given for that process can only be achieved if the correcting factors for the immediate condition of the gas are exactly known.

Please note: The flow direction cannot be reversed.

Equipment: All RITTER bellows-type gas meters include the following as standard equipment: twin-chamber measuring unit; 8-digit totalizing counter; large, one-needle dial; and magnetic coupling (between the measuring unit and counting mechanism); gas pipe connection: inch thread.

Performance Data:

- Measurement accuracy:
  - approx. **+/- 1%** at standard flow rate (exact value is stated in individual calibration certificate)
  - approx **± 2%** across the measurement range relative to calibration value at standard flow rate
- Maximum gas inlet pressure (overpressure):
  - BG4, BG6: 300 mbar
  - BG10, BG16: 50 mbar
  - BG 40, BG100: 500 mbar
- Temperature range: -20 to +50° Celsius
- **No reverse flow direction**
- Flow rate (measuring range) and meter indication:

Model	Flow Rate			Minimum Dial Division	Maximum Value
	Minimum [ltr/h]	Maximum [ltr/h]	Standard [ltr/h]	[ltr]	[ltr]
BG 4	40	6,000	3,000	0.1	99,999,999
BG 6	60	10,000	5,000	0.2	999,999,990
BG 10	100	16,000	10,000	0.5	999,999,990
BG 16	160	25,000	15,000	0.4	999,999,990
BG 40	400	65,000	39,000	0.4	999,999,990
BG 100	1,000	160,000	95,000	0.4	999,999,990

Materials:

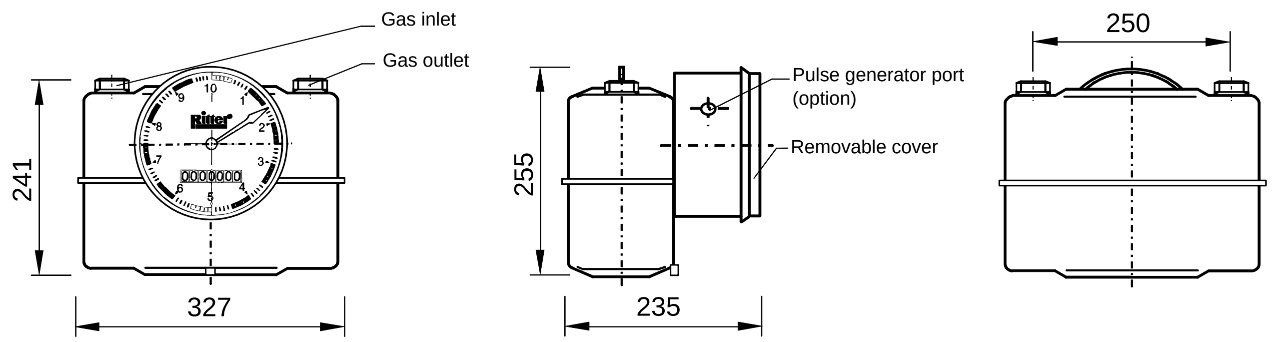
- Casing: zinc-coated steel sheet, powder-coated
  - BG4 – BG16: casing parts soldered
  - BG40 – BG100: casing parts screwed
- Measuring unit: tinplate
- Bellows (within measuring unit): textile-reinforced nitrile rubber (Perbunan®)
- Rod linkage: BG 4: polyamide; all others: polyamide/brass
- Slide gate: Bakelite

Accessories:

- Thermometer, range 0° to +60°C
- Manometer, range 60 mbar differential pressure
- Nozzles for flexible tube connection
- Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

- LCD display, resettable, 8-digit (substitutes Totalizing Roller Counter)
- Pulse Generator (for connection of Electronic Display Unit or Computer)



Performance Data:

Minimum flow Q_{min}	40	ltr/h	**Maximum gas inlet pressure**	**300**	**mbar**
Standard flow Q_{stand}	3,000	ltr/h	Minimum differential pressure [1)]	1	mbar
Maximum flow Q_{max}	6,000	ltr/h	Minimum dial division	0.1	ltr
Measuring cavity capacity	2	ltr	Indication dial plate	10.0	ltr
Measurement accuracy [2)]	+/- 2	%	Maximum indication value [3)]	99.999.999	ltr
Temperature range	-20 to + 50	°C	Weight	4.6	kg

[1)] Differential pressure (= pressure loss) gas inlet / gas outlet

[2)] Across the measuring range in relation to the calibration value at nominal flow

[3)] Standard totalizing roller counter

No reverse flow direction possible!

Materials:

Casing:	zinc-coated steel sheet (soldered) with outside also lacquered
Measuring unit:	Tinplate
Bellows (within measuring unit):	textile-reinforced nitrile rubber (Perbunan®)
Rod linkage:	Polyamide
Slide gate:	Bakelite

Standard Equipment:

Twin-Chamber Measuring Unit	Totalizing Roller Counter (8-digit)
Magnetic Coupling	Screw Connection 1" (G 1 A, DIN ISO 228)

Accessories:

Thermometer, range 0° to +60°C, scale 1°C

Manometer (capsule pressure gauge), range 0 to 60 mbar, scale 2 mbar

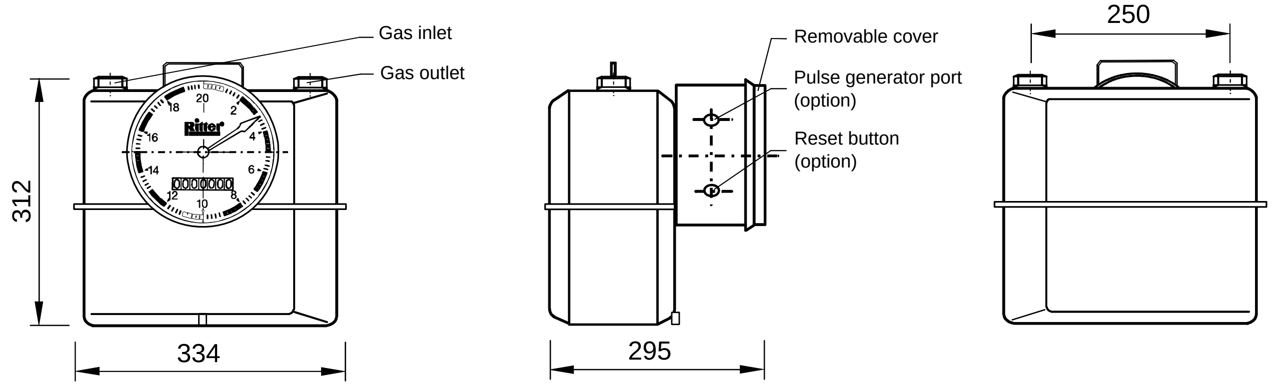
Nozzles for flexible tube connection, outer ∅ 16 mm, inner ∅ 10 mm

Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 8-digit (substitutes Total Roller Counter)

Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)



Performance Data:

Minimum flow Q_{min}	60	ltr/h	**Maximum gas inlet pressure**	**300**	**mbar**
Standard flow Q_{stand}	5,000	ltr/h	Minimum differential pressure [1)]	1	mbar
Maximum flow Q_{max}	10,000	ltr/h	Minimum dial division	0.2	ltr
Measuring cavity capacity	3.5	ltr	Indication dial plate	20.0	ltr
Measurement accuracy [2)]	±2	%	Maximum indication value [3)]	99.999.999	ltr
Temperature range	-20 to + 50	°C	Weight	6.4	kg

[1)] Differential pressure (= pressure loss) gas inlet / gas outlet
[2)] Across the measuring range in relation to the calibration value at nominal flow
[3)] Standard totalizing roller counter

No reverse flow direction possible!

Materials:

Casing:	Zinc-coated steel sheet (soldered) with outside also lacquered
Measuring unit:	Tinplate
Bellows (within measuring unit):	textile-reinforced nitrile rubber (Perbunan®)
Rod linkage:	Polyamide
Slide gate:	Bakelite

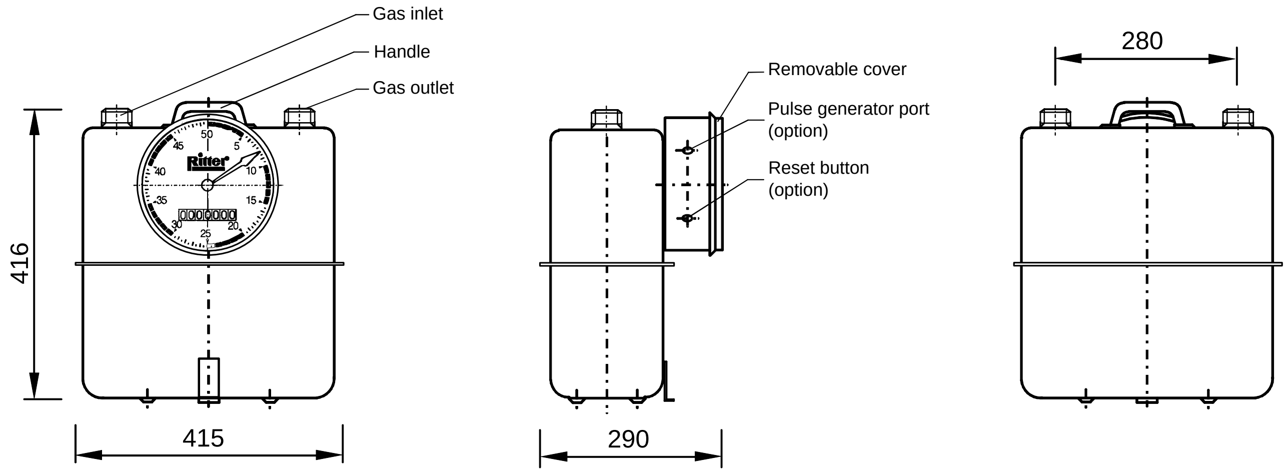
Standard Equipment:

Twin-Chamber Measuring Unit	Totalizing Roller Counter, 9 digits, last digit (unit) = 0
Magnetic Coupling	Screw Connection 1-$^{1}/_{4}$" (G 1 A, DIN ISO 228)

Accessories:

Thermometer, range 0° to +60°C, scale 1°C
Manometer (capsule pressure gauge), range 0 to 60 mbar, scale 2 mbar
Nozzles for flexible tube connection, outer ∅ 20 mm, inner ∅ 14 mm
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:
LCD display, resettable, 8-digit (substitutes Total Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)



Performance Data:

Minimum flow Q_{min}	100	ltr/h	**Maximum gas inlet pressure**	**50**	**mbar**
Standard flow Q_{stand}	10,000	ltr/h	Minimum differential pressure [1)]	1	mbar
Maximum flow Q_{max}	16,000	ltr/h	Minimum dial division	0.5	ltr
Measuring cavity capacity	10	ltr	Indication dial plate	50,00	ltr
Measurement accuracy [2)]	±2	%	Maximum indication value [3)]	999.999.990	ltr
Temperature range	-20 to + 50	°C	Weight	11	kg

[1)] Differential pressure (= pressure loss) gas inlet / gas outlet

[2)] Across the measuring range in relation to the calibration value at nominal flow

[3)] Standard totalizing roller counter

No reverse flow direction possible!

Materials:

Casing:	zinc-coated steel sheet (soldered) with outside also lacquered
Measuring unit:	Tinplate
Bellows (within measuring unit):	textile-reinforced nitrile rubber (Perbunan®)
Rod linkage:	Polyamide/brass
Slide gate:	Bakelite

Standard Equipment:

Twin-Chamber Measuring Unit	Totalizing Roller Counter, 9 digits, last digit (unit) = 0
Magnetic Coupling	Screw Connection 2" (G 2 A, DIN ISO 228)

Accessories:

Thermometer, range 0° to +60°C, scale 1°C

Manometer (capsule pressure gauge), range 0 to 60 mbar, scale 2 mbar

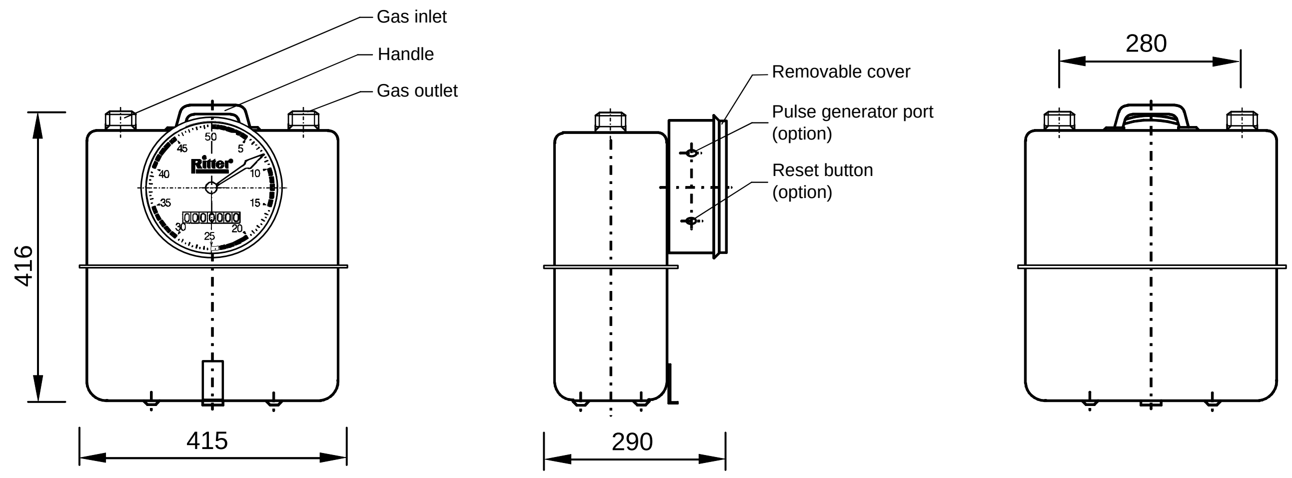
Nozzles for flexible tube connection, outer ∅ 25 mm, inner ∅ 19 mm

Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 8-digit (substitutes Total Roller Counter)

Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)



Performance Data:

Minimum flow Q_{min}	160	ltr/h	**Maximum gas inlet pressure**	**50**	**mbar**
Standard flow Q_{stand}	15,000	ltr/h	Minimum differential pressure [1)]	1	mbar
Maximum flow Q_{max}	25,000	ltr/h	Minimum dial division	0.4	ltr
Measuring cavity capacity	10	ltr	Indication dial plate	100,00	ltr
Measurement accuracy [2)]	+/- 2	%	Maximum indication value [3)]	999,999,990	ltr
Temperature range	-20 to + 50	°C	Weight	11	kg

[1)] Differential pressure (= pressure loss) gas inlet / gas outlet

[2)] Across the measuring range in relation to the calibration value at nominal flow

[3)] Standard totalizing roller counter

No reverse flow direction possible!

Materials:

Casing:	zinc-coated steel sheet (soldered) with outside also lacquered
Measuring unit:	Tinplate
Bellows (within measuring unit):	textile-reinforced nitrile rubber (Perbunan®)
Rod linkage:	Polyamide/brass
Slide gate:	Bakelite

Standard Equipment:

Twin-Chamber Measuring Unit	Totalizing Roller Counter, 9 digits, last digit (unit) = 0
Magnetic Coupling	Screw Connection 2" (G 2 A, DIN ISO 228)

Accessories:

Thermometer, range 0° to +60°C, scale 1°C

Manometer (capsule pressure gauge), range 0 to 60 mbar, scale 2 mbar

Nozzles for flexible tube connection, outer ∅ 32 mm, inner ∅ 22.5 mm

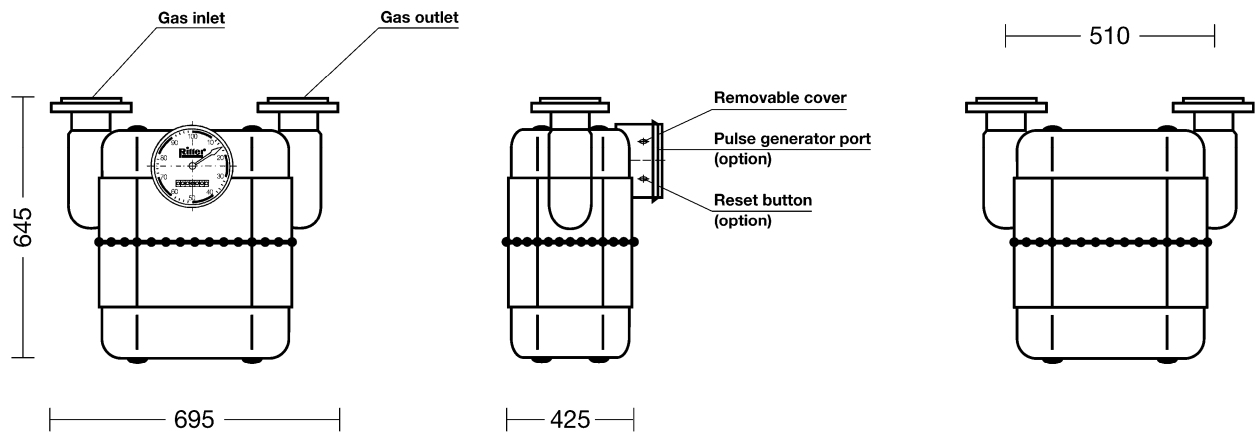
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 8-digit (substitutes Total Roller Counter)

Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)

Subject to alterations



Performance Data:

Minimum flow Q_{min}	400	ltr/h	**Maximum gas inlet pressure**	**0.5**	**bar**
Standard flow Q_{stand}	39,000	ltr/h	Minimum differential pressure [1)]	1	mbar
Maximum flow Q_{max}	65000	ltr/h	Minimum dial division	0.4	ltr
Measuring cavity capacity	30	ltr	Indication dial plate	100,00	ltr
Measurement accuracy [2)]	±2	%	Maximum indication value [3)]	99.999.990	ltr
Temperature range	-20 to + 50	°C	Weight	33	kg

[1)] Differential pressure (= pressure loss) gas inlet / gas outlet
[2)] Across the measuring range in relation to the calibration value at nominal flow
[3)] Standard totalizing roller counter

No reverse flow direction possible!

Materials:

Casing:	powder-coated steel sheet (screwed) with outside also lacquered
Measuring unit:	Tinplate
Bellows (within measuring unit):	textile-reinforced nitrile rubber (Perbunan®)
Rod linkage:	Polyamide/brass
Slide gate:	Bakelite

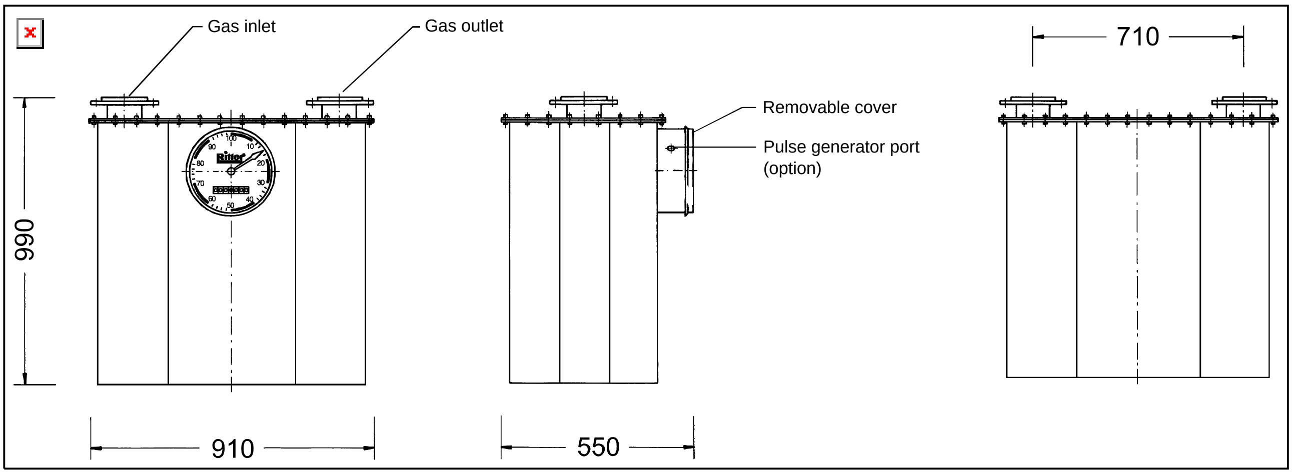
Standard Equipment:

Twin-Chamber Measuring Unit	Totalizing Roller Counter, 9 digits, last digit (unit) = 0
Magnetic Coupling	Flange connection, diameter 65 mm, according to DIN 2642-PN10

Accessories:

Thermometer, range 0° to +60°C, scale 1°C
Manometer (bourdon tube pressure gauge), range 0 to 0,6 bar
Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:
LCD display, resettable, 8-digit (substitutes Total Roller Counter)
Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)



Performance Data:

Minimum flow Q_{min}	1,000	ltr/h	**Maximum gas inlet pressure**	**0.5**	**bar**
Standard flow Q_{stand}	95,000	ltr/h	Minimum differential pressure [1)]	1	mbar
Maximum flow Q_{max}	160,000	ltr/h	Minimum dial division	0.4	ltr
Measuring cavity capacity	120	ltr	Indication dial plate	100.0	ltr
Measurement accuracy [2)]	±2	%	Maximum indication value [3)]	999,999,990	ltr
Temperature range	-20 to + 50	°C	Weight	130	kg

[1)] Differential pressure (= pressure loss) gas inlet / gas outlet

[2)] Across the measuring range in relation to the calibration value at nominal flow

[3)] Standard totalizing roller counter

No reverse flow direction possible!

Materials:

Casing:	Powder-coated steel (welded, screwed), with outside also lacquered
Measuring unit:	tinplate
Bellows (within measuring unit):	textile-reinforced nitrile rubber (Perbunan®)
Rod linkage:	Polyamide
Slide gate:	Bakelite

Standard Equipment:

Twin-Chamber Measuring Unit	Totalizing Roller Counter, 9 digits, last digit (unit) = 0
Magnetic Coupling	Flange connection, diameter 100 mm

Accessories:

Thermometer, range 0° to +60°C, scale 1°C

Manometer (bourdon tube pressure gauge), range 0 to 0,6 bar

Electronic Display Unit, including Interface RS 232 and Analog Output (requires Pulse Generator)

Built-in Options:

LCD display, resettable, 8-digit (substitutes Total Roller Counter)

Pulse Generator, standard or Ex-proof version (for connecting Electronic Display Unit/Computer)

1. Installation and measuring

1.1 After unpacking the gas meter, ensure that no pieces of packing material are stuck to the meter casing.

1.2 The bellows-type gas meter can be installed to the piping system either in a standing position or suspended therein. Reduced piping diameters, elbows and shut-off facilities do not have any adverse effect on measurement accuracy. During installation, pay attention to the correct flow direction (refer to the directional arrow on the casing).

For installation to the piping system, the bellows-type gas meters are equipped with inch-threaded screw connection (BG 4 - BG 16) resp. with flange connection (BG 40 – BG 100). There are nozzles for flexible tube connection available as auxiliary equipment.

1.3 Before taking measurements, establish the current counter reading. On LCD display (accessory), set the counter manually to zero. On all counters, set the large indicator needle manually to zero.

The meter is thus ready for use.

1.4 When taking measurements, pay attention to the capacity of the respective gas meter (refer to the attached data sheet).

The maximum pressure load is 300 mbar for bellow-type gas meters models BG4 and BG6, 50 mbar for BG10, BG16, and 0.5 bar for models BG40 and BG100!

2. Maintenance

2.1 RITTER bellows-type gas meters do not require any maintenance.

2.2 In the event of inaccurate measurements or other defects, we recommend that the gas meter be returned to the factory for inspection and recalibration.

Ritter Made in Germany

ACCESSORIES
Thermometer (Gas) for TG series
Data Sheet

03.01
V 2.0
Rev. 04/2013

Suitable for:	RITTER Drum-type Gas Meters		
Filling liquid:	Mercury “Hg"		
alternatively:	Isoamylbenzoat “IAB”		
Measuring Ranges:	0 °C	to + 60°C,	scale graduation 0.5°C
	0 °C	to + 50°C,	scale graduation 0.1°C
	0 °C	to + 125°C,	scale graduation 1°C
	15 °C	to + 30°C,	scale graduation 0.1°C

Application:

The Thermometer (Gas) can be used for measurement of the gas temperature while measuring the gas flow. Among other reasons, this is necessary if the measured and indicated **actual volume** of gas must be recalculated into the **norm volume**. The **actual** volume is the volume at the **actual** temperature and the **actual** pressure. The **norm volume** of a gas is the volume at **norm conditions** which are (in Germany):

Norm temperature	=	273.15	Kelvin (= 0 °C)
Norm pressure	=	1,013.25	mbar

The formula for converting the **actual volume** into **norm volume** is:

$$V_N = V_i \ x \ \frac{P_a}{P_N} \ x \ \frac{T_N}{T_i}$$

where

V_N	=	Norm Volume in	[ltr]
V_i	=	indicated Volume in	[ltr]
p_N	=	Norm Pressure in	[mbar-absolute]
p_a	=	actual Pressure in	[mbar-absolute]
T_N	=	Norm Temperature in	[Kelvin]
T_i	=	indicated Temperature in	[Kelvin]

Installation:

Unpack the Thermometer. Unscrew the closing cap of the Thermometer (Gas) support on the Gas Meter. Mount the Thermometer by inserting carefully through the Thermometer (Gas) support (see middle picture above). Seal the Gas Meter's casing by tightly screwing the union nut which is attached to the Thermometer. Thus, the Thermometer is ready for use. The removed closing cap of the support can be stored easily by screwing it onto the respective thread support located at the base plate of the gas meter. (See arrow in the right-hand photo above.)

Ritter Made in Germany	**ACCESSORIES** **Thermometer (Packing Liquid), TG series** Data Sheet	**03.02** V 2.0 Rev. 04/2013

Suitable for:	**RITTER** Drum-type Gas Meters		
Filling liquid:	Mercury “Hg"		
alternatively:	Isoamylbenzoat “IAB”		
Measuring Ranges:	0 °C	to + 60°C,	scale graduation 0.5°C
	0 °C	to + 50°C,	scale graduation 0.1°C
	0 °C	to + 125°C,	scale graduation 1°C
	15 °C	to + 30°C,	scale graduation 0.1°C

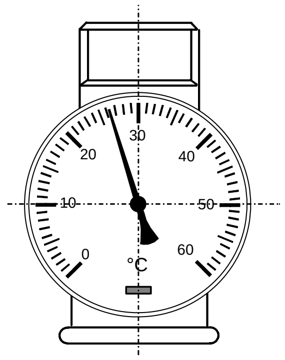
Application:

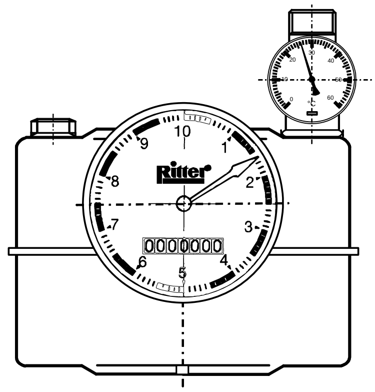
The Thermometer (Packing Liquid) can be used for measurement of the Packing Liquid temperature while measuring the gas flow.

According to the rules for calibration and measurement with Drum-type Gas Meters, the temperature of the Packing Liquid may vary from the gas temperature by up to 0.5 °C at most. A greater temperature deviation would cause too great a change to the gas temperature when the gas comes unavoidably into contact with the Packing Liquid during measurement. This temperature change would cause an unknown change in the volume of the measured gas which might lead to a measurement/indication error.

Installation:

Unpack the Thermometer. Unscrew the closing cap of the Thermometer (Packing Liquid) support on the Gas Meter. Mount the Thermometer by inserting carefully through the Thermometer (Packing Liquid) support (see middle picture above). Seal the Gas Meter's casing by tightly screwing the union nut which is attached to the Thermometer. Thus, the Thermometer is ready for use. The removed closing cap of the support can be stored easily by screwing it onto the respective thread support located at the base plate of the gas meter. (See arrow in the right-hand photo above.)





Suitable for:	RITTER Bellows-type Gas Meters
Measuring Range:	0° to +60°C
Resolution:	1°C

Application:

The Thermometer can be used for measurement of the gas temperature while measuring the gas flow. Among other reasons, this is necessary if the measured and indicated **actual volume** of gas must be recalculated into the **norm volume**. The **actual** volume is the volume at the **actual** temperature and the **actual** pressure. The **norm volume** of a gas is the volume at **norm conditions** which are (in Germany):

Norm temperature	=	273.15	Kelvin (= 0 °C)
Norm pressure	=	1,013.25	mbar

The formula for converting the **actual volume** into **norm volume** is:

$$V_N = V_i \, x \, \frac{P_a}{P_N} \, x \, \frac{T_N}{T_i}$$

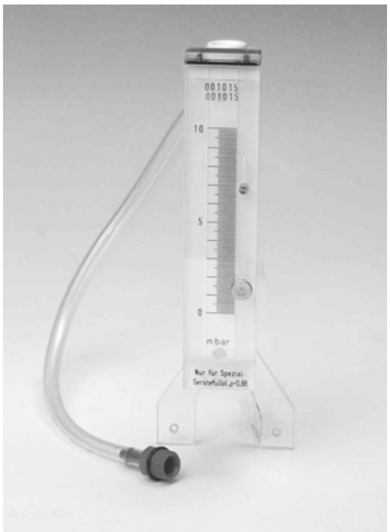
where

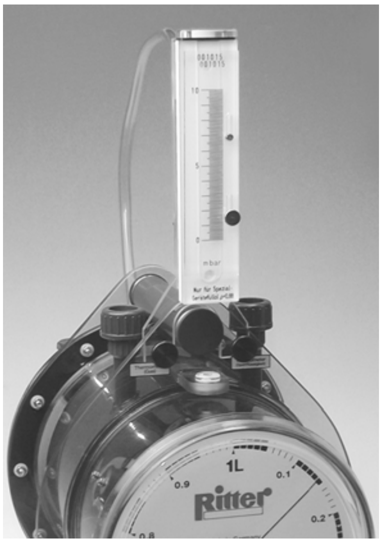
V_N	=	Norm Volume in	[ltr]
V_i	=	indicated Volume in	[ltr]
p_N	=	Norm Pressure in	[mbar]
p_a	=	actual Pressure in	[mbar]
T_N	=	Norm Temperature in	[Kelvin]
T_i	=	indicated Temperature in	[Kelvin]

Installation:

Unpack the Thermometer which is mounted into a T-piece. According to the rules for calibration and measurement with gas meters, the thermometer must be positioned at the gas outlet of the meter (see right picture above). The gas outlet nozzle is labelled accordingly.

Mount the Thermometer onto the gas outlet nozzle by tightly screwing the union nut which is attached to the Thermometer. Thus, the Thermometer is ready for use.





Suitable for:	**RITTER** Drum-type Gas Meters
Measuring Range:	0 to 10 mbar (over- / underpressure); also available: 0 to 20 mbar
Resolution:	0.1 mbar

Application:

The Manometer can be used for measurement of the gas pressure while measuring the gas flow. Among other reasons, this is necessary if the measured and indicated **actual volume** of gas must be recalculated into the **norm volume**. The **actual** volume is the volume at the **actual** temperature and the **actual** pressure. The **norm volume** of a gas is the volume at **norm conditions** which are (in Germany):

Norm temperature	=	273.15	Kelvin (= 0 °C)
Norm pressure	=	1,013.25	mbar

The formula for converting the **actual volume** into **norm volume** is:

$$V_N = V_i \; x \; \frac{P_a}{P_N} \; x \; \frac{T_N}{T_i}$$

where

V_N	=	Norm Volume in	[ltr]
V_i	=	indicated Volume in	[ltr]
p_N	=	Norm Pressure in	[mbar-absolute]
p_a	=	actual Pressure in	[mbar-absolute]
T_N	=	Norm Temperature in	[Kelvin]
T_i	=	indicated Temperature in	[Kelvin]

Note: The indicated gas pressure at the manometer is the differential pressure between the gas pressure at the gas inlet and the actual atmospheric air pressure. Thus, the actual gas pressure (p_a) of the above formula equals the **indicated gas pressure** at the Manometer **plus** the **actual atmospheric air pressure** in [mbar].

Installation:

Unpack the Manometer. Mount the Manometer into the Manometer support (see middle picture above). Unscrew the closing cap of the "Manometer Connection" port located at the "Gas Inlet" nozzle at the centre of the rear plate. The removed closing cap of the port can be stored easily by screwing it onto the respective thread support at the rear side of the Manometer. (See arrow in the right-hand picture above.) Screw the closing cap, which is attached to the flexible Manometer pipe, tight to the "Manometer Connection" port.

Filling:

The Manometer must be filled unpressurised. It is to be filled with the blue Special-Equipment Filling Oil (“Spezial-Gerätefüllöl”) provided with the Manometer. First remove the white thumb screw from the Filling Hole. Pour in the oil until the oil column reaches the “0”-mark at the adjustable scaled front plate (or until it comes close to the “0”-mark). If necessary, adjust the moveable plate to the exact liquid level by loosening the screw(s) and moving the plate.

Replace the white thumb screw. **Please note: Only the specially provided blue oil should be used with this Manometer** (Density 0.88)**!!** If the manometer is filled with an oil with a different density, the Manometer indication will inevitably be wrong.

Then, unscrew the closing cap of the “Manometer Connection” port located at the Gas Inlet nozzle (on the rear side of the Gas Meter casing). The removed closing cap of the port can be stored easily by screwing it onto the thread support on the rear of the Manometer (see arrow in the right-hand picture). Lastly, tightly screw the closing cap attached to the flexible Manometer tube, onto the “ Manometer Connection” port.

The Manometer is then ready for use.

Prior to future measurements the correct position of the adjustable scaled front plate must be checked. For doing this, the manometer must be unpressurised. If the liquid level of the manometer column is not exactly at the “0”-mark of the adjustable scaled front plate, the plate must be adjusted accordingly.

Reading:

The oil column of the Manometer indicates the differential pressure in [mbar] of the gas between the Gas Inlet of the Gas Meter and the atmospheric pressure.

Caution: If the Manometer is connected to the gas inlet of the Gas Meter but **not** filled with oil, gas will leak through the Manometer. This will inevitably cause a **measurement error** of the Gas Meter.

ACCESSORIES
Manometer (inclined tube) for TG-Series
Data Sheet

Suitable for:	**RITTER** Drum-type Gas Meters
Measuring Range:	0 - 4 mbar with oil filling (γ = 0.88) 0 - 60 mbar with mercury filling (γ = 13.85) (both over- and underpressure)
Resolution:	0.1 mbar with oil filling (γ = 0.88) 1 mbar with mercury filling (γ = 13.85)

Application:

The Manometer can be used for measurement of the gas pressure while measuring the gas flow. Among other reasons, this is necessary if the measured and indicated **actual volume** of gas must be recalculated into the **norm volume**. The **actual** volume is the volume at the **actual** temperature and the **actual** pressure. The **norm volume** of a gas is the volume at **norm conditions** which are (in Germany):

Norm temperature	=	273.15	Kelvin (= 0 °C)
Norm pressure	=	1,013.25	mbar

The formula for converting the **actual volume** into **norm volume** is:

$$V_N = V_i \; x \; \frac{P_a}{P_N} \; x \; \frac{T_N}{T_i}$$

where

V_N	=	Norm Volume in	[ltr]
V_i	=	indicated Volume in	[ltr]
p_N	=	Norm Pressure in	[mbar-absolute]
p_a	=	actual Pressure in	[mbar-absolute]
T_N	=	Norm Temperature in	[Kelvin]
T_i	=	indicated Temperature in	[Kelvin]

Note: The indicated gas pressure at the manometer is the differential pressure between the gas pressure at the gas inlet and the actual atmospheric air pressure. Thus, the actual gas pressure (p_a) of the above formula equals the **indicated gas pressure** at the Manometer **plus** the **actual atmospheric air pressure** in [mbar].

General:

The inclined tube manometer consists of a acryl glass block 30 mm thick. The size of the board corresponds to the individual measuring range. The liquid container and the measuring column are built into this block. The measuring scale is adjustable, which allows for a quick an easy setting to zero point.

Installation:

Unpack the Manometer. Mount the Manometer to the Manometer support by screwing the two provided knurled screws to the support unit (see right-hand picture above). Unscrew the sealing plug of the "Manometer Connection" port located at the "Gas Inlet" nozzle at the centre of the rear plate. The removed sealing plug of the port can be stored easily by screwing it into the respective thread support at the rear side of the meter handle. Screw the hose tap nozzle, which is attached to the flexible pressure supply pipe, tight to the "Manometer Connection" port.

Adjusting of the manometer:

For exact horizontally adjusting each inclined tube manometer is provided with a bubble level. For easy adjusting there are two suspension eye hooks one of which is slot shaped. After releasing both the fixing screw on top of the manometer as well as the screw inside the slot, the manometer can be adjusted. After adjusting both screws must be fixed again.

Filling:

Filling is easily performed via the vertical left-hand connection port. If the manometer was not pre-mounted: Unscrew the yellow screw cap. Fill in the respective filling liquid (blue Special-Equipment Filling Oil [γ = 0.88] or mercury[1]). For easier handling the hose barb nozzle can be removed.

Please note that only the liquid must be filled which the manometer is designed for!

Fill in the liquid until the liquid column inside the inclined tube is in the near of the zero mark. The liquid column must not be set perfectly to the zero mark, because the manometer scale is moveable. The "fine tuning" (= setting the zero mark perfectly to the end of the liquid column) can then be done by moving the scale up or down. The scale can be moved after releasing the white fixing knob (fixing screw) of the scale.

After the scale is moved into the correct position. the fixing know **must** be fixed again.

Connection of the pressure supply pipe to the manometer:

Unscrew both yellow screw plugs on top of the manometer. The pressure supply pipe is to be provided with a hose tap nozzle. Screw this tap nozzle

- into the left-hand connection port if overpressure is to be measured,
- into the right-hand connection port if underpressure is to be measured.

The Manometer is then ready for use.

Reading:

The oil column of the Manometer indicates the differential pressure in [mbar] of the gas between the Gas Inlet of the Gas Meter and the atmospheric pressure.**Caution:** If the Manometer is connected to the gas inlet of the Gas Meter but **not** filled with oil, gas will leak through the Manometer. This will inevitably cause a **measurement error** of the Gas Meter.**Operating:**

[1] The mercury version is labelled by the engraving „For Mercury Only“ at the front side.

Operate the manometer only within its pressure limits.
When operating the manometer, care should be taken that it is protected against radiant heat.

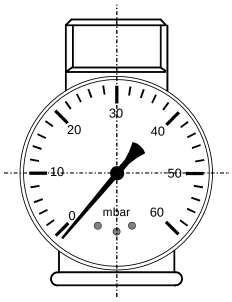
Maintenance:

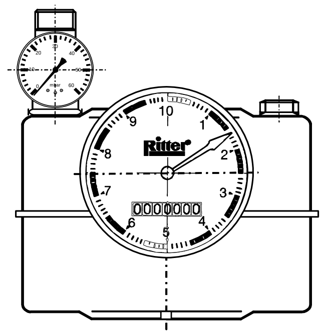
In general a special maintenance service is not necessary. But it is recommended to check the zero-point of the scale from time to time. If necessary, the scale must be re-adjusted or measuring liquid may have to be refilled.

Cleaning:

According to the degree of contamination cleaning agent M 3 is used. After the filling liquid was removed, M 3 is filled into the unit via the left-hand hose nozzle. Leave the cleaning agent there for some time to dissolve the contamination. If special filling oil γ = 0,88 has been used and the contamination is considerable, the cleaning process has to be repeated several times. Subsequently rinse well with pure warm water until the liquid container and the measuring column are clear again.

Ritter Made in Germany	**ACCESSORIES** **Manometer for BG -Series** Data Sheet	**03.09** V 2.1 Rev. 04/03





Suitable for:	**RITTER** Bellows-type Gas Meters
Measuring Range:	0 to 60 mbar
Resolution:	2 mbar
Type of manometer:	Capsule pressure gauge

Application:

The Manometer can be used for measurement of the gas pressure while measuring the gas flow. Among other reasons, this is necessary if the measured and indicated **actual volume** of gas must be recalculated into the **norm volume**. The **actual** volume is the volume at the **actual** temperature and the **actual** pressure. The **norm volume** of a gas is the volume at **norm conditions** which are (in Germany):

Norm temperature	=	273.15	Kelvin (= 0 °C)
Norm pressure	=	1,013.25	mbar

The formula for converting the **actual volume** into **norm volume** is:

$$V_N = V_i \times \frac{P_a}{P_N} \times \frac{T_N}{T_i}$$

where

V_N	=	Norm Volume in	[ltr]
V_i	=	indicated Volume in	[ltr]
p_N	=	Norm Pressure in	[mbar]
p_a	=	actual Pressure in	[mbar]
T_N	=	Norm Temperature in	[Kelvin]
T_i	=	indicated Temperature in	[Kelvin]

Note: The indicated gas pressure at the manometer is the differential pressure between the gas pressure at the gas inlet and the actual atmospheric air pressure. Thus, the actual gas pressure (p_a) of the above formula equals the **indicated gas pressure** at the Manometer **plus** the **actual atmospheric air pressure** in [mbar].

Installation:

Unpack the Manometer which is mounted into a T-piece. According to the rules for calibration and measurement with gas meters, the Manometer must be positioned at the gas inlet of the meter (see right picture above). The gas inlet nozzle is labelled accordingly.

Mount the Manometer onto the gas inlet nozzle by tightly screwing the union nut which is attached to the Thermometer. Thus, the Manometer is ready for use.

ACCESSORIES **Manometer for higher-pressure Meters (≥ 0.5 bar)** Data Sheet	**03.10** V 1.0 Rev. 02/2009

Suitable for	RITTER Gas Meters			
Measuring Range	0 … 600 mbar	0 … 1 bar	0 … 6 bar	0 … 10 bar
Resolution	20 mbar	50 mbar	0.2 bar	0.5 bar
Type	Capsule pressure gauge			
Material	Stainless steel (Cr-Ni)			

Application:

The Manometer can be used for measurement of the gas pressure while measuring the gas flow. Among other reasons, this is necessary if the measured and indicated **actual volume** of gas must be recalculated into the **norm volume**. The **actual** volume is the volume at the **actual** temperature and the **actual** pressure. The **norm volume** of a gas is the volume at **norm conditions** which are (in Germany):

Norm temperature	=	273.15	Kelvin (= 0 °C)
Norm pressure	=	1,013.25	mbar

The formula for converting the **actual volume** into **norm volume** is:

$$V_N = V_i \, x \, \frac{P_a}{P_N} \, x \, \frac{T_N}{T_i}$$

where

V_N	=	Norm Volume in	[ltr]
V_i	=	indicated Volume in	[ltr]
p_N	=	Norm Pressure in	[mbar]
p_a	=	actual Pressure in	[mbar]
T_N	=	Norm Temperature in	[Kelvin]
T_i	=	indicated Temperature in	[Kelvin]

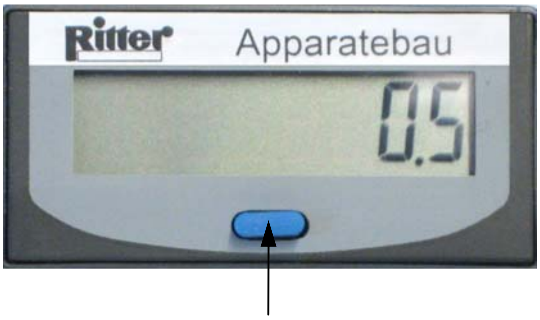
Note: The indicated gas pressure at the manometer is the differential pressure between the gas pressure at the gas inlet and the actual atmospheric air pressure. Thus, the actual gas pressure (p_a) of the above formula equals the **indicated gas pressure** at the Manometer **plus** the **actual atmospheric air pressure** in [mbar].

Installation:

The Manometer is pre-mounted to the gas meter (positioned at the gas inlet nozzle). The gas inlet nozzle is labelled accordingly. Therefore, the manometer is ready for use and no further installation is to be performed by the user.

Please note: The manometer screw connection to the gas meter is sealed by Teflon® tape. When disassembling the manometer from the gas meter, the Teflon® tape cannot be used again and must be replaced by a new Teflon® tape.

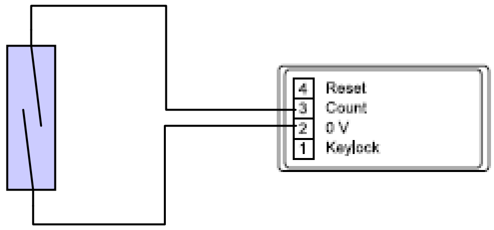
Counter
(Display with TG05)



Reset

Reed Contact

Terminal Assignment
of Counter



Suitable for: RITTER drum-type and bellows-type gas meters (not for TG01)

Indication: TG05: 0 to 9,999,999.5 ltr
all other meters: 0 to 99,999,999 ltr

Resolution: = volume of measuring drum

Application:

The resettable LCD counter displays the volume measured by the gas meter. As an option it is available for Ritter drum-type and bellows-type gas meters and must be ordered along with the gas meter.

Use in ex-proof areas:

The LCD counter is not intrinsically safe. **Therefore, it cannot be used in ex-proof areas in general!** For exceptions please check with your authorized ex-proof safety representative .

Functional principle:

A permanent magnet as well as a reed contact are mounted within the counter casing of the gas meter. The permanent magnet closes the reed contact once per revolution of the measuring drum of the gas meter. Each pulse of the reed contact adds a volume increment to the displayed volume. The volume increment equals the measuring drum volume of the respective gas meter. Fractions of a drum revolution are indicted by the dial face indicator (needle).

The LCD display is battery operated.

Please note:

- If the direction of drum rotation is reversed (by under-pressure at the gas inlet or over-pressure at the gas outlet), the pulses of the reed contact are detected by the counter. Subsequently, the respective "negative" gas volume is wrongly added because a detection of the rotational direction of the drum is not possible with the red contact.

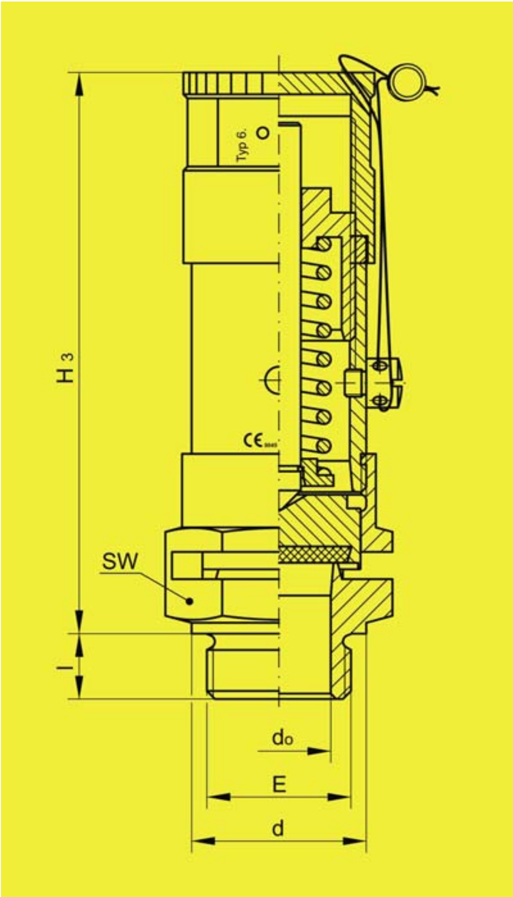
- Prior to resetting the counter to „zero", the indication needle must be turned to „zero" as well. Because the indication needle is coupled to the drum via the shaft and magnetic coupling, the gas meter must be depressurised (gas inlet/outlet open). Thus, the drum can rotate without resistance and the indicator needle can be reset to "zero" easily.

Technical data:

Battery life time approx.	approx. 5 years
Reset	manual reset via pushbutton, (can be locked)
Reset lock	via bridge between terminals “Keylock” and “0 V”
Operating temperature	-10 .. +50°C
Display	8-digit LCD, 7 mm
Supply voltage	internal lithium battery
Protection class (IEC 144)	Front side IP 65, terminals IP 20
Electrical connection	screw terminals
Input resistance	< 50 kΩ (static)

Suitable for:	RITTER drum-type and bellows-type gas meters
Gases:	**non-toxic**
Set pressure:	type 1: **50 mbar** type 2: **500 mbar** type 3: **1 bar**
Maximum flow rate:	see table below
Material:	1.4571 / 1.4301
Function:	spring loaded
Operating temperature: [1]	-60°C … +130°C
Installation position:	vertical
Sealing	Viton

Maximum flow rate		**at set pressure of**
Air (0°C)	27 Nm³/h	type 1: **50 mbar**
CO_2 (0°C)	22 Nm³/h	type 2: **500 mbar**
N (0°C)	50 Nm³/h	type 3: **1 bar**



Caution:

When exceeding the respective above-mentioned set pressure, the safety valve opens. However, if the flow rate from the gas source exceeds the respective max. flow rate, the valve would not be able to vent the meter quickly enough.

This would built-up a pressure inside of the meter and may destroy the gas meter despite of the opened valve!

Inlet				Outlet	Dimensions				Set pressure	Weight
E	d_0 mm	D mm	l mm	A	H_3 mm	H_5 mm	SW mm	d_0 mm	p bar	kg
G ½	13	26	12	free	103	120	36	13	0.05 / 0,5 / 1	0.4

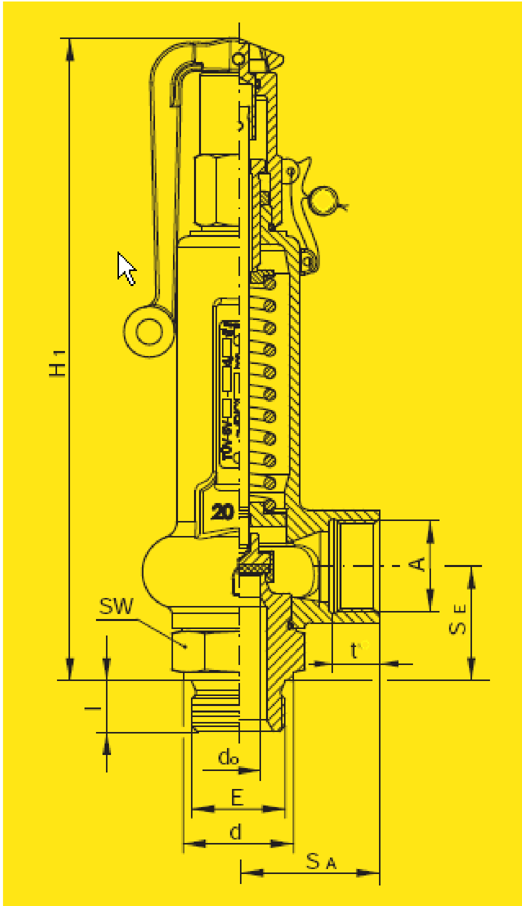
[1] Please mind the temperature range of the gas meter!

Ritter Made in Germany

ACCESSORIES
Safety Valve – closed completion
Data Sheet

03.14
V 1.0
Rev. 10/2013

Suitable for:	**RITTER** drum-type and bellows-type gas meters
Gases:	**toxic**
Set pressure:	type 1: **50 mbar** type 2: **500 mbar** type 3: **1 bar**
Maximum flow rate: (with air at 0°C)	type 1: **5 Nm³/h** type 2: **11 Nm³/h** type 3: **17 Nm³/h**
Material:	1.4571 / 1.4581
Function:	spring loaded
Connection:	pipe connection
Operating temperature: [1]	-60°C to +280°C
Installation position:	vertical
Sealing	Viton



Caution:

When exceeding the respective above-mentioned set pressure, the safety valve opens. However, if the flow rate from the gas source exceeds the respective max. flow rate, the valve would not be able to vent the meter quickly enough.

This would built-up a pressure inside of the meter and may destroy the gas meter despite of the opened valve!

Inlet				Outlet			Dimensions					Set pressure	Weight
E	S_E	d	l	A	S_A	t	H_1	H_2	H_3	SW	d_0	p	
	mm	mm	mm	G	mm	mm	mm	mm	mm	mm	mm	bar	kg
G 3/4	34	32	16	1/2	40	14	200	205	185	32	16	0.05 / 0,5 / 1	1

[1] Please mind the temperature range of the gas meter!

Pulse Generator	Properties	Page
Version V2.0ex	• 50 pulses per revolution of measuring drum • For use with TG05 to TG50, BG4 to BG100 • Uni-directional • Applicable for ex-proof areas [2]	03.21
Version V3.2	• 200 pulses per revolution of measuring drum • For use with TG05 to TG50, BG4 to BG100 • Uni-directional • Not applicable for ex-proof areas	03.16
Version V4.01	• 2 x 200 pulses per revolution of measuring drum • For use with TG05 to TG50, BG4 to BG100 • Bi-directional • Not applicable for ex-proof areas	03.26
Version V4.11	• 500 pulses per revolution of measuring drum • For use with TG05 to TG50, BG4 to BG100 • Uni-directional • Not applicable for ex-proof areas	03.33
Version V5.0	• 50 pulses per revolution of measuring drum • For use with TG01 version V4.x • Uni-directional • With standard output socket: Not applicable for ex-proof areas With optional explosion-proof output socket: Applicable for ex-proof areas [1]	03.38

[2] Please note: According to European laws (EC directive 94/9/EC), a Declaration of Conformity ("ATEX" Declaration of Conformity) must be available for the gas meter, in which the Pulse Generator is built into, if and when the meter shall be used in ex-proof areas. This Declaration of Conformity is in preparation for the meter models made out of PE-el (model no. 8).

Quick reference:

- 200 pulses per revolution of measuring drum
- For use with TG05 to TG50, BG4 to BG100
- Uni-directional
- Not applicable for ex-proof areas

Application: The Pulse Generator for **RITTER** gas meters is a rotary encoder for pulse output. It can be used to transfer the measured gas volume for remote display and/or data processing (calculation of flow rate, data transfer via RS232) to the accessory EDU 32 or to an external measuring system / PC. In the latter case, the external system must provide the power supply for the photo sensor as well as the evaluation circuit/logic which enables the direct readout of the measured volume and flow rate. For connection to an external system, please refer to the electrical data on page 03.18 and the wiring diagrams on page 03.19.

Components: The Pulse Generator is located within the housing of the counter mechanism of the Gas Meter (behind the dial plate) and it consists of the following components:

- Optical encoding film disc
- mini board with integrated infra-red photo sensor and LED operating indicator
- round, 5-pin output socket (180°, DIN 41524)

Description: The measuring drum of drum-type meters and the measuring unit of bellow-type meters are coupled 1:1 to the slit disc via a magnetic coupling. The slits/flags of the slit disc rotate through the U-shaped photo sensor, thereby interrupting the light beam of the photo diode intermittently. Thus, the photo interrupter converts the revolution of the measuring drum into a sequence of pulses. The number of pulses represents the **volume of gas** which has passed through the Gas Meter, depending on the respective resolution (see table on Page 03.17). The frequency of the sequence of pulses is a measure of the rotational speed of the measuring drum and thereby a measure of the **flow rate** of the gas.

For operation of the photo sensor, an external electric power supply in the range of 5-24 Volts DC is required. More electrical data are stated on the data sheet 03.18. **The output signal is a TTL signal**, whereby the pulse level (= min./max. voltage of the signal) depends on the power supply:

- Power Supply 5 V ⇒ Output Signal Level 0.7 / 3.7 Volt
- Power Supply 24 V ⇒ Output Signal Level 2 / 21 Volt

For power supply values between 5 and 24 Volts, the output signal level can be linearly interpolated for the first approximation.

Output Socket: The pin connection of the 5-pin output socket is shown on data sheet 03.18.

Sample circuit: The connection of a measurement instrument to the Pulse Generator is shown schematically on data sheet 03.19.

Use with Drum-type Gas Meters:

Drum-type gas meters are <u>volumetric</u> gas meters. That means, that they are measuring gas <u>volume</u> precisely. When the Pulse Generator is used with drum-type gas meters for recording the gas <u>flow</u>, it is possible for the respective Voltage Output curve (line) to be wavy, even when gas flow is constant. This is (unpreventably) caused by the type of construction of the measuring drum: the drum consists of four separate chambers, which are closed and opened in sequence. The previous chamber **has to be** closed **before** the next chamber will open.

This compulsory measurement is the reason for the high measurement accuracy. However, each closing also causes a little build-up of pressure at the inside of a chamber. The surface tension creates an additional pressure increase during emerging of a chamber (water highest surface tension, oil: lower, CalRix lowest). The resulting pressure increase causes a small reduction in the rotational speed of the measuring drum. This is barely visible to the eye but is documented precisely by a computer/transcriber. Thus, the wavy output line at constant input flow documents the **true** flow through the gas meter.

Performance Data:

Gas Meter [Type]	Pulses per Revolution* [P/R]	Gas Flow per Revolution* [ltr/R]	Resolution [ltr/Pulse]	Pulses per Liter [Pulse/ltr]	Maximum Pulse Frequency [Pulse/min]
TG 01	not applicable				
TG 05	200	0.5	0.0025	400	400
TG 1	200	1.0	0.005	200	400
TG 3	200	3.0	0.015	66.7	400
TG 5	200	5.0	0.025	40	400
TG 10	200	10	0.05	20	400
TG 20	200	20	0.1	10	467
TG 25	200	25	0.125	8	933
TG 50	200	50	0.25	4	1,200
BG 4	200	10	0.05	20	2,000
BG 6	200	20	0.1	10	1,667
BG 10	200	50	0.25	4	1,067
BG 16	200	100	0.5	2	833
BG 40	200	100	0.5	2	2,167
BG 100	200	100	0.5	2	2,167

* TG types: Revolution of measuring drum
(= revolution of large needle of dial plate)
BG types: Revolution of large needle of dial plate

Temperature range:

- 0 to +55°C

At higher temperatures the Pulse Generator must be cooled by flushing the counter mechanism casing with room air.
Necessary equipment: Optional connection nozzle at counter mechanism casing.

Humidity range:

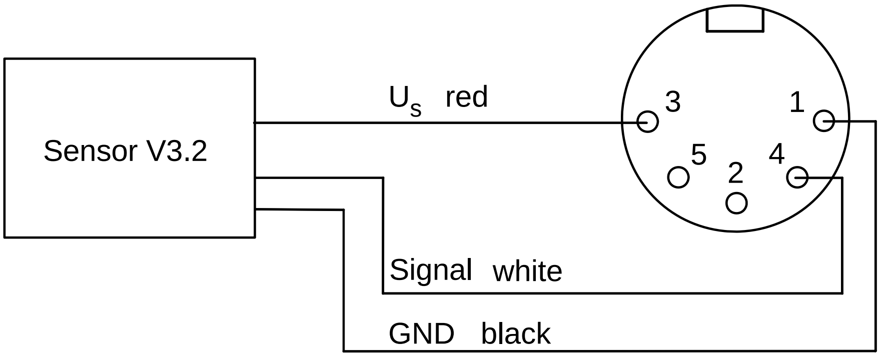
- 0 to 65% relative humidity, **non-condensing**

With a higher humidity, the circuit board of the Pulse Generator can be covered with a protective lacquer. Please indicate prior to order.

Electrical Data:

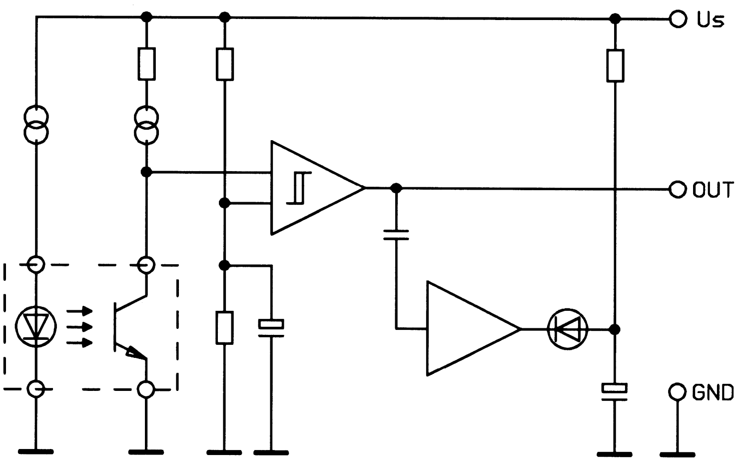
Supply Voltage U_S		5 – 24	V DC
Supply Current		< 3	mA
Voltage output Us = 5 V:	high level	min. 3.7	V
	low level	max. 0.7	V
Voltage output Us = 24 V:	high level	min. 21	V
	low level	max. 2	V
Current Output	Source	min. +7	mA
	Sink	min. -6	mA
Operating Frequency photo diode		0 – 250	Hz

Pin configuration of the Output Socket:
(View to **plug-side** of the socket)



Circuit diagram:

Pin No.
(PG-socket)

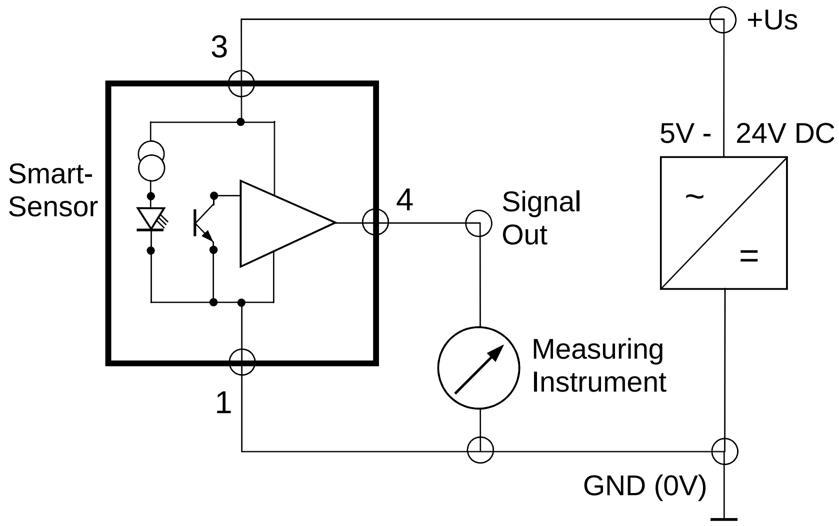


3

1

Caution: The Pulse Generator is not protected against incorrect connection of wires. Inverting of wires will damage the Pulse Generator!

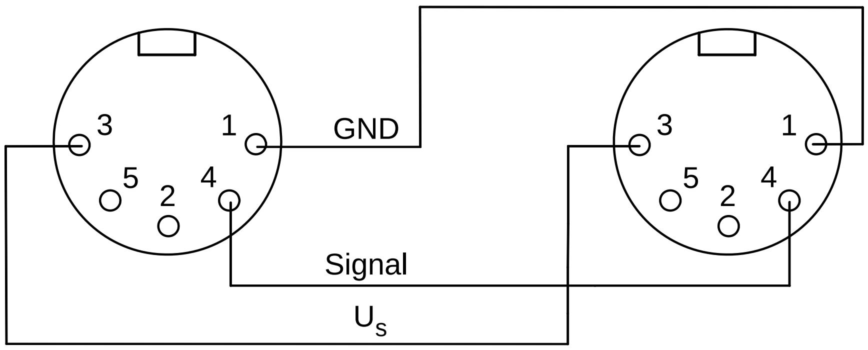
Wiring diagram / sample circuit (schematic):



Connection of the Pulse Generator
to the "Electronic Display Unit" EDU 32 FP (optional accessory)**:**

The Pulse Generator can be connected to the optional accessory "Electronic Display Unit" by means of the 3-pin connection cord, which is supplied in conjunction with the Electronic Display Unit. The Electronic Display Unit contains the power supply for the inductive sensor as well as the evaluation circuit/logic which enables the direct readout of the measured volume [ltr] and flow rate [ltr/h].

Wiring of the Pulse Generator to the EDU socket
(view to **plug-side** of the sockets):



Pulse Generator Output Socket EDU Input Socket

The measurement results displayed by the Electronic Display Unit can be transmitted to a computer via the standard-type interface RS 232 (refer to chapter 4 "Electronic Display Unit" as well). Additionally, the value of the flow rate can be transmitted to an analog measurement device via the standard-type analog output (0-1 Volt or 4-20 mA).

Set-up of EDU:

- Programming of sensor type: Select sensor type "PG V3.X"
(please refer to the EDU Operation Instructions par. 6.2.4 as well)
- Programming of slit disc / encoding disc: Select "200 Pulses/Rev"
(please refer to the EDU Operation Instructions par. 6.2.5 as well)

Dimensions of slit disc:

	TG05 to TG50 BG [mm]
Diameter:	144
Slit width:	1.2
Flag width:	1.0

Exchanging the spare parts kit „Complete Photo diode "

The kit consists of the following components which are already mounted on a transparent plastic cover plate:

- Photo diode on a mini board,
- Fixture,
- Wiring,
- 5-pin socket.

Removal of the built-in kit:

- Remove the plug of the signal transmission cable from the socket of the pulse generator,
- Unscrew the 4 screws of the transparent cover plate,
- Remove the cover plate together with the built-in-kit.

Replacement with the new kit:

- Carefully mount the fork-shaped photo diode over the circumference of the folio disc without bending the disc,
- Fasten the cover plate to the counter mechanism casing with the 4 screws. By way of the free play in the washer holes the photo diode can be positioned such that the folio disc can freely rotate through the middle of the fork-shaped photo diode. After that tighten the screws to fix the built-in-kit.

Quick reference:

- 50 pulses per revolution of measuring drum
- For use with TG05 to TG50, BG4 to BG100
- Uni-directional
- Applicable for ex-proof areas [3]

Application: The Pulse Generator for **RITTER** gas meters is a rotary encoder for pulse output. It can be used to transfer the measured gas volume for remote display and/or data processing (calculation of flow rate, data transfer via RS232) to the accessory EDU 32 or to an external measuring instrument (PC, transcriber). In the latter case, the external system must provide the power supply for the sensor as well as the evaluation circuit/logic which enables the direct readout of the measured volume and flow rate. For connection to an external system, please refer to the pin configuration on page 03.22 and the electrical data on page 03.24.

This explosion proof Pulse Generator is equipped with an inductive sensor for use in hazardous environments[3] according categories[4] ATEX 1G and ATEX 2G. Approval No.: PTB 99 ATEX 2219 X, marking: ⟨Ex⟩ II 1 G EEx ia IIC T6

For use in **ex-proof areas** an external intrinsic safety barrier has to be installed between Pulse Generator (gas meter) and the power supply (for example by the EDU) for galvanic decoupling.

For selection of the gas meter model to be used in ex-proof areas: See footnote.

Equipment: The Pulse Generator is located within the casing of the counter mechanism of the Gas Meter (behind the dial plate) and it consists of the following components:

- Slit disc
- Sensor: inductive proximity switch with PTB/ATEX certificate
- 3-pin ex-proof output socket

Description: The measuring drum of drum-type meters and the measuring unit of bellow-type meters are coupled 1:1 to the slit disc via a magnetic coupling. The slits/flags of the slit disc rotate through the U-shaped inductive sensor. Thus, the inductive sensor converts the revolution of the measuring drum into a sequence of pulses. The number of pulses represents the **volume of gas** which has passed through the Gas Meter, depending on the respective resolution (see table on page 03.22). The frequency of the sequence of pulses is a measure of the rotational speed of the measuring drum and thereby a measure of the **flow rate** of the gas.

For operation of the inductive sensor, an external electric power supply with 5 Volts DC is required. More electrical data are stated on the data sheet 03.24. The

[3] Please note: According to European laws (EC directive 94/9/EC), a Declaration of Conformity ("ATEX" Declaration of Conformity) must be available for the gas meter, in which the Pulse Generator is built into, if and when the meter shall be used in ex-proof areas. This Declaration of Conformity is in preparation for the meter models made out of PE-el (model no. 8).

[4] Equivalence of categories and zones: category 1 = zone 0, category 2 = zone 1, category 3 = zone 2
"G" stands for "gas" ("D" for "dust")

output signal is a rectangular pulse, whereby the pulse level (= min./max. voltage of the signal) depends on the user-side circuit, i.e. the value of the used resistors.

Output Socket: The pin connection of the 3-pin output socket is shown on page 03.22.

Use with Drum-type Gas Meters:

Drum-type gas meters are volumetric gas meters. That means, that they are measuring gas volume precisely. When the Pulse Generator is used with drum-type gas meters for recording the gas flow, it is possible for the respective Voltage Output curve (line) to be wavy, even when gas flow is constant. This is (unpreventably) caused by the type of construction of the measuring drum: the drum consists of four separate chambers, which are closed and opened in sequence. The previous chamber **has to be** closed **before** the next chamber will open.

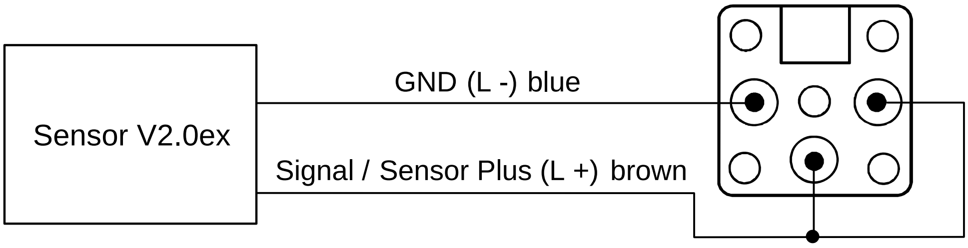
This compulsory measurement is the reason for the high measurement accuracy. However, each closing also causes a little build-up of pressure at the inside of a chamber. The surface tension creates an additional pressure increase during emerging of a chamber (water highest surface tension, oil: lower, CalRix lowest). The resulting pressure increase causes a small reduction in the rotational speed of the measuring drum. This is barely visible to the eye but is documented precisely by a computer/transcriber. Thus, the wavy output line at constant input flow documents the **true** flow through the gas meter.

Performance Data:

Gas Meter [Type]	Pulses per Revolution* [P/R]	Gas Flow per Revolution* [ltr/R]	Resolution [ltr/Pulse]	Pulses per Liter [Pulse/ltr]	Maximum Pulse Frequency [Pulse/min]
TG 01	not applicable				
TG 05	50	0.5	0.01	100	100
TG 1	50	1.0	0.02	50	100
TG 3	50	3.0	0.06	17	100
TG 5	50	5.0	0.1	10	100
TG 10	50	10	0.2	5	100
TG 20	50	20	0.4	3	117
TG 25	50	25	0.5	2	233
TG 50	50	50	1.0	1	300
BG 4	50	10	0.2	5	500
BG 6	50	20	0.3	3	417
BG 10	50	50	1	1	267
BG 16	50	100	2	1	208
BG 40	50	100	2	1	542
BG 100	50	100	2	1	1,333

* TG types: Revolution of measuring drum
(= revolution of large needle of dial plate)
BG types: Revolution of large needle of dial plate

Pin configuration of the Output Socket:
(View to the (female) socket)



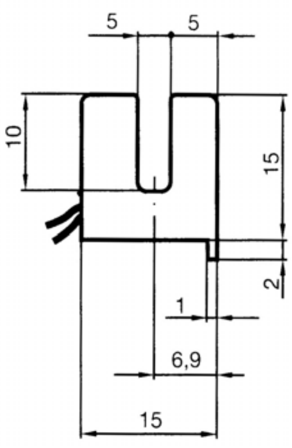
Temperature range:

- -25°C to +70°C
- At higher temperatures the Pulse Generator can be cooled by flushing the counter mechanism casing with room air. Necessary equipment: Optional connection nozzle at counter mechanism casing.

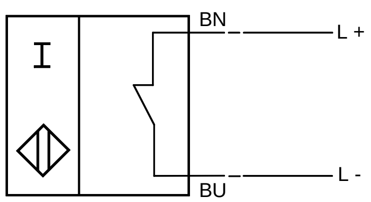
Dimensions of slit disc:

	TG05 to TG50 BG [mm]
Diameter:	144
Slit width:	4.2
Flag width:	4.4

Dimensions of Sensor:



Standard symbol, connection:



Technical Data:

Slot width	5	mm
Entry depth	5 … 7	mm
Nominal voltage	8	V
Current consumption:		
Sensing face covered	≤ 1	mA
Sensing face free	≥ 3	mA
Switching frequency	0 … 2000	Hz
Hysteresys	0.05 … 0.65	mm
EMC to	EN 60947-5-2	
In compliance with	DIN EN 60947-5-6 (NAMUR)	
Protection to IEC 60529	IP67	
Operating temperature	-25 … +100	°C
Connection	0.5 m, leads LIY	
Conductor cross section	0,14 mm^2	
Casing material	PBT	
Ex category	1G, 2G	

Connection of the Pulse Generator
to the "Electronic Display Unit" EDU 32 FP (optional accessory)**:**

The EDU is not suitable for use in ex-proof areas and must therefore be positioned outside of the ex-proof area.

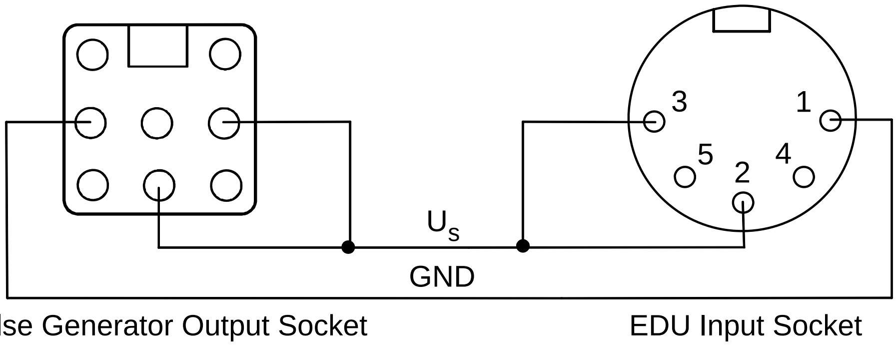
In this case the pulse generator must be connected to the EDU via an external intrinsic safety barrier for galvanic decoupling of the power supply (by the EDU).

For programming of the EDU for this application please refer to the instructions in "Set-up of the EDU" below.

In case the gas meter is not positioned in an ex-proof area and/or shall be connected to the EDU for testing purposes only, the Pulse Generator can be connected to the EDU by means of the 3-pin connection cord, which is supplied in conjunction with the EDU.

The Electronic Display Unit contains the power supply for the inductive sensor as well as the evaluation circuit/logic which enables the direct readout of the measured volume [ltr] and flow rate [ltr/h].

Wiring of the Pulse Generator to the EDU socket
(view to **plug-side** of the sockets):



The measurement results displayed by the Electronic Display Unit can be transmitted to a computer via the standard-type interface RS 232 (refer to chapter 4 “Electronic Display Unit” as well). Additionally, the value of the flow rate can be transmitted to an analog measurement device via the standard-type analog output (0-1 Volt or 4-20 mA).

Set-up of EDU:

1. Gas meter is positioned inside of ex-proof area and connected to the EDU via an external switch amplifier for galvanic decoupling of the power supply (by the EDU):
   - Programming of sensor type: Select sensor type “PG **V3.X**”
     (please refer to the EDU Operation Instructions par. 6.2.4 as well)
   - Programming of slit disc / encoding disc: Select “50 Pulses/Rev”
     (please refer to the EDU Operation Instructions par. 6.2.5 as well)
2. Gas meter is positioned outside of ex-proof area and connected to the EDU via the 3-pin connection cord, which is supplied in conjunction with the EDU:
   - Programming of sensor type: Select sensor type “PG **V2.0Ex**”
     (please refer to the EDU Operation Instructions par. 6.2.4 as well)
   - Programming of slit disc / encoding disc: Select “50 Pulses/Rev”
     (please refer to the EDU Operation Instructions par. 6.2.5 as well)

Quick reference:

- 2 x 200 pulses per revolution of measuring drum
- For use with TG05 to TG50, **not** for BG types (because of pawl with BG types)
- Bi-directional[1]
- Not applicable for ex-proof areas

Application: The Pulse Generator for RITTER gas meters is a rotary encoder for pulse output. It can be used to transfer the measured gas volume for remote display and/or data processing (calculation of flow rate, data transfer via RS232) to the accessory EDU 32 or to an external measuring system / PC. In the latter case, the external system must provide the power supply for the photo sensor as well as the evaluation circuit/logic which enables the direct readout of the measured volume and flow rate. For connection to an external system, please refer to the electrical data on page 03.29 and the wiring diagram on page 03.29.

The version V4.01 is a twin channel encoder with bi-directional recognition of the rotation of the measuring drum. **(Please refer to footnote!)** This feature provides the possibility to recognize a backward rotation of the measuring drum caused by a change of gas flow direction or by vibration of the drum (e.g. due to a pulsating gas flow with negative pressure peaks). (A mono-channel encoder would wrongly cumulate the pulses (= volume) in these conditions.)

Please note however: The ability to measure a backward rotation does not mean that the gas meter can measure a continuing reversed gas flow correctly. The measuring drum is measuring correctly only at standard gas flow direction from the gas inlet towards the gas outlet. This gas flow direction can either be generated by a positive (over)pressure at the gas inlet or by a negative (under)pressure at the gas outlet. The feature of bi-directional recognition of the rotation of the measuring drum is only for compensation of limited reverse flow or vibrations of the measuring drum.

Components: The Pulse Generator is located within the housing of the counter mechanism of the Gas Meter (behind the dial plate) and it consists of the following components:

- Optical encoding film disc
- Sensor unit with integrated twin infra-red photo sensors and LED operating indicators
- Round, 5-pin output socket (180°, DIN 41524)

Description: The measuring drum of drum-type meters and the measuring unit of bellow-type meters are coupled 1:1 to the slit disc via a magnetic coupling. The optical encoding bars of the film disc rotate through the U-shaped photo sensor, thereby interrupting the light beam of the photo diode intermittently. Thus, the photo interrupter converts the revolution of the measuring drum into a sequence of pulses. The number of pulses represents the **volume of gas** which has passed through the Gas Meter, depending on the respective resolution (see table on page 03.28).

[1] The recognition of the rotating direction is done by evaluating the signals of the two channels. The logic for this feature is incorporated in the Electronic Display Unit EDU 32, i. e. the EDU 32 indicates the resulting volume (= volume forward rotation minus volume backward rotation). If connected to an external data acquisition system the evaluation of the two channels has to be done by the data acquisition system.

The frequency of the sequence of pulses is a measure of the rotational speed of the measuring drum and thereby a measure of the **flow rate** of the gas.

For operation of the photo sensor, an external electric power supply in the range of 5-28 Volts DC is required. More electrical data are stated on the data sheet 03.29. **The output signal is a TTL signal**, whereby the pulse level (= min./max. voltage of the signal) depends on the power supply voltage and current load (please refer to the table on data sheet 03.29).

For power supply values between 5 and 28 Volts, the output signal level can be linearly interpolated for the first approximation.

Output Socket: The pin configuration of the 5-pin output socket is shown on data sheet 03.29. These pin numbers are equivalent to the numbers shown in the diagram of the photo sensor on data sheet 03.29.

Use with Drum-type Gas Meters:

Drum-type gas meters are volumetric gas meters. That means, that they are measuring gas volume precisely. When the Pulse Generator is used with drum-type gas meters for recording the gas flow, it is possible for the respective Voltage Output curve (line) to be wavy, even when gas flow is constant. This is (unpreventably) caused by the type of construction of the measuring drum: the drum consists of four separate chambers, which are closed and opened in sequence. The previous chamber **has to be** closed **before** the next chamber will open.

This compulsory measurement is the reason for the high measurement accuracy. However, each closing also causes a little build-up of pressure at the inside of a chamber. The surface tension creates an additional pressure increase during emerging of a chamber (water highest surface tension, oil: lower, CalRix lowest). The resulting pressure increase causes a small reduction in the rotational speed of the measuring drum. This is barely visible to the eye but is documented precisely by a computer/transcriber. Thus, the wavy output line at constant input flow documents the **true** flow through the gas meter.

Performance Data:

Gas Meter [Type]	Pulses per Revolution* [P/R]	Gas Flow per Revolution* [ltr/R]	Resolution [ltr/Pulse]	Pulses per Liter [Pulse/ltr]	Maximum Pulse Frequency [Pulse/min]
TG 01	not applicable				
TG 05	200	0.5	0.0025	400	400
TG 1	200	1.0	0.005	200	400
TG 3	200	3.0	0.015	66.7	400
TG 5	200	5.0	0.025	40	400
TG 10	200	10	0.05	20	400
TG 20	200	20	0.1	10	467
TG 25	200	25	0.125	8	933
TG 50	200	50	0.25	4	1,200
BG 4	200	10	0.05	20	2,000
BG 6	200	20	0.1	10	1,667
BG 10	200	50	0.25	4	1,067
BG 16	200	100	0.5	2	833
BG 40	200	100	0.5	2	2,167
BG 100	200	100	0.5	2	2,167

* TG types: Revolution of measuring drum
(= revolution of large needle of dial plate)
BG types: Revolution of large needle of dial plate

Temperature range:

- 0 to +55°C
- At higher temperatures the Pulse Generator can be cooled by flushing the counter mechanism casing with room air. Necessary equipment: Optional connection nozzle at counter mechanism casing.

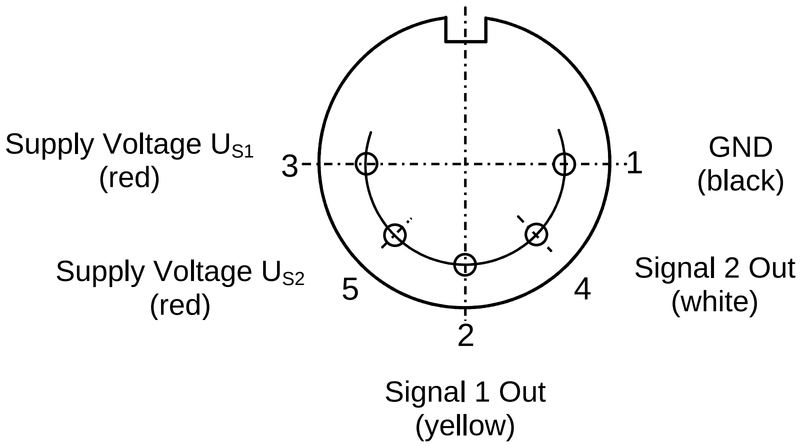
Dimensions of encoding disc:

	TG05 to TG50 BG [mm]
Diameter:	144
Slit width:	1.2
Bar width:	1.0

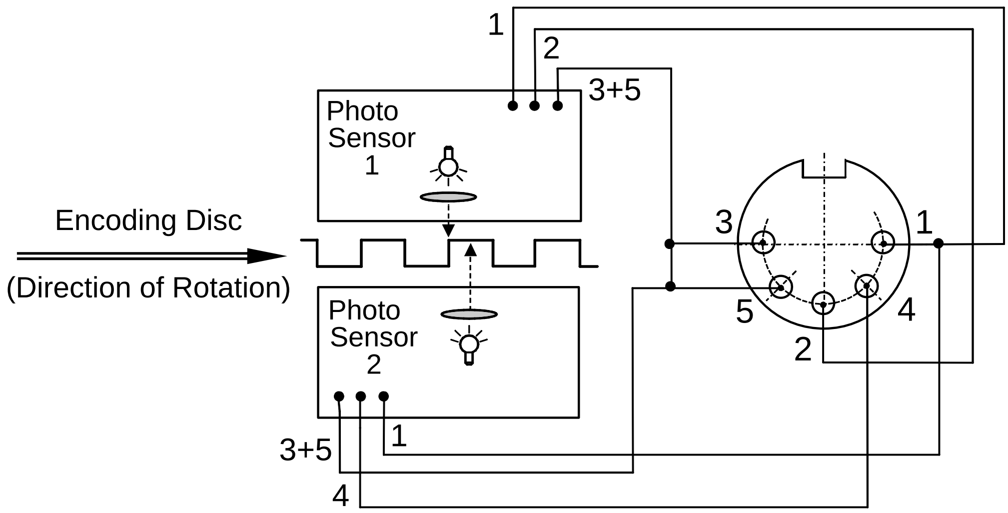
Electrical Data:

Supply Voltage U_S			5 – 28	V DC
Supply Current	Us = 5 V:		< 2	mA
	Us = 28 V:		< 4	mA
Voltage Output	Us = 5 V, no load:	high level	4.95	V
	Us = 5 V, load I_{Source} 4.7 mA:	high level	3.56	V
	Us = 5 V, no load:	low level	0.01	V
	Us = 5 V, load I_{Sink}7 mA:	low level	1.05	V
Voltage Output	Us = 28 V, no load:	high level	26.8	V
	Us = 28 V, load I_{Source} 7 mA:	high level	26.5	V
	Us = 28 V, no load:	low level	0.01	V
	Us = 28 V, load I_{Sink} 7 mA:	low level	1.2	V
Current Output	Us = 5 V:	source	4.7	mA
	Us = 28 V:	source	7	mA
	Us = 5-28 V:	sink	7	mA
Operating frequency photo diode			0 – 500	Hz

Pin configuration of the Output Socket:
(View to **plug-side** of the socket)



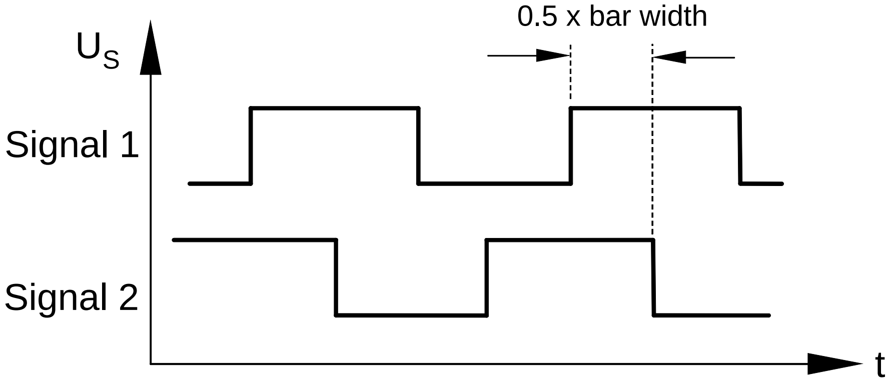
Internal wiring:



	Pin No.	Function	Lead Colour
Photo Sensor 1	3+5 2 1	Supply Voltage U_{S1} + U_{S2} Signal 1 Out Ground	red yellow black
Photo Sensor 2	3+5 4 1	Supply Voltage U_{S1} + U_{S2} Signal 2 Out Ground	red white black

Attention: The mini plugs of the cables which connect the leads from the sensor to the output socket **must not** be exchanged. (The yellow lead of signal 1 must be on the sensor side showing to the meter drum, the white lead of signal 2 must show to dial face.) Furthermore, the plugs **must** be put onto the pins of the sensor in the shown position. Especially the red leads must be connected to the pin close to the corner of the sensor casing. **Otherwise the sensor will be destroyed!**

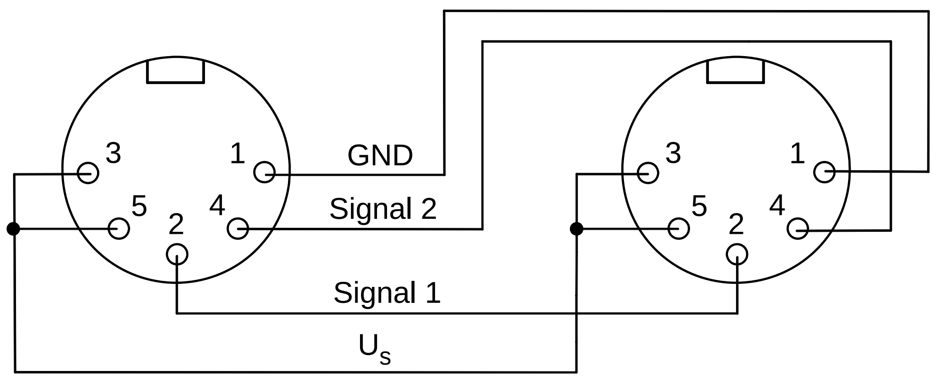
Signal Output:



Connection of the Pulse Generator
to the "Electronic Display Unit" EDU 32 FP (optional accessory)**:**

The Pulse Generator can be connected to the optional accessory "Electronic Display Unit" (V 5.0 or higher) by means of the 5-pin connection cord, which is supplied in conjunction with the Electronic Display Unit. The **maximum possible length** of the connection cable is **10 m** (unshielded cable) or **100 m** (shielded cable). The Electronic Display Unit contains the power supply for the photo sensor as well as the evaluation circuit/logic which enables the direct readout of the measured volume [ltr] and flow rate [ltr/h].

Wiring of the Pulse Generator to the EDU socket
(view to **plug-side** of the sockets):



Pulse Generator Output Socket EDU Input Socket

The measurement results displayed by the Electronic Display Unit can be transmitted to a computer via the standard-type interface RS 232 (refer to chapter 4 "Electronic Display Unit", par. 7.3, as well). Additionally, the value of the flow rate can be transmitted to an analog measurement device via the standard-type analog output (0-1 Volt or 4-20 mA).

Set-up of EDU:

- Programming of sensor type: Select sensor type “PG V4.0”
  (please refer to the EDU Operation Instructions par. 6.2.4 as well)
- Programming of slit disc / encoding disc: Select “2 x 200 Pulses/Rev”
  (please refer to the EDU Operation Instructions par. 6.2.5 as well)

Quick reference:

- 500 pulses per revolution of measuring drum
- For use with TG05 to TG50, BG4 to BG100
- Uni-directional
- Not applicable for ex-proof areas

Application: The Pulse Generator for **RITTER** gas meters is a rotary encoder for pulse output. It can be used to transfer the measured gas volume for remote display and/or data processing (calculation of flow rate, data transfer via RS232) to the accessory EDU 32 or to an external measuring system / PC. In the latter case, the external system must provide the power supply for the photo sensor as well as the evaluation circuit/logic which enables the direct readout of the measured volume and flow rate. For connection to an external system, please refer to the electrical data on page 03.35 and the wiring diagram on page 03.35.

Components: The Pulse Generator is located within the housing of the counter mechanism of the Gas Meter (behind the dial plate) and it consists of the following components:
- Optical encoding film disc
- Sensor unit with integrated infra-red photo sensor and LED operating indicator
- Round, 5-pin output socket (180°, DIN 41524)

Description: The measuring drum of drum-type meters and the measuring unit of bellow-type meters are coupled 1:1 to the slit disc via a magnetic coupling. The optical encoding bars of the film disc rotate through the U-shaped photo sensor, thereby interrupting the light beam of the photo diode intermittently. Thus, the photo interrupter converts the revolution of the measuring drum into a sequence of pulses. The number of pulses represents the **volume of gas** which has passed through the Gas Meter, depending on the respective resolution (see table on page 03.34). The frequency of the sequence of pulses is a measure of the rotational speed of the measuring drum and thereby a measure of the **flow rate** of the gas.

For operation of the photo sensor, an external electric power supply in the range of 5-28 Volts DC is required. More electrical data are stated on the data sheet 03.35. **The output signal is a TTL signal**, whereby the pulse level (= min./max. voltage of the signal) depends on the power supply voltage and current load (please refer to the table on data sheet 03.35).

For power supply values between 5 and 28 Volts, the output signal level can be linearly interpolated for the first approximation.

Output Socket: The pin configuration of the 5-pin output socket is shown on data sheet 03.35.

Use with Drum-type Gas Meters:

Drum-type gas meters are volumetric gas meters. That means, that they are measuring gas volume precisely. When the Pulse Generator is used with drum-type gas meters for recording the gas flow, it is possible for the respective Voltage Output curve (line) to be wavy, even when gas flow is constant. This is (unpreventably) caused by the type of construction of the measuring drum: the drum consists of four separate chambers, which are closed and opened in sequence. The previous chamber **has to be** closed **before** the next chamber will open.

This compulsory measurement is the reason for the high measurement accuracy. However, each closing also causes a little build-up of pressure at the inside of a chamber. The surface tension creates an additional pressure increase during emerging of a chamber (water highest surface tension, oil: lower, CalRix lowest). The resulting pressure increase causes a small reduction in the rotational speed of the measuring drum. This is barely visible to the eye but is documented precisely by a computer/transcriber. Thus, the wavy output line at constant input flow documents the **true** flow through the gas meter.

Performance Data:

Gas Meter	Pulses	Gas Flow	Resolution	Pulses	Maximum
	per	per		per	Pulse
	Revolution*	Revolution*		Liter	Frequency
[Type]	[P/R]	[ltr/R]	[ltr/Pulse]	[Pulse/ltr]	[Pulse/min]
TG 01	not applicable				
TG 05	500	0.5	0.001	1,000.0	1,000
TG 1	500	1.0	0.002	500.0	1,000
TG 3	500	3.0	0.006	166.7	1,000
TG 5	500	5.0	0.010	100.0	1,000
TG 10	500	10	0.020	50.0	1,000
TG 20	500	20	0.040	25.0	1,167
TG 25	500	25	0.050	20.0	2,333
TG 50	500	50	0.100	10.0	3,000
BG 4	500	10	0.020	50.0	5,000
BG 6	500	20	0.040	25.0	4,167
BG 10	500	50	0.100	10.0	2,667
BG 16	500	100	0.200	5.0	2,083
BG 40	500	100	0.200	5.0	5,417
BG 100	500	100	0.200	5.0	13,333

* TG types: Revolution of measuring drum
(= revolution of large Needle of dial plate)
BG types: Revolution of large Needle of dial plate

Temperature range:

- 0 to +55°C
- At higher temperatures the Pulse Generator can be cooled by flushing the counter mechanism casing with room air. Necessary equipment: Optional connection nozzle at counter mechanism casing.

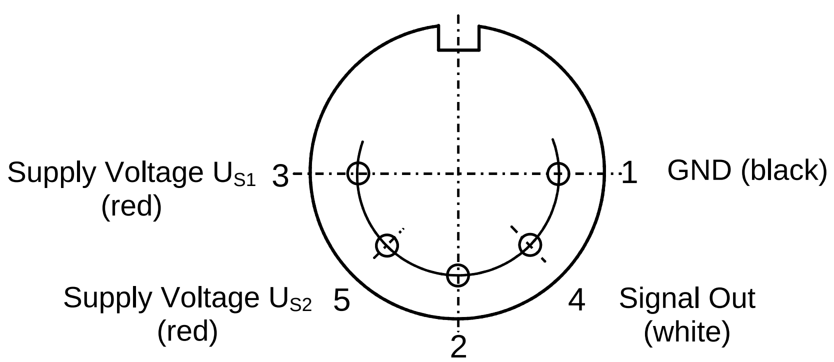
Dimensions of encoding disc:

	TG05 to TG50 BG [mm]
Diameter:	144
Slit width:	0.492
Bar width:	0.356

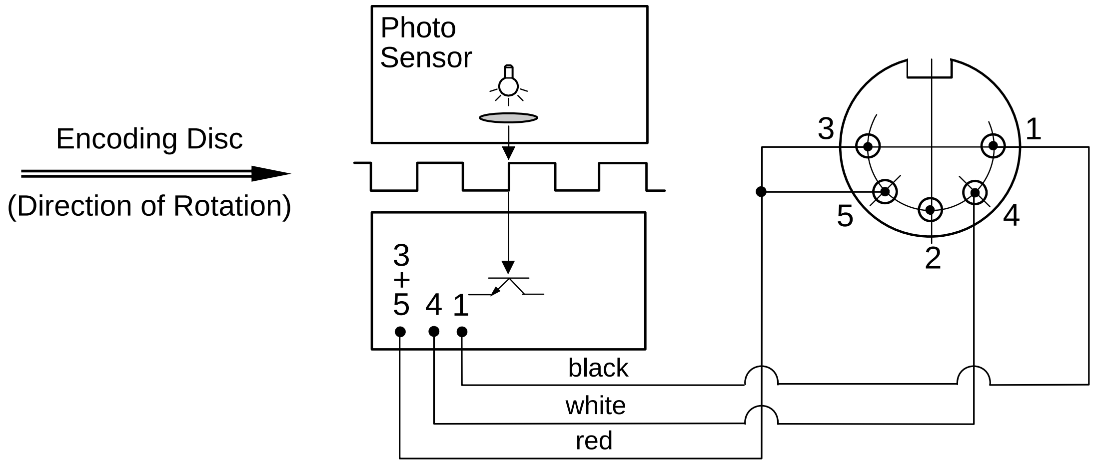
Electrical Data:

Supply Voltage U_S			5 – 28	V DC
Supply Current	Us = 5 V:		< 2	mA
	Us = 28 V:		< 4	mA
Voltage Output	Us = 5 V, no load:	high level	4.95	V
	Us = 5 V, load I_{Source} 4.7 mA:	high level	3.56	V
	Us = 5 V, no load:	low level	0.01	V
	Us = 5 V, load I_{Sink}7 mA:	low level	1.05	V
Voltage Output	Us = 28 V, no load:	high level	26.8	V
	Us = 28 V, load I_{Source} 7 mA:	high level	26.5	V
	Us = 28 V, no load:	low level	0.01	V
	Us = 28 V, load I_{Sink} 7 mA:	low level	1.2	V
Current Output	Us = 5 V:	source	4.7	mA
	Us = 28 V:	source	7	mA
	Us = 5-28 V:	sink	7	mA
Operating frequency photo diode			0 – 500	Hz

Pin configuration of the Output Socket:
(View to **plug-side** of the socket)



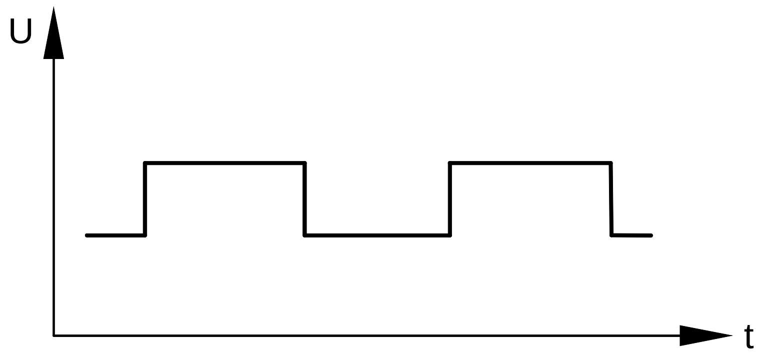
Internal wiring:



	Pin No.	Function	Lead Colour
Photo Sensor	3+5	Supply Voltage $U_{S1} + U_{S2}$	red
	4	Signal Out	white
	1	Ground	black

Attention: The mini plug of the cable which connects the sensor to the output socket **must** be mounted to the sensor in the shown position. Especially the red leads must be connected to the pin close to the corner of the sensor casing. **Otherwise the sensor will be destroyed!**

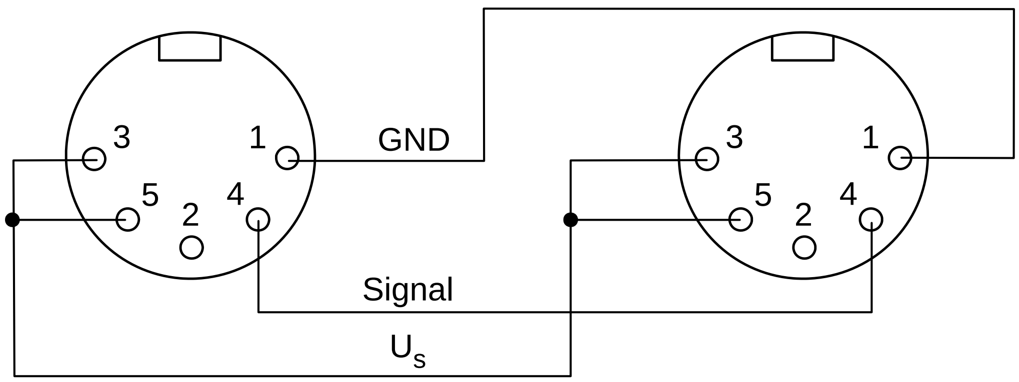
Signal Output:



Connection of "Electronic Display Unit" EDU 32 FP (optional accessory**)**
to the Pulse Generator:

The Pulse Generator can be connected to the optional accessory "Electronic Display Unit" (V 5.0 or higher) by means of the 5-pin connection cord, which is supplied in conjunction with the Electronic Display Unit. The **maximum possible length** of the connection cable is **10 m** (unshielded cable) or **100 m** (shielded cable). The Electronic Display Unit contains the power supply for the photo sensor as well as the evaluation circuit/logic which enables the direct readout of the measured volume [ltr] and flow rate [ltr/h].

Wiring of the Pulse Generator to the EDU socket
(view to **plug-side** of the sockets):



The measurement results displayed by the Electronic Display Unit can be transmitted to a computer via the standard-type interface RS 232 (refer to chapter 4 "Electronic Display Unit" as well). Additionally, the value of the flow rate can be transmitted to an analog measurement device via the standard-type analog output (0-1 Volt or 4-20 mA).

Set-up of EDU:

- Programming of sensor type: Select sensor type “PG V4.1”
(please refer to the EDU Operation Instructions par. 6.2.4 as well)
- Programming of slit disc / encoding disc: Select “500 Pulses/Rev”
(please refer to the EDU Operation Instructions par. 6.2.5 as well)

Quick reference:

- 50 pulses per revolution of measuring drum
- For use with TG01 version V4.x
- Uni-directional
- Applicable for ex-proof areas with explosion-proof output socket only (option) [5]

Application: The Pulse Generator for **RITTER** gas meters is a rotary encoder for pulse output. It can be used to transfer the recorded data (quantity of measured gas volume [ltr]) to the accessory EDU 32 or to an external measuring instrument (PC, transcriber). In the latter case, the external system must provide the power supply for the photo sensor as well as the evaluation circuit/logic which enables the direct readout of the measured volume and flow rate. For connection to an external system, please refer to the pin configuration and electrical data on page 03.40.

Please note: The Pulse Generator provides a currency signal, not a voltage signal. In order to read the signal by an external data acquisition system, it is therefore necessary in general to use a terminal amplifier with a power supply of 10-30 VDC.

Use in ex-proof areas[5]: The gas meter must be equipped with a 3-pin explosion-proof output socket instead of the standard DIN 5-pin output socket (please specify when ordering).

For use in **ex-proof areas** an external switch amplifier for galvanic decoupling of the power supply (by the EDU) has to be installed between Pulse Generator (gas meter) and the EDU.

For selection of the gas meter model to be used in ex-proof areas: See footnote.

Equipment: The Pulse Generator is located within the meter casing and it consists of the following components:

• Sensor:	Inductive proximity switch	
	Device category 2G:	For use in hazardous areas with gas, vapour, and mist
	Directive conformity:	94/9/EG
	Ignition protection:	“Intrinsic safety”
	EC Type Examination Certificate:	PTB 00 ATEX 2048 X,
	Ex identification:	II 2G Eex ia IIC T6.
• Socket:	Standard equipment:	DIN 5-pin output socket
	EX- equipment:	3-pin EX-proof output socket

Description: The inductive sensor converts the revolution of the measuring drum into a sequence of pulses. The number of pulses represents the **volume of gas** which has passed through the Gas Meter, depending on the resolution (see “Performance Data” on page 03.39). The frequency of the sequence of pulses is a measure of the rotational speed of the measuring drum and thereby a measure of the **flow rate** of the gas.

[5] Please note: According to European laws (EC directive 94/9/EC), the gas meter, in which the Pulse Generator is built into, must be certified (“ATEX” Declaration of Conformity) if and when used in ex-proof areas. This Declaration of Conformity is available for all meter models made out of PE-el (model no. 8).

For operation of the inductive sensor, an external electric power supply with 5 Volts DC is required. More electrical data are stated on the data sheet 03.40. The output signal is a rectangular current signal with min. / max. level of 1 mA / 3 mA.

Output Socket: The pin configuration of the output sockets is shown on page 03.40.

Use with Drum-type Gas Meters (general):

Drum-type gas meters are volumetric gas meters. That means, that they are measuring gas volume precisely. When the Pulse Generator is used with drum-type gas meters for recording the gas flow, it is possible for the respective Voltage Output curve (line) to be wavy, even when gas flow is constant. This is (unpreventably) caused by the type of construction of the measuring drum: the drum consists of four separate chambers, which are closed and opened in sequence. The previous chamber **has to be** closed **before** the next chamber will open.

This compulsory measurement is the reason for the high measurement accuracy. However, each closing also causes a little build-up of pressure at the inside of a chamber. The surface tension creates an additional pressure increase during emerging of a chamber (water highest surface tension, oil: lower, CalRix lowest). The resulting pressure increase causes a small reduction in the rotational speed of the measuring drum. This is barely visible to the eye but is documented precisely by a computer/transcriber. Thus, the wavy output line at constant input flow documents the **true** flow through the gas meter.

Performance Data:

Pulses per Revolution*	50	Pulse/Rev
Gas Volume per Revolution	0.1	[ltr/Rev]
Resolution	0.002	[ltr/Pulse]
Pulses per Liter	500	[Pulse/ltr]
Maximum Pulse Frequency	250	[Pulse/min]
Output signal	Current signal	

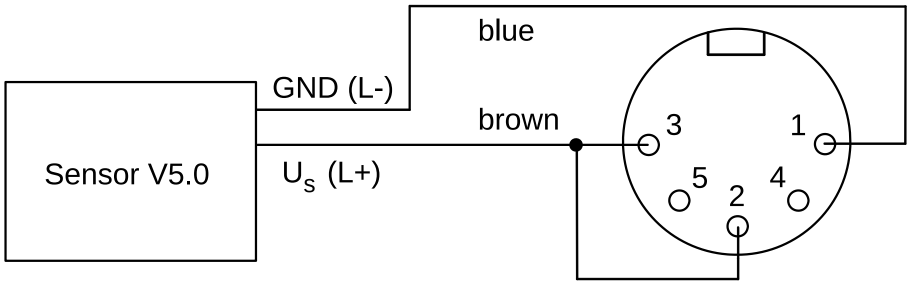
* Revolution of measuring drum

Temperature range:

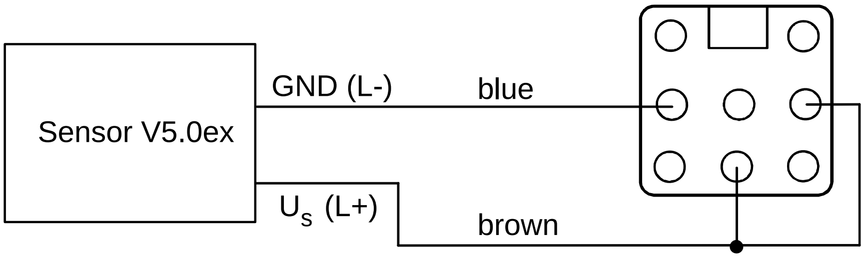
- -25°C to +100°C
- **But:** Mind the minimal/maximal working temperature of gas meter casing and drum

Pin configuration of the Output Socket
(View to **plug-side** of the (female) socket) **:**

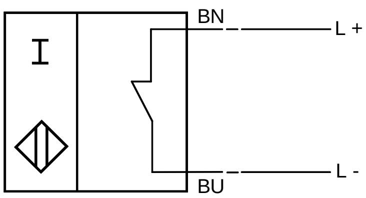
Standard version:



EX-proof version:



Standard symbol, connection:



Technical Data of sensor:

Switching element function	NAMUR NC	
Installation	embaddable	
Nominal voltage U_0	8	V
Current consumption:		
Measuring plate not detected	1	mA
Measuring plate detected	3	mA
Max. switching frequency f	5000	Hz
Self inductance L_i	50	µH
Self capacitance C_i	71	nF
EMC to	EN 60947-5-2	
In compliance with	EN 50227	
Protection to IEC 60529	IP67	
Operating temperature	-25 – +70	°C

Connection	0.2 m, PVC cable	
Conductor cross section	0,14 mm^2	
Housing material	Stainless steel	
Sensing face	PBT	
Device category	2G	

Connection of "Electronic Display Unit" EDU 32 FP (optional accessory) **to the Pulse Generator:**

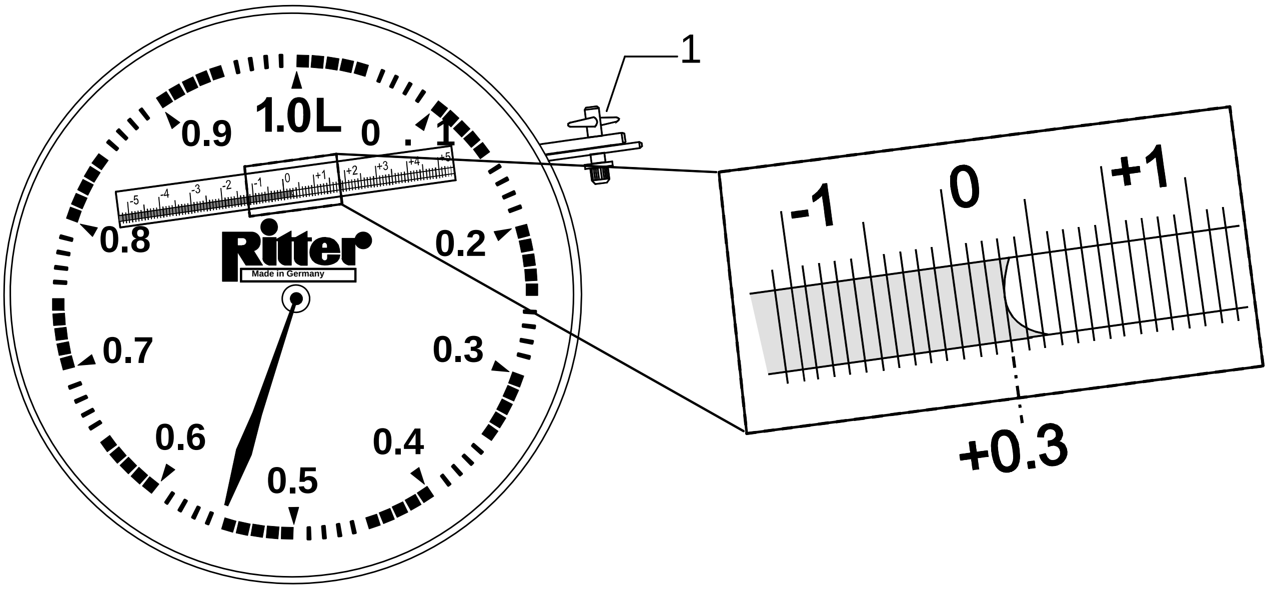
The Pulse Generator can be connected to the optional accessory "Electronic Display Unit" (V 4.0 or higher) by means of the 3-pin connection cord, which is supplied in conjunction with the Electronic Display Unit. The Electronic Display Unit contains the power supply for the inductive sensor as well as the evaluation circuit/logic which enables the direct readout of the measured volume [ltr] and flow rate [ltr/h].

The measurement results displayed by the Electronic Display Unit can be transmitted to a computer via the standard-type interface RS 232 (refer to chapter 4 "Electronic Display Unit" as well). Additionally, the value of the flow rate can be transmitted to an analog measurement device via the standard-type analog output (0-1 Volt or 4-20 mA).

For use in **ex-proof areas** an external switch amplifier for galvanic decoupling of the power supply (by the EDU) has to be installed between Pulse Generator (gas meter) and the EDU.

Set-up of EDU:

- Programming of sensor type (please refer to the EDU Operation Instructions par. 6.2.4 as well):
  With EDU versions V4.x : Select sensor type “PG V2.0Ex”
  With EDU versions V5.x and higher: Select sensor type “PG V5.0”
- Programming of slit disc / encoding disc: Select “50 Pulses/Rev”



(1) Screw cap
(Not with high pressure meters; with high pressure meters the upper end of the HPLI tube is connected to the inside of meter casing above the liquid level.)

Location of indicator shown for models TG 01 to TG 10
Location with models TG 20 to TG 50: Beside of the counter mechanism casing.

1. Application:

The High-Precision Packing Liquid Level Indicator allows highly precise reading and setting of the packing liquid level in RITTER drum-type Gas Meters. Precise adherence to the factory-set level is very important for the Meter's measurement accuracy, as the measurement deviation given in the Calibration Certificate is only valid when the packing liquid level is correct. Packing liquid levels other than that set in the factory cause the volume in the chambers of the measuring drum to be different to the volume at time of calibration, which inevitably results in a measurement error.

2. Operational principle:

The High Precision Packing Liquid Level Indicator consists of the following parts:

- sloping glass tube
- scale (behind the sloping tube)
- screwed cap (not present on High Pressure Meters)

Following the principle of communicating pipes, the sloping tube is connected with the packing liquid in the Gas Meter casing. Because of this, the liquid level in the sloping tube exactly reflects the level in the Gas Meter casing.

Because the tube is sloping i.e. set at a small angle to horizontal, a small change in the liquid level in the Gas Meter casing results in a large change in the liquid level inside the sloping tube. Thus, the sloping tube acts like a „magnifier“ of the liquid level inside the casing and can therefore be set extremely precisely. Furthermore, parallax error when reading the level, as can occur with the Standard Level Indicator, is nearly impossible.

3. Setting the correct level:

The gas meter must be aligned horizontally and unpressurised (not connected to gas tubes). Before filling the Gas Meter casing with the Packing Liquid (through the filling nozzle on the rear plate of the casing), the screwed cap (1) on the outer end of the glass tube must be removed by unscrewing it (not applicable to High Pressure Meters). During filling, the liquid level rises inside the sloping glass tube in proportion to the level in the casing. (It becomes visible only when the liquid level in the casing approaches the correct level.)

The value on the scale in the sloping tube which represents the correct liquid level is stated in the Calibration Certificate of the respective Meter. The Gas Meter casing must be filled so that the liquid level in the sloping tube exactly reaches that scale value (see below).

Attention: If water is used as packing liquid during application of the gas meter it might be possible that the high surface tension of the water disables the movement of the liquid column inside the inclined glass tube of the Liquid Level Indicator. **Thus, the usage of oil as packing liquid is recommended.**

If application of water is necessary the inside of the glass tube should be moistened with water before adjustment of the scale value. This can either be done by slightly tilting the meter forwards or by a soft and quick tapping with a finger tip on the glass tube's open end (so that the glass tube will close and open in quick changes). In this case the filling nozzle cap has to be opened. After forcing the liquid column up the tube in one of these ways, it will swing backwards and forwards in a pendulum effect, gradually coming to a standstill at the scale value which represents the current level of the liquid in the gas meter casing.

Adjustment of the packing liquid level in the Gas Meter casing using the scale value given in the Calibration Certificate is done as follows:

The surface of the liquid column inside the tube has a concave meniscus due to surface tension. **The <u>base</u> of the meniscus arc defines the correct liquid level** (and <u>not</u> the points where the meniscus touches the glass tube). This is demonstrated in the right-hand drawing on the previous page. In this example, the base of the meniscus arc is positioned exactly at the scale value of + 0.3. If this were also the scale value given in the Meter's Calibration Certificate, the packing liquid level of this Meter would be correct.

In the above example, if the scale value given in the Meter's Calibration Certificate were +0.8, packing liquid would have to be added through the filling nozzle on the rear-plate of the casing until the base of the meniscus arc was positioned exactly on the sloping tube's scale value of +0.8. Similarly, if the scale value given in the Meter's Calibration Certificate were –1.2, packing liquid would have to be drained out of the Meter casing via the drainage faucet on the casing's rear-plate, until the base of the meniscus arc was positioned exactly on –1.2.

Once the packing liquid level has been correctly set in this way, the screwed cap on the outer end of the sloping tube must be replaced (not applicable to High Pressure Meters). Hereby the level will slightly be moved downwards. However, this does not affect the measurement accuracy. The screwed cap must always be closed before gas measurements are made, otherwise the gas pressure will force packing liquid out of the tube!!

4. Cleaning of the glass tube (inside):

If the liquid column inside of the glass tube doesn't run smoothly during setting of the liquid level, this may be caused by soiling of the tube's inside surface. (The soiling may occur through the use of oil or grease polluted gas.)

In this case, the glass tube can be cleaned by using the attached cleaning rods (similar to pipe cleaners). The cleaning rods should be soaked with an appropriate cleaning liquid (alcohol, detergent, etc.).

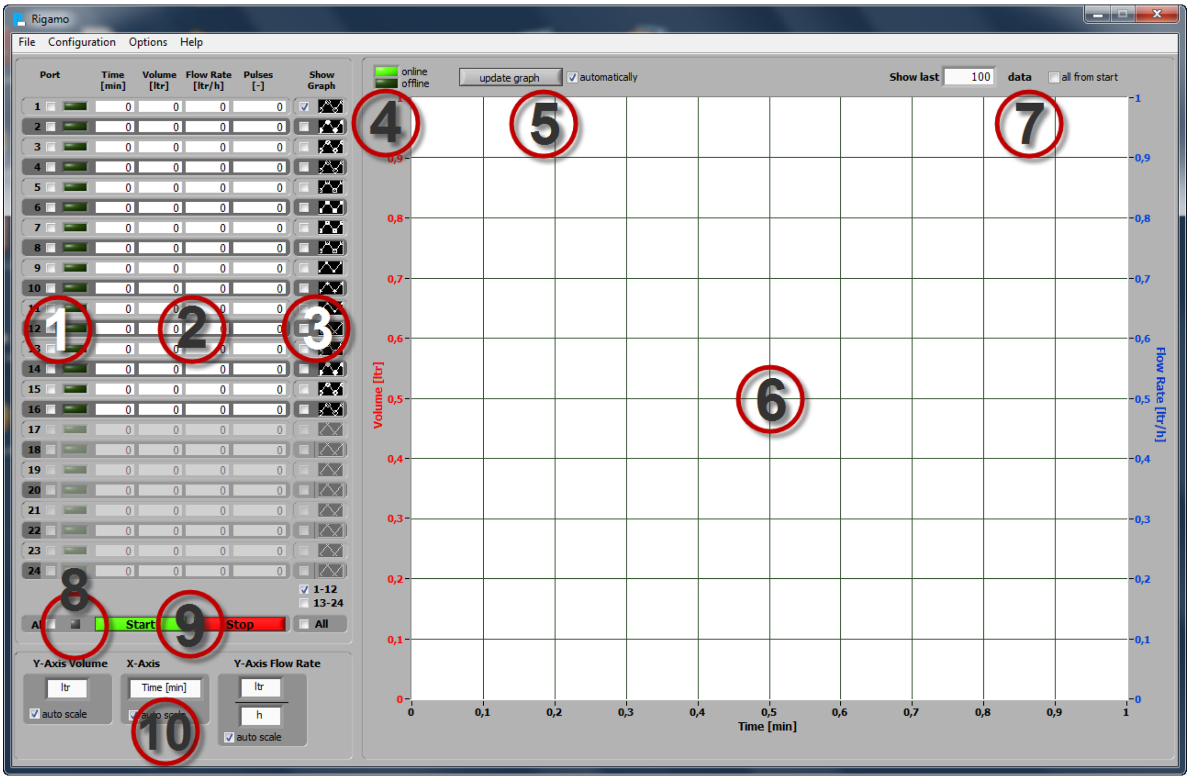
a) With Standard Meters: Remove the screwed cap.

b) With High Pressure Meters: **The Gas Meter must be pressure-free.** Take out the hexagon socket screw by turning it anti-clockwise. The hexagon socket screw is located at the 2-o'clock-position of the counter mechanism casing.

Lower the liquid level within the glass tube by either tilting the Meter backwards or by partly emptying out the packing liquid. Clean the inside of the glass tube by using a cleaning rod. Finally, the glass tube must be closed again.

Software Features (overview):

- Windows software for **data acquisition** of gas volume and flow rate from up to 24 Ritter gas meters to a PC USB port.
- Support of **multi-core processors**
- **Graphical and tabular display** of measurement data
- **Storing** of data
- **Print out** (separately or in any combination) of
  - o Diagram
  - o Test parameters
  - o Measured values in tabular form
- **Export** of stored data to Microsoft Excel® spread-sheet (Excel 2003 or higher)
- **Automatic correction** of the dynamic (flow rate dependent) measurement error (MGC only)
- **Please note:** Rigamo can only started once at a time at one PC.
  No support of bi-directional recognition of the measuring drum rotation with Pulse Generator V4.01



- Area 1: Display of port status
- Area 2: Tabular display of data for respective ports in real time
- Area 3: Tick boxes for display "show" / "no show" of graphs
- Area 4: Indicator for online / offline display of graphs
- Area 5: Selection of graph updating mode (automatically/manually)
- Area 6: Diagrams for gas volume and flow rate
- Area 7: Number of last measurement data to show in diagram
- Area 8: Indicator of processor load status
- Area 9: Buttons „Start/Stop" of data acquisition
- Area 10: Dimensions of diagram axes

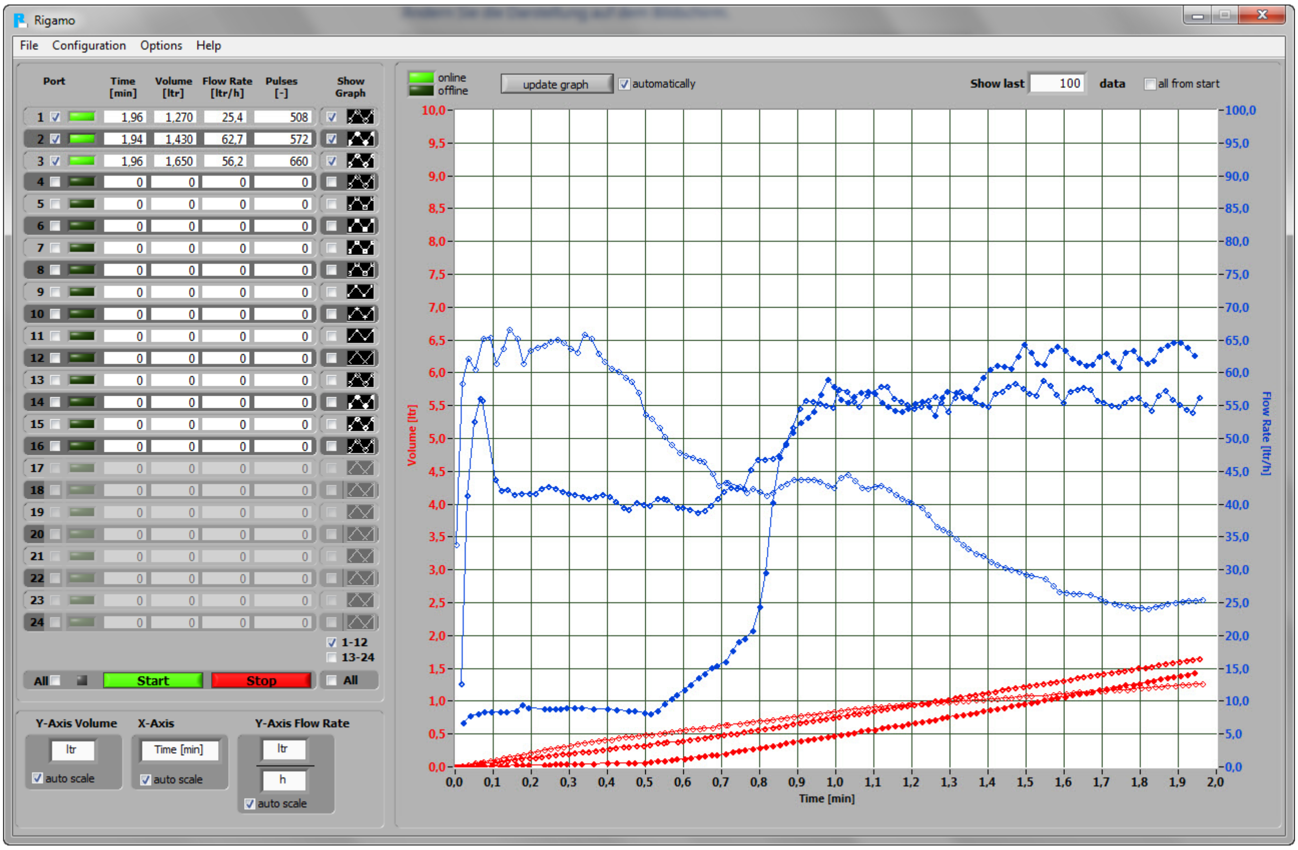
System Requirements:

- Gas meter with built-in pulse generator (option)
- Digital Input Module "DIM" (accessory)
- Operating system Windows XP®, Windows Vista®, Windows 7®
- Licence (dongle) for requested number of ports (= gas meters to be connected)
- Microsoft Excel® 2003 or higher for data export to Excel®
- Recommended processor performance: ≥1.5 GHz
- Random access memory (RAM): ≥500 MB
- 2 free USB ports (1 port for data acquisition, 1 port for licence dongle)
- Monitor 17"
- Monitor setting: Optimised for monitor resolution of 1280x 1024 pixel or higher
- Mouse / mouse pointer

Please note: A standard converter "USB to RS232" for connection to COM port cannot be used.

Monitor Display of Data Acquisition (Example):

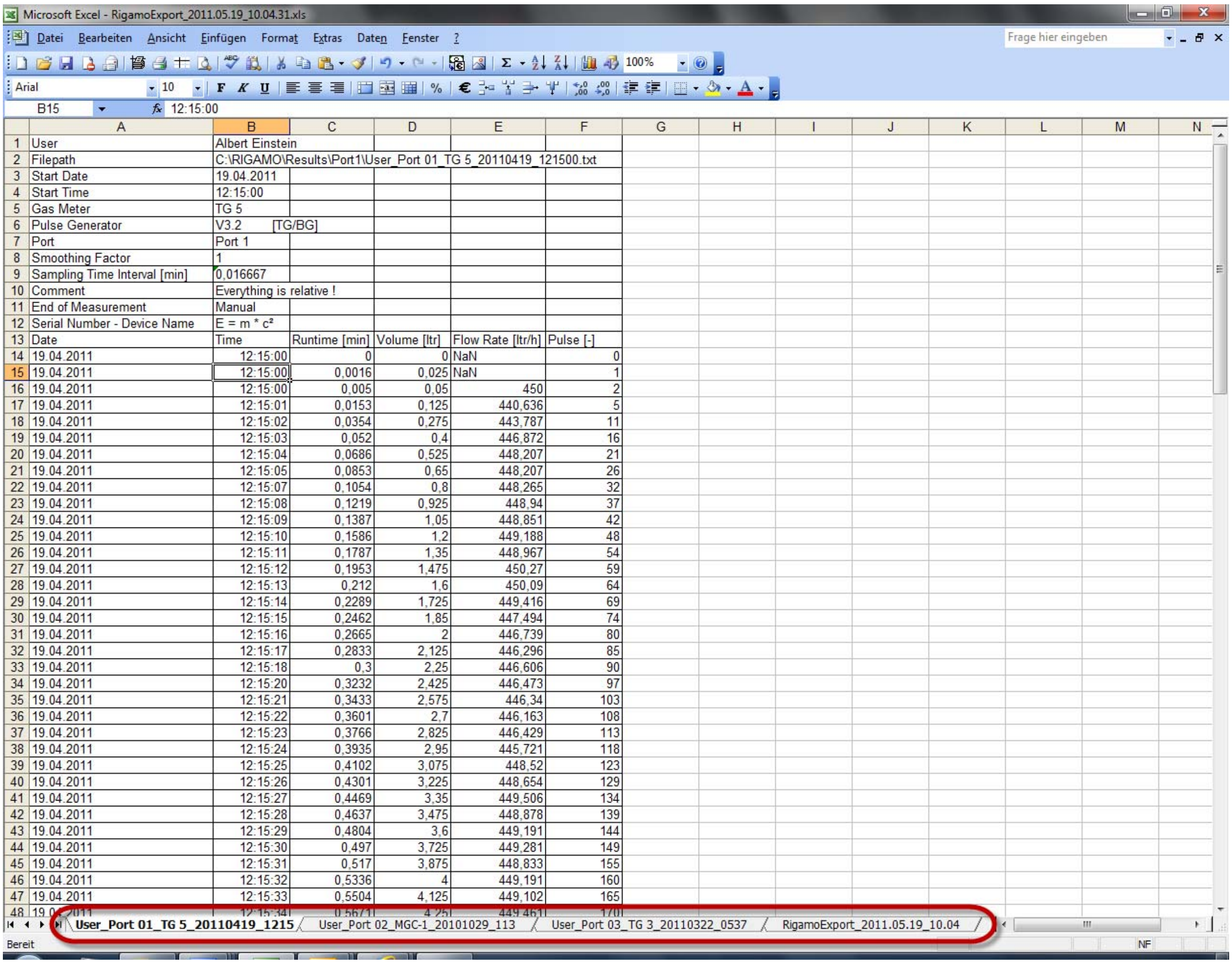
(Data acquisition from 3 gas meters; red graphs: volume; blue graphs: flow rates)



<u>Data export to Microsoft Excel®:</u>

System requirement: Microsoft Excel® 2003 or a later version

Export example of three data files:



	A	B	C	D	E	F
1	User	Albert Einstein				
2	Filepath	C:\RIGAMO\Results\Port1\User_Port 01_TG 5_20110419_121500.txt				
3	Start Date	19.04.2011				
4	Start Time	12:15:00				
5	Gas Meter	TG 5				
6	Pulse Generator	V3.2 [TG/BG]				
7	Port	Port 1				
8	Smoothing Factor	1				
9	Sampling Time Interval [min]	0,016667				
10	Comment	Everything is relative !				
11	End of Measurement	Manual				
12	Serial Number - Device Name	E = m * c²				
13	Date	Time	Runtime [min]	Volume [ltr]	Flow Rate [ltr/h]	Pulse [-]
14	19.04.2011	12:15:00	0	0	NaN	0
15	19.04.2011	12:15:00	0,0016	0,025	NaN	1
16	19.04.2011	12:15:00	0,005	0,05	450	2
17	19.04.2011	12:15:01	0,0153	0,125	440,636	5
18	19.04.2011	12:15:02	0,0354	0,275	443,787	11
19	19.04.2011	12:15:03	0,052	0,4	446,872	16
20	19.04.2011	12:15:04	0,0686	0,525	448,207	21
21	19.04.2011	12:15:05	0,0853	0,65	448,207	26
22	19.04.2011	12:15:07	0,1054	0,8	448,265	32
23	19.04.2011	12:15:08	0,1219	0,925	448,94	37
24	19.04.2011	12:15:09	0,1387	1,05	448,851	42
25	19.04.2011	12:15:10	0,1586	1,2	449,188	48
26	19.04.2011	12:15:11	0,1787	1,35	448,967	54
27	19.04.2011	12:15:12	0,1953	1,475	450,27	59
28	19.04.2011	12:15:13	0,212	1,6	450,09	64
29	19.04.2011	12:15:14	0,2289	1,725	449,416	69
30	19.04.2011	12:15:15	0,2462	1,85	447,494	74
31	19.04.2011	12:15:16	0,2665	2	446,739	80
32	19.04.2011	12:15:17	0,2833	2,125	446,296	85
33	19.04.2011	12:15:18	0,3	2,25	446,606	90
34	19.04.2011	12:15:20	0,3232	2,425	446,473	97
35	19.04.2011	12:15:21	0,3433	2,575	446,34	103
36	19.04.2011	12:15:22	0,3601	2,7	446,163	108
37	19.04.2011	12:15:23	0,3766	2,825	446,429	113
38	19.04.2011	12:15:24	0,3935	2,95	445,721	118
39	19.04.2011	12:15:25	0,4102	3,075	448,52	123
40	19.04.2011	12:15:26	0,4301	3,225	448,654	129
41	19.04.2011	12:15:27	0,4469	3,35	449,506	134
42	19.04.2011	12:15:28	0,4637	3,475	448,878	139
43	19.04.2011	12:15:29	0,4804	3,6	449,191	144
44	19.04.2011	12:15:30	0,497	3,725	449,281	149
45	19.04.2011	12:15:31	0,517	3,875	448,833	155
46	19.04.2011	12:15:32	0,5336	4	449,191	160
47	19.04.2011	12:15:33	0,5504	4,125	449,102	165
48	19.0[illegible]2011	12:15:34	0,5671	4,25	449,461	170

The data of each data file (parameters plus measurement data) are exported into a separate table. Additionally, a blank table is created with the name of the export file (see red mark in the window above).

Schematic of a completed configuration
(Example for 4 connected gas meters)

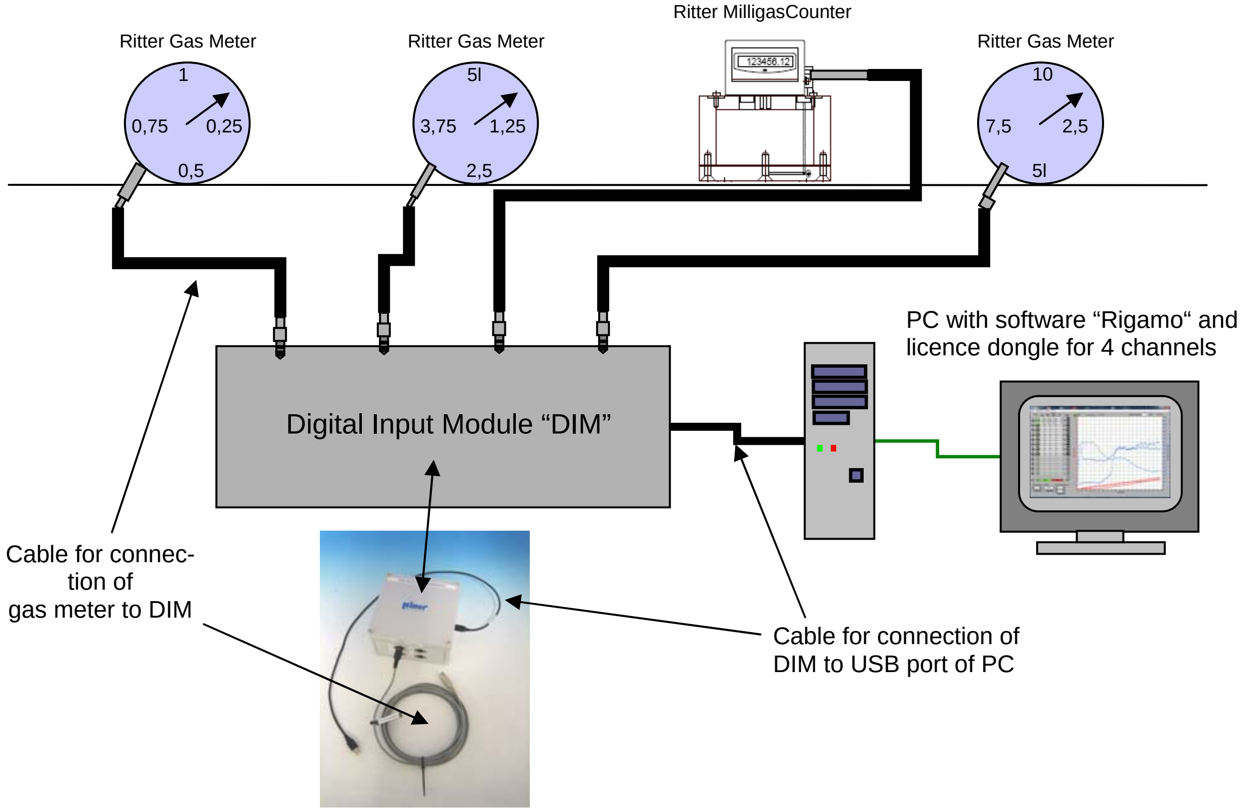


Table of Contents

Front View

Rear View

1. Technical Data

Power supply:
either 110 V / 60 Hz or 230 V / 50 Hz (must be specified with order)
Over-/undervoltage: +15%
-5% with Current Output “On”;
-20% with Current Output “Off”
Standard power socket, power cord[6]
6 Volt Accumulator for battery operation

Input:
Pulses from Pulse Generator built into Gas Meter,
round 5-pin-socket
suitable for all RITTER TG- and BG-type Gas Meters
(Type and Model programmable via the control buttons)

Output:

1. Interface RS 232 (Standard Sub-D-9-pin-socket):
   Signal: +/- 15 Volts
   Transmission rate: 9,600 Baud
   Data = 8 Bit, Parity = N, Stopbit = 1
2. Analog Output, programmable, round 5-pin-socket:
   (a) Current Output: 4 - 20 mA or 0 – 20 mA
   Or
   (b) Voltage Output : 0 - 1 Volt

Display:
large 2-line LCD Display, 16 characters per line
Display language programmable: English / German
Display contrast adjustable (via the Menu)
Display of:
- measured Gas Volume in [Liters]
- actual Flow Rate in [Liters per hour]

[6] The power cord is provided only when the Unit is delivered into countries with the German Standard for socket/plug.

Display: (continued)

- programmed Gas Meter type/model
- power status (Mains / Battery / Low Batt)

Control elements:

Push-buttons, waterproof

Button	Function
ON/OFF	On/Off
RESET	(in measurement Mode): Resetting the Display to zero
ENTER	(in set-up mode): For scrolling through provided Menu Options and saving of selected option
MODE	(in Measurement Mode): Choice of Display “Volume” and/or “Flow Rate”
SELECT	(in set-up mode): For selection of required Menu Option

Further Functions:

- Data transmission via RS 232 to a PC
- Configuration of the EDU 32 FP from the PC
- Pre-selection of a minimal or maximal Flow Rate
- Acoustic Signalling (Beep) when the Flow Rate values exceed the pre-selected min./max. range
- Power supply for the power interface can be turned off (to increase the running time during battery operation)

Control Codes:

(for data transmission from Interface RS 232 to Computer)

Ctrl-V (Hex 16) provides:	VOL 00000,00 LTR
Ctrl-F (Hex 06) provides:	FLOW 000,00 L/H
Ctrl-C (Hex 03) causes:	RESET
Ctrl-T (Hex 14) provides:	Type + Power Status

Fuse: 0.1 Ampere - located at the rear wall in a fuse drawer below the power socket. The fuse drawer contains a spare fuse as well.

Dimensions: Width x depth x height = 155 x 200 x 120 mm

Weight: 1.4 kg

Temperature Range: 0 °C to + 50 °C

Scope of supply:

- Power cord (with delivery into countries with German Standard for socket / plug only);
- Connection cord to Pulse Generator

2. General Overview

2.1. Application

The EDU 32 FP accessory is a microcomputer-controlled counter and display apparatus. It is designed to be used in conjunction with RITTER Gas Meters, to count and display the absolute volume and flow-rate of Gases flowing through the RITTER meter. It consists of a unit in a separate (desk top) casing with a two-line Plain-Text-LCD-Display, and can be used with all types of RITTER Gas Meters. The following individual alterations and functions can be programmed via the Control Buttons:

1. Gas Meter type being used
2. Individual measurement range (min./max. flow rates) for custom-built Gas Meters
3. Upper and lower limiting values for Flow Rate
4. Pulse Generator in use: Standard (200 Pulses per revolution of the measurement drum), Ex-Proof (50 Pulses/Revolution) or custom-built Models (customer-preferred number of pulses under 200 or 50 respectively)
5. Language German/English in the Display
6. Analog-Output: Current Output or Voltage Output
7. Contrast adjustment of the Display

2.2. Standard Adjustment Specifications

If the EDU 32 FP is ordered together with a Gas Meter, or ordered separately but with notification included of the type of Gas Meter with which it will be used, it will be delivered to the Customer already programmed for that Meter. If ordered separately with no such notification, it will be programmed to the following standard specifications:

Gas Meter Type:	TG 05
Sensor Type	PG 3.2
Language:	English
Output Signal:	4 - 20 mA
Current Out	OFF

Point 6 below explains how the Display Unit can be programmed for other adjustments, should these be required

2.3. Changing the fuse

Before changing the fuse, disconnect the mains supply cable from the unit!

The EDU contains a semi time-lag fuse of 0.1 ampere. The fuse is in a fuse drawer located on the rear panel in the black “rectangle” directly under the mains supply socket.

After having disconnected the unit from the mains supply, the fuse drawer can be pulled out. This can be done by inserting the tip of a little screwdriver into the slit at the top edge of the drawer , squeezing out the drawer with gentle pressure.

The fuse drawer contains two fuses, an “active” one and an additional one as a replacement-fuse. The “active” fuse which is held by a friction spring, is visible when the drawer is removed. This “active” fuse can be taken out of the friction spring by pushing the spring sideways. The replacement fuse is positioned inside of a storage bin which is located directly in front of the “active” fuse. It can be pushed out of the bin with the screwdriver.

3. Initial Installation

The unpacked Unit can be connected to the Mains supply via the provided (1) Mains Cable. When not connected to a Mains Supply, it automatically operates with the built-in 6 Volt Lead-Gel Accumulator.

(1) The power cord is provided only when the Unit is delivered into countries with the German Standard for socket/plug.

3.1. Connection of the Display Unit to the Gas Meter

A Connecting Cable with round 5-pin plugs is provided to attach the Display Unit to the Gas Meter. It needs only to be inserted into the two appropriate sockets. The Display Unit socket is located at the back of the apparatus, and is labelled "Input/Eingang". The connection point for the Gas Meter is the Pulse Generator socket, which is located on the side of the Counter Mechanism housing, at the 7-O'clock position.

For a description of the Display Unit "Input/Eingang" socket: refer to Point 7.1.

3.2. Turning on the EDU 32

The Display Unit is turned on by pressing the ON/OFF button. Pressing this button a second time will turn the Unit off. When first turned on, the Unit will display for 3 seconds, details of the apparatus type and of the Version Number of the installed Software. (Initial Announcement)

After this Initial Announcement, the following details will be displayed: The Gas Meter type for which the Display Unit has been programmed; the power status (Mains / Battery / Low Batt) and the Gas Volume in litres. Every time that the Unit is switched on, please check that it has been programmed for use with the correct Gas Meter type! If the programmed Gas Meter type is not the same as the Gas Meter in use, measurement errors will inevitably occur! (For further information on Display Announcements, refer to Point 4: "Display".

The Display Unit is then ready for operation.

Initial Announcement:

```
Ritter      EDU 32 FP
VERSION 5.1
```

Display Example:

```
TG 05          Battery
VOL 0000,000 LTR
```

3.3. Battery Operation

3.3.1. General

The built-in Battery is a rechargeable, maintenance-free and fully-sealed Lead-Gel Accumulator. It can be recharged simply by connecting the Display Unit to a Mains Supply. Overloading of the Accumulator is not possible, no matter how long the Display Unit remains connected to the Electricity Supply.

When the Display Unit is battery operated, the displayed power status will be "Battery".

3.3.2. Technical Data

Voltage (internal):	6.8 Volts
Battery Service Life:	⇒ 4 hours with Pulse Generator connected and 4-20 mA Current Output turned **on** and maximum current of 20 mA ⇒ 18 hours with Pulse Generator connected and 4-20 mA Current Output turned off
Display "Low Batt":	indicates that the Battery charge is down to about 10% capacity, with a remaining operational duration of about 0.5 / 1.5 hours with Current Output turned on / off.
Recharging time:	about 12 hours (Overloading not possible)
Life span:	4 years or 200 recharge/discharge cycles

3.3.3. Care when not in regular use

The Display Unit must never be stored with an empty Accumulator, otherwise damage to the Accumulator is likely to occur after about 24 hours (as a consequence of sulphation of the lead plates). **The Accumulator should be recharged by connecting the EDU to the mains supply for about 2 - 3 hours no later than every three months. It is not necessary to switch on the EDU while recharging.**

3.3.4. Accumulator Change

1. **Pull power cord out of the socket!**
2. A screw is located in each of the four feet of the Accumulator - that is, on the bottom of the casing , in each of the four corners. These screws are accessed by pushing the covers over the Accumulator feet sideways and outwards.
3. After undoing the screws, lift the upper part of the housing from the lower part. These two parts are internally connected by a wide band cable, which leads from the main board to the Display. The upper part of the housing should therefore be very carefully removed and placed on its head in front of the lower part.
4. The Accumulator is secured to the base plate of the Accumulator Support with two holding clamps. It can be removed by undoing the nut on each holding clamp, and by detaching the connecting cable from the Accumulator Poles.
5. After inserting a new Accumulator, the reassembly of the casing follows the same directions, but in reverse order.

4. Display

4.1. General

The unit has a two-line LCD-Display with 16 characters per line; character height: 7.5 mm. The brightness of the characters can be adjusted using the Control Buttons in the set-up mode or over a connected PC (please refer to Points 6.2 / 6.3). The display languages of English or German are also selectable/programmable in the set-up mode.

4.2. Display Modes

Various alternating display modes can be selected by use of the "MODE" button (when operated in measurement mode). Each press of this button switches the display to the next selection choice (Toggle Principle).

Display Mode 1
(=Initial Display when the Unit is switched on):
1st Line: Gas Meter Type + Power Status
2nd Line: Volume in Liters

Example:
Gas Meter Type TG 1
Mains operated,
Language English:

```
TG 1            Mains
VOL      00000,00 LTR
```

Display Mode 2
1st Line: Gas Meter Type + Power Status
2nd Line: Flow Rate in Liters/hour

Example (as before):

```
TG 1            Mains
FLOW       000,00 L/H
```

Display Mode 3
1st Line:
2nd Line:

Example (as before):

```
FLOW       000,00 L/H
VOL      00000,00 LTR
```

After a further press of the MODE button, the first Display Mode again appears.

4.3. Display of "Power Status"

The Power Status shown in the Display will be indicated by one of the following:

- "Mains": Unit is connected to Mains Supply
- "Battery": Unit is battery operated
- "Low Batt": Battery charge is down to 10% capacity (see Point 3.3 "Battery Operation"). The display “Low Batt” blinks.

4.4. List of Decimal Places and Increments in Volume and Flow Displays

The resolution and the number of decimal places displayed for Volume [ltr] and Flow Rate [ltr/h] varies, depending on the Gas Meter type for which the Unit is programmed and the serial no. of the connected Gas Meter. These are listed in the following tables 1 to 3.

Gas Meter type	Volume [ltr]	Flow Rate [ltr/h]	Time Window for Average Calculation [sec]
TG 05, TG 1	00000.00	000.00	30
TG 3, TG 5, TG 10	000000.0	0000.0	30
TG 20, TG 50	0000000	00000	30
BG 4	000000.0	0000.0	6
BG 6	0000000	00000	8
BG 10	0000000	00000	12
BG 16	0000000	00000	15
BG 25	0000000	00000	9
BG 40	0000000	00000	6

Table 1: List of Decimal Places and Duration of Time Windows for Calculation of Average Flow Rate for connected **Gas Meters up to and including Serial No. 17.105** (model 3/1996) which are equipped with a Pulse Generator with a 100-slit-disc.

Gas Meter	Volume [ltr]		Flow Rate [ltr/h]		Time Window for Average Calculation
type	Decimals	Resolution	Decimals	Resolution	[sec]
TG 01	000.0000	0.0005	0000.0	0.2	9
TG 05	000.0000	0.0025	0000.00	0.3	30
TG 1	0,000.000	0.005	0,000.00	0.6	30
TG 3	0,000.000	0.015	0,000.0	1.8	30
TG 5	0,000.000	0.025	0,000.0	3.0	30
TG 10	00,000.00	0.05	0,000.0	6.0	30
TG 20	000,000.0	0.1	00,000	12	30
TG 25	0,000.000	0.125	0,000.0	32.2	14
TG 50	00,000.00	0.25	00,000	75	12
BG 4	00,000.00	0.05	0,000.0	30	6
BG 6	000,000.0	0.1	00,000	45	8
BG 10	00,000.00	0.25	00,000	75	15
BG 16	000,000.0	0.5	00,000	120	15
BG 40	000,000.0	0.5	00,000	300	6
BG 100	000,000.0	0.5	00,000	900	2

Table 2: List of Decimal Places and Duration of Time Windows for Calculation of Average Flow Rate for

- connected **Gas Meters with Serial No. 17.106** (model 3/1996) **and following**
- **Pulse Generators with a 200-slit-disc**

Gas Meter type	Volume [ltr]		Flow Rate [ltr/h]		Time Window for Average Calculation
	Decimals	Resolution	Decimals	Resolution	[sec]
TG 01	0,000.000	0.002	000.00	0.16	45
TG 05	00,000.00	0.01	0,000.0	0.6	60
TG 1	00,000.00	0.02	0,000.0	1.2	60
TG 3	00,000.00	0.06	0,000.0	3.6	60
TG 5	000,000.0	0.1	00,000	6	60
TG 10	000,000.0	0.2	00,000	12	60
TG 20	000,000.0	0.4	00,000	24	60
TG 25	000,000.0	0.5	0000.0	31.7	57
TG 50	0,000,000	1.0	00,000	72	50
BG 4	000,000.0	0.200	00,000	30	30
BG 6	000,000.0	0.400	00,000	48	30
BG 10	0,000,000	1.000	00,000	120	30
BG 16	0,000,000	2.000	00,000	240	30
BG 40	0,000,000	2.000	00,000	248	25
BG 100	0,000,000	2.000	00,000	720	10

Table 3: List of Decimal Places and Duration of Time Windows for Calculation of Average Flow Rate for

- connected **Gas Meters with Serial No. 17.106** (model 3/1996) **and following**
- **Pulse Generators with a 50-slit-disc**

4.5. Display-Overflow from too high a Volume

If the accumulative volume exceeds the maximum volume to be displayed, the display would start at "zero" again

4.6. Display-Overflow from too high a Flow Rate

When the connected Gas Meter type is selected on the EDU, the maximum flow rate according to the Data Sheet for that Meter will be automatically defined as such. For custom-made Gas Meters, the appropriate maximum flow rate can be programmed in (See Point 6).

If the connected Gas Meter is operated with a flow rate that is higher than the maximum indicated for it in its Data Sheet, the announcement "Too Fast" will appear in the Display.

4.7. Resetting the Display Values

All displayed values can be returned to zero using the RESET button. As protection against the RESET button being pressed by mistake, it has a short response delay built-in. It must be held pressed for about 0.5 sec. to activate it. After resetting, the Initial Announcement (with the identification name EDU 32 FP and the Program Version Number) will be displayed again for about 3 seconds.

5. Calculation of Average Flow Rates

The calculation of flow rates is based on use of a time window which is stated in table 2 in paragraph 4.4. The calculation of flow rates is done by measuring the time between 2 incoming pulses. The calculation of the output to the current and voltage interface (Analog Output) can be made using one of two methods (setting in set-up menu, see paragraph 6.1, point 12):

5.1. The Arithmetic Method

- Moving average within the respective time window with equal weighting of single values
- Recommended when fluctuations in the flow rate are large
- Fast, small changes will be averaged

5.2. The Integrating Method

- Moving average within the respective time window with larger weighting of last values by an e-function
- Recommended when fluctuations in the flow rate are small
- Changes in the flow rate will be displayed immediately

6. Programming the Unit (Set-up)

The Unit can be programmed via

- the Control Buttons
- a connected PC

6.1. Programming via the Control Buttons

Programming of the Unit is carried out from the set-up menu. The set-up menu is activated by pressing the ENTER and SELECT Buttons at the same time (for about 0.5 seconds).

Warning: By activating the set-up menu, all measurement values will be reset to zero, as a new initialisation follows.

Activation of the set-up mode will be indicated in the Display as shown below, to differentiate it from the operational mode:

```
>>>>Set-up<<<<
```

Each time the ENTER Button is pressed in the set-up mode, the individual menu points will be successively called up. The SELECT Button has a selection function and pressing the SELECT Button will then select the desired setting. Following this, pressing the ENTER Button will save the selected Setting and move to the next Menu Point.

If no input is made in the set-up mode within a time frame of 20 seconds, the program leaves the set-up mode, having saved all instructions given up to that time (Exception: Application of a maximum Volume value for the Analog-Output, Point 6.2.14).

After the last Menu Point, the set-up menu will be closed through a new initialisation, which will save the given data.

6.2. Set-up Menu:

6.2.1. Language

>>>>Set-up<<<< Deutsch	>>>>Set-up<<<< English

6.2.2. Contrast

>>>>Set-up<<<< LCD Contrast 0	>>>>Set-up<<<< LCD CONTRAST 7

The Contrast is programmable in a Scale range of 0 to 7. 0 is the smallest and 7 the greatest contrast. The contrast is increased by one scale value with each press of the SELECT Button.

6.2.3. Gas Meter Type

>>>>Set-up<<<< Type TG05	>>>>Set-up<<<< Type TG05P

Each press of the SELECT Button calls up the next Gas Meter type in increasing order of Meter size (in the order of the Gas Meter types in Tables 1 and 2 in Point 4.4). After the last Gas Meter (BG100), the first (TG01) will appear again.

Example on the right: A “P” behind the Gas Meter type indicates that this Meter was programmed individually (see also Menu Point 6).

6.2.4. Sensor Type

>>>>Set-up<<<< Sensor PG V2.0	>>>>Set-up<<<< Sensor PG V2.0Ex
>>>>Set-up<<<< Sensor PG V3.X	>>>>Set-up<<<< Sensor PG V4.0
>>>>Set-up<<<< Sensor PG V4.1	>>>>Set-up<<<< Sensor PG V5.0

Sensor type “V3.X” stands for all sensors of version V3

Attention: If the sensor “V2.0Ex” is connected to the EDU via an “Isolated Switch Amplifier” or “Sensor Output Interface Terminal”, it must be selected:

- Sensor type “V3.X”
- Pulses 50/Rev (see par. 6.2.5 as well)

6.2.5. Slit disc / encoding disc

```
>>>>Set-up<<<<
Pulses     50/Rev
```

```
>>>>Set-up<<<<
Pulses   200/Rev
```

```
>>>>Set-up<<<<
Pulses 2 x200/Rev
```

```
>>>>Set-up<<<<
Pulses   500/Rev
```

Selection of Gas Meter's slit disc / encoding disc:

Please refer to the data sheet of the delivered Pulse Generator which states the number of pulses per revolution and select the respective menu point accordingly.

6.2.6. Standard-/Individual-Parameter

```
>>>>Set-up<<<<
Parameter Stand.
```

```
>>>>Set-up<<<<
Parameter extra
```

"Parameter Stand.": Activation of the pre-programmed standard values for the Gas Meter type.

"Parameter extra": Activation of the altered values from individual programming
(The configuration of the "Parameter extra" can only be made via the RS 232 Interface and PC, not via the Buttons of the EDU 32 FP itself)
When a Gas Meter is individually programmed and this is activated, a "P" will appear in the Display behind the Gas Meter type (see Menu Point 3).

6.2.7. Alarm Function "maximum flow rate"

```
>>>>Set-up<<<<
Flow max          012.90
```

An Alarm Maximum Flow Rate value in [ltr/h] can be programmed within the measurement range of the Gas Meter, such that **overshooting** this value will cause a built-in Beeper to give an alarm. In order for this to happen however, the Beeper must be activated through the Menu Point "Beeper". Exceeding the flow rate produces a repeating sequence of notes in the form of "short-pause-long" ("beep - pause - beeeeeep").

The Alarm Maximum Flow Rate value can be programmed by pressing the SELECT Button. By constantly holding the SELECT Button pressed, the Alarm Maximum Flow Rate value will be automatically increased. The longer the Button is pressed, the faster the values will be increased. After releasing the Button and pressing it again, the counting process begins slowly again. After reaching the maximum flow rate of the measurement range of the respective Meter, the values will start counting at zero again.

When the programmed value is exceeded, the actual true flow rate value is sent to the RS 232 Interface regardless, as it is assumed that this value will be further processed in an external system with its own limiting value processes. This occurs independently of the programmed maximum flow rate for that Meter.

6.2.8. Alarm Function “minimum flow rate”

>>>>Set-up<<<<
Flow min 001.2

An Alarm Minimum Flow Rate value in [ltr/h] can be programmed within the measurement range of the Gas Meter, such that **undershooting** this value will cause a built-in Beeper to give an alarm. In order for this to happen however, the Beeper must be activated through the Menu Point “Beeper”. Being under this flow rate value produces a repeating sequence of notes in the form of “long -pause” (“beeeeeep - pause”).

The Alarm Minimum Flow Rate value can be programmed by pressing the SELECT Button. By constantly holding the SELECT Button pressed, the Alarm Minimum Flow Rate value will be automatically increased. The longer the Button is pressed, the faster the values will be increased. After releasing the Button and pressing it again, the counting process begins slowly again. After reaching the maximum flow rate of the measurement range of the respective Meter, the values will start counting at zero again.

When undershooting the programmed value, the actual true flow rate value is sent to the RS 232 Interface regardless, as it is assumed that this value will be further processed in an external system with its own limiting value processes. This occurs independently of the programmed minimum flow rate for that Meter.

6.2.9. Beeper

>>>>Set-up<<<<	>>>>Set-up<<<<
BEEPER ON	BEEPER OFF

The Beeper must be activated or deactivated depending on whether a signal is required to indicate that programmed maximum and minimum flow rates have been exceeded or not reached. Even when the Beeper is deactivated, other technical warning signals will be given (=> short circuit at the Current Output, => EEPROM defect).

6.2.10. Selection of Current Output or Voltage Output

>>>>Set-up<<<<	>>>>Set-up<<<<
CURRENT OUT ON	CURRENT OUT OFF

A power supply is required for the operation of any Current Interface. To operate the Current Interface of the EDU (4-20 mA or 0-20 mA) the EDU’s internal power supply can be used.

“Current Output ON”:

A 24 Volt subsidiary (additional) voltage is generated in the EDU 32 FP from the line voltage of the EDU 32 FP over an internal DC/DC-Converter. In this way, the Current Interface can be used without an external power supply.

The Voltage Output is not switched off in this mode, rather, it delivers 0-3 Volt or 600 mV – 3 Volt respectively (please refer to next Point 6.2.11)

"Current Output OFF":

No 24 Volt subsidiary (additional) voltage is generated, the Current Interface is switched off.

The Voltage Output delivers 0-1 Volt

The creation of the 24-Volt auxiliary voltage requires a higher power supply, which results in a reduction of the operating time of the Unit under battery operation (Point 3.3.2 also refers to this). Therefore, "Current OFF" should be selected when the Current Interface is not required.

The position "Current ON" is also indicated by a green LED light on the back of the Unit.

6.2.11.Selection of the measurement range for the current output signal

>>>>Set-up<<<<	>>>>Set-up<<<<
CURR. OUT 4-20mA	**CURR. OUT 0-20mA**

"Curr. Out 4-20mA": Measurement Range 4 – 20 mA
The Voltage Output delivers 600 mV – 3 Volt in this mode

Curr. Out 0 – 20 mA: Measurement Range 0 – 20 mA
The Voltage Output delivers 600 mV – 3 Volt in this mode

6.2.12.Calculation of the Flow Rate average

>>>>Set-up<<<<	>>>>Set-up<<<<
FLOW e-Funct.	**FLOW arithmet**

"Flow e-Funct.": The flow rate average is calculated as e-function by calculating the integral.

"Flow arithmet": The flow rate average is calculated arithmetically

6.2.13.Selection of „Flow rate " or „Volume" for the Analog-Output signal

>>>>Set-up<<<<	>>>>Set-up<<<<
Analog Flow	**Analog Volume**

„Analog Flow":
The Analog-Output signal is proportional to flow rate

„Analog Volume":
The Analog-Output signal is proportional to accumulative volume

6.2.14.Maximum volume value for Analog-Output signal

>>>>Set-up<<<<
Max 000,5120 LTR

For the indication of volume as an Analog-Output signal, a maximum Volume value must be programmed in, by which the maximum value of the Analog signal will be achieved. In order to obtain the greatest possible resolution, the selection of the maximum volume value is made in discrete increments. These result from the number of slits in the Pulse Generator disc and the Gas Meter type, as well as from the different volume values per pulse. The possible increment is automatically determined according to the selected Gas Meter.

After this Menu point has been selected using the ENTER Button, the desired value can be programmed in using the SELECT Button. The lower and upper limits of the maximum volume value are presented in the following Table. By pressing the SELECT Button once, the volume value will be increased by the amount of the lower limit value. By constantly holding the SELECT Button pressed, the volume value will be automatically increased. The longer the Button is pressed, the faster the values will be increased. After releasing the Button and pressing it again, the counting process begins slowly again.

Once the desired value has been reached, it can be saved by pressing the ENTER Button. **Warning:** If nothing is entered within a 20 second period, the Program leaves the set-up mode **without saving** a possibly newly selected maximum volume value.

Gas Meter Type	Lower limit = Increment [ltr]	Upper limit [ltr]
TG 01	0.128	196.608
TG 05	0.64	983.04
TG 1	1.28	1,966.08
TG 3	3.84	5,898.24
TG 5	6.400	9,830.4
TG 10	12.8	19,660.8
TG 20	25.6	39,321.6
TG 25	32.0	9,984.0
TG 50	64.0	98,304
BG 4	12.8	19,660.8
BG 6	25.6	39,321.6
BG 10	64.0	98,304
BG 16	128	196,608
BG 25	128	196,608
BG 40	128	196,608
BG 100	128	196,608

Table: Upper and lower limits for the maximum volume values, by which the maximum value of the analog signal can be achieved.

For a comprehensive description of the Analog Output: see Point 7.2

6.3. Programming via connected PC

All program settings which can be made via the Control Buttons can also be made via a PC. The PC must be connected to the RS232 Interface of the EDU. The advantage of this is that the input of figures can be done much more easily.

A further advantage exists in the possibility of being able to program-in further parameters with a PC (via the RS232 Interface on the EDU). The program can be adapted to match custom-made alterations to the Gas Meter being used, or application-specific parameters can be set. Examples are as follows:

Number of pulses of the Pulse Generator per revolution of the Gas Meters measuring drum

Setting of a different flow rate value at which the maximum value of the Analog Output can be reached.

Decimal place positions for volume and flow rate indications

In order to do this however, users require a detailed knowledge of the internal programming of the EDU. If needed, please contact either the Ritter Company or your local Ritter Distributor.

To transfer data from a PC to the EDU, the following is required:

- PC
- Serial Cable (all leads are connected 1:1, that means: pin 1 of socket = pin 1 of plug, pin 2 of socket = pin 2 of plug etc.)
- Terminal program (hyper terminal) e.g. Procom or hyper terminal in Windows

When using a terminal program (e.g. hyper terminal in Windows), a direct connection must be made via a COM interface (COM1, COM2 etc.) between the PC and EDU. The terminal program has to be adjusted to the COM interface being used. The EDU can be switched into the set-up mode using the control codes Ctrl-C and Ctrl-E. Both control codes must be sent within 0.5 seconds. The EDU Display will indicate when the EDU is in set-up mode.

The EDU “Enter”-Function is then replaced by the RETURN key on the PC, and the “Select”-Function by the space-bar. These two keys on the computer keyboard can be used in the same way as the above-mentioned Control Buttons on the EDU to change settings. Parallel to this, settings can also be changed using the Control Buttons on the EDU. All settings and alterations appear on the computer monitor (terminal or terminal program of the computer) and in the EDU Display.

If the EDU is in normal operational mode, the actual content of the EEProm can be read in Intel-Hex-Format using the Ctrl-R function. This string contains all created settings, as well as, if applicable, any special programming. Special programming can also be transmitted via the terminal program in Intel-Hex-Format to the EDU.

7. In-/Outputs

7.1. Socket “Pulse Input”

(For Wiring Diagram of the socket, refer to Point 8)

The pulses from the built-in Pulse Generator on the Gas Meter are read by the EDU via this analogue input socket (acc. DIN 41524 type “D”). The required power supply (5 Volts) for the operation of the Pulse Generator is given out by this socket as well.

This power supply is given out via an internal resistor of 1 kOhm at the Pin “LED +” and “LED GND”. The power supply runs the LED of the Pulse Generator’s photo interrupter, or any connected electrical sensor designed to work with this voltage.

The two Pins “+ Darlington” are two separate input channels for the pulses to be read in. Ritter Gas Meter Pulse Generators at present use only one input channel. A pulse is generated when one of these input channels is connected to GND. GND is the respective earth reference point. The input resistor has a value of about 20 kOhm when using the sensor types PG 2.0 and PG 3.0. When using the sensor type PG 2.0EX, the value of the input resistor is about 200 Ohm. The signals are shaped by the EDU via a Schmitt-Trigger. The lower trigger threshold value is about 1.5 Volts, and the upper trigger threshold value is about 3.5 Volts.

7.2. Socket "Analog Output"

(For Wiring Diagram of the socket, refer to Point 8)

An Current Output signal (4 – 20 mA or 0 – 20 mA) and also an Voltage Output signal (0 – 1 Volt) can be transmitted via the round 5-pin "Analog Output" socket (acc. DIN 41524 type "D") at the back of the Unit. The values of these signals are proportional to the programmed measuring unit (refer to point 6.2.13) which is:

a) the actual **flow rate** or

b) the summarised **volume**

of the gas in the connected Gas Meter. To this socket can be connected, for example, an Analogue-Recorder, Regulator etc.

7.2.1. Current Output

The advantage of the Current Output is that the transmission of measurement signals can also occur over longer distances without being fundamentally influenced by outside disturbance.

For the respective measurable variable (Flow Rate/Volume), the following Minimum and Maximum Output signal values apply:

Measurable variable			Output Signal [mA]
Flow Rate [Ltr/h]	Volume [Ltr.]		
0	0	Corresponds to	0 or 4
max. **Flow Rate** of the connected Gas Meter as given in its Data Sheet	max. **Volume** corresponding to the Programming according to Points 6.2.14		20

The standard output signal is preset at 4 - 20 mA for the measurable variable „Flow Rate ". To program the Output signal to 0 –20mA, see Point 6.2.11, to program the measurable variable, see Point 6.2.13.

The Current Interface is provided with a voltage of 24 V from within the Unit.

If the permissible current is exceeded by a malfunction within the EDU, the Unit switches the internal 24 Volt voltage off and the text "24 Volt" appears in the upper left-hand corner of the Display. At the same time, the green LED light at the back of the EDU 32 FP goes out and the internal Beeper gives off a continuous tone. After about 3 seconds, the Unit checks whether the overload is still present. If it is still present, the EDU 32 FP switches the Current Interface off again; after a short disconnection of the Display, the text "24 Volt" appears in the Display again and the continuous Beeper tone is given off again.

As the Current Interface output is short circuit proof and current limited, this announcement indicates that there is an internal error in the Unit.

7.2.2. Voltage Output

In order to activate the Voltage Output as Analog Output, the Current Output has to be switched off. The selection/programming is made via the set-up menu (Point 6.2.10: “Selection of Current Output or Voltage Output” refers).

The impedance of the Voltage Output Port is about 3 kOhm. Connected recorders or similar instruments should therefore have an input impedance of 10 kOhm or more, in order to avoid influencing the Voltage value.

For the respective measurable variable (Flow Rate/Volume), the following Minimum and Maximum Output signal values apply:

Measurable variable		Corresponds to	Output Signal [V]
Flow Rate [Ltr/h]	Volume [Ltr.]		
0	0		0
max. **Flow Rate** of the connected Gas Meter as given in its Data Sheet	max. **Volume** corresponding to the Programming according to Points 6.2.14		1

To program the measurable variable, see Point 6.2.13.

7.2.3. Output of Flow Rate

The length of the intervals between the pulses is measured for the calculation of the flow rate. This means that a change in the flow rate has an immediate influence on the Voltage and Current Output values. If no pulse is measured for longer than 10 seconds, the flow rate is calculated as “Zero”. Because the Analog values are generated over a 16-bit pulse-width modulation, the level has to be given out over a so-called “Integrator”. This Integrator reacts with a short delay within seconds and also dependant upon whether the calculation Mode is set to “Arithmetic” or “e-Function” (smoothing).

The higher the maximum pulse frequency is, the faster the output can react to changes.

Examples when set to „arithmetic“ Mode:

1. TG 05 max. Frequency 1.6666 Hz for a pulse generator with 50 Pulses/Drum Revolution
   ⇒ Reaction time from 0 mA – 20 mA about 65 seconds.
2. BG 100 – max. Frequency 88 Hz for a pulse generator with 200 Pulses/Drum Revolution
   ⇒ Reaction time from 0 mA – 20 mA about 7 seconds.

The times in the examples correspond to a spring function, this means that the Gas Meters spring from not moving at all to the highest flow rate or alternatively that it suddenly ceases to move from the highest flow rate. This does not reflect reality. The data provided in the examples therefore symbolically indicate the maximum possible leading and trailing edges of the signal in relation to the maximum counting frequency. As the change in the Analog Output level is immediately readjusted with the change in the flow rate, only high springs in the flow rate can lead to a short delay in the output of the Analaog values.

7.2.4. Signal-Overflow from too high a Flow Rate

When the connected Gas Meter type is selected on the EDU, the maximum flow rate according to the Data Sheet for that Meter will be automatically defined as such. For customer-made Gas Meters, the appropriate maximum flow rate can be programmed in (see Point 6).

If the connected Gas Meter is operated with a flow rate that is higher than the maximum indicated for it in its Data Sheet, the Output signal will remain constant once it reaches its maximum value. This means that for any overrun of flow rate, the Voltage Output will have a constant value of 1 Volt (when programmed to Voltage Output Signal), and the Current Output will have a constant value of 20 mA (when programmed to Current Output Signal).

7.3. Interface RS 232

(For Wiring Diagram, refer to Point 8)

The Display Unit can be connected to a Computer using the Interface RS 232.

For doing so the data transmission cable must be a cable with nine leads and with nine-pole terminals on both ends. All used leads between plug and socket of the cable are connected directly with each other, i. e. pin 2 of the plug is connected with pin 2 of the socket, pin 3 with pin 3 and so on. The pins/leads used for the data transmission are listed in point 7.3.1.

7.3.1. Interface Description:

Sub-D-9-Socket:	Pin 2 = TxD	Transmitted Data
	Pin 3 = RxD	Received Data
	Pin 4 = DTR	Data Terminal Ready (for Hardware-Handshake)
	Pin 5 = GND	Ground
	Pin 6 = RTS	Request To Send (for Hardware-Handshake)

Signal Voltage: +/- 15 Volts
Data Transmission: 9600 Baud, Data = 8 Bit, Parity = N, Stopbit = 1

All of the data which are indicated in the Display can be transmitted to a Computer. In order to receive data, a Computer Program must send Control-Codes to the Interface. The Control Codes and the corresponding data are listed in Point 7.3.2.

7.3.2. Control-Codes:

Ctrl-V	Hex 16	provides:	VOL 00000,00 LTR (List of Decimals see Point 4, Table 1 & 2)	
Ctrl-F	Hex 06	provides:	FLOW 000,00 L/H (List of Decimals see Point 4, Table 1 & 2)	
Ctrl-C	Hex 03	causes:	RESET	
Ctrl-T	Hex 14	provides:	Type + Power Status	
		e.g. :	TG 05	Battery
			TG 10	Mains
			TG 20	Low Batt etc.

The Interface will only send data when it has received a Control-Code. The text will be written in either English or German, depending on which language it has been programmed for use.

Use of the Control-Code "Ctrl-C" resets the Unit in the same way as pressing the RESET Key: All internal registers (counters) are set to zero, the programmed Set-up Values are then read, the Initial Announcement appears in the Display, followed by the Display Mode 1 values (refer to Point 4: "Display Modes").

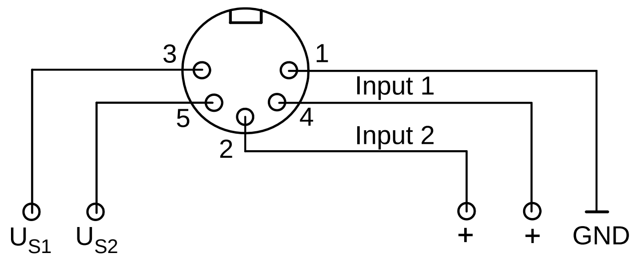
7.3.3. Hardware-Handshake:

The adjustment of the Interface 232 to the connected Computer regarding the Hardware-Handshake is performed automatically. After receipt of a Control-Code (e.g. Ctrl-V for Volume), the Interface transmits the requested byte sequence (e.g. for Volume) as follows:

1. When the connected Computer offers a Hardware-Handshake, that means, when the DTR signal is set to "High" at the reception site (i.e. the Computer), the Interface will set the RTS signal to "High", and will transmit information (in the form of a byte sequence) until the DTR signal is again set to "Low" by the Computer.
2. When the connected Computer does not offer a Hardware-Handshake, that means when the DTR signal is not set to "High" within a defined time delay, the Interface will transmit the total byte sequence according to X-ON / X-OFF mode after that period of time has elapsed. The time delay equals the transmission time of a character at 9,600 Baud (= 0.8 msec).

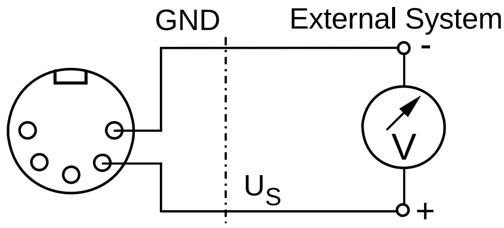
8. Wiring Diagrams for In- and Output Sockets

Socket: „Pulse/Input“:
(acc. DIN 41524 type “D”)



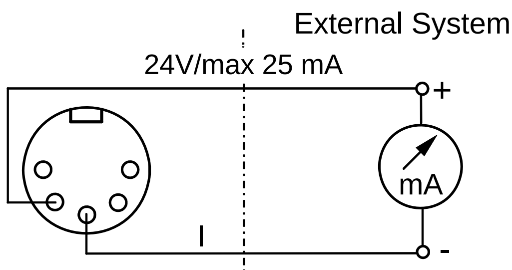
Socket "Analog Output":
(acc. DIN 41524 type “D”)

Voltage Output signal

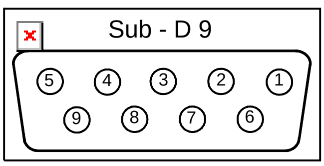


"Analog Output" Socket:

Output current signal with **internal** power supply



Interface RS 232:

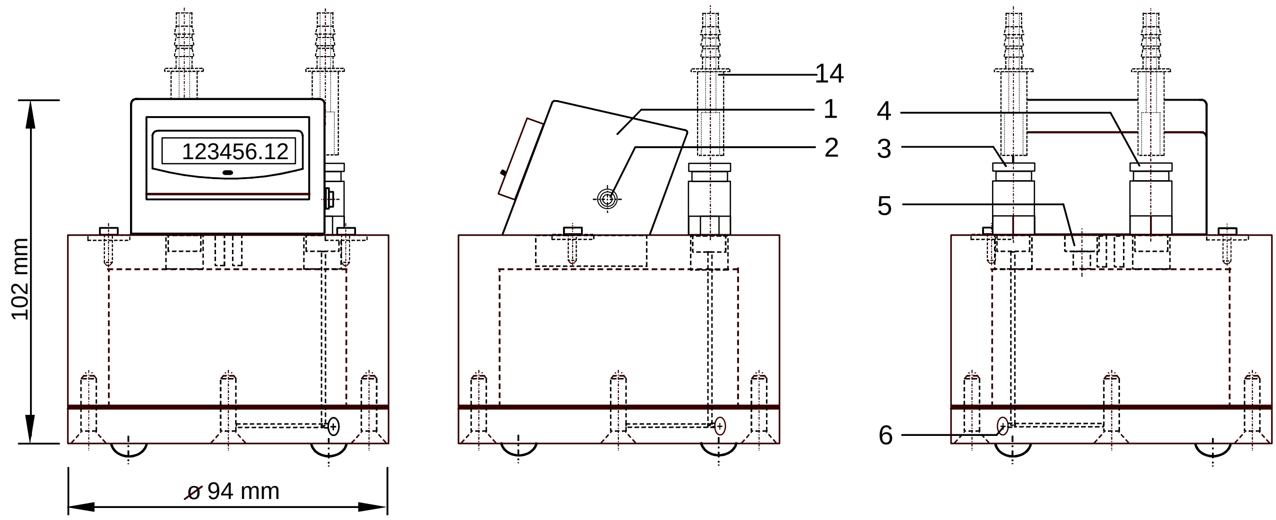


Pin 2 = TxD Transmitted Data
Pin 3 = RxD Received Data
Pin 4 = DTR Data Terminal Ready (for Hardware Handshake)
Pin 5 = GND Ground
Pin 6 = RTS Request To Send (for Hardware Handshake)

(1) Registered trademark. The MilliGascounter was developed at the University of Applied Science Hamburg under the leadership of Prof. Dr. Paul Scherer

Table of Contents

1. Data Sheets



Front View Side View Rear View

(1) Counter unit with LCD display
(2) Signal Output (reed contact)
(14) Tube adaptors for flexible connecting tubes
(3) Gas Inlet
(4) Gas Outlet
(5) Air-vent screw for filling
(6) Inspection screw gas channel

Technical Data

Minimum flow rate Q_{min}	1	ml/h	Maximum gas inlet pressure	**100**	**mbar**
Maximum flow rate Q_{max}	1	ltr/h	Minimum gas inlet pressure	5	mbar
Measurement accuracy, approx. [1]	±3	%	Gas inlet pressure at measurement start, approx. [5]	9	mbar
Volume of measurem. chamber, approx. [2]	3	ml			
Min. measuring volume (resolution) [3]	3	ml	Gas temperature [6]	+10 ~ +60	°C
Resolution of indication [4]	0.01	ml	Connection gas in/outlet: Plug-in connector	Ø 8_i	mm
Packing liquid quantity, approx.	120	ml	Tube adaptor	Ø 8_a	mm
			Diameter connecting tube	Ø 7_i / 11_o	mm

[1] Because of the physical measurement principle, the measurement error is dependent on the flow rate. The **data acquisition software "Rigamo"** (accessory) provides an algorithm, which automatically recalculates the actual measurement data to the real values at the respective actual flow rate on the basis of the calibration curve. Thus, the remaining error can be reduced significantly or the flow rate range can be extended at the constant measurement error of ±3%. The remaining error is better than approx. ±1% across the full flow rate range.

[2] = Nominal value; exact value will be determined by individual calibration

[3] = Volume of measuring chamber

[4] Because of calibration factor with 2 decimals

[5] Higher gas inlet pressure until gas inlet channel and micro capillary in the base plate are clear of packing liquid

[6] For complete MGC unit applies: With temperatures > room temperature (e.g. if placed in heating furnace) a foam formation of the packing liquid was monitored in particular cases.

Materials

Casing	Plexiglas (PMMA)
Measurement cell	PVDF (Polyvinylide fluoride)
Plug-in connectors	Brass, nickel-plated
Tube adaptors	PBT (Polybutylenterephthalat)

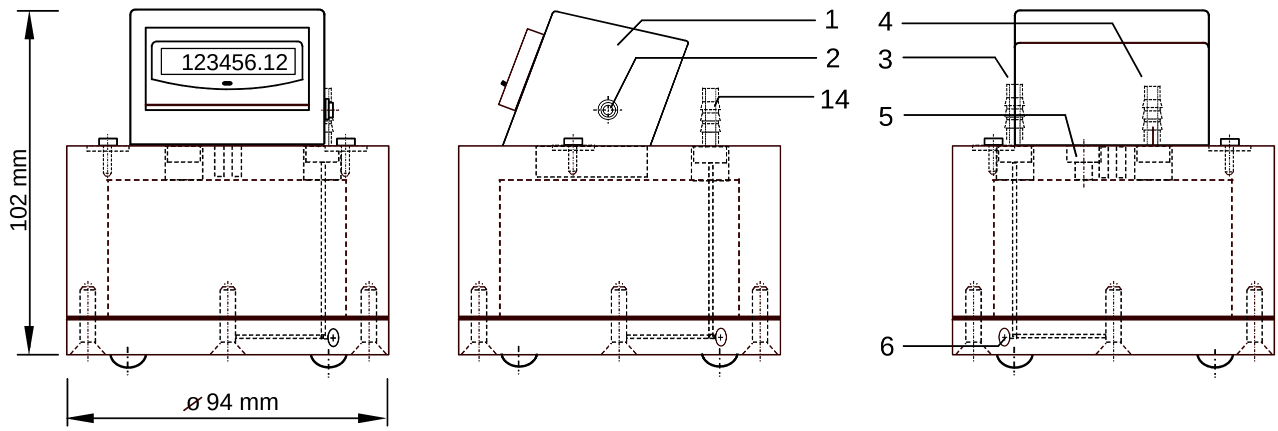
Standard Equipment

Electronic counter / LCD display	1 cleaning rod for micro capillary per each 1 to 5 MGC's
Display: 6 digits [ml] + 2 decimals	Funnel for filling of liquid
Pulse Generator V6.0 as signal output (reed contact, floating output)	200 ml packing liquid
Twin-chamber measurement cell	1.5 m gas connection tubing (PVC)
2 tube adaptors for flexible connecting tubes	1 syringe for fine adjustment packing liquid level

Accessories

Data acquisition software "Rigamo" for Windows®	Packing liquid 100 / 500 / 1,000 ml
Gas connection tubing (PVC)	

Subject to alterations



Front View   Side View   Rear View

(1) Counter unit with LCD display
(2) Signal Output (reed contact)
(14) Hose barb for flexible connecting tube
(3) Gas Inlet
(4) Gas Outlet
(5) Air-vent screw for filling
(6) Inspection screw gas channel

Technical Data

Minimum flow rate Q_{min}	1	ml/h	Maximum gas inlet pressure	**100**	**mbar**
Maximum flow rate Q_{max}	1	ltr/h	Minimum gas inlet pressure	5	mbar
Measurement accuracy, approx. [1)]	±3	%	Gas inlet pressure at measurement start, approx. [5)]	9	mbar
Volume of measurem. chamber, appr. [2)]	3	ml			
Min. measuring volume (resolution) [3)]	3	ml	Gas temperature [6)]	+10 ~ +80	°C
Resolution of indication [4)]	0.01	ml	Connection gas in/outlet	Compression fitting	
Packing liquid quantity, approx.	120	ml	Diameter compression fitting	Ø 8_i	mm

1) Because of the physical measurement principle, the measurement error is dependent on the flow rate. The **data acquisition software "Rigamo"** (accessory) provides an algorithm, which automatically recalculates the actual measurement data to the real values at the respective actual flow rate on the basis of the calibration curve. Thus, the remaining error can be reduced significantly or the flow rate range can be extended at the constant measurement error of ±3%. The remaining error is better than approx. ±1% across the full flow rate range.

2) = Nominal value; exact value will be determined by individual calibration

3) = Volume of measuring chamber

4) Because of calibration factor with 2 decimals

5) Higher gas inlet pressure until gas inlet channel and micro capillary in the base plate are clear of packing liquid

6) For complete MGC unit applies: With temperatures > room temperature (e.g. if placed in heating furnace) a foam formation of the packing liquid was monitored in particular cases.

Materials

Casing / connection hose barbs	PVDF (Polyvinylide fluoride)
Measurement cell	PVDF (Polyvinylide fluoride)

Standard Equipment

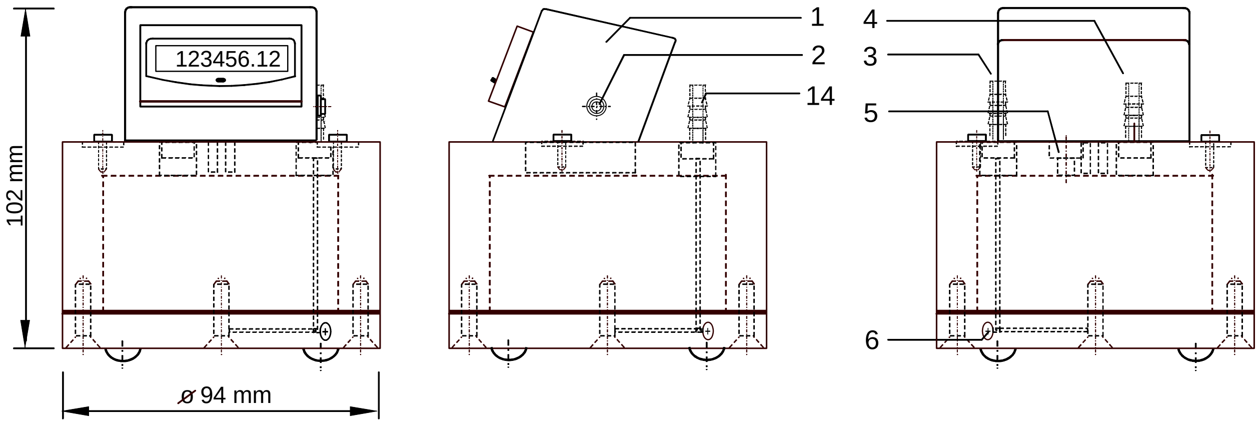
Electronic counter / LCD display	1 cleaning rod for micro capillary per each 1 to 5 MGC's
Display: 6 digits [ml] + 2 decimals	Funnel for filling of liquid
Pulse Generator V6.0 as signal output (reed contact, floating output)	200 ml packing liquid
Twin-chamber measurement cell	1.5 m gas connection tubing Polytetrafluoroethylene (PTFE - Teflon)

Accessories

Data acquisition software "Rigamo" for Windows®	Packing liquid 100 / 500 / 1,000 ml
Gas connection tubing Polytetrafluoroethylene (PTFE – Teflon®)	

MilliGascounter®
Type MGC-1 PVC (red)
Data Sheet 1 of 2

05.07
V 3.2
Rev. 08/2012



Front View Side View Rear View

(1) Counter unit with LCD display
(2) Signal Output (reed contact)
(14) Hose barb for flexible connecting tube
(3) Gas Inlet
(4) Gas Outlet
(5) Air-vent screw for filling
(6) Inspection screw gas channel

Subject to change

Technical Data

Minimum flow rate Q_{min}	1	ml/h	Maximum gas inlet pressure	**100**	**mbar**
Maximum flow rate Q_{max} @ measurement accuracy ±3% [1)]	0.6	ltr/h	Minimum gas inlet pressure	5	mbar
Maximum flow rate Q_{max} @ measurement accuracy ±5% [1)]	1.0	ltr/h	Gas inlet pressure at measurement start, approx. [5)]	9	mbar
Volume of measurem. chamber, appr. [2)]	2	ml			
Min. measuring volume (resolution) [3)]	2	ml	Gas temperature [6)]	+10 ~ +40	°C
Resolution of indication [4)]	0.01	ml	Connection gas in/outlet	Hose barb	
Packing liquid quantity, approx.	120	ml	Diameter hose barb	Ø 8_o	mm
			Diameter connecting tube	Ø 7_i	mm

[1)] Because of the physical measurement principle, the measurement error is dependent on the flow rate. The **data acquisition software "Rigamo"** (accessory) provides an algorithm, which automatically recalculates the actual measurement data to the real values at the respective actual flow rate on the basis of the calibration curve. Thus, the remaining error can be reduced significantly or the flow rate range can be extended at the constant measurement error of ±3%. The remaining error is better than approx. ±1% across the full flow rate range.

[2)] = Nominal value; exact value will be determined by individual calibration

[3)] = Volume of measuring chamber

[4)] Because of calibration factor with 2 decimals

[5)] Higher gas inlet pressure until gas inlet channel and micro capillary in the base plate are clear of packing liquid

[6)] For complete MGC unit applies: With temperatures > room temperature (e.g. if placed in heating furnace) a foam formation of the packing liquid was monitored in particular cases.

Materials

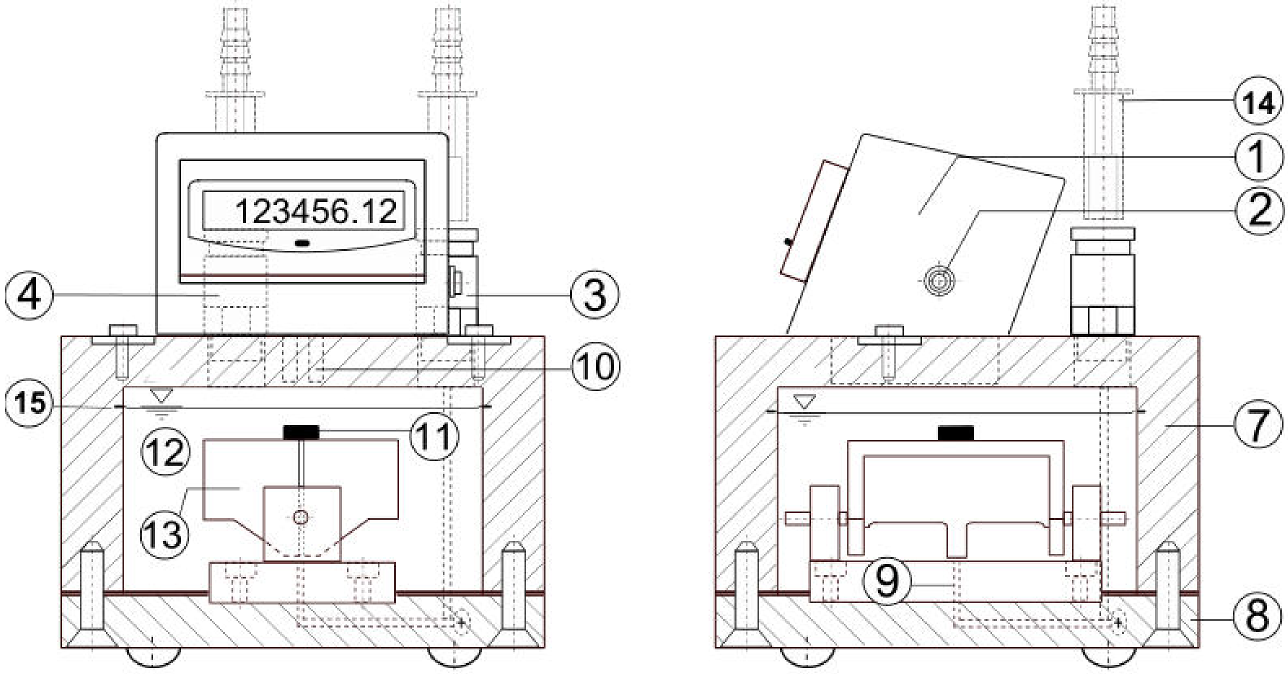
Casing / connection hose barbs	PVC (Polyvinyl chloride), red
Measurement cell	PVC (Polyvinyl chloride), red

Standard Equipment

Electronic counter / LCD display	1 cleaning rod for micro capillary per each 1 to 5 MGC's
Display: 6 digits [ml] + 2 decimals	Funnel for filling of liquid
Pulse Generator V6.0 as signal output (reed contact, floating output)	200 ml packing liquid
Twin-chamber measurement cell	1.5 m gas connection tubing (PVC)

Accessories

Data acquisition software "Rigamo" for Windows®	Packing liquid 100 / 500 / 1,000 ml
Gas connection tubing (PVC)	



MGC-1(Graphic shows PMMA version)

(1) Counter unit including LCD display
(2) Signal output socket of reed contact
(3) Gas inlet connector
(4) Gas outlet connector
(7) Casing
(8) Casing base plate
(9) Micro capillary tube
(10) Two Reed Contacts
(11) Permanent magnet
(12) Packing liquid
(13) Measurement cell (tilting body) with twin-chambers
(14) Tube adaptors for flexible connecting tubes
(15) Scratch mark (filling level packing liquid)

2. Initial Operation

2.1. Handling after receipt

a) Please read these operation instructions carefully to guarantee a long and trouble-free operation.

b) Unpack the MilliGascounter carefully. The box contains:
- 1 MilliGascounter
- 2 tube adaptors for flexible connecting tubes
- 1 bottle of packing liquid (200ml)
- 1.5 m tubing
- 1 funnel for filling of packing liquid
- 1 syringe (fine adjustment of the packing liquid level) per each 1 to 5 MGC's
- 1 Level for horizontal alignment of the MilliGascounter
- 1 cleaning tool (PMMA rod with inserted wire) per each 1 to 5 MGC's

2.2. Installation

a) The MilliGascounter should be installed on a horizontal, solid and vibration-free base.

b) If condensation from the gas to be measured can possibly occur inside of the MilliGas-counter please refer to par. 3.4 "Condensation".

2.3. Filling

The special packing liquid supplied along with the MilliGascounter should be used for filling **only** as the calibration is only valid with this packing liquid. (If a different liquid is used, unavoidable measurement errors will occur due to the different liquid properties like viscosity or surface tension.)

The packing liquid is physiologically safe. If clothing is stained, it can be treated in the same way as oil stains (the packing liquid is an oily polymer).

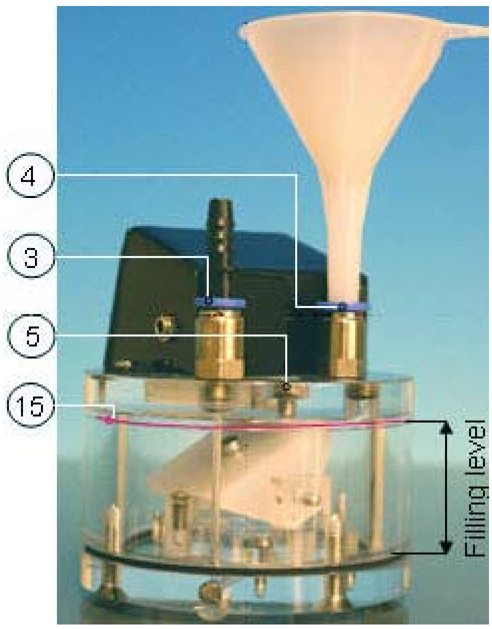
Approximately 120 ml of liquid are needed for one filling of the MilliGascounter.

2.3.1. PMMA Version (Transparent Casing)

For filling of the liquid the supplied funnel should be placed into the gas outlet nozzle (4). After removing of the air-vent screw (5) the liquid can be poured into the casing.

For fine adjustment of the packing liquid level (15) (highlighted red line) please refer to par. 2.4 "Fine Adjustment of the Packing Liquid Level".

Screw the air-vent screw to the liquid container with a maximum torque of 1 Nm otherwise the PMMA thread might break. (In general, this torque can be described as "hand-tight".)



2.3.2. PVDF and PVC Version

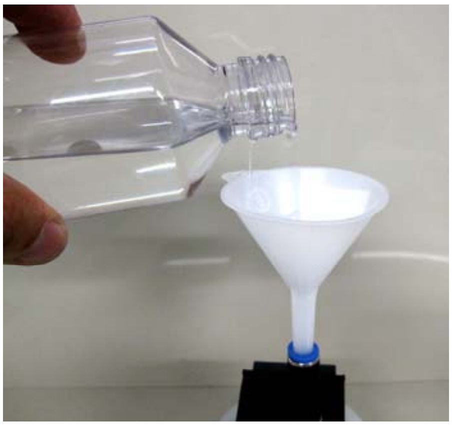
Scope of delivery[7]:

Open the air-vent screw:

Put the funnel into gas outlet nozzle

Place the level onto the casing and align horizontally:

Pour the liquid into the MGC:



2.4. Fine Adjustment of the Packing Liquid Level

2.4.1. PMMA Version (Transparent Casing)

a) As a first step please fill as much packing liquid until the liquid covers the measurement cell completely.

b) Tilt the MilliGascounter twice in such a way that the measuring cell executes two tilting movements. For this purpose hold the MilliGascounter in front of you so, looking to the display of counter unit. Tilt the MilliGascounter once to the right and once to the left side. Thus a potential air entrapment within the two measuring chambers will be eliminated.

c) Remove the gas inlet connection tube from gas inlet nozzle or put or put the gas inlet to atmospheric pressure. Wait until the packing liquid at the vertical gas inlet channel has reached the same level as the inside of the casing.

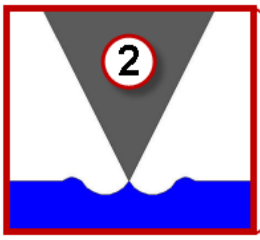
---

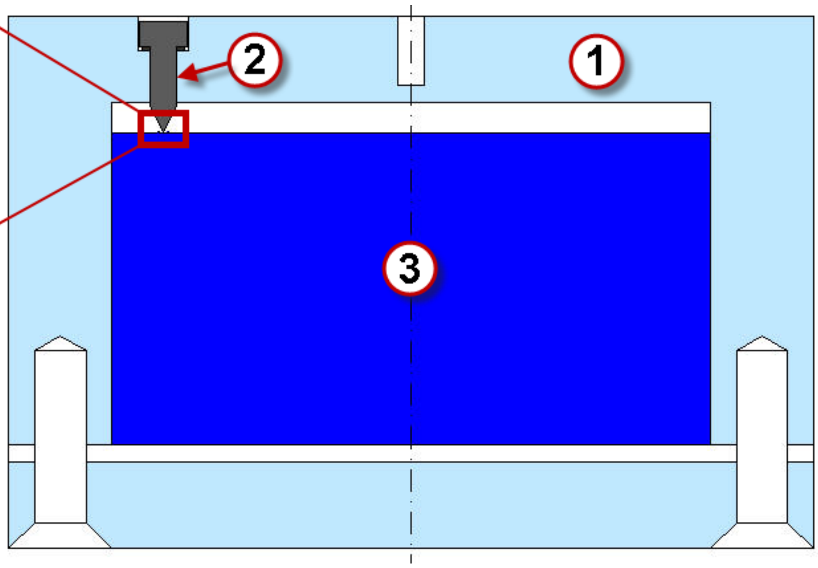
[7] Scope of delivery: MGC / packing liquid / cleaning rod / tubing / funnel / funnel adaptor / level / syringe / 2 compression fittings (PVDF version only)

d) Execute the fine adjustments according to the following instructions. For this, that means for increasing or lowering of the packing liquid, using of the supplied syringe is recommended.

At the upper part of the casing (1) a tracing screw (2) is located to set the correct level of the packing liquid (3).

By all means, the position of this screw must not be changed!





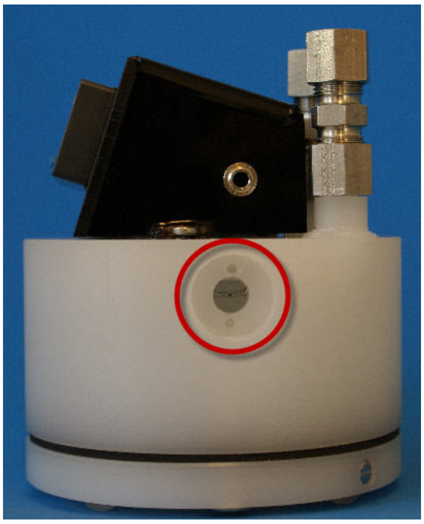
(1) Casing

(2) Tracing Screw for Liquid Level

(3) Packing Liquid

The MilliGascounter is filled correctly when tip of the tracing screw (2) just slightly touches the surface of the packing liquid (3). (With respect to the surface tension of the packing liquid, a small liquid cone is lifted towards the tip of the screw.)

2.4.2. PVDF and PVC Version



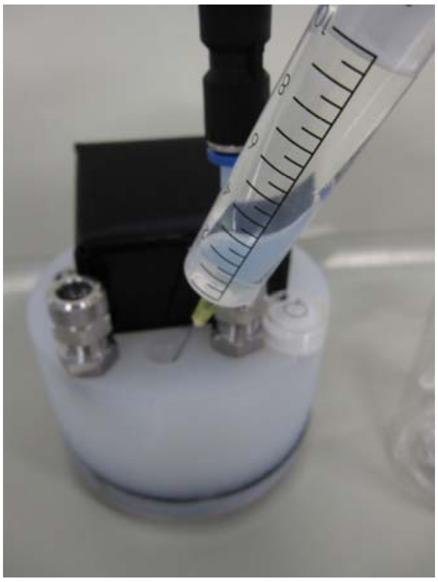
a) At first please pour as much packing liquid into the casing until the liquid level is filled up to about the middle of the sight glass (in the casing wall, beneath the counter unit)

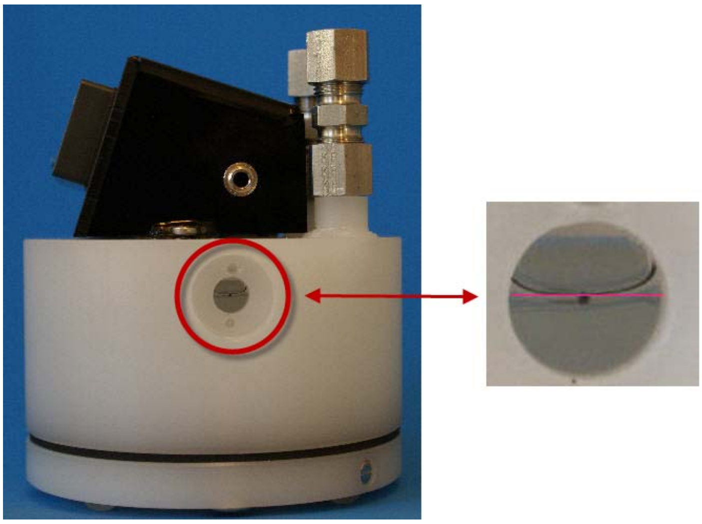
b) Tilt the MilliGascounter twice in such a way that the measuring cell executes two tilting movements. For this purpose hold the MilliGascounter in front of you so, looking to the display of counter unit. Tilt the MilliGascounter once to the right and once to the left side. Thus a potential air entrapment within the two measuring chambers will be eliminated.

c) Remove the inlet connection tube from the gas inlet nozzle or put the gas inlet to atmospheric pressure. Please keep a short waiting period of two minutes after that procedure. (The liquid level inside the casing will then be levelled with the liquid level inside the vertical gas inlet channel during that time.)

d) For the fine adjustment, that means for increasing or lowering of the packing liquid, using of the supplied syringe is recommended

The MilliGascounter is filled correctly if the liquid level matches the indicated mark inside the sight glass (see figure below).





2.5. Connection of Tubing

Flexible tubing to and from the MilliGascounter can be connected to the tube adaptors which belong to the scope of delivery. These adaptors are then plugged into the gas inlet/outlet connectors (3). An O-ring inside of the connector provides a gas tight connection; recommended dimensions of flexible tubing[8]: Inside diameter 7 mm, outside diameter 11 mm.

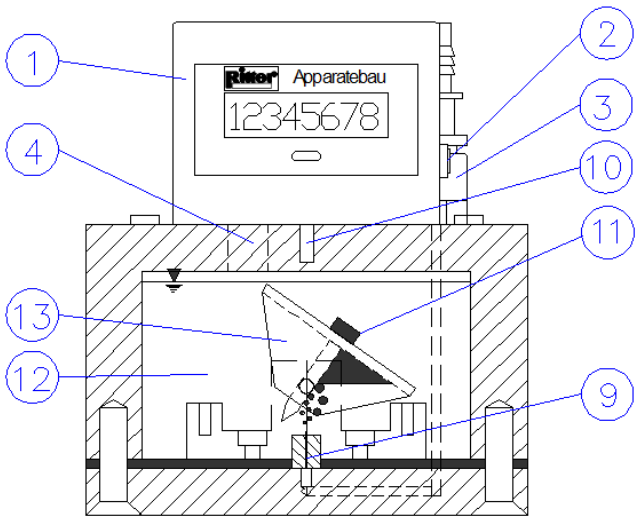
Rigid tubing (such as polyamide tubing) to and from the MilliGascounter can be connected to the gas inlet/outlet connectors (3) without using the above-mentioned tube adaptors; recommended dimensions of rigid tubing: Inside diameter 6 mm, outside diameter 8 mm.

Please use gas-tight tubing for connection to the MilliGascounter. Silicone tubing is therefore not suitable and simple rubber tubing is only conditionally suitable.

[8] 1.5 m of tubing is included as standard equipment and is therefore delivered with the unit.

3. Measurement

3.1. Measurement principle



The gas to be measured flows in via the gas inlet nozzle (3), through the micro capillary tube (9) located at the base of the MilliGascounter and up into the liquid casing which is filled with a packing liquid (12).

The gas rises as small gas bubbles through the packing liquid, up and into the measurement cell (13). The measurement cell consists of two measuring chambers, which are filled alternatingly by the rising gas bubbles. When a measuring chamber is filled, the buoyancy of the filled chamber causes the measurement cell to abruptly tip over into such a position that the second measuring chamber begins to fill and the first empties.

The measurement of gas volume therefore occurs in discrete steps by counting the tilts of the measurement cell (13) with a resolution of approximately 3 ml (= content of one measuring chamber, please refer to Point 3.2). This “residual error” (= max. 3 ml) caused by the resolution should be taken into account when estimating/calculating the total measurement error.

The tilting procedure of the measurement cell creates by the permanent magnet (11) on top of the cell and one of the two magnetic sensors (reed contacts) (11) a pulse which is registered by the counter unit (1).

For external data logging (PC) the switching pulses of the second reed contact can be obtained via the signal output socket (2). (Please refer to Point 4.3).

The measured gas escapes through the gas outlet nozzle (4).

3.2. Calibration / Measurement Error

3.2.1. Static Correction of Manufacturing Tolerances

Because of manufacturing tolerances, the exact volume of a measurement cell is generally ≠ 3 ml. The deviation (= measurement error) from the norm-value of 3 ml is determined at the time of calibration. This calibration factor

- Is determined at the standard flow rate of 600 ml/h,
- is noted in the calibration protocol,
- is programmed into the counter unit. This means that the measured volume (= number of tilts of the measuring cells) is multiplied by the programmed Calibration Factor and the result is displayed.

3.2.2. Dynamic Correction of the Measurement Error

Because of the physical measurement principal, the measurement error is dependent on the flow rate. The error is approx. +3% at min. flow rate and -3% at max. flow rate.

A data acquisition software "Rigamo" is available as accessory which provides -among other features- an automatic correction of the dynamic (= flow rate dependent) measurement error. The algorithm of this software automatically recalculates the actual measurement data of gas volume and flow rate to the real flow rate on the basis of the calibration curve. **The remaining error is better than approximately ±1% across the full flow rate range.**

3.3. Effect of Dead Space Volume

The dead space volume is defined as the volume of the total gas pipe line system between the gas source and the MilliGascounter (for fermentation tests: including the volume of the fermentation vessel above the substrate).

If the measurement of the gas volume starts at ambient pressure (gauge pressure in the dead space volume = ambient pressure), the generated gas volume causes an increase of the pressure in the pipe system only at first. Only after exceeding the minimum gas inlet pressure of 5 mbar the measuring of the gas volume by the MilliGascounter starts.

Due to the design of the MilliGascounter this overpressure of 5 mbar will remain in the dead space volume at the end of the test. The deficit volume caused by this effect has to be added to the measured volume and it is calculated as follows:

$$V_D = V_{DS} \; x \; \left(\frac{P_a + P_{DS}}{P_a} - 1 \right)$$

whereby

V_D	=	Deficit volume	
V_{DS}	=	Dead space volume	
P_a	=	Actual ambient pressure	[mbar]
P_{DS}	=	Remaining pressure in dead space volume **= 5**	[mbar]

3.4. Condensation

If the gas to be measured contains water vapour or another condensable gas, it is necessary to make sure that the gas does not condense inside the MilliGascounter. This can be achieved through *cooling* the gas to room temperature before-hand or through using a *condensation trap*. The easiest way to cool the gas is using proportionately longer gas inlet tubing or a metal pipe (e.g. 20 cm long); if necessary, the gas inlet tubing can be put into a water bath.

If condensation cannot be avoided, the MilliGascounter should be installed in such a way, that the condensation present in the gas inlet tubing cannot flow into it[9]. At the same time

[9] We recommend the use of condensation traps when the MilliGascounter is connected to a fermentation tank, and in particular with thermophilic fermentation processes. A lot of water vapour can escape particularly in those cases.

such a condensation trap also prevents the reverse, i.e. it prevents the packing liquid from flowing backwards into the gas supply line or to the gas source (fermentation tank). This can occur as a result of a drop in temperature within the gas source/gas supply line system (fermentation equipment) creating an under-pressure. Appropriate condensation traps can be supplied upon request by Ritter. If condensation gets into the MilliGascounter nevertheless, it will collect at the bottom of the packing liquid casing and can be siphoned off with a pipette.

3.5. Influence of Particles (Dirt & Dust) in the Gas Flow

If the gas flow in the incoming tubes or in the micro capillary tube is obstructed by particles or liquid, the calibration factor will be affected. Therefore, dust particles have to be absorbed by a suitable filter and the inner surface of the tubes from the gas source must be dry.

3.6. Effect of Temperature

Because of the extreme resolution of the MilliGascounter in the millilitre range, "volume flows" can also be registered as a consequence of changes in temperature. A temperature rise [or decrease] at the gas source or respectively in the supply system causes an expansion [or contraction] of the gas present in the system proportional to its volume. Whereas an expansion of the gas generates a „virtual" gas flow (with an corresponding display at the counter unit), a contraction causes an under-pressure in the supply system. This under-pressure enables packing liquid to flow through the micro capillary tube into the gas feeder tubing. Packing liquid in the gas feeder tubing causes

⇒ an increased admission pressure,
⇒ a time delay until the first display on the counter unit (until the micro capillary tubing is once again free of packing liquid),
⇒ erroneous measurement deviations.

No actual measurement should therefore be started until the temperature of the total system has been adjusted[10]. An expansion of the gas during adjustment of the temperature and the subsequent build-up of an overpressure can simultaneously be used as an operational check of the MilliGascounter (description of the Reset Button, please refer to Point 4.2).

The room temperature should remain approximately the same during the whole of the measurement period. (Please mind a temperature decrease during the night and over the weekend.) Otherwise the temperature has to be monitored so that an integrating correction of the measurement values can be made (please refer also to: „Temperature- and Pressure corrections"). Another alternative is the installation of the MilliGascounter, gas feeder tubing and gas source in a temperature-controlled cupboard.

3.7. Effect of System Gas Pressure

A rise [decrease] in pressure at the gas source or respectively in the gas supply system causes an expansion [contraction] of the gas present, proportional to its volume. The same therefore applies to air pressure as was mentioned in the previous Section on the Effect of Temperature.

[10] With fermentation tests: After equalization with the fermentation temperature.

3.8. Effect of Water Vapour Partial Pressure[11]

If the measurement result has to be corrected for the volumetric share of water vapour, the values in the following table 1, which take the temperature into account, can be used in the equation listed under point 3.9.

Temp. °C	Water vapour partial pressure mbar (psi)		Temp. °C	Water vapour partial pressure mbar (psi)		Temp °C	Water vapour partial pressure mbar (psi)
15	17.0 (0.246)		20	23.4 (0.339)		25	31.7 (0.459)
16	18.1 (0.262)		21	24.9 (0.361)		30	42.6 (0.617)
17	19.4 (0.281)		22	26.4 (.0383)		35	56.4 (0.817)
18	20.6 (0.299)		23	28.1 (0.407)		40	73.9 (1.071)
19	22.0 (0.319)		24	29.9 (0.433)		45	95.9 (1.390)

Table 1: Values of water vapour partial pressure

3.9. Temperature and Pressure Corrections

The MilliGascounter is a volumetric gas meter and therefore measures gas volume in the actual operating state existing at the time of measurement. The gas volume is dependent on gas temperature, air pressure and water vapour partial pressure (for water vapour partial pressure refer to footnote “10“). These measurable variables are therefore needed to recalculate to norm conditions. The gas temperature is to be measured at the gas **outlet**.

According to the general gas laws the following equation is used for temperature and pressure corrections:

$$V_N = V_i \, x \, \frac{P_a - P_V + P_L}{P_N} \, x \, \frac{T_N}{T_a}$$

whereby

V_N	=	Norm-Volume	in	[ltr]
V_i	=	Indicated (displayed) Volume	in	[ltr]
P_a	=	Actual Air Pressure	in	[mbar-absolute]
P_V	=	Water vapour partial pressure	in	[mbar]
P_L	=	Pressure of the Liquid Column above the Measurement Chamber	**= 1**	[mbar]
P_N	=	Norm-Pressure	**= 1013.25**	[mbar]
T_N	=	Norm-Temperature	**= 273.15**	[Kelvin]
T_a	=	Actual Temperature	in	[Kelvin]

If the exact air pressure is not known, the norm-pressure can in that case be used. Air pressure swings of 980 - 1050hPa create errors in the range of -3.3% to +3.7%.

[11] The information in this point 3.8 is valid only for gases which contain water vapour **and** if the volume of the water vapour **must be** mathematically eliminated from the measurement result. If the water vapour is a „natural“ element of the gas and its volume should therefore be taken into account, then no (partial-)pressure correction should be carried out. In that case, $p_V = 0$ must be used in the equation listed under point 3.9.

3.10. Special Features with Fermentation Tests

- In incubators without compulsory ventilation, uneven temperature distribution can cause under-pressure in the reaction vessels.

- The free volume in the fermentation tank and in the feeder tubing to the MilliGascounter should not be smaller than 0.5 ltr. This volume acts as a buffer volume with both eruptively running fermentation processes and reduction of temperature to prevent the generation of under-pressure. Because of this, only tanks which have a free volume of at least 0.5 liters above the test material should be used.

- To determine the total gas production as accurately as possible, it is advisable to leaven the released CO_2 in the fermentation tank to pH 1-2 after the fermentation test has ended. However, this can lead to foam formation and wetting of the tubing.

- The MilliGascounter was calibrated at room temperature (21ºC). If the in-house standard temperature is 21°C as well (instead of the international standard of 0°C / 273.15 K), the temperature correction is not necessary when the gas is cooled down to 21°C. With a fermentation temperature of 37ºC this is obtained when using a connecting tubing with a length of 1.5 m.

- If the biogas contains high amounts of ammonium and H_2S the possibility increases, that the micro capillary of the gas inlet pipe plugs. In such a case it is recommended to install an absorber flask in the gas tubing to the MilliGascounter. This absorber flask can content ferric iron pebbles (ferrous oxide). Hydrogen sulphide will be linked to the ferric iron pebbles. But such an absorber flask can also content that kind of charcoal, which is used also e.g. in kitchen hoods. If the medium in the absorber flask is used up (recognised by the smell or if there is no cleaning effect any more) the medium has to be replaced.

- Experiments to determine the methanogenic potential of organic substances in the laboratory of Prof. Dr. Paul Scherer[12] (University of Applied Sciences Hamburg, Paul.Scherer@rzbd.haw-hamburg.de) have shown that the dry matter content of the seed sludge has not only an influence on the velocity of the gas production, but also on the total amount of produced gas. Of course in all cases parallel to the gas production of a test substance a reference without added organics was subtracted. Based on these findings it is recommended to use in such experiments at least 3% dry matter content of a seed sludge. It is important to homogenize the sludge by a mixer before use. It is also of importance that thickened sewage sludge often contains small amounts of polymers to support the coagulation. But added polymers often contain substantial amounts of biodegradable alkanes to facilitate the addition. These additives increase the background production of biogas during a test period. If the background production of biogas is too high this could complicate the calculation of the gas production of the test substance.

  But if the gas production of the seed sludge is too low then in some situations it can occur that the pressure in the test flasks drops down below the atmospheric pressure. According to the principle of connected tubes this can lead to a flow of oily packing liq-

[12] Scherer, P.A. (2001) Influence of high solid content on anaerobic degradation tests measured online by a MilliGascounter® station for biogas. In: Proceedings of the 9th World Congress on “Anaerobic Digestion 2001” (L. van Velsen, W. Verstraete, Eds.), Antwerpen.

uid into the test trial vessel. In such cases it is recommended to increase the background gas production by the addition of cellulose powder (e.g., Avicel). Also the test approach should be started at room temperature so that the temperature in the incubators (mostly 35-37°C) increases smoothly generating thereby a small overpressure.

4. Counter unit

4.1. Display

Gas volume is displayed in milli-liters (6 digits) with a resolution of 0.01 ml. The calibration factor resulting from the calibration is programmed into the counter unit. This means that the measured volume (= number of tilts of the measuring cells) is multiplied by the programmed calibration factor and the result is displayed.

4.2. Reset Button

The blue reset button is located under the digital display. A press of the reset button erases the measurement value memory and sets the display back to zero. The calibration factor remains preserved in the counter unit.

4.3. Signal Output

4.3.1. Reed Contact

- **Function:**

The measurement of the flowing gas volume occurs by counting the number of tilts of the measurement cell (13) by means of a permanent magnet (11) and two magnetic sensors (reed contacts). The magnet is located at the top of the measurement cell, the reed contacts are located within the cover on top of the casing.

The tilting procedure of the measurement cell closes the two reed contacts. The first reed contact initiates a counter pulse at the counter mechanism (1). Additionally, the second reed contact works as a pulse generator (V6.0) and can be used as a signal output from the MilliGascounter to an external data acquisition system. Please note that **display** shows the **true gas volume** (i.e. the measured volume multiplied by the calibration volume) whereas the **pulses** counted at the **output socket** are equivalent to the number of tilts and hereby equal to the **uncorrected (not calibrated) gas volume**.

The reed contact of the signal output works as a potential-free closing contact.

- **Electrical Data:**

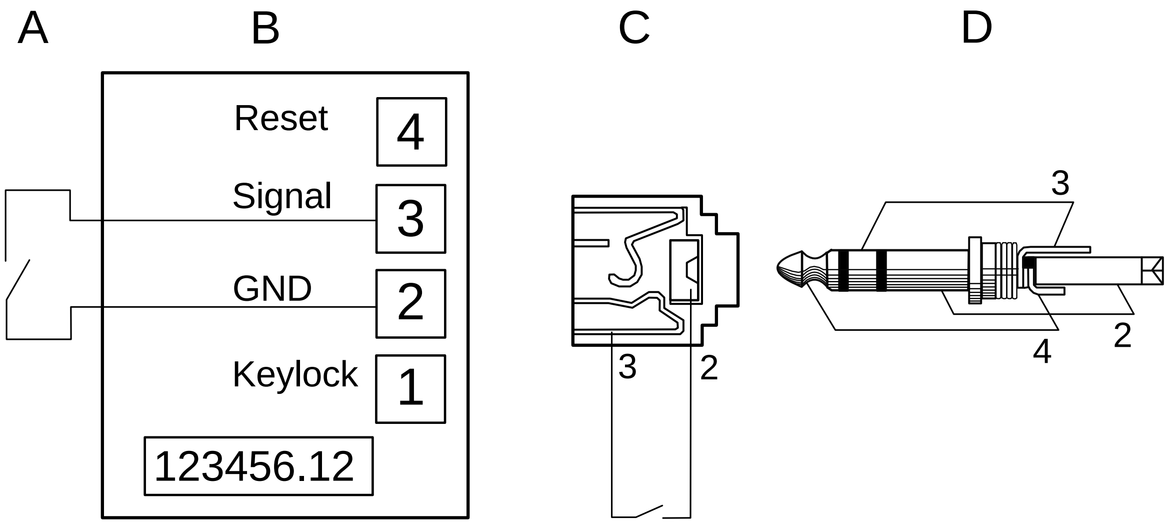
Max. switching power	10	Watt
Max. switching current	0.5	A/DC
Max. switching voltage	100	V/DC
Switch-/closing time, approx.	0.1	sec
Rebound time	< 1	msec
Max. switched contact resistance	150	mOhm

4.3.2. Output Socket

The switching pulses of the reed contact can be obtained at the output socket (2).

Attention: The switch pulses of the reed contact are equal to the number of tilts of the measurement cell. The pulses therefore represent the uncorrected (not calibrated) measured gas volume. The gas volume obtained via the signal output socket must therefore be multiplied by the calibration factor to get the true gas volume.

The output socket is a standard 3.5 mm stereo socket, into which a compatible jack plug can be inserted (identical to a jack plug of walkman cassette players).



Legend:

Part	Function
A	Reed Contact no. 1 for counter
B	Counter and LCD display
C	Reed Contact no. 2 for output signal and Output Socket
D	Jack plug (3.5 mm stereo socket)

Pin / Contact of Jack Plug	Function
2	Ground
3	Signal
4	Not used

5. Maintenance

5.1. Checking the Packing Liquid Level

The rate of evaporation of the packing liquid in the MilliGascounter is very slow but dependant upon the gas flow rate as well as the operating temperature. Also the diameter of the gas outlet nozzle (4) contributes to it. Therefore the evaporation can be diminished even more by closing the outlet with a stopper and piercing it with a syringe needle. To ensure stable measurement accuracy therefore, the packing liquid level must be checked from time to time. (Regarding the correct level please refer to par. 2.3 “Filling.

5.2. Exchange of Packing Liquid

An exchange of the packing liquid

- is **necessary** when particles or substances of the gas, which are imposed to the liquid, create a bubbling of foaming of the liquid,
- is **recommended** when a visible large quantity of particles are floating in the liquid.

5.3. Cleaning the Micro Capillary Tube

The free cross-section of the micro capillary outlet (9) on the bottom of the liquid container has a substantial influence on the measurement accuracy. A narrowed gas outlet primarily influences the gas pressure, which can then also increase to over 30 mbar in the gas supply lines and cause a pulsating gas flow. This leads to erroneous measurement deviations. The micro capillary tubing should therefore be cleaned occasionally.

a) To do this, empty the MilliGascounter by either pouring out the packing liquid through the gas outlet nozzle (4) or by sucking it out through this nozzle with a pipette.
b) Remove the 4 closing screws underneath the casing base plate.
c) Remove the 4 screws of the fixture of the measurement cell support (bearing block) which is located at the base plate.
d) The micro capillary should only be cleaned with the cleaning rod containing a fine wire delivered for this purpose with the MilliGascounter. A wire with a smaller diameter would not have the desired cleaning effect, a larger diameter could damage the micro capillary and consequently lead to an alteration in the calibration and **measurement error**.
e) Re-assemble the fixture of the measurement cell to its original position.
f) Re-assemble the casing base plate to the casing. Please mind the proper position of the sealing ring. The tightening sequence of the 4 base plate screws should be such that one screw pair positioned at opposite sides of the casing base plate is tightened first followed by the second screw pair (not all screws one after the other in circumferential direction). The **torque for tightening the screws** must not exceed **3 Nm** (“hand-tight”) to avoid a damage of the plastic threads.
g) Fill the MilliGascounter with liquid according to par. 2.3 “Filling”.

5.4. Counter Unit Battery Exchange

The counter unit is equipped with a lithium battery (2 V) with a life-time of 4 to 5 years (information without engagement[13]). Unfortunately, the battery cannot be exchanged because it is welded to its support.

Therefore, the MilliGascounter has to be sent back to the manufacturer for changing of the counter unit.

5.5. Disassembly / Exchange of the Measurement Cell

If it should become necessary to exchange the measurement cell, it is recommended to return the whole unit to the manufacturer. If this is not possible or if it is uneconomical, the measurement cell (including the cell bearing block) can be exchanged as follows:

---

[13] Besides tolerances during manufacturing the storage and working temperature of the battery / MilliGascounter affects the working life.

- Follow the instructions according par. 5.2 (a) to (c)

- After having received the replacement cell (including the cell bearing block), follow the instructions according par. 5.2 (d) to (g) for re-assembling the cell.

After the assembly is completed, it is recommended to perform the following function tests:

- Free swinging: Hold the MilliGascounter upside down and swing the whole unit. The measurement cell should swing free and easily.

- Gas tightness of the MilliGascounter: Close the gas outlet nozzle (4) by inserting a sealed tube. Apply a gas pressure of approx. 10 to 20 mbars to the gas inlet and monitor the pressure indication (manometer). The pressure should remain constant.

5.6. Long-term Storage

The permanent magnet on top of the measurement cell is not resistant to corrosion. When not needed, store the MilliGascounter therefore either completely dry and airtight (both connection nozzles closed) or filled with packing liquid.