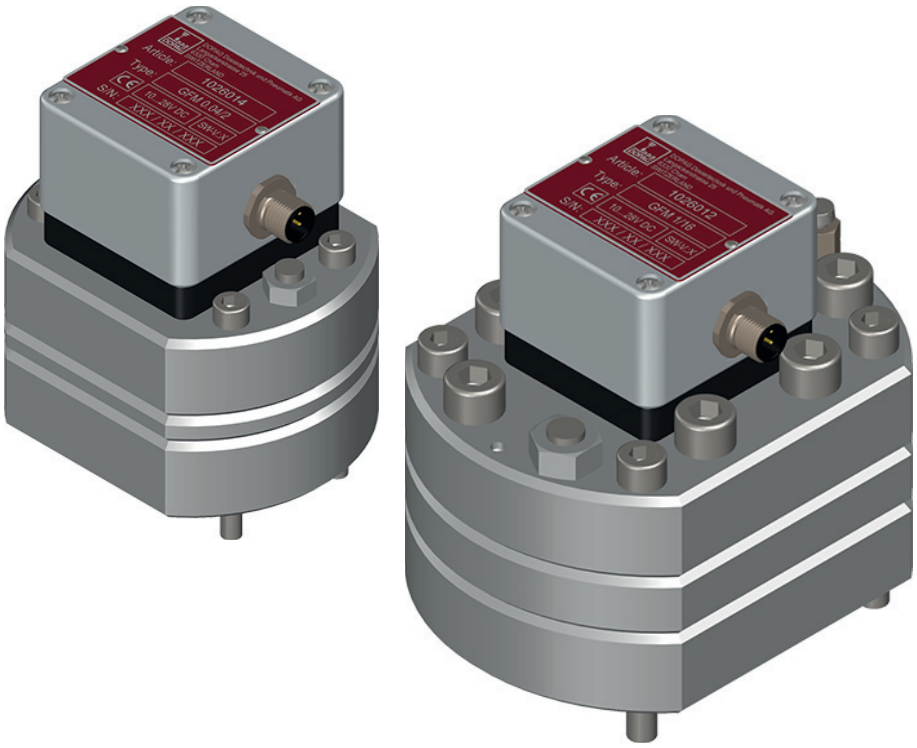
Translation of the original instructions

GEAR-TYPE VOLUME COUNTER (GFM)



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HILGER&KERNGROUP

1 Contents

2 General

2.1 Object of Operating Instructions

These operating instructions are to ensure the safe, intended and efficient use of the equipment. They contain the relevant information for the safety, construction, function, commissioning, operating, servicing and disposal. The required information can be located in the operating instructions using the contents index, the key word index, title and marginal columns.

Ignoring the operating instructions and the safety information can lead to dangers and restrictions for:

- life and limb of the operator;
- the system and material assets of the operating company;
- efficient operation of the system.

NOTICE

Ignoring the operating instructions

The company DOPAG (hereafter called the manufacturer of the equipment) takes no responsibility for any damage resulting from not observing the operating instructions.

► Observe the operating instructions!

2.2 Keeping the Operating Instructions

The operating instructions including the declaration of conformity must be enclosed with the module until it is installed in the machine. After the installation, the assembly instructions and the included declaration of conformity form part of the machine's technical documentation.

2.3 Target audience

The machine operator has the responsibility for ensuring that the operating and service staff have the appropriate qualifications. He must ensure that only company authorized personnel operate the machine.

Operators

Persons working at and operating the system must possess sufficient training for the operations concerned. It is essential for personnel to have read and understood the operating instructions.

Service personnel

Persons who service and repair the system must be skilled and:

- adequately trained to undertake the operations necessary.
- be familiar with and follow the relevant technical regulations and safety instructions.
- have read and understood the operating instructions.

Skilled persons mean those whose training and experience have provided them with adequate knowledge in the fields of hydraulics, pneumatics, material-handling technology and electrical engineering, and who are familiar with the regulations applicable to occupational safety and accident prevention, directives and generally recognized rules on technology and standards, so that they can evaluate the operational safety of the system.

2.4 Note on changes

Text, illustrations and data conform to the technical status of the module at the time of these assembly instructions going to print. The company reserves the right to make changes in the interests of ongoing development.

2.5 Symbols and pictograms

The operating instructions contain various symbols and pictograms. They provide warning signs, directions for action, information and indication signs to the operating and maintenance staff.

▶ D...
• T...

Directions for action

▶ The triangle symbol indicates actions that must be carried out in a specific sequence.
  • The dot symbol indicates the reaction to an action.

Help symbols regarding directions for actions to be taken

Help symbols are found in graphic diagrams only. They support a direction for action to be taken by means of a sequence of numbers directly on the respective part. Help symbols usually consist of a colored circle and a number.

Warning signs, prohibition signs and mandatory signs.

Notes on safety, instructions and warnings are indicated by the appropriate ISO Safety Signs. They can be found in the operating instructions and on the equipment and it is essential that they are obeyed.

Pictograms

Buttons, switches, pressure gauges and functions are designated by pictograms in the operating instructions and on the system itself. The letters A, B, C... in the pictograms identify the components.

Notes for the users

Notes for the users and tips for efficient operation of the system are indicated by the light bulb symbol and typeset in bold type. Follow these instructions!

2.6 Margin column

The margin column contains additional information (pictograms, keywords and descriptions of illustrations as well as directions for action to be taken). In addition, the margin column points out hazards and makes it easier to find what you search.

2.7 Safety advice

There are four types of safety information: Danger, warning, caution, note. They contain: Source of danger, consequences of the risk and avoidance measures to be taken.

Danger

Signal word to indicate a danger with a high risk that will lead directly to death or serious physical injury.

DANGER

Source of danger

Consequences of the risk

► Avoidance measures to be taken

Warning

Signal word to indicate a hazard with a medium risk that could possibly lead to death or serious physical injury.

WARNING

Source of danger

Consequences of the risk

► Avoidance measures to be taken

Caution

Signal word to indicate a hazard with a low risk that can lead to minor or moderate physical injury.

CAUTION

Source of danger

Consequences of the risk

► Avoidance measures to be taken

Note

Signal word for a possible damaging situation, were the system or anything in the vicinity could be damaged.

NOTICE

Source of danger

Consequences of the risk

► Avoidance measures to be taken

2.8 Mandatory signs

Mandatory

Mandatory signs prescribe specific courses of action. They must be followed, as they help protect against injury.

Wear protective gloves

Wearing protective gloves prevents contact with toxic substances. Caustic burns, skin irritations and poisoning are avoided.

Wear protective goggles

Parts of the machine operate under pressure and spraying substances can cause damage to eyes. Wearing eye protection avoids damage to eyes.

2.9 Transportation

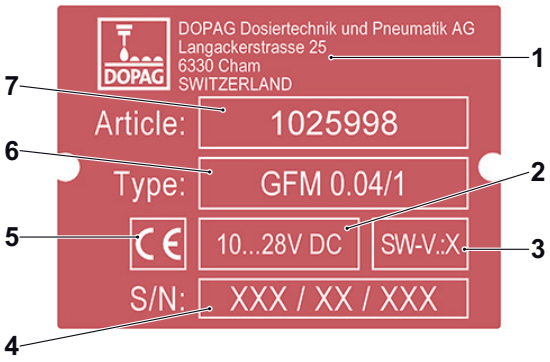
The module is packaged and delivered by the manufacturer in a proper manner. It is protected for transport and against weather conditions, and provided with suitable packaging materials.

Transport the module to the application site in packaged condition if possible and only remove package before first use. The packaging protects the module.

2.10 Labeling

The nameplate is located on the gear-type volume counter and provides the following details:

1 Manufacturer
2 Sensor voltage
3 Software version of the preamplifier
4 Serial number
5 CE mark
6 Type designation
7 Item number



Type designation

Information on the size (tooth gap volume) and the interpolation factor.

3 Safety rules

3.1 Intended use

A gear-type volume counter (GFM) is a measuring device. The module is solely intended to measure the volumetric flow rate of viscous liquids, adhesives, greases, etc. The materials to be processed must be approved by DOPAG Service. The gear-type volume counters have been manufactured according to the state of the art and according to the recognized safety regulations. However, when using them, risks for the health of the user or a third person can remain or damage to the module or other material damage can occur.

- This module and its functions may only be used for the purposes of measuring liquid flows.
- Measurement of liquid or paste-like media in accordance with the respective technical data.
- The operation must occur within the specified environmental conditions.
- It is prohibited to measure materials that form explosive vapors. This module is not explosion-proof.
- Measuring foodstuff is prohibited. The materials used are not suitable for processing foodstuffs.
- The material to be measured must be approved by DOPAG Service. If the composition changes or if a different type of material is to be used, this must be clarified and approved by DOPAG Service.

NOTICE

The use of material not approved by DOPAG Service may damage this module.

If for example seals cannot withstand the new composition, they will be destroyed.

► Information on your telephone contact can be obtained from www.dopag.com.

3.2 Foreseeable misuse

This module must not be used for:

- Measuring reactive (mixed) material.
- Measuring air, gas and water.
- Measuring foodstuff.
- Measuring powder or similar substances.

3.3 Product safety

The module conforms to acknowledged rules of engineering and technology and the relevant safety regulations. The correct operation of the module is required to avoid damage and accidents. Operating it incorrectly or subjecting it to abuse, or ignoring the application limits and the safety instructions, may imperil:

- the operator's health.
- the module and material assets of the operating company.
- efficient operation of the module.
- the environment.

The module may only be operated if it is in perfect condition and if the assembly instructions are observed.

3.4 Responsibilities of the operating company

The following responsibilities are generally applicable to the company operating the module:

- Observe the generally recognized rules that apply to occupational safety (PPE). Moreover, observe the basic regulations and rules on occupational safety and accident prevention applicable on site.
- The operating company is obliged to observe the regulations applicable to the use of equipment, especially those specified in EC Directive 2009/104/EC.
- The module may only be operated in a perfect and clean condition.
- Redesigning or modifying this module is prohibited.
- For repairs, please contact DOPAG Service www.dopag.com. Only genuine DOPAG spare parts may be used.
- Check the module at regular intervals for visible signs of damage and for correct functions.
- The operating company is responsible for the safety regulations in dealing with the material used.

3.5 Changes on the module

Basically, changes on the module are prohibited. However, if changes become necessary, please observe the following points:

- Do not undertake changes, add-on or modification to the module without express approval by the manufacturer.
- All redesigning measures require written approval by the manufacturer.
- Only genuine DOPAG spare parts may be used. Trouble-free operation is not guaranteed if parts other than the genuine parts are used.

3.6 Hazardous zones

The hazardous zone denotes the area on a module and/or in its vicinity in which there are dangers to safety or personal health. There are various danger zones around the module. All safety regulations given in the assembly instructions and information signs on the module must be observed. Observe the safety regulations in force for the respective installation site.

Particular sources of danger

Operating this module conforms to the general safety standards. However, hazards can arise in some situations.

- Whenever performing work relating to the assembly, disassembly, commissioning, operation, relocation, adaptation, maintenance and cleaning of the machine, the safety information given in the assembly instructions are to be observed.
- All service and maintenance work on the module must be carried out only after it has been turned off or depressurized.
- In all cases, observe the local regulations applicable to safety and accident prevention when operating the module.

Danger from electric power

Electricity is dangerous in many ways. Adhere to the following points:

- Work on power supply systems may only be performed by qualified electricians.
- Check the module's electrical equipment regularly. Loose connections and burnt cables should be removed immediately or restored to their proper condition.
- If work is necessary on live parts, a second person, who can turn off the main switch in an emergency, must assist.

Danger from high pressure

Pneumatic and hydraulic modules are pressurized.

- When dealing with the module, you must wear protective goggles and gloves.
- Depressurize the module before beginning the repair works.

Danger from toxic and combustible materials

Depending on the material being processed, special rules and regulations regarding occupational safety and accident prevention must be observed:

- When using solvents or other corrosive chemicals, special precautions must be taken, e.g. eye washing facilities.
- During flushing and cleaning processes, vaporization of solvents may create an explosive zone.
- See the material data sheet provided by the manufacturer.

3.7 Warranty and liability

Claims under the warranty and liability for personal and material damage are excluded if they are due to one or several of the following causes:

- Improper use of the module.
- Improper assembly, commissioning, operation and maintenance.
- Operating the module with faulty safety systems or protective systems that have been incorrectly fitted, or non-functional safety and protection devices.
- Disregarding instructions on safety, transport, storage, assembly, commissioning, maintenance and disposal of the module.
- Unauthorized structural modification to the components.
- Poor monitoring of components subject to wear.
- Repair work carried out improperly.
- Disasters caused by extraneous influences and force majeure.
- Use of spare parts which are not genuine DOPAG parts.
- Damage arising from normal wear and tear.

3.8 Conformity

The module complies with the requirements of the directives listed in the declaration of conformity (see chapter *10 EC Declaration of Conformity (as per EMC directive 2014/30/EU)*).

Reference to the Pressure Equipment Directive 2014/68/EU

Gear-type volume counters (GFM) are subject to the Pressure Equipment Directive.

In accordance with Article 4 (1d) and due to the fact that fluids are allocated to group 2 according to Article 13 (1b), the limit values according to Article 4 (1c) apply. These limit values must not be exceeded.

Pursuant to Article 4 (3), GFMs must be designed and manufactured in accordance with the sound engineering practice and shall not be provided with the CE marking.

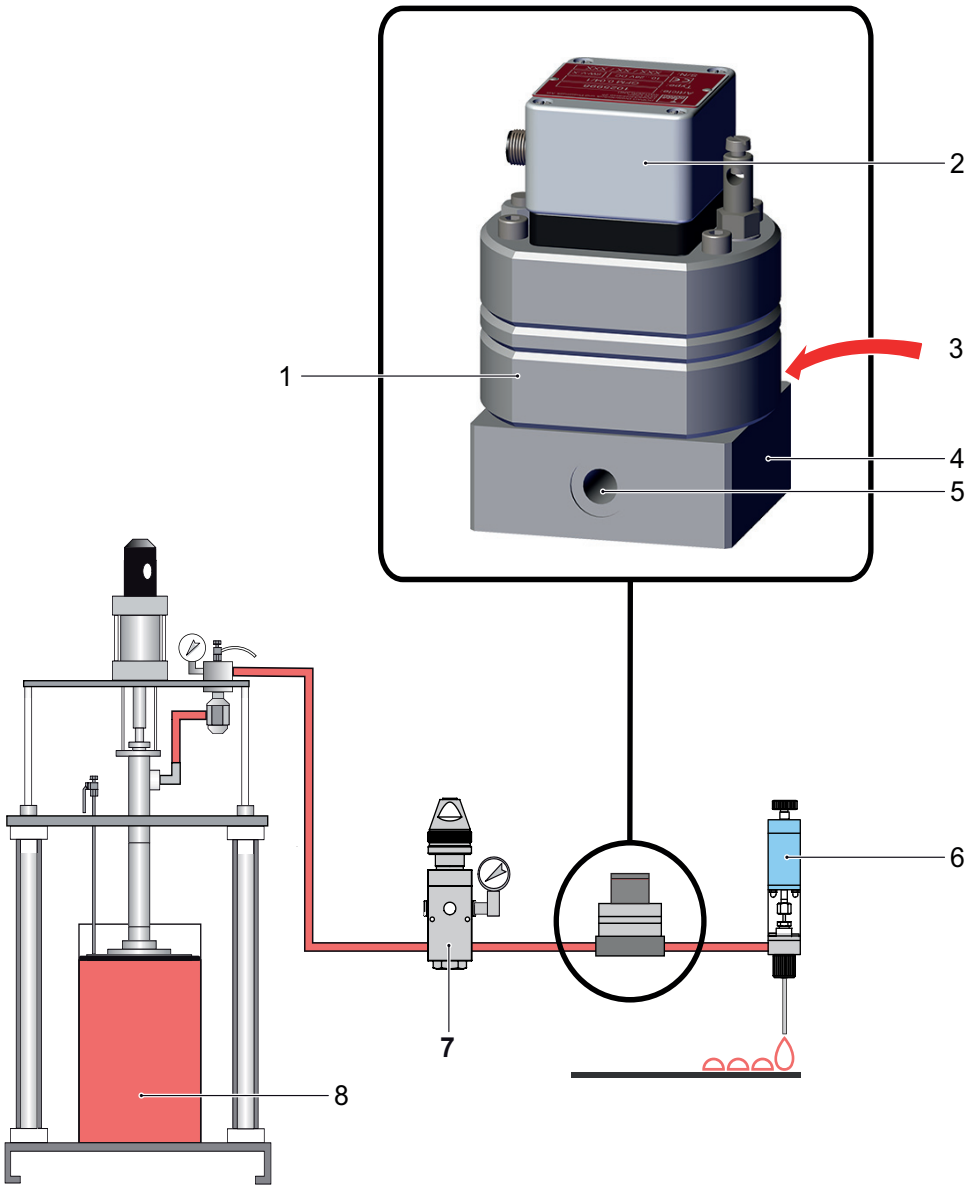
4 Overview and function

4.1 Basic function

A gear-type volume counter (GFM) is a high-precision measuring instrument.

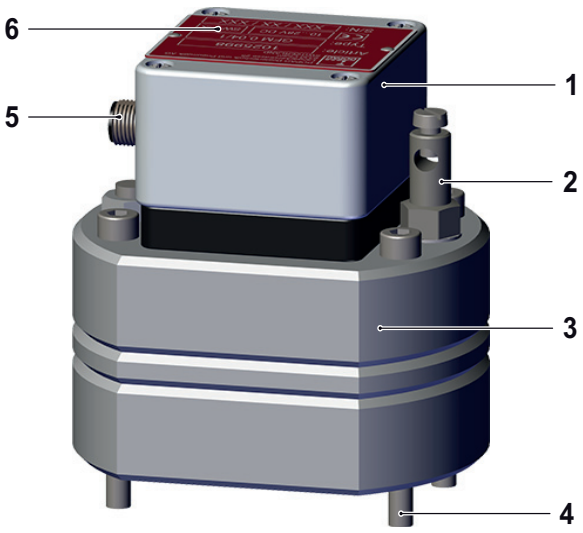
Its measuring principle is based on a gear-type volumetric displacement system. The housing of the volume counter accommodates a pair of very precisely fitted gears that form the measuring unit. Due to its high accuracy and pressure resistance, the latter is used for flow measurement and metering applications under varying pressure, temperature and viscosity conditions. Here, a signal sensor system measures the revolutions of the gears tooth by tooth, processes them and, depending on the setting of the interpolation factor, outputs them by means of a series of digital pulses. The appropriate setting of DIP switches enables a pulse multiplication with a factor of up to 128.

1 Measuring unit
2 Electronic system
3 Material inlet/outlet
4 Connection plate
5 Material inlet/outlet
6 Discharge system
7 Material pressure regulator
8 Supply



4.2 Overview

1 Electronic system
2 Protective earth conductor terminal
3 Measuring unit
4 Screw
5 4-pin M12 port
6 Nameplate



4.3 Field of application

To ensure trouble-free operation of the gear-type volume counter, it is imperative to select the correct type and size. The counter to be selected depends on flow rate, viscosity, pressure gradient, pressure level and desired measurement resolution.

Measuring range

Size	Measuring range [l/min]	Frequency range [Hz]	Pulse value [cc/pulse]
0.04	0.004 - 4	1.667 * IPF - 1666.67 * IPF	0.04 / IPF
0.1	0.01 - 10	1.667 * IPF - 1666.67 * IPF	0.1 / IPF
0.2	0.02 - 18	1.667 * IPF - 1500 * IPF	0.2 / IPF
0.4	0.03 - 40	1.25 * IPF - 1666.67 * IPF	0.4 / IPF
1	0.05 - 80	0.833 * IPF - 1333.33 * IPF	1 / IPF
2	0.1 - 120	0.833 * IPF - 1000 * IPF	2 / IPF

IPF: Adjustable interpolation factor

Standard 1; 4; 8; 10; 16; 32; 64; 128

Optional 2; 3; 5; 12; 24; 50; 100

The measuring range refers to hydraulic oil with a viscosity of 21 mm²/s at 20°C as the testing medium.

Operating pressure

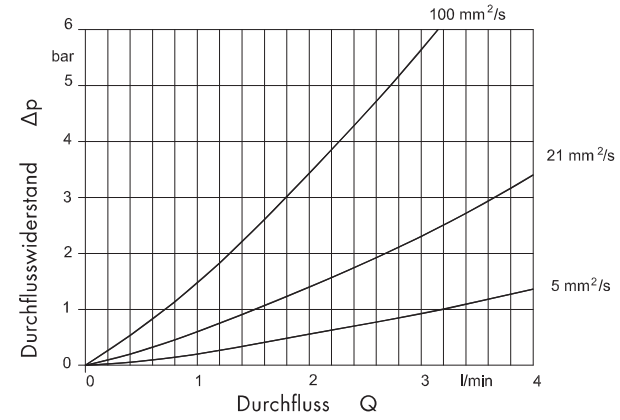
Version	p max [bar]
Gray cast iron	315
Rust-proof	450
Special version	700

Material

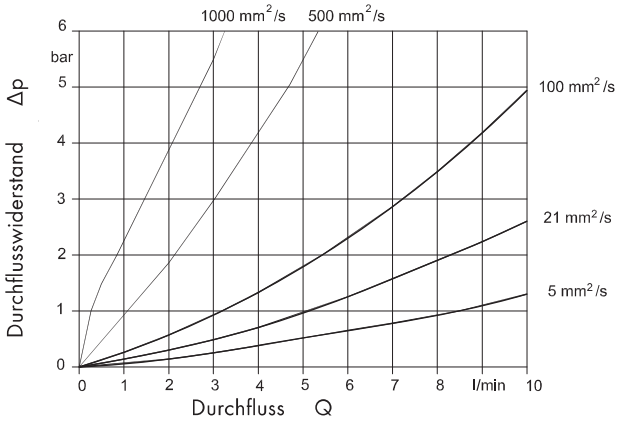
Technical data	
Viscosity range	1 - 100,000 mPas
Material temperature	-40°C - 120°C

4.4 Pressure drop

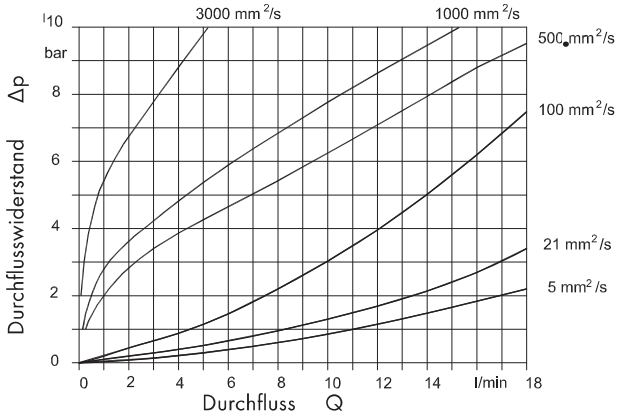
GFM0,04



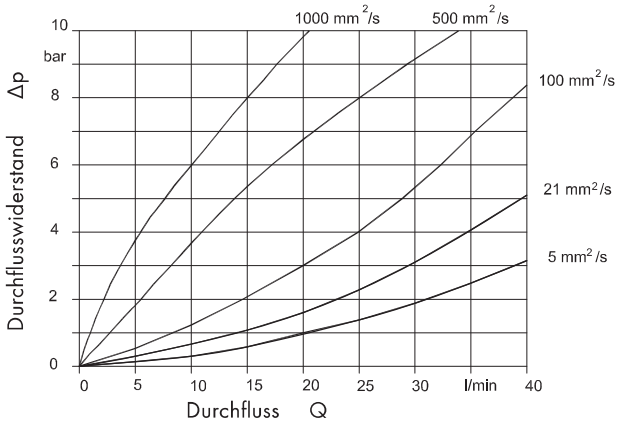
GFM0,1



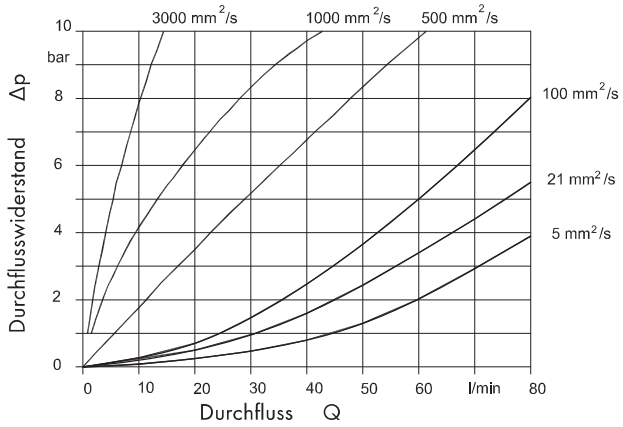
GFM0,2



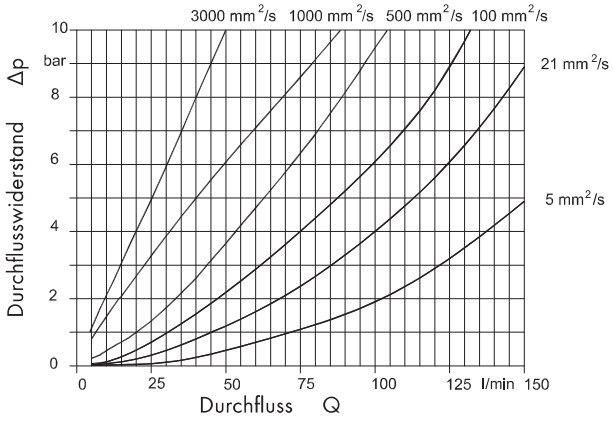
GFM0,4



GFM1



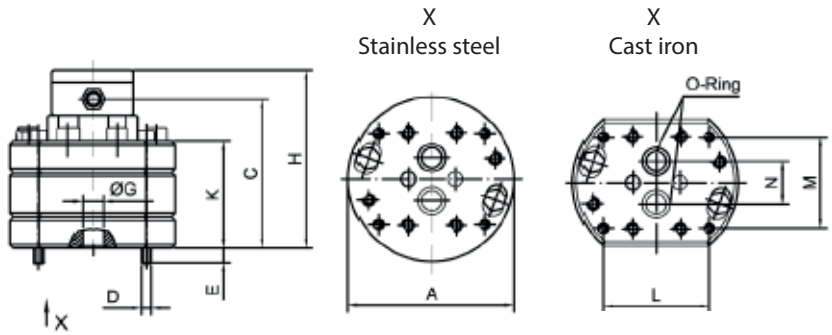
GFM2



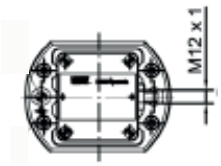
4.5 Technical data

4.5.1 Dimensions of type 0.04 - 2.0

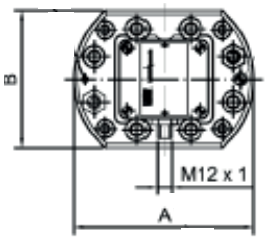
Dimensions



Connector position of sizes 0.04 to 0.4



Connector position of sizes 1 and 2



Type	A	B	C	D	E	ØG	H	K	L	M	N	O-ring
0.04	100	80	83	M6	11.5	9	106.5	59	70	40	20	11 x 2
0.1	100	80	85	M6	9	9	108.5	61	70	40	20	11 x 2
0.2	100	80	85	M6	9.5	9	108.5	61	70	40	20	11 x 2
0.4	115	90	87.5	M8	11.5	16	111.5	63.5	80	38	34	17.96 x 2.62
1	130	100	92	M8	12.5	16	115.5	68	84	72	34	17.96 x 2.62
2	130	100	109	M8	15	16	132.5	85	84	72	34	17.96 x 2.62

Weight

Type	Gray cast iron [kg]	Stainless steel [kg]
0.04	2.8	3.4
0.1	2.8	3.4
0.2	3.0	3.7
0.4	4.0	5.0
1	5.3	6.8
2	6.7	8.4

4.5.2 Ambient conditions

Operation

Operation (without material)	
Air temperature	+ 5 to + 40 °C
Relative humidity	30 to 70%

Transport and storage

Transport and storage (without material)	
Air temperature	- 25 to + 55 °C
Relative humidity	30 to 80%, no condensation

Material processing temperature

For all operations, the material must be brought to the correct processing temperature. Please observe the fields of application of the gear-type volume counters.

NOTICE

Observe the temperature information on the data sheet provided by the material manufacturer.

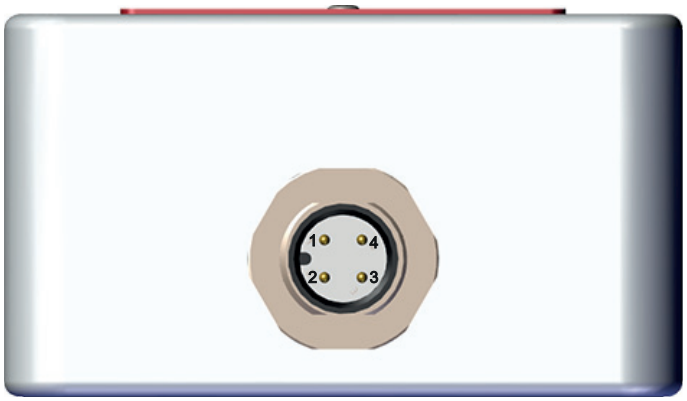
4.6 Preamplifier

The sensors in the housing scan the movement of the gear magnetically. When the gear is rotated by one tooth pitch, a signal that is similar to a sinus signal and corresponds to the measured volume (VT) is generated. The signal is converted into a square wave signal by the incorporated preamplifier.

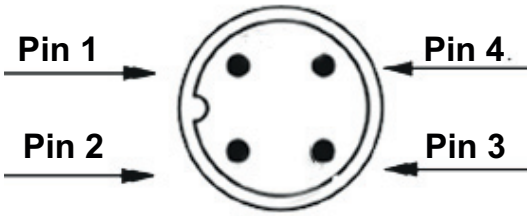
Technical data	
Sensor type	2 x AMR sensor
Operating voltage range	8 - 28 V DC
Power consumption	approx. 40 mA, depending on the load of the outputs
Outputs	2 voltage-limited, driver current 200 mA
Frequency	120 kHz
ESD protection	Yes
Plug	M12 x 1
Protection class	IP 65
Short-circuit proof	Yes
Reverse polarity protection	Yes

4.7 Connector pin assignment

Plan view of the housing



Connector pin assignment



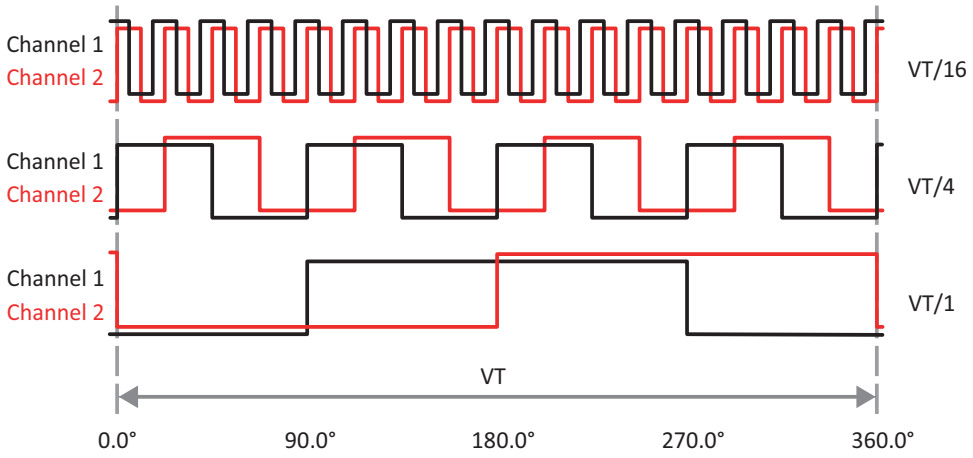
Pin 1: Power supply +V
Pin 2: Digital signal, channel 1
Pin 3: Power supply GND (0 V)
Pin 4: Digital signal, channel 2

4.8 Signal description

The measured volume per pulse is defined by the mechanically displaced liquid volume of a tooth gap and the set interpolation. The output signals are offset by 90°. The direction of flow can be determined based on an evaluation of the rising and falling edges.

The signal frequency is proportional to the current flow rate (volumetric flow rate) and depends on the size of the respective volume counters.

Pulse/volume diagram



By way of example, the figure shows the resolution of the measured volume with the interpolation factors 1, 4 and 16.

Example: interpolation factor 4

The evaluation of a pulse at the signal output of channel 1 or channel 2 has the valency of 1/4 of the measured volume per pulse.

If one edge per channel is evaluated, the resulting valency is 1/2 * 1/4 of the measured volume, i.e. 1/8 of the measured volume per pulse.

If both the rising and the falling edge are evaluated per channel, the resulting valency is 1/4 * 1/4 of the measured volume, i.e. 1/16 of the measured volume per pulse.

Maximum resolution

When the rising and falling edges are evaluated per channel, the maximum adjustable interpolation factor of 128 can be used to achieve a resolution of 1/4 * 1/128, i.e. 1/512 of the measured volume per pulse.

General formula

In practice, it is recommended to evaluate both the rising and the falling edge per channel. So, the following formula shall be applied: VI = VT / (4 * IPF).

For the calculation of the flow rate in the electronic evaluation unit, the value VI is multiplied by the signal frequency.

Output signal frequency

The connected electronic evaluation unit must be able to process the maximum frequency fmax. The latter can be calculated using the formula mentioned below.

The maximum frequency of the output signals is achieved at the maximum flow rate of the gear-type volume counter and is calculated as follows:

fmax = (Mmax * 1000 * IPF) / (60 * VT)

The maximum frequency is limited to 120,000 Hz by the electronic system of the preamplifier.

Explanations

Abbreviations	Meanings
VT	Measured volume or size, respectively; designates the size of the tooth gap volume.
Mmax	Maximum value of the flow rate to be expected [l/min].
fmax	Maximum pulse frequency [Hz]. It is limited by the electronic system.
VI	Volume (quantity) per pulse [ml] that has flown through the counter during one pulse.
IPF	Pulse multiplication factor. Defines the number of portions into which the measured volume (VT) is divided. The higher the interpolation factor, the smaller the detectable volume. For the settings, see *6.6 DIP switch*.

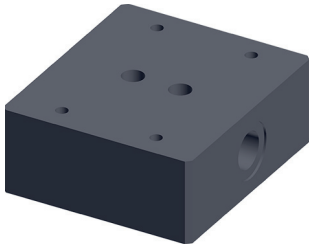
4.9 GFM model codes

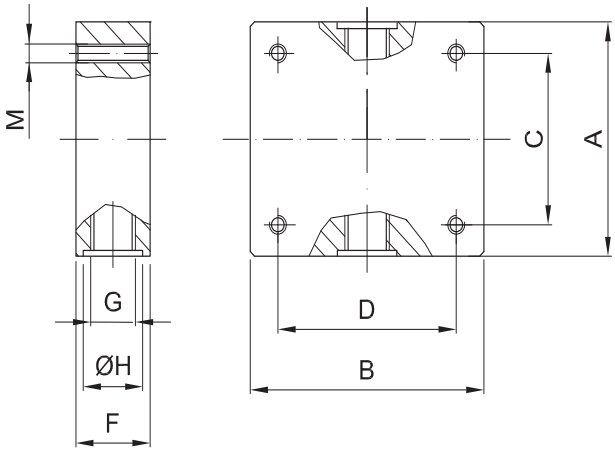
Type *Typ*	Nominal size *Nenngrösse*	/ /	Multiplication *Impulsvervielfachung*	16 16	- -	Material *Material*	S S	Connection *Anschluss*	S S	Gear wheel coating *Messradbeschichtung*	0 0	Bearing *Lagerungsart*	B B	Tolerance *Toleranz*	N N	- -	Seal *Dichtungsart*	F F	Sensor type *Sensortyp*	A A
GFM	0.04	/			-		S		S		0		B		N	-		F		A
																				AMR
																		F		FPM
																		T		PTFE
																		E		EPDM
															N					Normal tolerance / *Normales Spiel*
															I					Increased tolerance / *Vegrössertes Spiel*
															D					Decreased tolerance / *Verkleinertes Spiel*
														B						Ball bearing / *Kugellager*
														P						Plain bearing / *Gleitlager*
														T						Plain bearing tungsten carbide / *Gleitlager Hartmetall*
											0									No coating / *Ohne Beschichtung*
											D									DLC coating / *DLC Beschichtung*
									S											Subplate / *Anschlussplatte*
									P											Pipe connection / *Rohranschluss*
								C												Cast iron / *Gusseisen*
								A												Aluminum / *Aluminium*
								S												Stainless steel / *Edelstahl*
							S													*Vl= VT per / pro Imp.*
							A													*Vl= VT/2 per / pro Imp.*
							S													*Vl= VT/3 per / pro Imp.*
							A													*Vl= VT/4 per / pro Imp.*
							S													*Vl= VT/5 per / pro Imp.*
							A													*Vl= VT/8 per / pro Imp.*
							S													*Vl= VT/10 per / pro Imp.*
							A													*Vl= VT/12 per / pro Imp.*
							S													*Vl= VT/16 per / pro Imp.*
							A													*Vl= VT/24 per / pro Imp.*
							S													*Vl= VT/32 per / pro Imp.*
							A													*Vl= VT/50 per / pro Imp.*
							S													*Vl= VT/64per / pro Imp.*
							A													*Vl= VT/100 per / pro Imp.*
							S													*Vl= VT/128 per / pro Imp.*
				1		-fold / *-fach*														Vl= Impulse volume / *Impulsvolumen*
				2		-fold / *-fach*														VT= Tooth volume / *Zahnlückenvolumen*
				3		-fold / *-fach*														
				4		-fold / *-fach*														
				5		-fold / *-fach*														
				8		-fold / *-fach*														
				10		-fold / *-fach*														
				12		-fold / *-fach*														
				16		-fold / *-fach*														
				24		-fold / *-fach*														
				32		-fold / *-fach*														
				50		-fold / *-fach*														
				64		-fold / *-fach*														
				100		-fold / *-fach*														
				128		-fold / *-fach*														
	0.04	Tooth volume VT= 0.04ccm/Imp / *Zahnlückenvolumen VT= 0.04 ccm/Imp*																		
	0.1	Tooth volume VT= 0.1 ccm/Imp / *Zahnlückenvolumen VT= 0.1 ccm/Imp*																		
	0.2	Tooth volume VT= 0.2ccm/Imp / *Zahnlückenvolumen VT= 0.2 ccm/Imp*																		
	0.4	Tooth volume VT= 0.4ccm/Imp / *Zahnlückenvolumen VT= 0.4 ccm/Imp*																		
	1	Tooth volume VT= 1 ccm/Imp / *Zahnlückenvolumen VT= 1 ccm/Imp*																		
	2	Tooth volume VT= 2ccm/Imp / *Zahnlückenvolumen VT= 2 ccm/Imp*																		

5 Options

5.1 Connection plates

Connection plated made of gray cast iron

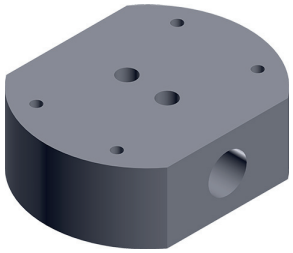


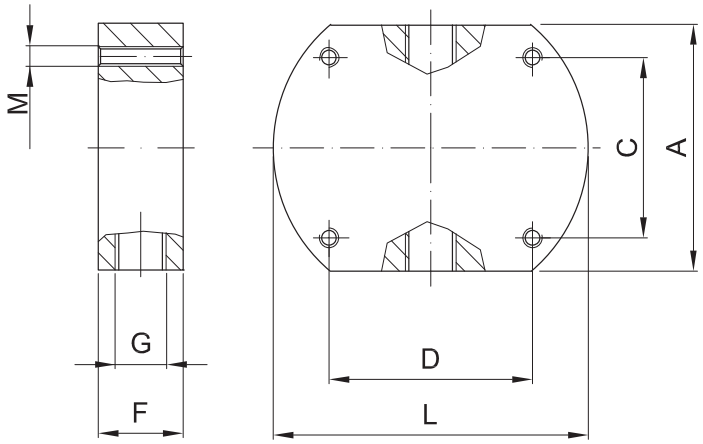


Type	DOPAG item No.	A	B	C	D	F	G	Ø H	M*	Weight [kg]
0.04 / 0.1 / 0.2	31.02.100	80	90	40	70	35	1/4"	20	M6 / 12	1.8
	31.02.055	80	90	40	70	35	3/8"	23	M6 / 12	1.8
	31.02.059	80	90	40	70	35	1/2"	28	M6 / 12	1.8
0.4	22013674	90	100	38	80	35	1/2"	28	M8 / 15	2.7
1.0 / 2.0	31.02.057	100	110	72	84	35	1/2"	28	M8 / 15	3.6
	31.02.052	100	110	72	84	40	3/4"	33	M8 / 15	3.6
	22029253	100	110	72	84	50	1"	41	M8 / 15	3.6

*M: Thread size / thread depth

Terminal boards made of stainless steel



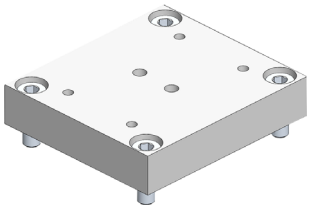


Type	DOPAG item No.	A	C	D	F	G	L	M*	Weight [kg]
0.04 / 0.1 / 0.2	133881	80	40	70	35	1/4"	100	M6 / 12	1.8
	22029206	80	40	70	35	3/8"	100	M6 / 12	1.8
	31.02.061	80	40	70	35	1/2"	100	M6 / 12	1.8
0.4	22003996	90	38	80	40	3/4"	115	M8 / 15	2.7
1.0 / 2.0	22025033	100	72	84	35	1/2"	130	M8 / 15	3.6

*M: Thread size / thread depth

5.2 Adapter plates

Adapter plates



If a gear-type volume counter must be replaced by a counter of another size, the new counter can be mounted on the existing connection plate using an adapter plate.

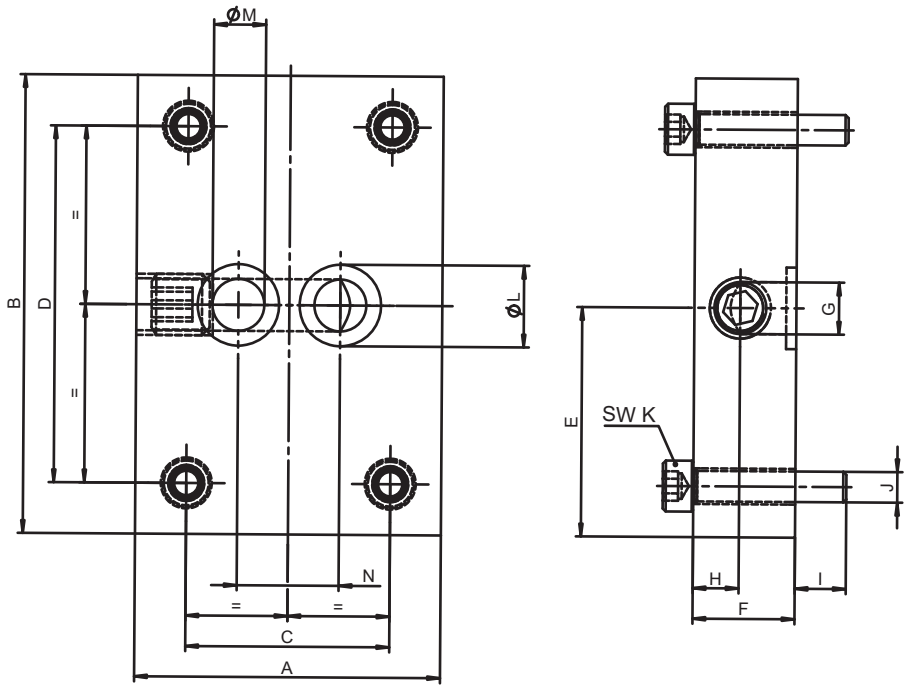
DOPAG item No.	Material	Dimensions	GFM connection holes	GFM mounting
1015290	Rust-proof steel	100 x 76 x 20 mm	40 x 70 mm	4 x M6 / 12
1026308	Nickel-plated steel	100 x 80 x 20 mm	38 x 80 mm	4 x M8 / 12.5
480.01.20	Nickel-plated steel	100 x 90 x 20 mm	40 x 70 mm	4 x M6 / 20
480.04.27	Nickel-plated steel	100 x 100 x 20 mm	38 x 80 mm	4 x M8 / 20
480.13.42	Nickel-plated steel	100 x 90 x 20 mm	72 x 84 mm	4 x M8 / 20
480.16.23	Anodized aluminum	120 x 100 x 19 mm	72 x 84 mm	4 x M8 / 19

DOPAG item No.	Machine connection holes	Machine mounting	Weight [kg]	GFM type
1015290	38 x 80 mm	4 x M6	1.14	0.04 / 0.1 / 0.2
1026308	40 x 80 mm	4 x M8	1.1	0.4
480.01.20	72 x 84 mm	4 x M6	1.33	0.04 / 0.1 / 0.2
480.04.27	72 x 84 mm	4 x M8	1.45	0.4
480.13.42	40 x 70 mm	4 x M8	1.35	1.0 / 2.0
480.16.23	95 x 46 mm	4 x M8	0.69	1.0 / 2.0

5.3 Passage plates

Passage plate

The passage plate can be used for system cleaning.
Its use is described in chapter (*7 Maintenance*).

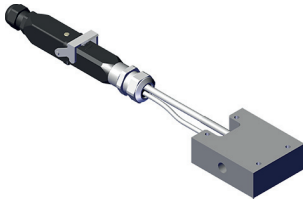


Type	DOPAG item No.	A	B	C	D	E	F	G	H	I
0.04 / 0.1 / 0.2	600.00.68	60	90	40	70	45	20	1/4"	9	10
0.4 / 1.0 / 2.0	540.04.69	90	100	72 / 38	84 / 80	50	30	1/2"	15	10

Type	DOPAG item No.	J	K	L	M	N	Weight [kg]	Material
0.04 / 0.1 / 0.2	600.00.68	M6	5	16	10	20	0.85	Rust-proof steel
0.4 / 1.0 / 2.0	540.04.69	M8	6	19.2	15	35	1.88	Rust-proof steel

5.4 Connection plate with heating

Connection plate with heating



The connection plate with heating serves to warm up and thus to facilitate a better processability of special media. Electrical connection of the heating system is required.

The heating is controlled using a temperature regulator unit or by a PLC (both units are not supplied with the system). For connection of the electrical components, see the enclosed diagram. The cable between connector and connection plate has a length of 1 m.

⚠ CAUTION

Caution - electrical current!

The heating plate is connected to a power supply unit (230 V).

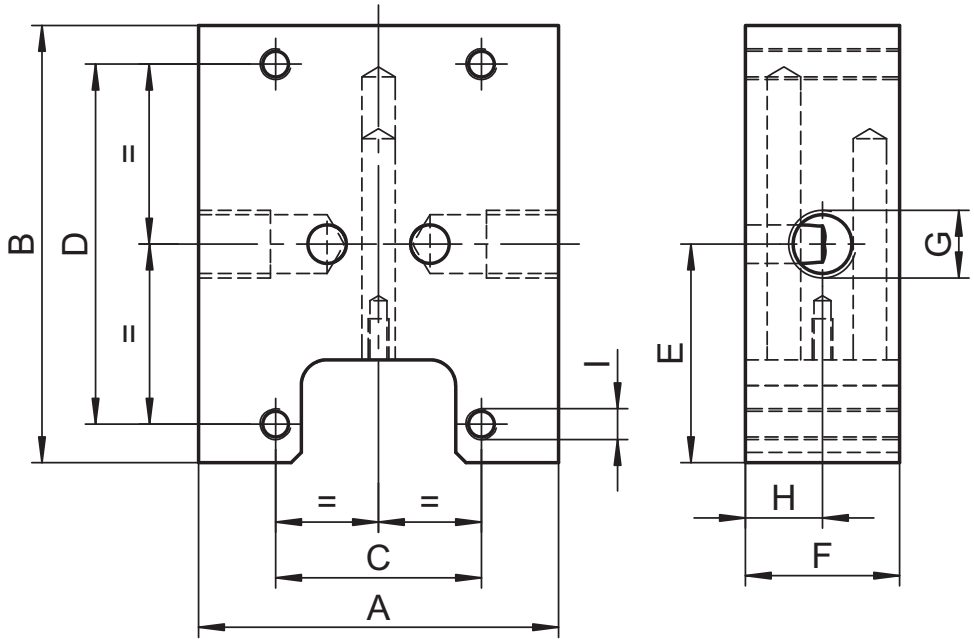
► Work on power supply systems may only be performed by qualified staff.

⚠ CAUTION

Caution – hot surface!

The heating plate with the GFM can reach temperatures of up to 80°C.

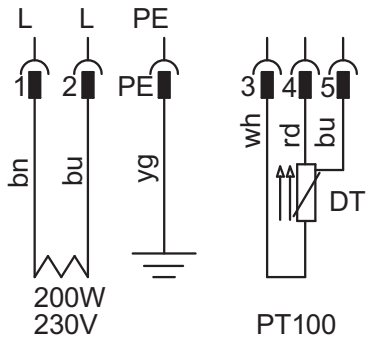
► Before performing work on them, let the heating plate and the GFM cool down or wear gloves.



Type	DOPAG item No.	A	B	C	D	E	F	G	H	I
0.04 / 0.1 / 0.2	1006706	70	85	40	70	42.5	30	1/4"	15	M6
0.4 / 1.0 / 2.0	1018550	90	100	72 / 38	84 / 80	50	34	1/2"	17	M8

Type	DOPAG item No.	Voltage	Performance	Sensor	Weight [kg]
0.04 / 0.1 / 0.2	1006706	230V	200W	PT100 / 3 conductors	1.29
0.4 / 1.0 / 2.0	1018550	230V	200W	PT100 / 3 conductors	2.06

Wiring diagram



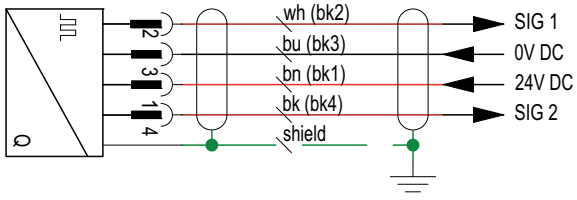
5.5 Connecting cable

Ready-made cable including connector.

Technical data	
Plug type	M12 x 1, 4 pins
Cable type	Shielded

DOPAG item No.	Length [m]	Structure	Diameter [mm]	Sheathing	Mold
31.02.200	5	4 x 0.34mm²	5.9	PVC	Straight
29.01.289	10	4 x 0.34mm²	5.9	PUR	Straight
29.01.283	10	4 x 0.34mm²	5.9	PUR	Angled
1017835	20	5 x 0.5mm²	6.9	PVC	Straight
1007071	20	4 x 0.34mm²	5.1	PUR	Angled

Wiring diagram



6 Assembly

6.1 Removing packaging

Disposal

All packaging material must be removed with care. Packaging material must be disposed of in the correct manner (see chapter *9 Disposal*).

Warranty conditions

The module must be checked for damage that may have occurred in transit. If damage is found, then the warranty conditions must be observed. The warranty conditions are described in the sales documents.

6.2 Prior to assembly

Prior to assembly of the gear-type volume counter, always flush and clean all pipes as well as the supply line carefully. To protect the gear-type volume counter, a *5.3 Passage plates* used to clean it can be installed. This will prevent foreign matters from blocking or even damaging the gears. For flushing, always use a medium that is compatible with the material and does not cause unwanted reactions.

NOTICE

There may still be test material in the module!

During the initial use of the module, such residues may result in defective products!

► During initial de-aeration, make sure that sufficient material is discharged so that any test material is flushed out thoroughly.

⚠ DANGER

Danger of explosion when using solvents!

When using solvents based on halogenated hydrocarbons, such as trichloroethane, chemical reactions can be caused on aluminum and on galvanized parts. The parts can oxidize and be destroyed as a result. In extreme cases, the reaction can occur in an explosive manner.

► Do not use any solvents based on halogenated hydrocarbons.

6.3 Material filtration

Heavily contaminated media or foreign matters in the medium can cause the gears of the gear-type volume counter to block or can damage or even destroy them. A filter having a sufficient filter mesh must thus be installed upstream of the gear-type volume counter to make sure foreign matters and solids cannot reach the gears. The maximum permissible particle size depends on the size, kind of storage and type of the gear-type volume counter.

A blocking gear-type volume counter can stop the entire flow. This will cause an increase of pressure. It's the responsibility of the operating company to ensure that the maximum pressure (Pmax) cannot be exceeded. This must be ensured by limiting the machine's capacity or by installing an excess pressure relief device.

For coarse filtering of large particles and foreign matters, DOPAG recommends using a filter having a filter mesh of 60 or 100.
The medium must not contain any particles larger than specified in the tables below.

Particle size for ball bearings

Type	Max particle size [µm]
0.04 / 0.1	10
0.2 / 0.4	20
1.0 / 2.0	50

As regards the maximum particle size for gear-type volume counters with plain bearings, of special type or provided with special tolerances, please contact DOPAG Service under www.dopag.com.

6.4 Assembly

Plastic plugs provide protection against contamination during storage and transport. They must be removed without fail before the gear-type volume counter is installed to ensure that inlet and outlet are open and the material can flow freely.

Gear-type volume counters can be installed on the machine in any position and with any direction of flow. However, care has to be taken that it is installed at a readily accessible position to facilitate its disassembly for cleaning purposes.

NOTICE

Make sure the maximum permissible operating pressure of the gear-type volume counter cannot be exceeded in any operating mode of the machine.

- ► Please observe the maximum operating pressure of the gear-type volume counter (see chapter *4.3 Field of application*).
- ► The flow rate measuring range depends on the viscosity of the medium to be measured.

The outlet of the gear-type volume counter should always be under pressure. If a closing element is not installed, it is recommended that the outlet is equipped with a non-return valve.

At machine standstill, the pressure in the pipes/hoses can be discharged in the direction opposite to the direction of flow. DOPAG recommends installing a non-return valve at the inlet of the gear-type volume counter.

NOTICE

When installing the gear-type volume counter, make sure that the seals are not damaged.

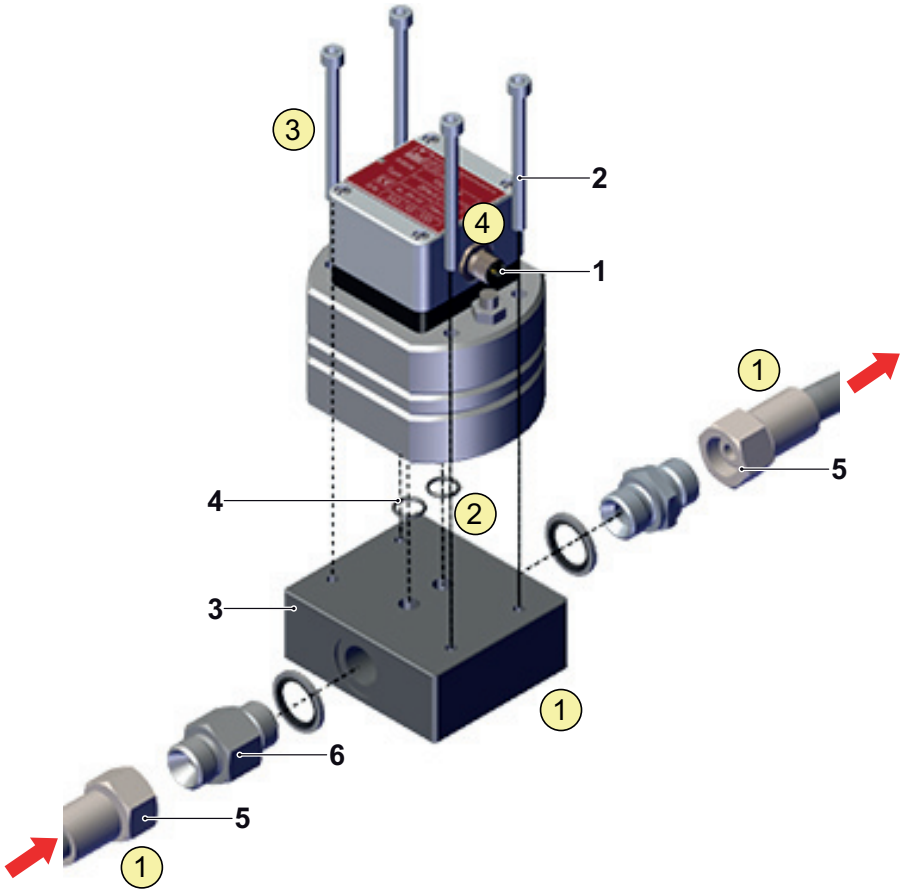
- ► Damaged seals will cause leakage with potentially serious consequences.
- ► The seals must be mounted correctly in the inlet and outlet.

Installation on connection plate

When installing the gear-type volume counter, make sure that the seals are not damaged. Always tighten the mounting screws with the following tightening torque.

Type	Torque [Nm]
0.04 / 0.1 / 0.2	15
0.4 / 1.0 / 2.0	35

1 Electrical connection
2 Mounting screws of the gear-type volume counter
3 Connection plate
4 O-rings
5 Pipes/hoses
6 Non-return valve



1. Install pipes/hoses on the connection plate.
2. Apply grease to the O-rings and install them in the base block of the gear-type volume counter.
3. Use screws to fasten the gear-type volume counter on the connection plate (observe the tightening torques specified in the list above).
4. For the electrical connection, use the connecting cable to connect the unit to the control unit.

6.5 Electrical connection

The module requires an appropriate connection to a power supply unit (see chapter *4.7 Connector pin assignment*).

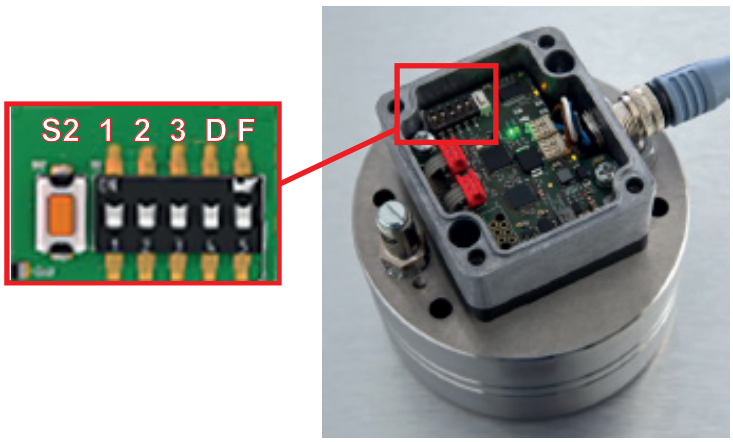
⚠ CAUTION

Caution - electrical current!

The module is connected to a power supply unit. Improper operation can cause an electric shock.

► Work on power supply systems may only be performed by qualified staff.

6.6 DIP switch



Setting the electronic system of the preamplifier

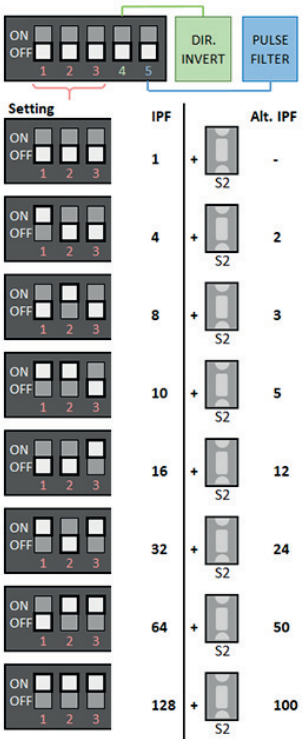
NOTICE

Electrostatic discharge

When setting the electronic system of the preamplifier, ESD protection measures must be taken to avoid damage of the PCB caused by electrostatic discharge.

The DIP switches 1, 2 and 3 are used to set the pulse multiplication according to the following figure.

DIP switch D serves for the reversal of the direction whereas DIP switch F is used to enable the pulse filter.



Optional interpolation factor

1) Set the DIP switches 1 to 3 to "OFF".
2) Press and hold the S2 button.
3) Set the DIP switches 1 to 3 to the desired optional interpolation factor.
4) Release the S2 button.
5) A green LED flashing at 2s intervals indicates that the optional interpolation factor is active.

Pulse filtration

Forward and reverse movement of the liquid due to vibrations in the fluid system are also detected and analyzed. Such movements can occur during flow interruptions or with discontinued flow. The pulses thus generated may be falsely interpreted by the downstream evaluation unit.

Pulse filtration is used to continuously set off such pulses internally in the electronic circuit during the fast forward and reverse movement of the measuring unit. The signals sent to the outputs, however, are suppressed until the internal offset has been successfully achieved, i.e. the measuring unit has returned to its initial position.

DIP switch "F" is used to enable pulse filtration. The filter memory has a capacity for a rotational movement by 8 teeth. The pulses are then output in the corresponding direction and this direction is automatically saved as the preferred direction.

6.7 De-aeration

The gear-type volume counter must be de-aerated when it is installed and after carrying out works on the superordinate system as well as each time pipe fittings of material carrying components have been loosened. Air in the system causes measuring errors.

⚠ CAUTION

Risk of splashing!

The material is released under high pressure and spraying may occur due to entrapped air.

► Wear eye protection and protective gloves.

7 Maintenance

7.1 General

Maintenance work must be carried out by properly trained service staff.

⚠ WARNING

Danger from high pressure!

Risk of injuries when working on modules and machine parts which have not been depressurized.

► Material and air pressure must be released when carrying out work. No residual pressure may exist. The compressed-air connection of your superordinate module/system must be removed.

7.1.1 DOPAG Service

Please note the Service Center responsible for your area. For current addresses, go to www.dopag.com.

7.1.2 Maintenance schedule

To ensure trouble-free operation, the following maintenance intervals must be observed for the module:

Maintenance task	Interval
Visual inspection	daily
Cleaning	daily
Recalibration	as required

In principle, the module requires little maintenance. If, however, liquids that may cause sedimentation in the module are used, it is necessary to clean the module.

The module may be cleaned in the course of the normal machine cleaning process. A change in the measuring accuracy can indicate wear. It is thus recommended that this is checked at regular intervals.

Faults

In most cases, troubles or damages are caused by contamination and lack of maintenance.

In case a revision of the module is required, please contact DOPAG Service. Send the gear-type volume counter together with the completely filled contamination record back to your distributor. For the contamination record, go to www.dopag.com.

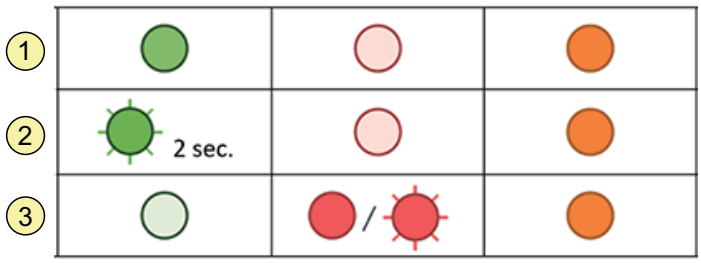
7.1.3 Status indication

The gear-type volume counter is equipped with LEDs that indicate the operating state, the status of the outputs and the errors.

The green LED indicates the general operating state ON / OFF.

The two orange LEDs indicate the status of the outputs and enable the operator to check whether fluid is flowing or at standstill.

The red LED signals an error.



1 Operation ON / output active.

2 Operation ON / optional interpolation factor active / output active.

3 Signal error / sensor error.

7.1.4 Visual inspection

The following points must be checked:

- Check all connections for leak tightness.
- Check the connection plate or adapter plate for leak tightness.
- Check the connection of the M12 connector on the preamplifier.

7.1.5 Cleaning

The module should be cleaned daily and immediately if it is contaminated with material. Dried material is very difficult to remove and requires a great effort.

Passage plate

The passage plate can be used to facilitate the cleaning of the pipes/hoses..

▶ For the cleaning process, the gear-type volume counter is replaced by the *5.3 Passage plates* (to be mounted on the connection plate/adapter plate).

NOTICE

Wrong cleaning agent for cleaning the module.

Under no circumstances must the module be sprayed with water.

▶ Determine which cleaning agent to use from the material used, and clean the module as environmentally friendly and with as much care as possible.

Cleaning the module

▶ Rub the module with a cloth.

The gear-type volume counter must be de-aerated when it is installed and after carrying out works on the superordinate system as well as each time pipe fittings of material carrying components have been loosened. Air in the system causes inaccurate measurements and measuring errors.

⚠ CAUTION

Risk of splashing!

The material is released under high pressure and spraying may occur due to entrapped air.

► Wear eye protection and protective gloves.

⚠ DANGER

Danger of explosion when using solvents!

When using solvents based on halogenated hydrocarbons, such as trichloroethane, chemical reactions can be caused on aluminum and on galvanized parts. The parts can oxidize and be destroyed as a result. In extreme cases, the reaction can occur in an explosive manner.

► Do not use any solvents based on halogenated hydrocarbons.

When selecting flushing and cleaning agents, please observe the following points:

- Observe the manufacturer's recommendations.
- Machine components must be capable of withstanding the recommended solvents and cleaning agents. If you have any questions, please contact DOPAG Service www.dopag.com.
- Observe the current material safety data sheets of your suppliers.

7.1.6 DOPAG spare parts

In case a component leaks, DOPAG recommends replacing all seals of the seal set in question.

You will find the spare parts on the service documentation and they can be ordered at DOPAG Service.

8 Disassembly

For disassembly of the module, the appropriate service documentation must be referred to. Each time, the module is disassembled, the O-rings must be replaced.

Disassembly

Make sure the pipes/hoses have been depressurized and the module has been disconnected from power supply.

The module and the pipes/hoses may still be filled with liquid medium.

⚠ CAUTION

Risk of splashing!

The material is released under high pressure and spraying may occur due to entrapped air.

► Wear eye protection and protective gloves.

NOTICE

Make sure the pertinent safety regulations for handling the liquid used last are observed.

► The contamination record can be taken from *7.1.1 DOPAG Service*.

1) Disconnect the electrical connection (4-pin connector).
2) Loosen the mounting bolts.
3) Remove the O-rings.
4) Remove the connection plate.

9 Disposal

Check the reusability value of materials and system parts prior to disposing of them. Recycle them as much as possible.

Careless or incorrect disposal can result in unforeseen consequences. Materials and system parts should be disposed of in a manner that is proven to be harmless to humans, nature and the environment. Note the details provided by the manufacturers and observe the legislation and regulations of the particular country.

Dispose of elements and module parts separately according to the type of material:

- Dispose of packaging material in an environmental-friendly manner.
- Non-ferreous metal
- Iron
- Electronic systems and components
- Plastics
- Organic substances, such as timber

Send the raw materials for recycling wherever possible.

Hazardous waste

NOTICE

Please observe the correct disposal of toxic substances and materials.

⚠ CAUTION

Observe the disposal!

Improper disposal may cause substantial harm for humans and environment.

► It is mandatory to correctly dispose of the used materials according to the material manufacturer's instructions.

For an appropriate disposal by the manufacturer, please fill in the Declaration of Contamination correctly. For the Declaration of Contamination, go to www.dopag.com.

10 EC Declaration of Conformity (as per EMC directive 2014/30/EU)

We, the manufacturer, declare that the following modules are in conformity with the directive listed below and that the mentioned standards were referred to.

The gear-type volume counter (GFM) has been checked for its electromagnetic compatibility within the meaning of the EMC compliance law and complies with the valid statutory EMC directives.

Manufacturer

DOPAG Dosiertechnik und Pneumatik AG
Langackerstrasse 25
CH-6330 Cham

Authorized person for the compilation of the technical documentation

DOPAG Dosiertechnik und Pneumatik AG
Langackerstrasse 25
CH-6330 Cham

Designation

Gear-type volume counter

Type

GFM0.04, GFM0.1, GFM0.2, GFM0.4, GFM1.0, GFM2.0

Directives

Designation	Date
2014/30/EU	20.04.2016

Standards

Standards referred to:	
EN 61000-6-3:2007/A1:2001	
EN 61000-6-2:2005/AC:2005	

Place and date

Cham, 10/21

Technical Director

Urs Lüthi

DOPAG Dosiertechnik und Pneumatik AG
Langackerstrasse 25
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HILGER&KERNGROUP