

DESCRIPTION

The innovative design of the Badger Meter® ModMAG® M3000 meter represents the next generation of electromagnetic flow meter technology. Incorporating the latest developments in micro processing signal conditioning the advanced design of the M3000 meter allows an accuracy $\pm 0.20\%$ with a flow range of 300:1. Targeted to a variety of oil and gas, industrial and municipal applications, the M3000 meter is virtually unaffected by density, temperature, pressure, and viscosity changes and provides an accurate and reliable long term metering solution. This meter complies with ANSI/NSF Standard 61, Annex G.

OPERATION

The operating principle of the electromagnetic flow meter is based on Faraday's law of magnetic induction: The voltage induced across any conductor, as it moves at right angles through a magnetic field, is proportional to the velocity of that conductor. The voltage induced within the fluid is measured by two diametrically opposed internally mounted electrodes. The induced signal voltage is proportional to the product of the magnetic flux density, the distance between the electrodes and the average flow velocity of the fluid.

ELECTRODES

When looking from the end of the meter into the inside bore, the two measuring electrodes are positioned at three o'clock and nine o'clock. As a conductive fluid flows through the magnetic field, a voltage is induced across the electrodes. This voltage is proportional to the average flow velocity of the fluid and is measured by the two electrodes. This induced voltage is then amplified and processed digitally by the converter to produce an accurate analog or digital signal. The signal can then be used to indicate flow rate and totalization or to communicate to remote sensors and controllers.

M3000 meters also have an "empty pipe" detection feature. This is accomplished with a third electrode positioned in the meter between twelve o'clock and one o'clock. If this electrode is not covered by fluid for minimum of five seconds, the meter will display an "empty pipe" condition. When the electrode again becomes covered with fluid, the error message will disappear and the meter will continue measuring.

DETECTOR

The flow meter is a stainless steel tube lined with a non-conductive material. Outside the tube, two DC powered electromagnetic coils are positioned opposing each other. Perpendicular to these coils, two electrodes are inserted into the flow tube. Energized coils create a magnetic field across the whole diameter of the pipe. With the no moving parts, open flow tube design there is no pressure lost and practically no maintenance required.



APPLICATION

The M3000 meter is suited for use in applications where indication of rate and totalization is required. The ability to display flow parameters locally at the flow meter, or remotely by mounting the amplifier up to 100 feet away from the detector, provides a versatile solution for most industrial and municipal flow applications. Whether the fluid is water or something highly corrosive, very viscous, contains a moderate amount of solids, or requires special handling, the meter is able to accurately measure it. Housed in a Class 1, Division 2, NEMA 4X/6P (IP66/IP67) enclosure, the M3000 design has been tested and approved by Factory Mutual (FM) in the United States and the Canadian Standards Association (CSA international) in Canada.

FEATURES

- Sizes 1/4 to 24 in. (6 to 600 mm)
- Accuracy of $\pm 0.20\%$
- Better than 0.1% repeatability
- Large 4-line by 16-character, back-lit, LCD display
- Digital Signal Processor (DSP) based
- Bi-directional flow sensing and totalization
- Automatic zero point stability
- Measures fluids with as low as 5.0 micromhos/cm conductivity
- Empty pipe detection
- No pressure loss for low operational costs
- Long life, corrosion-resistant liners
- Precise calibration
- NEMA 4X/6P (IP66/IP67) enclosure
- FM approved for Class I, Div 2 hazardous locations
- CE and FCC compliant
- CSA Certified
- KTW with PTFE liner for all sizes



Badger Meter

SPECIFICATIONS

Sizes	1/4–24 in. (6–600 mm)	
Flow Range	0.10–39.4 ft/s (0.03–12 m/s)	
Accuracy	± 0.20% of rate ± 1 mm/s	
Repeatability	0.1% of rate	
Power Supply	AC or optional 24V DC AC Power Supply: 85–240V AC, 45–65 Hz Voltage Fluctuation = ± 10% of nominal Over Voltage = Category II Power Consumption = 20 W DC Power Supply (optional): 24V DC ± 10% 8 W	
Analog Outputs	0–10 mA, 0–20 mA, 4–20 mA (programmable and scalable) Voltage sourced (18V DC) isolated Max. loop resistance = 750 Ω	
Digital Outputs	(2) Open Collector, (programmable – scaled pulse, flow alarm, status, or frequency output) Max. 24V DC, 0.5 W (2) AC solid-state relay (programmable – flow alarm or status) Max. 24V D C @ 0.5 A	
Frequency Output	Open Collector; Max. full scale flow = 10 kHz	
Communication	Modbus RTU communications and display for 110/220V AC (P.N. 65778-007) or 24V DC (P.N. 65778-008). Options must be selected at time of order.	
Pulse Width	Open Collector, 5 ms to 1 second (programmable) or automatic 50% duty cycle	
Min-Max Flow Alarm	Open collector or solid-state relay (programmable, 0 to 100% of flow)	
Empty Pipe Detection	Field tunable for optimum performance based on specific application	
Excitation Frequency	Programmable, 3.75 Hz, 7.5 Hz or 15 Hz	
Auxiliary Input	Max. 24V DC (programmable – positive zero return, external totalizer reset or preset batch start)	
Noise Dampening	1 to 30 seconds (programmable)	
Low Flow Cutoff	0–100% of full scale (programmable)	
Zero-Point Stability	Automatic correction	
Galvanic Separation	500V	
Fluid Conductivity	Min. 5 µS/cm (Min. 20 µS/cm for demineralized water)	
Fluid Temperature	With Meter-Mounted Amplifier: PFA, PTFE & Halar®: –4 to 212 °F (–20 to 100 °C) @ max. ambient temperature of 122 °F (50 °C). Hard rubber: 32 to 178 °F (0 to 81 °C) @ max. ambient temperature of 122 °F (50 °C).	With Remote Amplifier: PFA, PTFE & Halar: –4 to 248 °F (–20 to 120 °C) @ max. ambient temperature of 122 °F (50 °C). Hard rubber: 32 to 178 °F (0 to 81 °C) @ max. ambient temperature of 122 °F (50 °C).
Ambient Temperature	–4 to 122 °F (–20 to 50 °C)	
Relative Humidity	Up to 90% non-condensing	
Altitude	Maximum 6500 ft (2000 m)	
Flow Direction	Uni-directional or bi-directional	
Totalization	3 separate displayable totalizers; 10 digits (programmable – forward, reverse and net)	
Units of Measure	U.S. gallons, imperial gallons, million gallons per day, cubic feet, cubic meters, liters, oil barrels, pounds, ounces, acre feet (programmable). NOTE: Oil Barrels unit is only available for standard output with modbus 485 RTU.	
LC Display	4-line by 16-character, alphanumeric, back light Displays: 3 totalizer values, flow rate, alarm status, output status, error/diagnostic messages	
Programming	Internal 3-button or external magnetic wand	
Field Wiring Entry Ports	(3) 1/2 in. NPT, internal thread	
Amplifier Housing	Amplifier enclosure and remote junction enclosure: cast aluminum (powder coated paint)	
Amplifier Housing Rating	Amplifier enclosure and remote junction enclosure: NEMA 4X/6P (IP66/IP67)	
Detector Pipe Spool Material	304 stainless steel	
Detector Spool Housing Material	Carbon steel, welded, NEMA 4X/6P (IP66/IP67)	
Electrode Materials	Alloy C (standard), 316 stainless steel, gold/platinum plated, tantalum, platinum/rhodium	
Liner Material	PFA from 1/4–3/8 in. (6–10 mm), PTFE from 1/2–24 in. (15–600 mm), hard rubber from 1–24 in. (25–600 mm), Halar from 12–24 in. (300–600 mm)	
Flanges	Carbon steel or 316 stainless steel; In Accordance with ANSI/ASME, B16.5 Class 150 Flange Rating	
Coil Power	Pulsed DC	
Pressure Limits	In Accordance with ANSI/ASME, B16.5 Class 150 Flange Rating	
Mounting	Direct detector mount or remote wall mount, bracket included. For remote mount, max. cable distance = 100 ft (30 m)	
Junction Enclosure Material	For remote mounted amplifier option: Cast aluminum, powder-coated paint, NEMA 4X/6P (IP66/IP67)	
Grounding Ring Material (optional, 2 required)	316 stainless steel (standard) or alloy C	
	Meter Size	Thickness (one ring)
	1/4–10 in. (6–250 mm)	0.135 in. (3.43 mm)
Optional Grounding Electrodes	10–12 in. (250–600 mm)	0.187 in. (4.75 mm)
	Alloy C, 316 stainless steel, gold/platinum plated, tantalum, or platinum/rhodium	
Electrical Classification	FM approved for Class I, Div 2, Groups A-D; Class II, Div 2, Groups F and G, – CSA Certified	
NSF Listed	Models with hard rubber liner, size 4 in. and larger, PTFE liner, all sizes	
Approvals	KTW and PTFE liner for all sizes	

DIMENSIONS

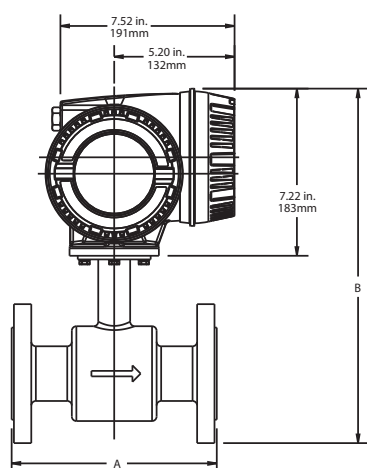


Figure 1: M3000 Meter Mount

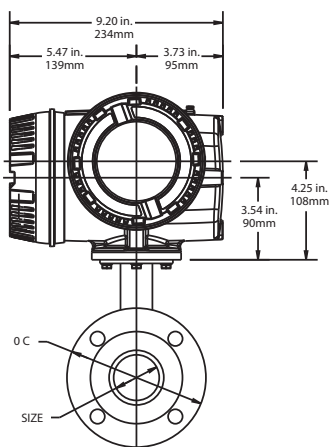


Figure 2: M3000 Remote Mount Junction Box on Detector

Size		A		B		C		D		Est. Weight with Amplifier		Flow Range			
												GPM		LPM	
inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	lb	kg	min	max	min	max
1/4	6	6.7	170	13.4	342	3.5	89	13.9	351	17	7.7	0.01	5	0.05	20
5/16	8	6.7	170	13.4	342	3.5	89	13.9	351	17	7.7	0.02	10	0.09	36
3/8	10	6.7	170	13.4	342	3.5	89	13.9	351	17	7.7	0.04	15	0.14	57
1/2	15	6.7	170	13.4	342	3.5	89	13.9	351	17	7.7	0.08	34	0.32	127
3/4	20	6.7	170	13.6	347	3.9	99	14	356	17	7.7	0.12	48	0.46	183
1	25	8.9	225	13.8	352	4.3	108	14.2	361	18	8.8	0.21	84	0.79	318
1-1/4	32	8.9	225	14.6	372	4.6	117	15	381	20.3	9.2	0.39	157	1.5	594
1-1/2	40	8.9	225	14.8	376	5.0	127	15.2	386	22	10	0.55	220	2.1	834
2	50	8.9	225	15.3	389	6.0	152	15.7	398	26	11.7	0.94	378	3.6	1431
2-1/2	65	11.0	280	16.5	420	7.0	178	16.9	429	35	15.7	1.63	653	6.2	2471
3	80	11.0	280	16.7	426	7.5	191	17.2	435	38	17.1	2.21	883	8.4	3344
4	100	11.0	280	17.8	452	9.0	229	18.2	461	49	22.1	3.30	1320	12	4997
5	125	15.8	400	19	484	10.0	264	19.4	493	60	27.1	5.29	2115	20	8008
6	150	15.8	400	20	510	11.0	279	20.4	519	71	32.1	7.85	3141	30	11890
8	200	15.8	400	21.9	558	13.5	343	22.9	583	96	43.1	15.69	6278	59	23765
10	250	19.7	500	26.2	677	16.0	406	26.6	676	130	59.1	25.05	10021	95	37934
12	300	19.7	500	28.3	720	19.0	483	28.7	729	219	99.3	33.61	13445	127	50894
14	350	19.7	500	30.2	768	21.0	533	30.7	779	287	130.2	45.75	18300	173	69272
16	400	23.6	590	33.1	842	23.5	597	33.5	851	354	160.9	59.75	23902	226	90477
18	450	23.6	590	34.4	876	25.0	635	34.9	885	409	185.3	75.63	30250	286	114511
20	500	23.6	590	37.6	955	27.5	699	38	964	502	228.3	93.37	37346	353	141371
22	550	23.6	590	39	991	29.5	749	39.4	1000	532	241.3	112.97	45189	428	171059
24	600	23.6	590	41.6	1057	32.0	813	42	1066	561	255.3	134.45	53779	509	203574

[illegible]

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MODMAG MODEL 3000

		Model Code																							
		3M	-	-	-	-	-	-	H	-	-	-	-	C	-	D	B	A	XX	-	-				
Hazardous Area	ATEX Zone 2	V																							
Hazardous Area	Class 1, Division 2	B																							
<u>Size and process connection EN 1092-1</u>																									
Size	PN 10	PN 16																							
DN 25	N/A	-	010																						
DN 32	N/A	-	012																						
DN 40	N/A	-	015																						
DN 50	N/A	-	020																						
DN 65	N/A	-	025																						
DN 80	N/A	-	030																						
DN 100	N/A	-	040																						
DN 125	N/A	-	050																						
DN 150	N/A	-	060																						
DN 200	-	-	080																						
DN 250	-	-	100																						
DN 300	-	-	120																						
DN 350	-	-	140																						
DN 400	-	-	160																						
DN 450	-	-	180																						
DN 500	-	-	200																						
DN 600	-	-	240																						
		PN 10	PN 16	<u>Pressure Rating</u>																					
		FEB	FEC	EN 1092-1 PN 16 FEC																					
				EN 1092-1 PN 10 FEB																					
<u>Flange and Housing material</u>																									
Carbon Steel (Standard)																				C1					
Carbon Steel w/ C5M Paint																				C2					
304 Stainless Steel Connection / Housing																				S3					
316 Stainless Steel Connection / Housing																				S7					
Carbon Steel Process Connections (Std. Paint) / 316 Stainless Steel Housing																				C4					
<u>Liner Material</u>																									
Hard Rubber																				H					
<u>Electrodes / Measuring, Empty pipe, Grounding</u>																									
Hastelloy C-22 (Standard / Measuring Empty pipe & Grounding)																				A					
AISI 316/1.4571																				B					
Tantalum																				C					
Platinum/Rhodium																				D					
<u>Grounding rings</u>																									
No Grounding Rings																				X					
304 Stainless Steel Grounding Rings																				A					
316 Stainless Steel Grounding Rings																				B					
<u>Meter LayLength</u>																									
Standard																				S					
ISO 20456																				O					
<u>Transmitter, Power Supply, Hardware</u>																									
110/220V AC; Meter-Mounted																				SA		AA		C	
110/220V AC; Remote-Mounted																				RA		AA		C	
24V DC; Meter-Mounted																				SA		AC		C	
24V DC; Remote-Mounted																				RA		AC		C	
<u>Junction Box</u> (for remote mounted version)																									
Aluminum Enclosure; IP67 (Type 6/4X) Rating																				A					
None Used for "Sensor-Mounted" Transmitter Configurations																				X					
<u>Remote Cable Length</u> (for remote mounted version)																									
15 ft. 5 m																				MA					
30 ft. 10 m																				MB					
50 ft. 15 m																				MC					
65 ft. 20 m																				MD					
80 ft. 25 m																				ME					
100 ft. 30 m																				MF					
None Used for "Sensor-Mounted" Transmitters Configuration																				WW					
<u>Input/Output Channel</u>																									
Standard Input/Output																				D		B		A	
<u>Communications</u>																									
Standard Communication (None)																				B					
Modbus RS-485																				L					
<u>Wiring Method</u>																									
None not applicable																				XX					
<u>Programming</u>																									
Standard (Default Metric units)																				EA					
<u>Testing & Tagging</u>																									
0.2% 3-Point Calibration; Factory																				(Standard)					

MODMAG MODEL 3000

Model Code			
3M	-	-	-
Hazardous Area	ATEX Zone 2		
Hazardous Area	Class 1, Division 2		
Size and process connection EN 1092-1			
	PN 10	PN 16	
DN 6	N/A	-	liner PFA / flange & housing 316 SST 002
DN 8	N/A	-	liner PFA / flange & housing 316 SST 003
DN 10	N/A	-	liner PFA / flange & housing 316 SST 004
DN 15	N/A	-	005
DN 20	N/A	-	007
DN 25	N/A	-	010
DN 32	N/A	-	012
DN 40	N/A	-	015
DN 50	N/A	-	020
DN 65	N/A	-	025
DN 80	N/A	-	030
DN 100	N/A	-	040
DN 125	N/A	-	050
DN 150	N/A	-	060
DN 200	-	-	080
DN 250	-	-	100
DN 300	-	-	120
DN 350	-	-	140
DN 400	-	-	160
DN 450	-	-	180
DN 500	-	-	200
DN 600	-	-	240
	PN 10	PN 16	Pressure Rating
	FEB	FEC	EN 1092-1 PN 16 FEC
			EN 1092-1 PN 10 FEB
Flange and Housing material			
Carbon Steel (Standard)			C1
Carbon Steel w/ CSM Paint			C2
304 Stainless Steel Connection / Housing			S3
316 Stainless Steel Connection / Housing			S7
Carbon Steel Process Connections (Std. Paint) / 316 Stainless Steel Housing			C4
Liner Material			
PTFE for sizes > DN10 (3/8 IN.)			P
PFA DN 6...DN 10 (1/4... 3/8 IN.) with PFA liner			A
Electrodes / Measuring, Empty pipe, Grounding			
Hastelloy C-22 (Standard / Measuring Empty pipe & Grounding)			A
AISI 316/1.4571			B
Tantalum			C
Platinum/Rhodium			D
Grounding rings			
No Grounding Rings			X
304 Stainless Steel Grounding Rings			A
316 Stainless Steel Grounding Rings			B
Meter LayLength			
Standard			S
ISO 20456			O
Transmitter, Power Supply, Hardware			
110/220V AC; Meter-Mounted			SA AA C
110/220V AC; Remote-Mounted			RA AA C
24V DC; Meter-Mounted			SA AC C
24V DC; Remote-Mounted			RA AC C
Junction Box (for remote mounted version)			
Aluminum Enclosure; IP67 (Type 6/4X) Rating			A
None Used for "Sensor-Mounted" Transmitter Configurations			X
Remote Cable Length (for remote mounted version)			
15 ft. 5 m			MA
30 ft. 10 m			MB
50 ft. 15 m			MC
65 ft. 20 m			MD
80 ft. 25 m			ME
100 ft. 30 m			MF
None Used for "Sensor-Mounted" Transmitters Configuration			WV
Input/Output Channel			
Standard Input/Output			D B A
Communications			
Standard Communication (None)			B
Modbus RS-485			L
Wiring Method			
None not applicable			XX
Programming			
Standard (Default Metric units)			EA
Testing & Tagging			
0.2% 3-Point Calibration; Factory (Standard)			F

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