

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...24 in. (6...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

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 | |

DIMENSIONS

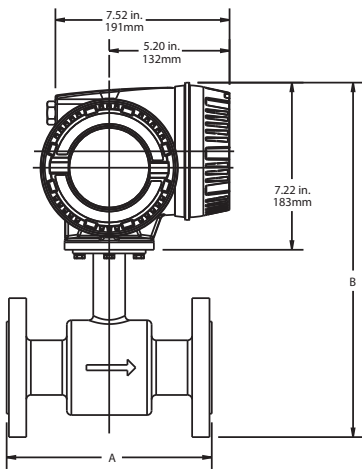


Figure 1: M3000 Meter Mount

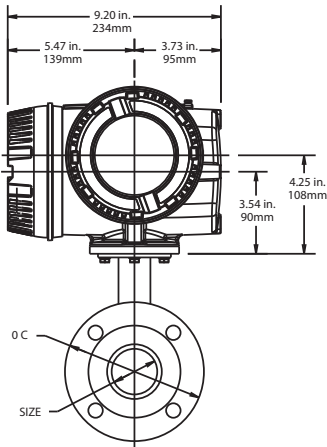
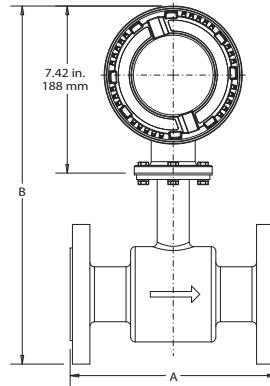


Figure 2: M3000 Remote Mount Junction Box on Detector



| 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 |

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 |
| Meter Type- Standard LL | | HARD RUBBER C-Steel 150# flanges | HARD RUBBER Stainless Steel 150# flanges | PTFE C-Steel 150# flanges | PTFE Stainless Steel 150# flanges | PFA Steel 150# Flange | Stainless Steel 150# flanges | HALAR C-Steel 150# flanges | HALAR Stainless Steel 150# flanges | | | | | | | |
| | | R1 | R4 | P1 | P4 | PA | H1 | 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 | | | | | | | | | | | | | | | | |
| Stainless Steel with 316 Stainless Steel Grounding Rings | | | | | | | | | | | | | | | | |
| Platinum Plated with 316 Stainless Steel Grounding Rings | | | | | | | | | | | | | | | | |
| Tantalum with 316 Stainless Steel Grounding Rings | | | | | | | | | | | | | | | | |
| Platinum/Rhodium with 316 Stainless Steel Grounding Rings | | | | | | | | | | | | | | | | |
| Alloy C Electrode and Grounding Electrode | | | | | | | | | | | | | | | | |
| Stainless Steel Electrode and Grounding Electrode | | | | | | | | | | | | | | | | |
| Platinum Plated Electrode and Grounding Electrode | | | | | | | | | | | | | | | | |
| Tantalum Electrode and Grounding Electrode | | | | | | | | | | | | | | | | |
| Platinum/Rhodium Electrode and Grounding Electrode | | | | | | | | | | | | | | | | |
| Amplifier Type | | | | | | | | | | | | | | | | |
| 110/220V AC; Meter Mounted | | | | | | | | | | | | | | | | |
| 110/220V AC; Remote Mounted | | | | | | | | | | | | | | | | |
| 24V DC; Meter Mounted | | | | | | | | | | | | | | | | |
| 24V DC; Remote Mounted | | | | | | | | | | | | | | | | |
| Remote Cable Length | | | | | | | | | | | | | | | | |
| None | | | | | | | | | | | | | | | | |
| 5 ft. Standard Cable | | | | | | | | | | | | | | | | |
| 10 ft. Standard Cable | | | | | | | | | | | | | | | | |
| 15 ft. Standard Cable | | | | | | | | | | | | | | | | |
| 30 ft. Standard Cable | | | | | | | | | | | | | | | | |
| 50 ft. Standard Cable | | | | | | | | | | | | | | | | |
| 75 ft. Standard Cable | | | | | | | | | | | | | | | | |
| 100 ft. Standard Cable | | | | | | | | | | | | | | | | |
| Communications/Outputs | | | | | | | | | | | | | | | | |
| Standard Output | | | | | | | | | | | | | | | | |
| Standard Output with MODBUS 485 RTU | | | | | | | | | | | | | | | | |
| Wiring Method | | | | | | | | | | | | | | | | |
| None | | | | | | | | | | | | | | | | |
| Unit of Measure Totalizer/ Flow Rate | | | | | | | | | | | | | | | | |
| Gallons/gallons per minute | | | | | | | | | | | | | | | | |
| Gallons/cubic feet per minute | | | | | | | | | | | | | | | | |
| Gallons/cubic meters per second | | | | | | | | | | | | | | | | |
| Cubic Meters/gallons per minute | | | | | | | | | | | | | | | | |
| Cubic Meters/cubic meters per second | | | | | | | | | | | | | | | | |
| Cubic Meters/cubic meters per minute | | | | | | | | | | | | | | | | |
| Cubic Meters/cubic meters per hour | | | | | | | | | | | | | | | | |
| Cubic Feet/gallons per minute | | | | | | | | | | | | | | | | |
| Cubic Feet/cubic feet per minute | | | | | | | | | | | | | | | | |
| Cubic Feet/cubic meters per hour | | | | | | | | | | | | | | | | |
| Liters/gallons per minute | | | | | | | | | | | | | | | | |
| Liters/liters per second | | | | | | | | | | | | | | | | |
| Liters/liters per minute | | | | | | | | | | | | | | | | |
| Liters/liters per hour | | | | | | | | | | | | | | | | |
| Million Gallons/gallons per minute | | | | | | | | | | | | | | | | |
| Gallons/millions gallons per day | | | | | | | | | | | | | | | | |
| Barrels/Barrels per day* | | | | | | | | | | | | | | | | |
| Acre Feet/gallons per minute | | | | | | | | | | | | | | | | |
| Second-Foot Day/cubic feet per second | | | | | | | | | | | | | | | | |
| Custom Units | | | | | | | | | | | | | | | | |
| Testing & Tagging | | | | | | | | | | | | | | | | |
| Factory Calibrated | | | | | | | | | | | | | | | | |
| 3rd Party Calibrated | | | | | | | | | | | | | | | | |
| Factory Calibrated/Stainless Steel Tag | | | | | | | | | | | | | | | | |
| 3rd Party Calibrated w/ Stainless Steel Tag | | | | | | | | | | | | | | | | |

*Available with Communications/Outputs option "M" Only

Control. Manage. Optimize.

ModMAG and M-Series are registered trademarks of Badger Meter, Inc. Other trademarks appearing in this document are the property of their respective entities. Due to continuous research, product improvements and enhancements, Badger Meter reserves the right to change product or system specifications without notice, except to the extent an outstanding contractual obligation exists. © 2020 Badger Meter, Inc. All rights reserved.

www.badgermeter.com

The Americas | Badger Meter | 4545 West Brown Deer Rd | PO Box 245036 | Milwaukee, WI 53224-9536 | 800-876-3837 | 414-355-0400
 México | Badger Meter de las Americas, S.A. de C.V. | Pedro Luis Ogazón N°32 | Esq. Angelina N°24 | Colonia Guadalupe Inn | CP 01050 | México, DF | México | +52-55-5662-0882
 Europe, Middle East and Africa | Badger Meter Europa GmbH | Nurtinger Str 76 | 72639 Neuffen | Germany | +49-7025-9208-0
 Europe, Middle East Branch Office | Badger Meter Europe | PO Box 341442 | Dubai Silicon Oasis, Head Quarter Building, Wing C, Office #C209 | Dubai / UAE | +971-4-371 2503
 Asia Pacific | Badger Meter | 80 Marine Parade Rd | 19-07 Parkway Parade | Singapore 449269 | +65-63464836
 Switzerland | Badger Meter Swiss AG | Mittelholzerstrasse 8 | 3006 Bern | Switzerland | +41-31-932 01 11