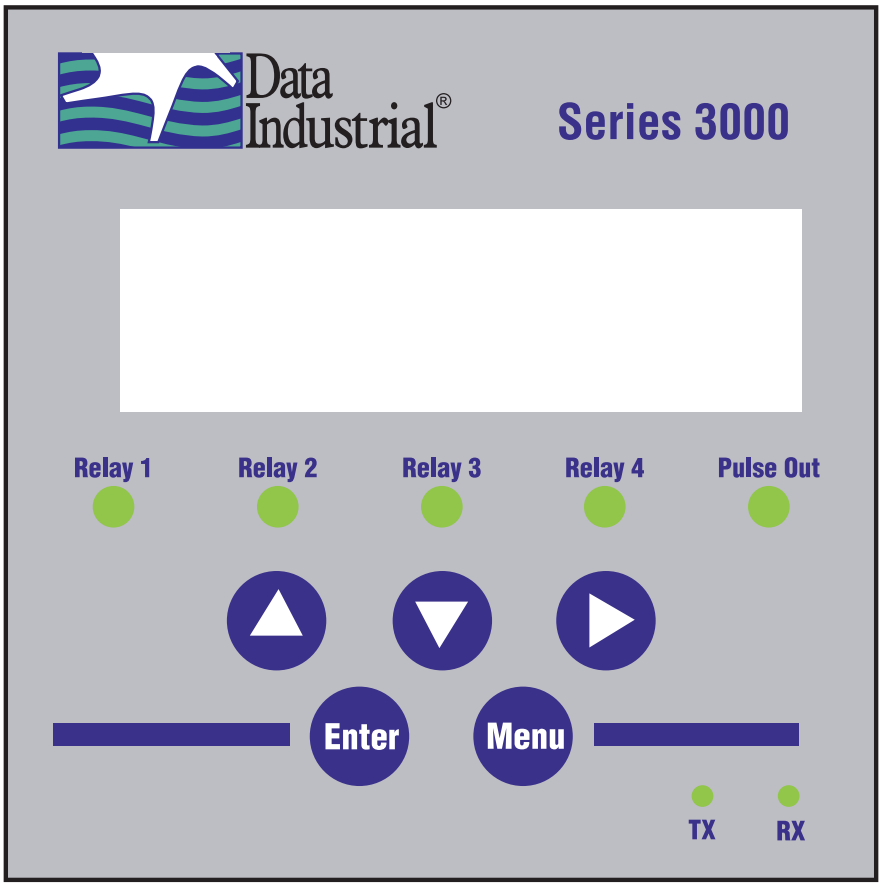
Badger Meter

Data Industrial® Series 3000
Flow Monitor



IMPORTANT:
This manual contains important information.
READ AND KEEP FOR REFERENCE.

941700-0022-EN (2-12)
Rev. 3

Installation & Operation Manual

CONTENTS

INTRODUCTION

This manual provides installation and operation instructions for the Badger Meter Data Industrial® Series 3000 Flow Monitor.

Product Unpacking and Inspection

Upon receipt of the product, perform the following unpacking and inspection procedures:

> **NOTE: If damage to the shipping container is evident upon receipt, request the carrier to be present when the product is unpacked.**

Carefully open the shipping package and follow any instructions that may be marked on the exterior. Remove all cushioning material surrounding the product and carefully lift the product from the package. Retain the package and all packing material for possible use in reshipment or storage.

Visually inspect the product and applicable accessories for any physical damage such as scratches, loose or broken parts, or any other sign of damage that may have occurred during shipment.

> **NOTE: If damage is found, request an inspection by the carrier's agent within 48 hours of delivery and file a claim with the carrier. A claim for equipment damage in transit is the sole responsibility of the purchaser.**

Product Description

The Badger Meter Data Industrial Series 3000 Flow Monitor is an economical, full featured, digital flow monitor.

The two line x 16-character alphanumeric display can be configured by the user to display flow rate and flow total. The panel meter has a NEMA 4X rated front panel and conforms to DIN Standard dimensions, 96 mm X 96 mm, for meter sizes and panel cutouts. An optional NEMA 4 wall mount is also available.

The Series 3000 Flow Monitor accepts pulse, sine wave or linear analog input signals. Like all Data Industrial flow monitors, the Series 3000 may be field calibrated by the user. For Data Industrial sensors "K" and "offset" numbers are entered, while other pulse or frequency output sensors may use a "K" factor only. Analog inputs are fully programmable for slope and intercept.

Programming the Series 3000 Flow Monitor

Programming is menu driven. All data is entered using the LCD/keypad interface. A password gate is included to prevent unauthorized access to programming parameters. Programming flexibility is extended to units of measure. In addition to several factory units of measure, the Series 3000 software permits the custom units for rate and total to be created by the installer.

The Series 3000 Flow Monitor provides one Form C solid-state relay, and one solid-state switch output. Both are fully programmable as either Pulse/Volume, or Set Point control. For pulse output, the installer can program both the resolution and the pulse width. Set Point control is extremely versatile with fully independent set and release points, each with its own time delay.

Available options:

- Analog output
- Analog input
- Single flow channel iInput
- One control relay output
- One programmable pulse output
- Low voltage AC/DC supply
- USB
- RS485 w\BACnet™ or Modbus® protocols
- Wall mounting

3000 Series Ordering Matrix					
	Example:	3000	-	x	x
Series					
	Flow Monitor	3000	-		
Outputs	No Option			0	
	Analog Output, plus RS485 with BACnet and Modbus, and USB			1	
Mounting					
	Panel Mount, NEMA 4x Front Panel				0
	Wall Mount, NEMA 4x				1

INSTALLATION

Mechanical Installation

The Series 3000 Flow Monitor can be either panel mounted or wall mounted.

Location

In any mounting arrangement the primary concern is easy viewing and convenient operation of the keypad. The unit generates very little heat, so no consideration need be given to cooling or ventilation. However, prolonged direct sunlight can damage the front panel so some level of shading is recommended, especially if installed in a tropical climate.

Panel Mount Installation

The Series 3000 panel mount is designed for through panel mounting, which allows access to the back of the unit. The Series 3000 Flow Monitor is secured to the panel by two draw brackets shown in Figure 1 below. Also refer to Figure 1 for flow monitor and panel cutout dimensions.

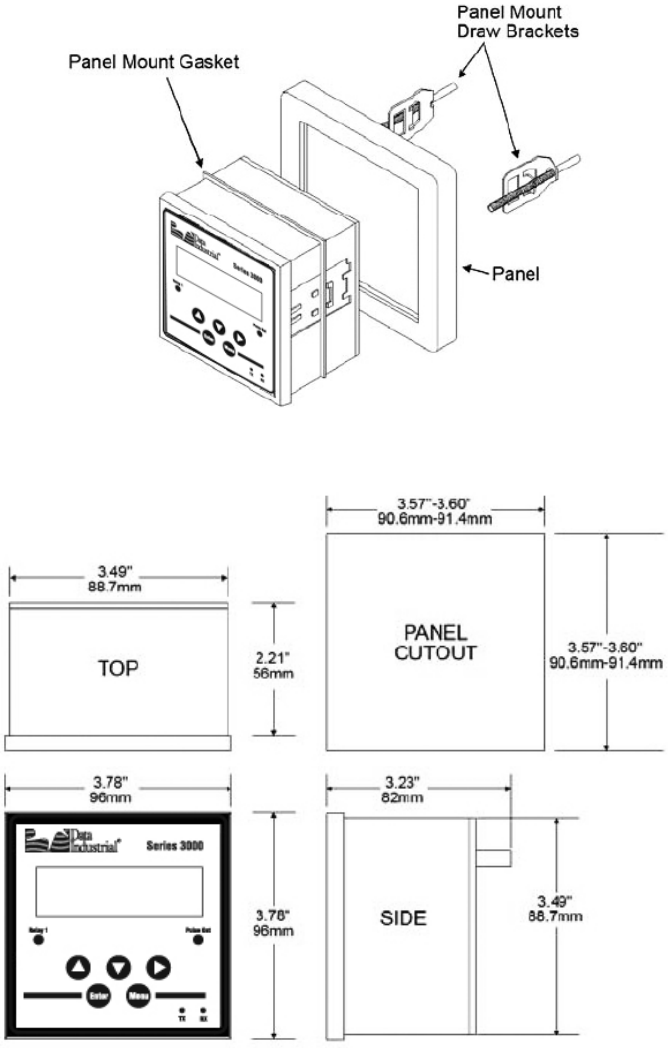


Figure 1: Series 3000 Panel Mount and Mounting Dimensions

Wall Mount Installation

The Series 3000 wall mount is designed to mount onto a wall with four bolts or screws. The mounting hole pattern and box dimensions for the Series 3000 NEMA4 wall mount are shown in Figure 2.

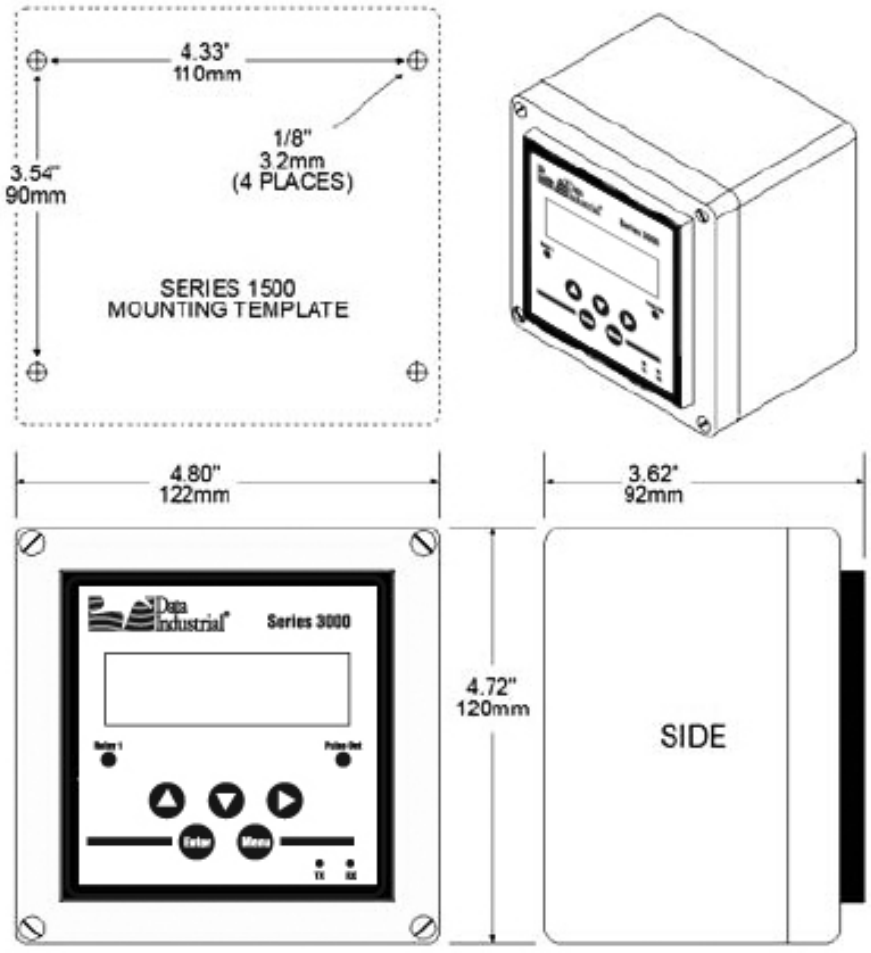


Figure 2: Wall Mount and Dimensions

Electrical Installation

Power Supply Wiring

The Series 3000 Flow Monitor requires 12-24 VDC/VAC to operate. Check the Specifications on page 23 for DC current draw and AC Volt-Amp requirements.

A fused circuit is always recommended. Connect the positive of the power supply to the Series 3000 terminal marked (ACL/DC+), and connect the negative of the power supply to the Series 3000 terminal marked (ACC/DC-).

If a Badger Meter Data Industrial plug-in power supply (Model A1026, A-503) is being used, connect the black-white wire to the terminal marked (ACL/DC+) and the black wire to the terminal marked (ACC/DC-).

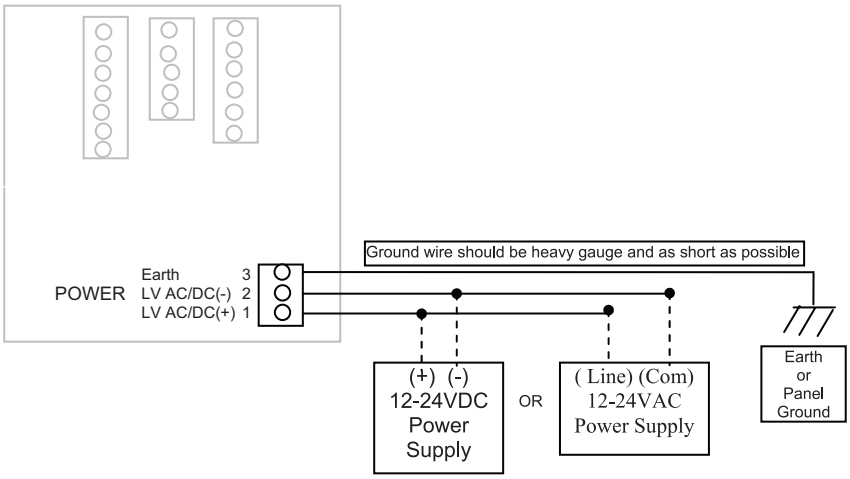


Figure 3: Power Supply Wiring

Flow Sensor Wiring

The Series 3000 flow sensor inputs are extremely versatile, designed to accept either two-wire or three-wire pulse inputs (Data Industrial 200 Series, 4000 Series) or Analog inputs. Although different rear panel terminals are used, all parameters are set with the LCD/keypad interface. There are no internal or external jumpers, switches or potentiometers to move or adjust.

The following pulse input types are accommodated.

- **Pulse-DI**: Used for all Badger Meter Data Industrial Flow Sensors. Provides an internal pull-up resistor and uses "K" and "Offset" values for calibration.
- **Pulse–K Factor**: Accepts non zero-crossing inputs but provides no internal pull-up, classical "K" (pulses/gallon) values for calibration.
- **Pull-up-K Factor**: Provides an internal pull-up resistor and uses classical "K" (pulses/gallon) values for calibration.

NOTE: All the above pulse input types wire the same as shown in Figure 4. See the Programming Flow Chart on page 16 for required input configuration.

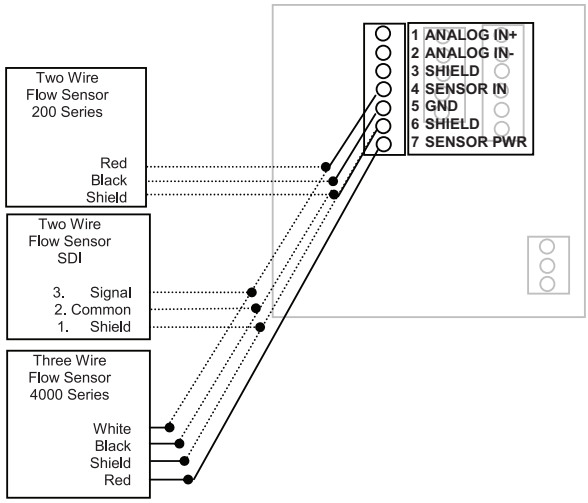


Figure 4: Data Industrial Flow Sensor Wiring Examples (Two- and Three-Wire Pulse Types)

Analog Input

As an alternative to the pulse inputs, the Series 3000 can accept an Analog input. The input is non-isolated, but can accept 0-1VDC, 0-5VDC, 0-10VDC, 0-20mA and 4-20mA with both factory-defined and custom units of measure.

Low impedance 100 Ohm input for current inputs optimizes performance and flexibility or loop power supplies. Both the low- and high-end scaling are independent and field configured by the installer.

NOTE: See the Programming Flow Chart on page 16 for required input configuration.

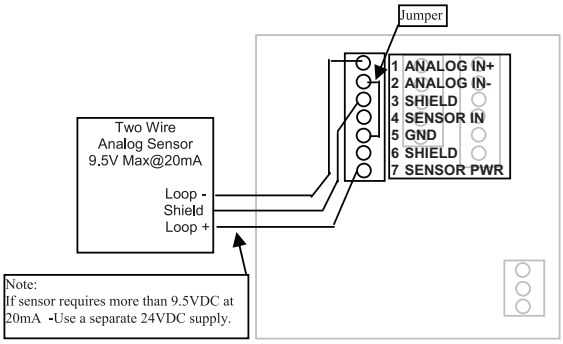


Figure 5: 4-20mA Analog Loop Powered Wiring

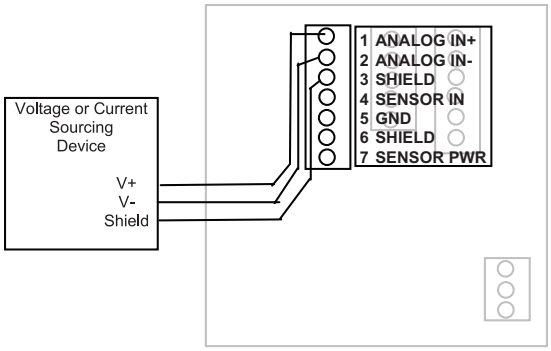


Figure 6: Voltage or Current Sourcing Analog Inputs

Solid State Switch and Form "C" Output Wiring

The Series 3000 Flow Monitor has one Normally Open (N.O.) solid state switch, and one solid state form "C" relay. Check the Specifications on page 23 for maximum voltage and current ratings for each type output.

These outputs are completely independent, electrically isolated, and can be programmed as either Pulse or Set Point outputs.

When the "Totalizer" function is selected, the unit of measure and resolution are independent from the displayed units and can be programmed where one pulse occurs once every 0000000.1 to 999999999. of units selected, with any pulse width from 0001 to 9999mS.

When the "Alarm" is selected as the unit of measure and the resolution is independent from the displayed units, it allows the unit to be programmed as either a high or low rate Set Point. Since the Set Point, Release Point and their associated time delays are fully independent, this output can be either a classical high rate or low rate alarm, depending on the settings selected. When design planning, keep in mind that although both of these outputs can be programmed as alarm points only, the relay provides both N.O. and N.C. contacts. The switch is a simple N.O. contact.

Examples:

High Flow Set Point

The Set Point must be a value greater than the Release Point**.**

The relay output will have continuity between its N.C. terminal and "COM" until the flow has exceeded the Set Point (**"SETPT")** for a continuous period of time exceeding the Set Point Delay (**"SDLY")**, at which time the N.C. connection will open and the N.O. contact will have continuity to the "COM" terminal. When the flow has dropped below the Release Point (**"RELP")** for a continuous period of time exceeding the Release Point Delay (**"RDLY"),** the relay states will return to their original states. If the latch has been set to "ON", the relay will not release until manually reset once the Set Point and Set Delay have been satisfied.

Low Flow Set Point

The Set Point must be a value less than the Release Point.

The relay output will have continuity between its N.C. terminal and "COM" until the flow has dropped below the Set Point ("**SETPT**") for a continuous period of time exceeding the Set Point Delay(**"SDLY"),** at which time the N.C. connection will open and the N.O. contact will have continuity to the "COM" terminal. When the flow has again risen above the Release Point ("**RELP**") for a continuous period of time exceeding the Release Point Delay (**"RDLY"),** the relay states will return to their original states. If the latch has been set to "ON", the relay will not release until manually reset once the Set Point and Set Delay have been satisfied.

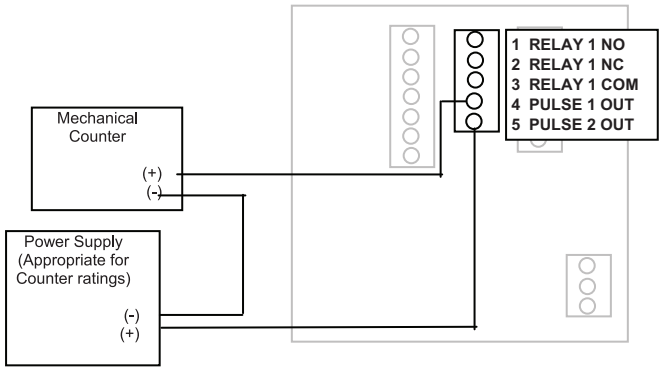


Figure 7: Relay and Switch Wiring Examples

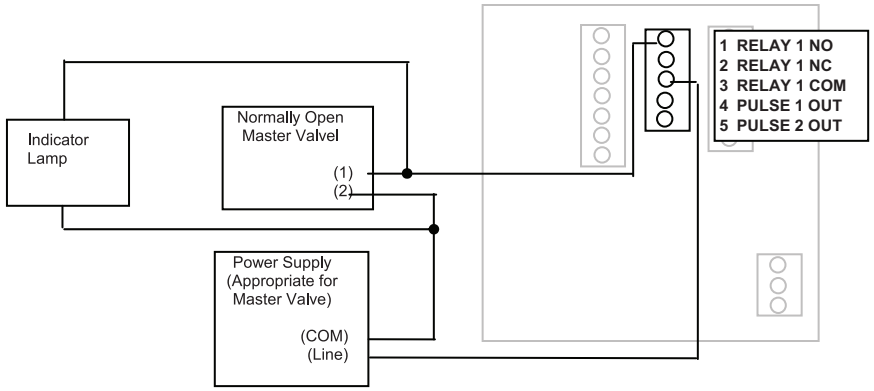


Figure 8: Relay and Switch Wiring Examples (continued)
High Flow Shut Down and Normally Open Master Valve with Indication

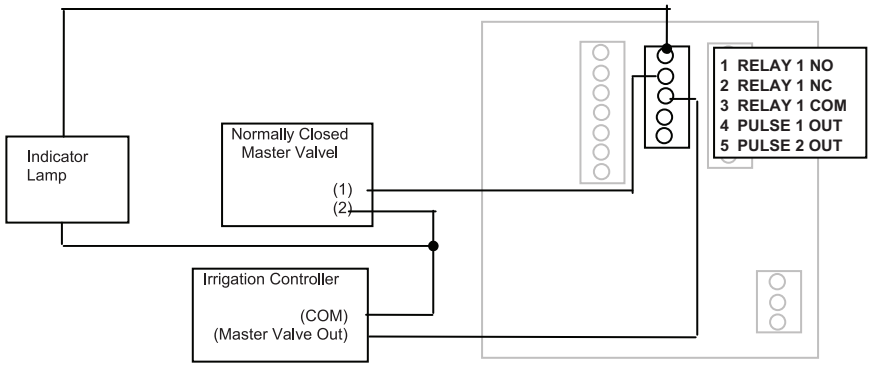


Figure 9: Relay and Switch Wiring Examples (continued)
High Flow Shut Down and Irrigation Clock Normally Closed Master Valve with Indication Program as High Flow with Latch

OUTPUT OPTION CARD

If the Series 3000 Flow Monitor was ordered with the Output Option card, it will have several additional outputs.

1. **Analog Output** (0-20mA; or 4-20mA) which can be converted externally to 0-5VDC, 1-5VDC with a 250 Ohm resistor; or 0-10VDC or 2-10VDC with a500 Ohm resistor. A 15VDC power supply is provided to permit current sinking or sourcing. The Series 3000 has special software that permits the Analog output.
2. **USB** for direct access to a computer using a standard mini-USB cable.
3. **RS-485** for fully addressable Modbus or BACnet communication.

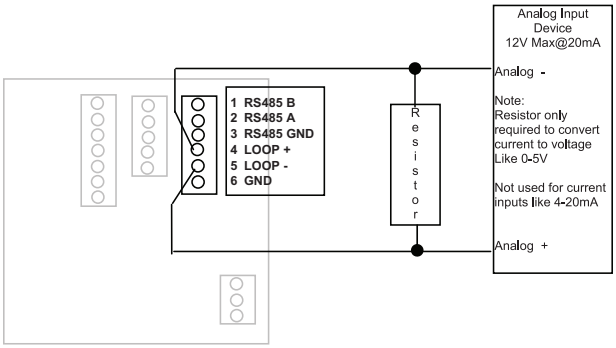


Figure 10: Current Sourcing Analog Output

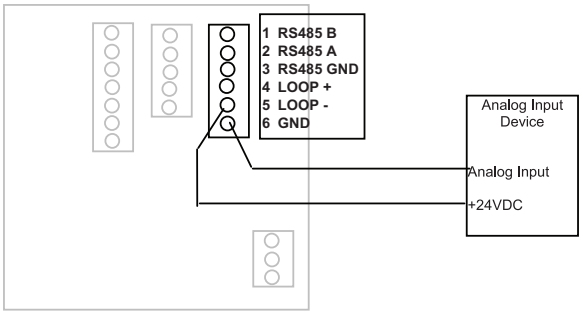


Figure 11: Current Sinking Analog Output

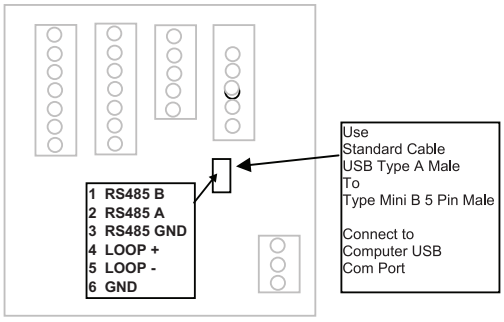


Figure 12: Analog Output Wiring

USB Port

NOTE: To communicate using the USB port requires Windows HyperTerminal or other similar communications software. This port is part of the Analog Output Option card. See the USB Communications section of PROGRAMMING on page 19 for instructions on how to use this port.

DISPLAY AND KEY PAD

The Series 3000 Flow Monitor has a two line by 16-character display with two modes of operation and 5 keys on the front panel for programming.

Menu	1-Switch to main menu 2-Backward/Previous menu	**Up ▲**	1-Select Menu option 2-Increase numerical value
Enter	1-Save value 2-Forward/Next menu	**Down ▼**	1-Select Menu option 2-Decrease numerical value
		Right ▶	1-Select Menu option 2-Move cursor to the right

When the Series 3000 is first powered up, it runs through internal self checks while displaying "**Badger Meter DIC Initializing."** At the end of this cycle its normal mode display will appear.

In the normal mode, if still using the factory defaults, Flow Rate will be displayed on the top line, and Flow Total displayed on the bottom. Both lines can be custom-defined in the field as desired. In the normal mode the ***Enter*** key has no function.

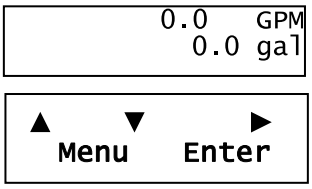


Figure 13: Normal Mode Display

The other mode is the program mode, used to configure the unit. Enter and exit this mode by pressing the ***Menu*** key. See the programming flow chart.

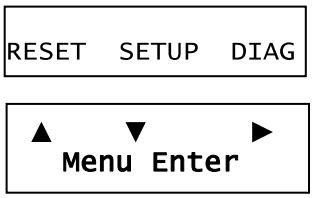


Figure 14: Program Mode Display

PROGRAMMING

With the normal mode display showing, pressing the ***Menu*** key will enter the programming mode. In this mode, the three arrow keys (▲▼▶) are used on the *selection* screens to select the option displayed above the key, and on the *option list* screens to scroll up or down a list of choices, like a pull-down menu. It should be noted that most screens presenting choices show three choices, one for each arrow key. When the number of choices exceeds three, a small arrow (→) appears on the upper right side of the display indicating there are more choices on that level. Pressing ***Enter*** toggles to the next set of choices. Once the selection has been made, the ***Enter*** key also is used to complete the selection. Pressing the ***Menu*** key returns back to the normal mode display.

Selection Screens

Most selection screens show three choices, one for each arrow (▲▼▶) key. When the number of choices exceeds three, a small arrow (→) appears on the upper right side of the display indicating there are more choices on that level. Press ***Enter*** to view the next set of choices.

For example, pressing ***Menu*** from the normal mode screen shows the "RESET SETUP DIAG" screen. Pressing the ▲key brings up the reset screens. The ▼key brings up the setup screens and the ▶key brings up the diagnostic screens. If the▼key is pressed, the screen would appear as follows.

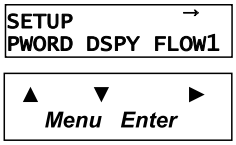


Figure 15: Selection Screen

Option List Screens

Units of measure is an example of an options list screen.

Pressing the ▲ key scrolls up the list while the ▼key scrolls down through the list. In this case starting with GPM; gal/s; gal/hr;…LPM;….ending in a selection of custom units.

Pressing ***Enter*** completes the selection. Pressing ***Menu*** leaves the selection unchanged. The ▶ key has no function on this type of screen.

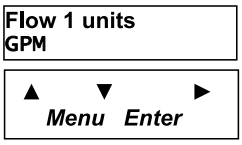


Figure 16: Option List Screen

Data Screens

Some screens are data entry screens. For example, Set Points or Custom Units screens.

When a data entry screen is first displayed, the current value will be displayed. The cursor will be flashing the most left hand digit. Pressing the ▲ key will increase the value. The ▼key will reduce it. If the cursor is flashing the decimal point pressing the▲key will move the decimal point to the right, pressing the ▼key will move the decimal to the left.

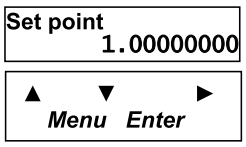
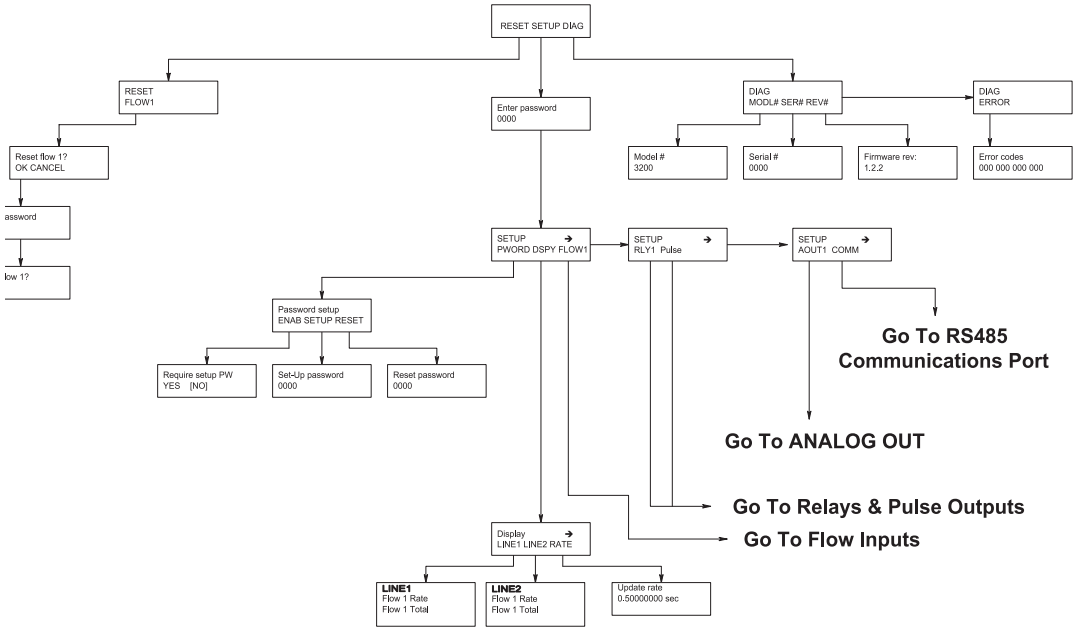
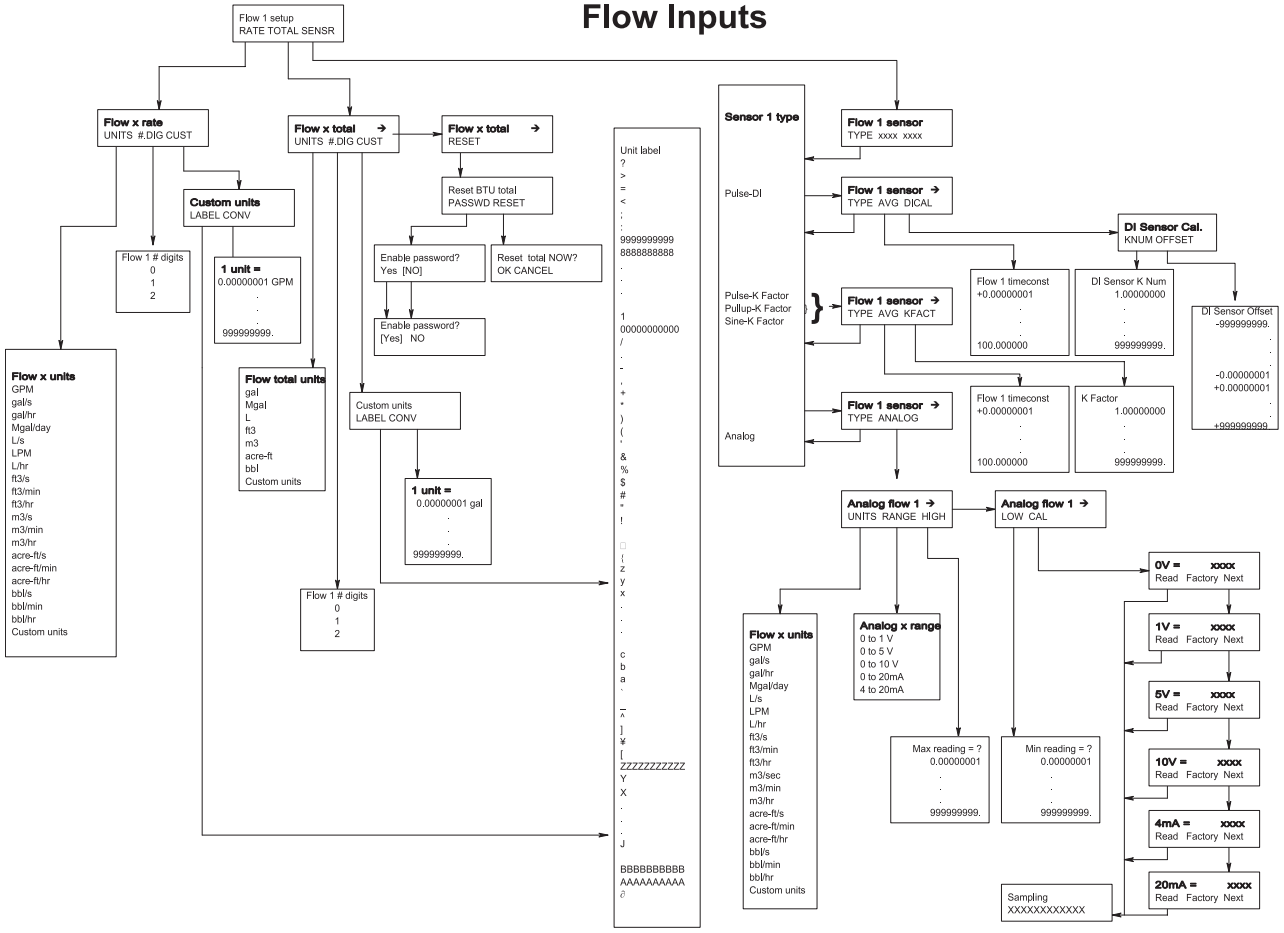


Figure 17: Data Screen

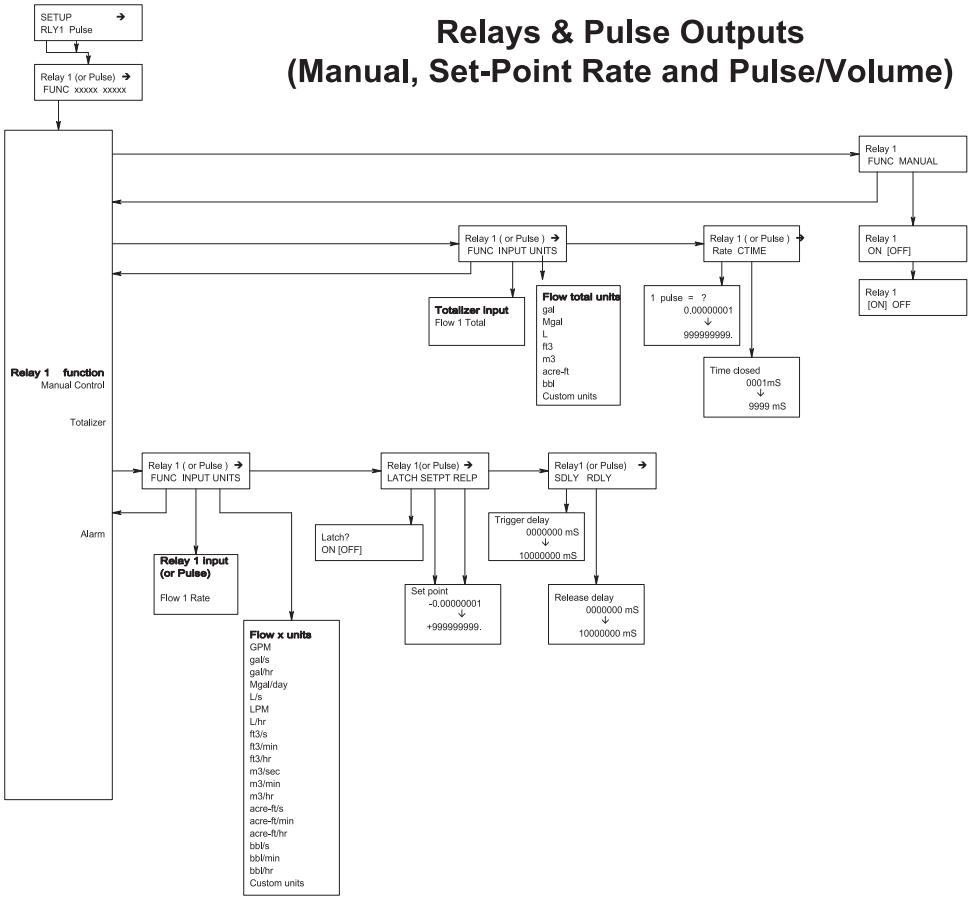
Programming Flow Chart
Software Version 1.2.2



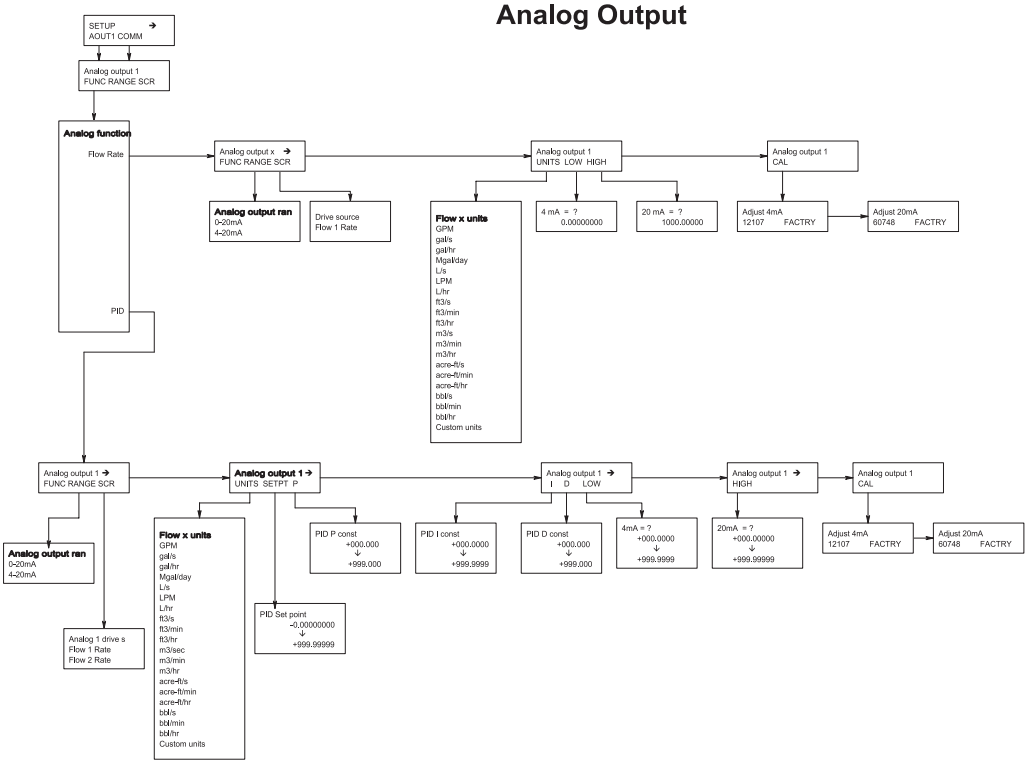
Flow Inputs



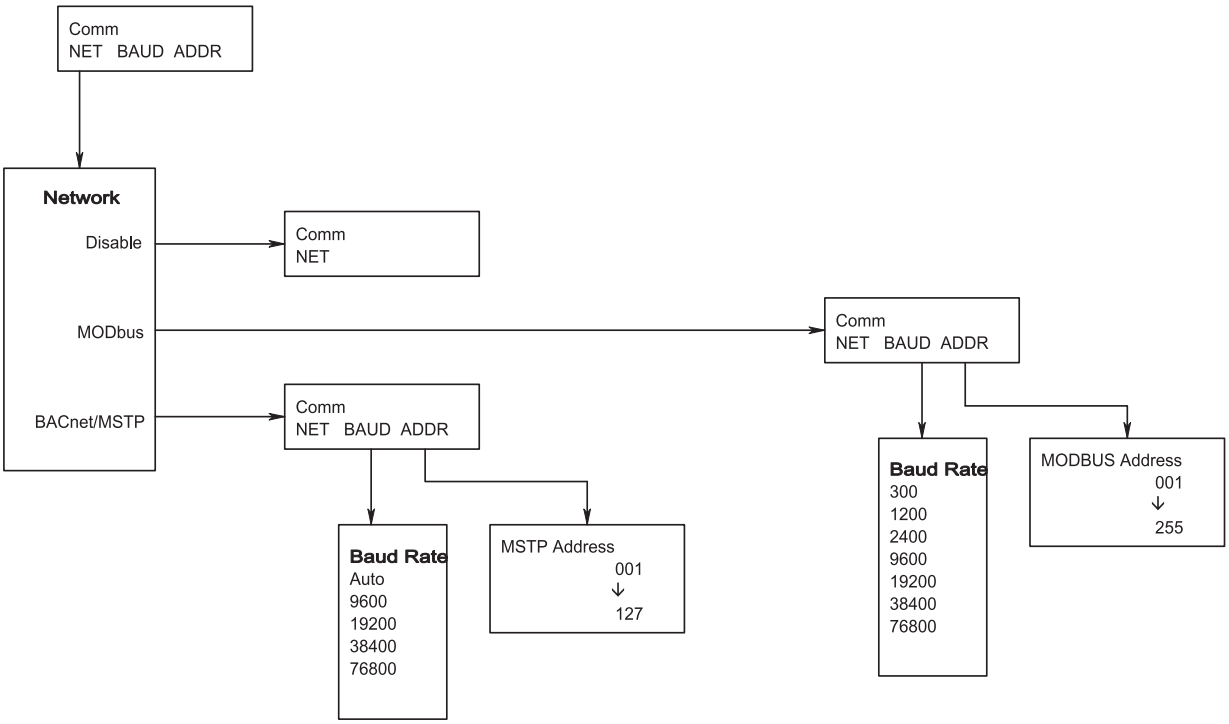
Relays & Pulse Outputs (Manual, Set-Point Rate and Pulse/Volume)



Analog Output



RS485 Communication Port



USB Communication

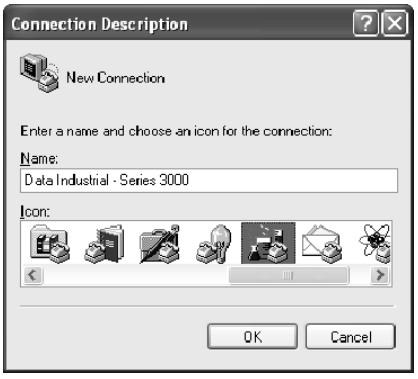
If the Series 3000 Flow Monitor is ordered with an Analog Output Option card, a five-pin USB connector is also included. As much as possible the commands mimic the use of the Front Panel controls.

To use this feature the following are required.

1. PC with USB ports and Windows HyperTerminal or other communications software
2. FTDI Virtual COM port drivers http://www.ftdichip.com/FTDrivers.htm
3. USB 2.0 A to Mini-B 5-pin cable

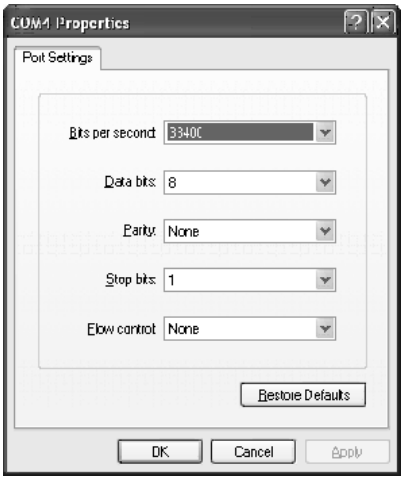
To communicate using HyperTerminal, use the following procedure.

1. Make sure that the Series 3000 has a Mini-B five-pin connector on the back panel. (The Series 3000 must have an Analog Output Option card installed and will be marked Series # 3000-1x.)
2. Be sure the appropriate FTDI Virtual COM port drivers are installed on you computer.
3. Plug the USB 2.0 A end of the cable into an available USB port on your computer. Plug the Mini-B five-pin end into the back of the Series 3000.



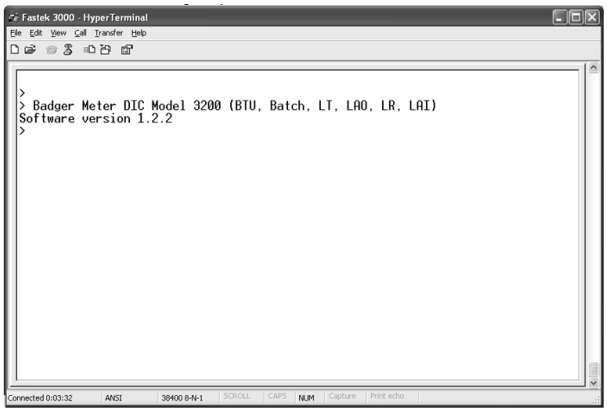
4. Run HyperTerminal (from the Windows Start Menu) and create a new connection, with a name and icon.

5. Configure this port with 38400 baud, 8 data bits, 1 stop bit, no parity and no flow control.



6. When connected, a ">" symbol will appear in the upper left corner of the main HyperTerminal display screen. Press the "Enter Key". Both the Rx and Tx LEDs on the front of the Series 3000 should flash once, and the "Badger Meter DIC … Software Version…" text message should appear.

The Series 3000 Flow Monitor is now communicating, ready to take commands from the list below.



USB COMMAND LIST

In the list below, brackets indicate an argument, specifying its type and value range. For instance [0-18] stands for any number between 0 and 18 (inclusive).

Example: "display line1 = 1" sets Line 1 of the display to display #1, which happens to be the totalizer for flow channel 1.

Diagnostics:

id – show model number & software version
echo [on/off] – turn on/off interactive command line:
with echo off, this interface is more amenable to scripting; it still accepts the same commands.
Any command entered without an " = " sign and variable will display the current setting.
Example: Typing "display line1" returns "0" which is the variable for Flow Rate.
read flow [1-2] – read the current flow on channel 1 or 2 in GPM.
read flow [1-2] total – read the current total flow on channel 1 or 2 in gallons.

DISPLAY CONFIGURATION

display line1 = [0-1] – set line 1 of the display
display line2 = [0-1] – set line 2 of the display
0: flow 1 rate
1: flow 1 total
display urate = [0.1-10] – set the update rate of the display, in seconds

INPUT CHANNEL CONFIGURATION

flow [1-2] sensor type = [0-4] – flow sensor type:
0: PulseDI,
1: PulseKFactor,
2: PullupKFactor
3: Analog
flow [1-2] sensor dical k = [x] – DI-type flow sensor k
flow [1-2] sensor dical off = [x] – DI-type flow sensor offset
flow [1-2] sensor kfact = [x] – K factor for non-DI sensors
flow [1-2] sensor analog units = [0-19] – flow units for analog input
flow [1-2] sensor analog range = [0-4] – current range for analog input
flow [1-2] sensor analog high = [x] – flow rate @max current
flow [1-2] sensor analog low = [x] – flow rate @min current
flow [1-2] sensor avg = [0-100] – averaging "time constant," in seconds:
flow [1-2] rate units = [0-19] – flow (channel) rate units to display.
0: GPM
1: gal/s
2: gal/hr
3: Mgal/day
4: L/s
5: LPM
6: L/hr
7: ft3/s
8: ft3/min
9: ft3/hr
10: m3/s
11: m3/min
12: m3/hr
13: acreft/s
14: acreft/min
15: acreft/hr
16: bbl/s
17: bbl/min
18: bbl/hr
19: Custom
flow [1-2] rate ndigits = [2-10] – number of decimal places to show for flow rate
flow [1-2] rate custom label = [string] – set the label for custom units
flow [1-2] rate custom conv = [0-100] – conversion factor for custom units
flow [1-2] total units = [0-7] – set the totalizer units to display
0: gal
1: Mgal
2: L
3: ft3
4: m3
5: acreft
6: bbl
7: Custom

RELAY OUTPUT CONFIGURATION

relay [1-5] func = [0-9] – relay function; relay 5 is the pulse output
- 0: Totalizer
- 1: Alarm
- 2: Manual Control

relay [1-5] input = [0-8] – relay input; depends on source
for totalizer:
- 0: Flow 1 Total

for alarms:
- 0: Flow 1 Rate

relay [1-5] units = [0-19] – units on setpoints/rates; depends on
src/input
flow units: same as 'flow [1-2] rate units' above
volume units: same as 'flow [1-2] total units'
relay [1-5] manual = [on/off] – manually set relay on or off, if in manual mode
relay [1-5] rate = [x] – totalizer rate
relay [1-5] ctime = [0-10000] – pulse width in milliseconds
relay [1-4] latch = [on/off] – turn on/off relay latching
relay [1-4] setpoint = [x]
relay [1-4] releasepoint = [x]

ANALOG OUTPUT CONFIGURATION

analogout [1-2] func = [0-3]
- 0: Flow rate

3: PID control
analogout [1-2] src = [0-4]
for flow rate:
- 0: Flow 1 rate

for PID control:
- 0: Flow 1 rate

analogout [1-2] range = [0-1]
- 0: 0-20mA
- 1: 4-20mA

analogout [1-2] low = [x] – value corresponding to 0 (or 4) mA
analogout [1-2] high = [x] – value corresponding to 20mA
analogout [1-2] setpoint = [x] – PID setpoint
analogout [1-2] P = [x] – PID constants
analogout [1-2] I = [x] – PID constants
analogout [1-2] D = [x] – PID constants

RS485 COMM PORT CONFIGURATION

comm baudrate = [0-7]
- 0: Auto
- 1: 300
- 2: 1200
- 3: 2400
- 4: 9600
- 5: 19200
- 6: 38400
- 7: 76800

comm mstpaddr = [0-127] – BACnet/MSTP address
comm maxmaster = [0-127] – BACnet/MSTP max master address
comm devinst = [x] – BACnet device instance ID
comm mbslaveaddr = [0-255] – Modbus slave address

TROUBLESHOOTING

Trouble Codes:
1 Relay 1 totalizer rate exceeded
2 Relay 2 rate exceeded
3 Relay 3 rate exceeded
4 Relay 4 rate exceeded
5 Pulse out rate exceeded
20 Error reading EEPROM on faceplate
21 Error writing EEPROM
22 Analog Input card missing
24 Temperature Input card missing
25 Invalid flow units configured
26 Invalid volume units configured
27 Bad input frequency
29 Internal error calculating flow rate
31 Error reading from analog input AD converter channel 1
32 Error reading from analog input AD converter channel 2
36 Error writing to analog input AD converter channel 1
37 Error writing to analog input AD converter channel 2
50 Error reading I2C address 0 (relays, buttons, and LEDs)
51 Error writing to I2C address 0
52 Error reading I2C address 1 (analog input card control lines)
53 Error writing I2C address 1
54 Error reading I2C address 2 (temperature input card control lines)
55 Error writing I2C address 2
71 Watchdog timer reset occurred
82 Fatal error initializing EEPROM

FLOW SENSOR INPUTS

Type	Threshold	Signal Limit	Frequency	Pull-up	Impedance	Aux. Power	Calibration
Pulse-Di	2.5 VDC	30VDC	0.4 Hz to 10kHz	1K to12VDC	—	12VDC@30mA	K + Offset
Pulse-K Factor	2.5 VDC	30VDC	0.4 Hz to 10kHz	—	—	12VDC@30mA	Pulse/Gal
Pull-up-K Factor	2.5 VDC	30VDC	0.4 Hz to 10kHz	1K to12VDC	—	12VDC@30mA	Pulse/Gal
Analog – 4-20mA	—	50mA Fused	—	—	100 Ω	12VDC@30mA	Pulse/Gal
Analog – 0-20mA	—	50mA Fused	—	—	100 Ω	12VDC@30mA	Linear
Analog – 0-1 VDC	—	30VDC	—	—	100 Ω	12VDC@30mA	Linear
Analog – 0-5 VDC	—	30VDC	—	—	100 Ω	12VDC@30mA	Linear
Analog – 0-10 VDC	—	30VDC	—	—	100 Ω	12VDC@30mA	Linear

Rate Units of Measure: GPM; gal/sec; gal/hr; Mgal/day; LPS; LPM; LPH; ft3/Sec; ft3/min; ft3/hr;m3/sec; m3/min; m3/hr; acre-ft/sec; acre-ft/min; acre-ft/hr; bbl/sec; bbl/min; bbl/hr; and field programmed custom units 0.00 to 999999999

Total Units: gallons; Mgal; liters; ft3; m3; acre-ft; bbl; and field programmed custom units 0.00 to 999999999

SPECIFICATIONS

Voltage
12-24 VDC / VAC
(Limit: 8-35VDC)
(Limit: 8-28VAC)

DC current draw (~280mA)
AC power rating (~5 VA)

Display
16 character by two line alphanumeric dot matrix 7.95mm high backlit LCD

Operating Temperature
-20°C to +70°C
Storage Temperature
-30°C to +80°C

Dimensions
Panel Mount:
3.78"W x 3.78"H x 3.23"D
(96mm x 96mm x 63mm)
Wall Mount:
4.80"W x 4.72"H x 3.63"D
(120mm x 120mm x 92mm)
Weight:
panel mount 12 oz

Pulse and Relays
Both pulse and relay are fully functional as either totalizing, or Set Point outputs.

Pulse Electrical
1 Amp @ 35VDC/ 30VAC
Closed: 0.5Ω @ 1 AMP Open: $>10^8\Omega$

Relay Electrical
Resistive load: 5Amp@120VAC/30VDC
Inductive load: 1Amp@120VAC/30VDC

Pulse/Unit Volume (Totalizer)
Driving Source: flow total; Btu total
Units: any predefined or custom unit
Rate: 1 Pulse per 1.0000000 to 99999999 units
Contact Time: 1 to 9999 mS

Set Point (Alarm)
Driving Source: flow rate; Btu rate; temperature 1; temperature 2, delta T
Units: Any predefined or custom unit
Set Point : 1.0000000 to 999999999
Delay to Set: 1 to 9999 Seconds
Release Point: 1.0000000 to 999999999
Delay to Release: 1 to 9999 seconds

Optional Analog Output
Driving Source: flow rate; PID control
Range: 4-20mA; 0-20mA (isolated current sinking or sourcing)
Sinking: 30VDC @ 0mA maximum; 3 volts @20mA minimum
Sourcing: 600 W maximum load

USB Communication
Provides complete access to all programming and operation features.
Requirements:
USB 2.0 A to Mini-B 5-Pin Cable
(Example: SYSONIC model UAM56 GWT/B)

RS-485 Communication
Supports: Modbus and BACnet/MSTP

Accessories
Programming kit
Wall mount kit

	Example:	3000	-	x	x
Series					
	Flow Monitor	3000			
	Portable Battery Operated Kit	3020			
Option - Analog Output, RS485 (BACnet / Modbus), and USB					
	No Option			0	
	Analog Output, RS485 with BACnet and Modbus, and USB			1	
Option - Mounting					
	Panel Mount				0
	Wall Mount				1

Figure 18: Series 3000 Ordering Matrix

Please see our website at www.badgermeter.com
for specific contacts.

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.

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