ModMAG®
M-Series® | Electromagnetic Flow Meters

Electromagnetic Flow Meters

ModMAG® M3000

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 ± 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.

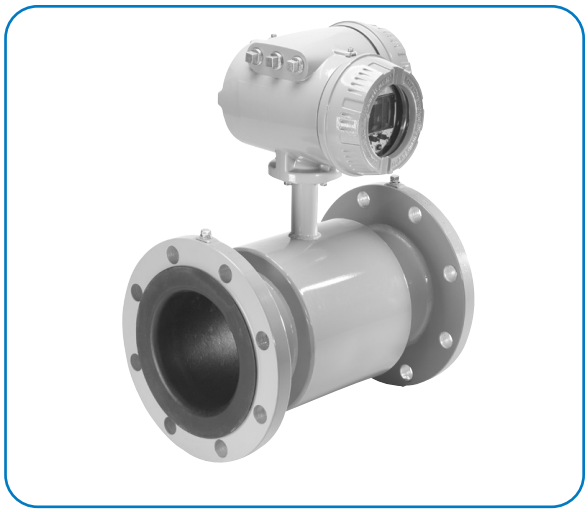
ELECTRODES

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…24 in. (6…600 mm)
- Accuracy of ± 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

MAG-DS-00493-EN-14 (May 2024)

Product Data Sheet

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…212° F (-20…100° C) @ max. ambient temperature of 122° F (50° C). Hard rubber: 32…178° F (0…81° C) @ max. ambient temperature of 122° F (50° C).	**With Remote Amplifier:** PFA, PTFE & Halar: -4…248° F (-20…120° C) @ max. ambient temperature of 122° F (50° C). Hard rubber: 32…178° F (0…81° C) @ max. ambient temperature of 122° F (50° C).
Ambient Temperature	– 4…122° F (–20…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)
	10…12 in. (250…600 mm)	0.187 in. (4.75 mm)
Optional Grounding Electrodes	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

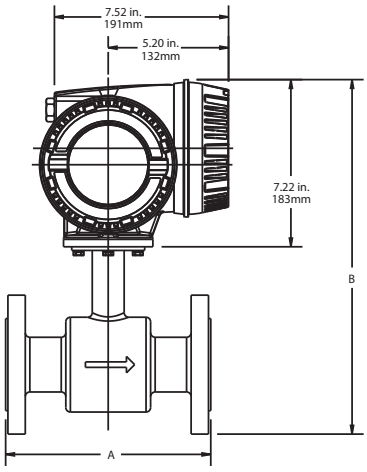
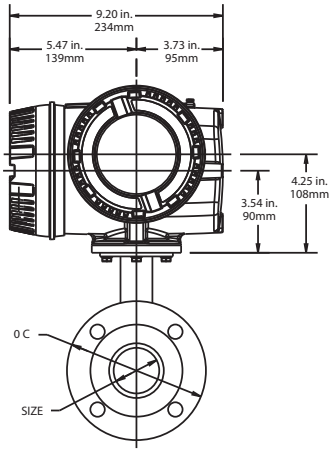


Figure 1: M3000 Meter Mount



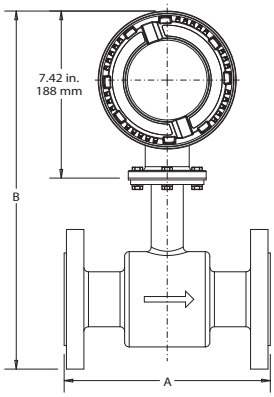


Figure 2: M3000 Remote Mount Junction Box on Detector

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	337.6	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

PART NUMBER CONSTRUCTION

M3000 for hazardous class 1, division 2 environments

M3	-		-		-		-			-		-	XX		
M3000		Meter Type		Detector		Electrodes & Grounding		Amplifier	Remote Cable Length		Communications/ Outputs		Wiring Method	Unit of Measure Totalizer/ Flow Rate	Testing & Tagging

Detector

Meter Type- Standard LL		HARD RUBBER C-Steel 150# flanges R1	HARD RUBBER Stainless Steel 150# flanges R4	PTFE C-Steel 150# flanges P1	PTFE Stainless Steel 150# flanges P4	PFA Stainless Steel 150# Flange PA	HALAR C-Steel 150# flanges H1	HALAR Stainless Steel 150# flanges H4
1/4"	002	N/A	N/A	N/A	N/A	—	N/A	N/A
5/16"	003	N/A	N/A	N/A	N/A	—	N/A	N/A
3/8"	004	N/A	N/A	N/A	N/A	—	N/A	N/A
1/2"	005	N/A	N/A	—	—	N/A	N/A	N/A
3/4"	007	N/A	N/A	—	—	N/A	N/A	N/A
1"	010	—	—	—	—	N/A	N/A	N/A
1-1/4"	012	—	—	—	—	N/A	N/A	N/A
1-1/2"	015	—	—	—	—	N/A	N/A	N/A
2"	020	—	—	—	—	N/A	N/A	N/A
2-1/2"	025	—	—	—	—	N/A	N/A	N/A
3"	030	—	—	—	—	N/A	N/A	N/A
4"	040	—	—	—	—	N/A	N/A	N/A
5"	050	—	—	—	—	N/A	N/A	N/A
6"	060	—	—	—	—	N/A	N/A	N/A
8"	080	—	—	—	—	N/A	N/A	N/A
10"	100	—	—	—	—	N/A	N/A	N/A
12"	120	—	—	—	—	N/A	—	—
14"	140	—	—	—	—	N/A	—	—
16"	160	—	—	—	—	N/A	—	—
18"	180	—	—	—	—	N/A	—	—
20"	200	—	—	—	—	N/A	—	—
22"	220	—	—	—	—	N/A	—	—
24"	240	—	—	—	—	N/A	—	—

Electrodes & Grounding	
Alloy C with 316 Stainless Steel Grounding Rings	A
Stainless Steel with 316 Stainless Steel Grounding Rings	S
Platinum Plated with 316 Stainless Steel Grounding Rings	P
Tantalum with 316 Stainless Steel Grounding Rings	T
Platinum/Rhodium with 316 Stainless Steel Grounding Rings	R
Alloy C Electrode and Grounding Electrode	C
Stainless Steel Electrode and Grounding Electrode	D
Platinum Plated Electrode and Grounding Electrode	G
Tantalum Electrode and Grounding Electrode	L
Platinum/Rhodium Electrode and Grounding Electrode	H

Amplifier Type	
110/220V AC; Meter Mounted	M
110/220V AC; Remote Mounted	R
24V DC; Meter Mounted	E
24V DC; Remote Mounted	F

Remote Cable Length	
None	WW
5 ft. Standard Cable	AA
10 ft. Standard Cable	AB
15 ft. Standard Cable	AC
30 ft. Standard Cable	AF
50 ft. Standard Cable	AK
75 ft. Standard Cable	AR
100 ft. Standard Cable	BW

Communications/Outputs	
Standard Output	S
Standard Output with MODBUS 485 RTU	M

Wiring Method	
None	XX

Unit of Measure Totalizer/ Flow Rate	
Gallons/gallons per minute	G
Gallons/cubic feet per minute	B
Gallons/cubic meters per second	D
Cubic Meters/gallons per minute	C
Cubic Meters/cubic meters per second	E
Cubic Meters/cubic meters per minute	T
Cubic Meters/cubic meters per hour	H
Cubic Feet/gallons per minute	F
Cubic Feet/cubic feet per minute	J
Cubic Feet/cubic meters per hour	K
Liters/gallons per minute	L
Liters/liters per second	N
Liters/liters per minute	P
Liters/liters per hour	Q
Million Gallons/gallons per minute	M
Gallons/millions gallons per day	R
Barrels/Barrels per day*	U
Acre Feet/gallons per minute	A
Second-Foot Day/cubic feet per second	S
Custom Units	Z

Testing & Tagging	
Factory Calibrated	F
3rd Party Calibrated	3
Factory Calibrated/Stainless Steel Tag	S
3rd Party Calibrated w/ Stainless Steel Tag	T

*Available with Communications/Outputs option "M" Only

Control. Manage. Optimize.