Badger® Data Industrial® 3000 Series	Flow Monitor	Installation & Operation Manual

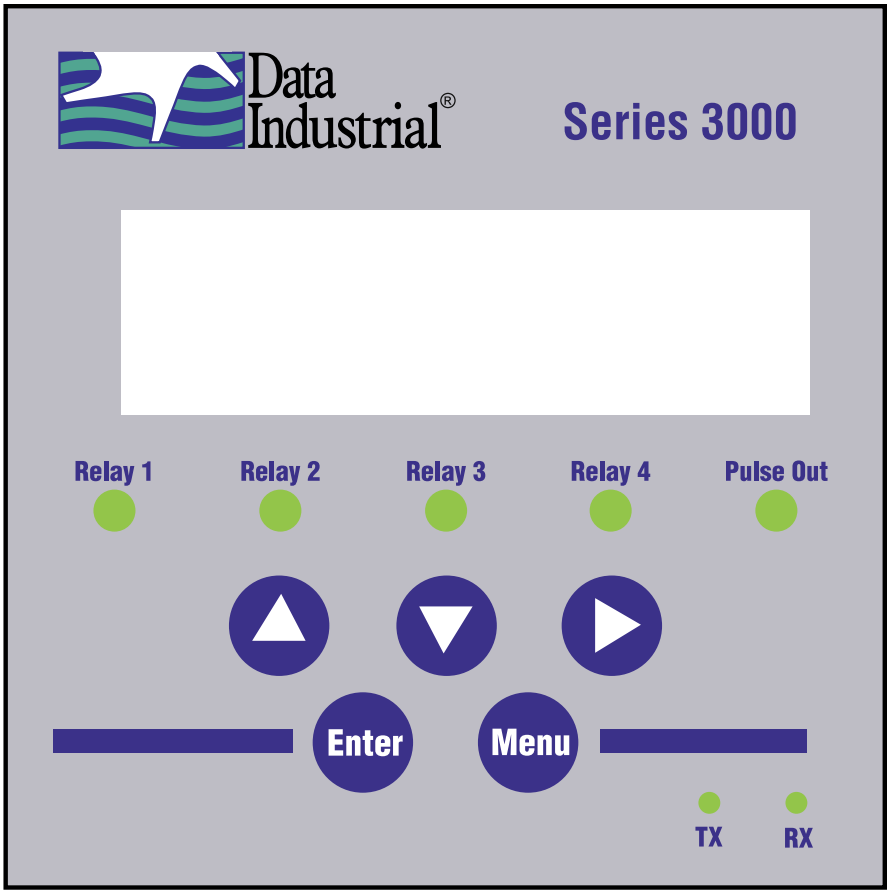


Table of Contents

INTRODUCTION

The Badger® 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 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 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 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.

Options available:

- Analog output
- Analog input
- Single Flow channel Input
- 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	-		
	Portable Battery Operated Kit	3020			
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 can be either panel mounted or wall mounted.

Location:

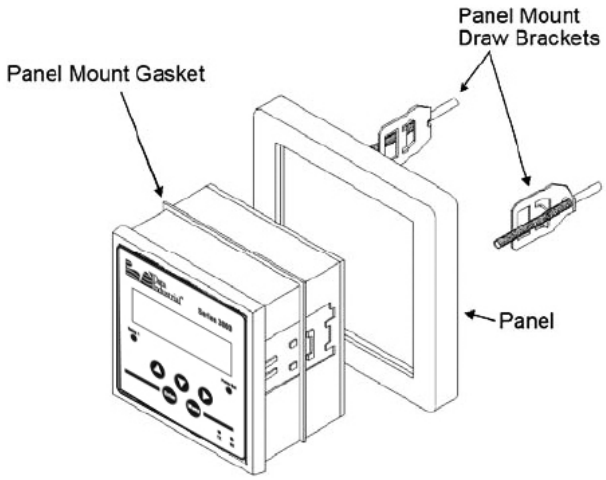
In any mounting arrangement the primary concern is easy viewing, and convenient operation of the keypad. The unit generates very little heat, so no consideration need be given to cooling or ventilation. However, prolonged direct sunlight can damage the front panel so some level of shading is recommended,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

Panel Mount Installation

The Model 3000 Panel Mount is designed for through panel mounting, which allows access to the back of the unit.

The 3000 is secured to the panel by two draw brackets shown in Figure 1 below.

Refer to Figure 1 for flow monitor and panel cutout dimensions.



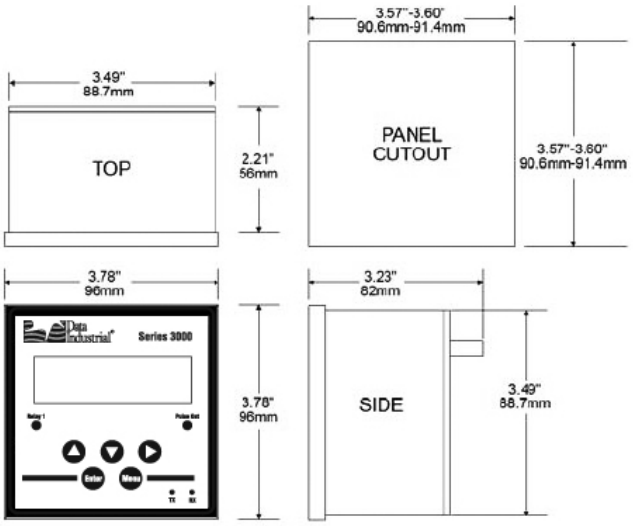


Figure 1: Panel Mounting Dimensions

Wall Mount Installation

The Badger® Data Industrial® Model 3000 Wall Mount is designed to mount onto a wall with four bolts or screws. The mounting hole pattern and box dimensions for the Model 3000 NEMA4 wall mount are shown in Figure 2.

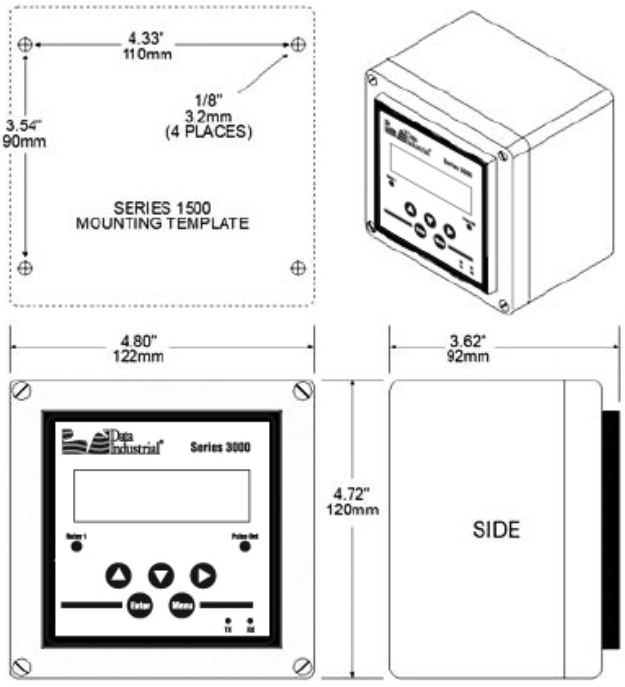


Figure 2: Wall Mounting Dimensions

ELECTRICAL INSTALLATION:

Power Supply Wiring

The Series 3000 requires 12-24 VDC/VAC to operate. Check the specifications page 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 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-).

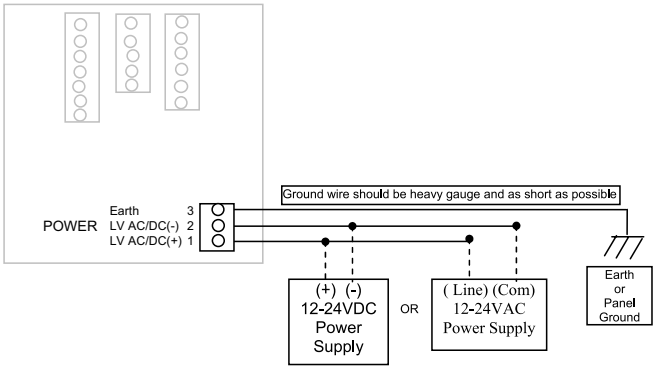


Figure 3: (Power Supply Wiring)

Flow Sensor Wiring

The Series 3000 Flow Sensor Inputs are extremely versatile, designed to accept either two wire or three wire pulse inputs (Badger Data Industrial 200 Series, 4000 Series), zero crossing sine wave inputs, 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.

Four types of Pulse Input Types are accommodated.

1. Pulse-DI: Used for all Badger Data Industrial Flow Sensors.
   Provides an internal Pull-Up resistor and uses “K” and “Offset” values for calibration.
2. Pulse –K Factor:
   Accepts non Zero Crossing inputs but provides no internal pull-up, classical “K” (Pulses/Gal) values for calibration.
3. Pullup-K Factor:
   Provides an internal Pull-Up resistor and uses classical “K” (Pulses/Gal) values for calibration.
4. Sine-K Factor:
   Accepts Zero Crossing low voltage sourcing devices, with classical “K” (Pulses/Gal) calibration.

All the above wire the same as shown in Figure 4. See Programming Flow Chart for required input configuration.

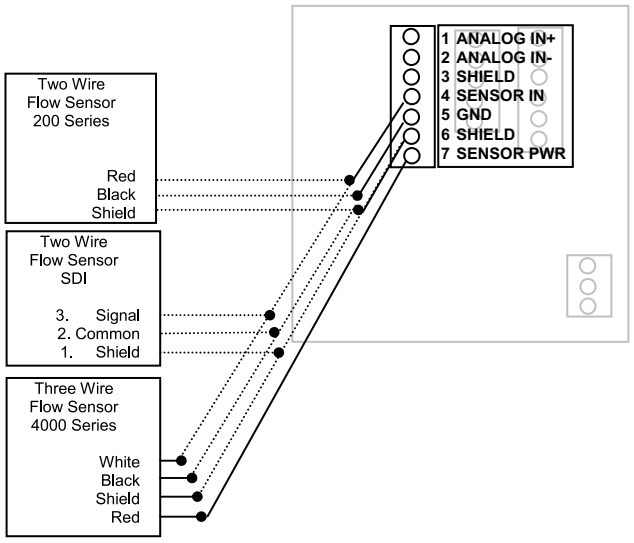


Figure 4: Data Industrial Flow Sensor Wiring Examples (Two and Three Wire Pulse Types)

Analog Input
As an alternative to the Pulse Inputs the Series 3000 can accept a 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.

See Programming Flow Chart for required input configuration

Analog Input Wiring

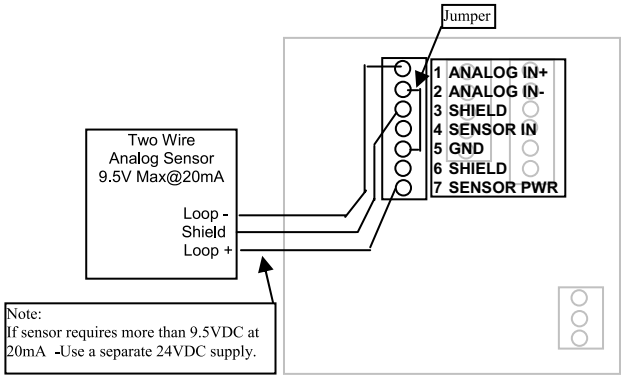


Figure 5: 4-20mA Analog Loop Powered Wiring

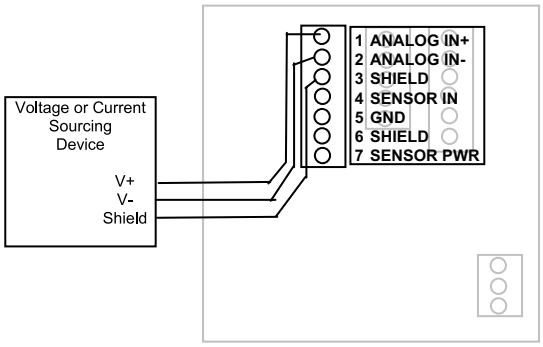


Figure 6: Voltage or Current Sourcing Analog Inputs

Solid State Switch and Form "C" Output Wiring
The Badger® Data Industrial® Series 3000 has one Normally Open (N.O.) solid state switch, and one Solid State Form "C" Relay.
Check the specifications page 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 function "Totalizer" is selected the unit of measure and resolution are independent from the displayed units, and can be programmed where 1 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 **"SETPT"** must be a value greater than the Release Point **"RELP."**

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 **"RDLY"** the relay states will return

to their original states. If the Latch has been set to “ON” once the set-point and set-delay have been satisfied the relay will not release until manually reset.

Low Flow Set-Point
The Set-Point **“SETPT”** must be a value less than the Release Point **“RELP.”**

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 **“RDLY”** the relay states will return to their original states. If the Latch has been set to “ON” once the set point and set-delay have been satisfied the relay will not release until manually reset.

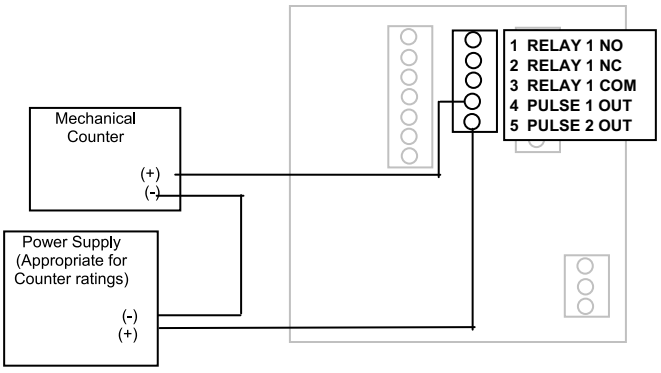


Figure 7: Relay and Switch Wiring Examples

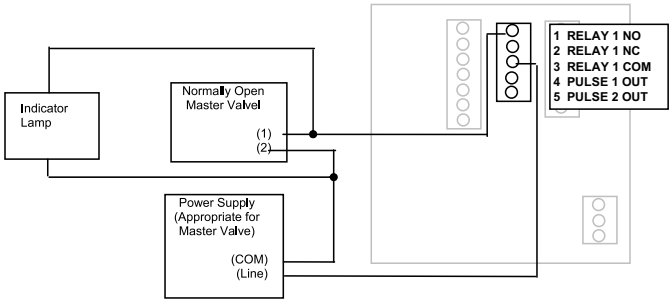


Figure 8: Relay and Switch Wiring Examples (continued)
High Flow Shut-Down with Normally Open Master Valve with indication

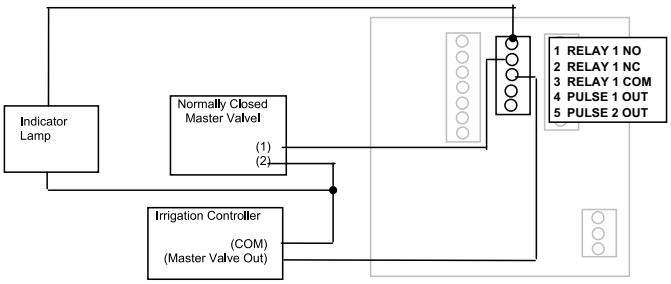


Figure 9: Relay and Switch Wiring Examples (continued)
High Flow Shut-Down with Irrigation Clock Normally Closed Master Valve with indication Program as High Flow with Latch

OUTPUT OPTION CARD:
If the Badger® Data Industrial® Model 3000 was ordered with the Output Option card, it will have several additional outputs.
These include the following:

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 a 500 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.

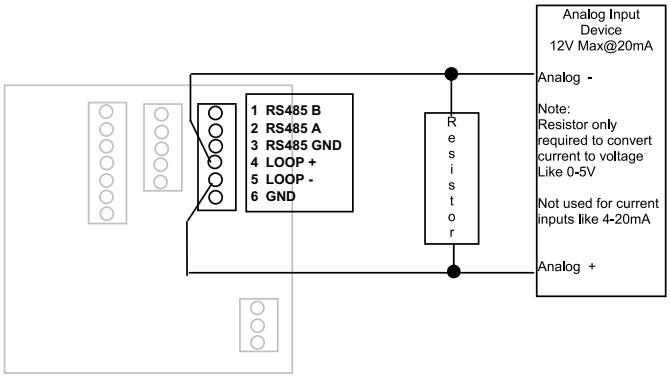


Figure 10: Current Sourcing Analog Output

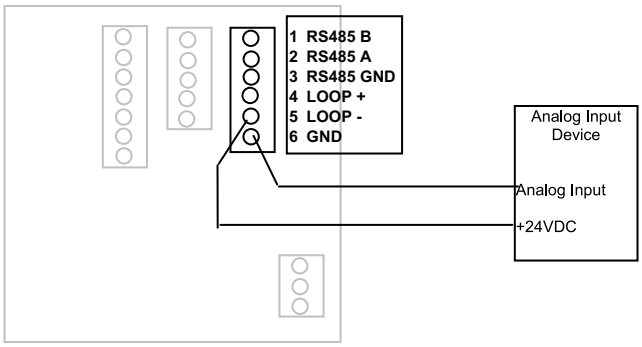


Figure 11: Current Sinking Analog Output

Analog Output Wiring

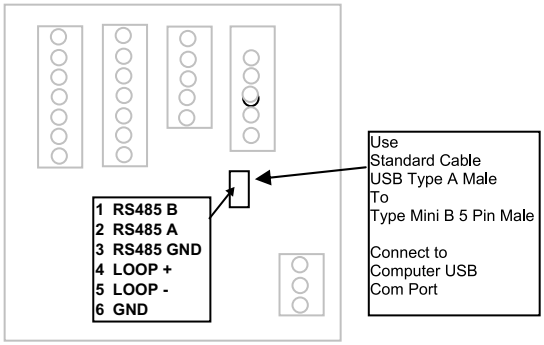


Figure 12

USB Port

To communicate using the USB Port requires Windows Hyper-Terminal or other similar communications software.
This Port is part of the Analog Output Option card. See the USB Communications section of PROGRAMMING for instructions on how to use this port.

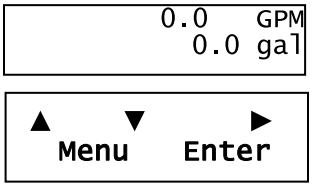
DISPLAY AND KEY PAD
The Badger® Data Industrial® Model 3000 Monitor has a 2 lines by 16 character display with two modes of operation, and 5 keys on the front panel for programming.

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

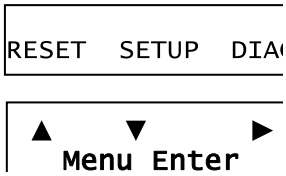
When the Model 3000 is first powered up, it runs through some internal self checks, while displaying **"Badger Meter DIC Initializing"**, at the end of this cycle its normal display will appear.

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.

Normal Mode Display



Program Mode Display
The other mode is the Programming Mode used to configure the unit. Enter and exit this mode by pressing the ***Menu*** key. See programming flow chart.

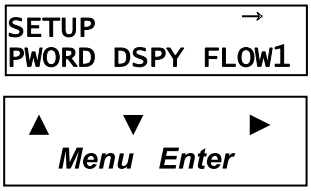


PROGRAMMING

With the normal display showing, pressing the ***Menu*** key will enter the Programming Mode. In this mode, the three arrow (▲▼►) keys are used in the *Selection Screens* to select the option displayed above the key, *Option List Screens* are used 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 button. When the number of choices exceeds three, a small arrow (→) appears in the upper right side of the display indicating there are more choices on that level. Pressing the ***Enter*** key 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 towards the normal screen.

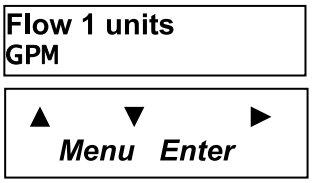
Selection Screens
Most selection screens show three choices, one for each arrow (▲▼►) button. When the number of choices exceeds three, a small arrow (→) appears in the upper right side of the display indicating there are more choices on that level. Press the ***Enter*** key to view the next set of choices.

For example: pressing the ***Menu*** from the normal 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



Option List Screens
Units of measure is an example of an options list. Pressing the ▲key scrolls up the list while the ▼key scrolls down through the list.

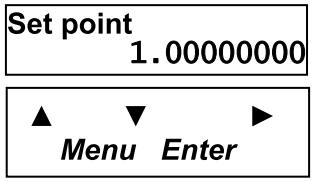
In this case starting with GPM; gal/s; gal/hr;…LPM;…. ending in a selection of Custom units.
Pressing the ***Enter*** key completes the selection. Pressing the ***Menu*** leaves the selection unchanged.
The ►key has no function on this type screen.



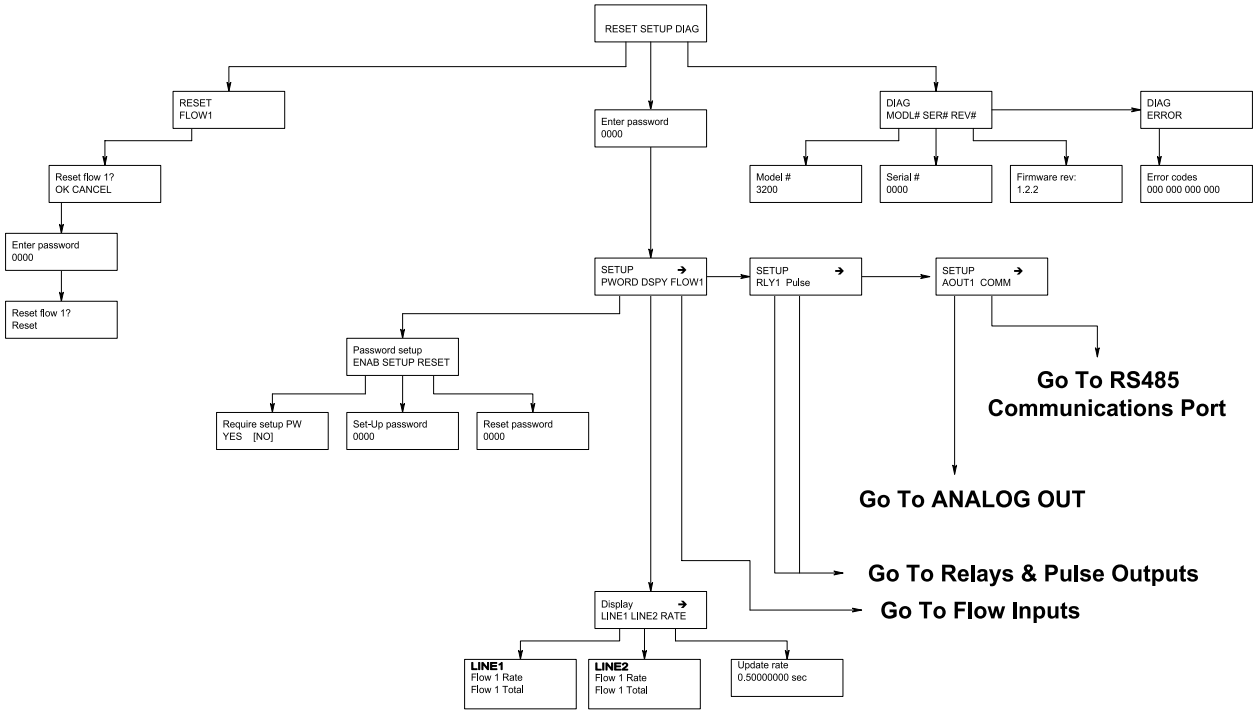
Data Screens
Some screens are Data Entry screens (Examples: Set-Points or Custom units).

When this 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.

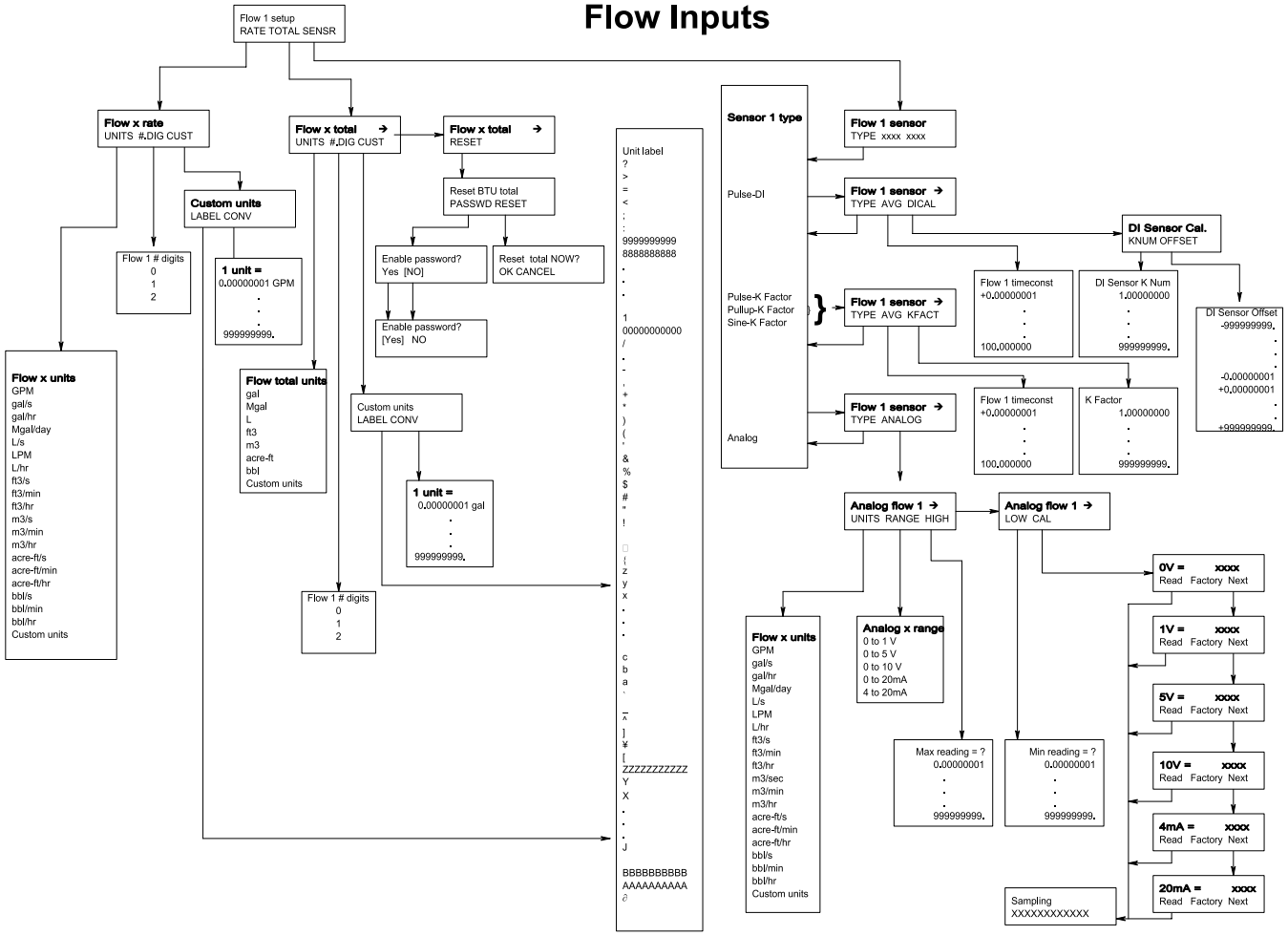
If the cursor is flashing the decimal point pressing the ▲ key will move the decimal point to the right, pressing the ▼ key will move the decimal to the left.



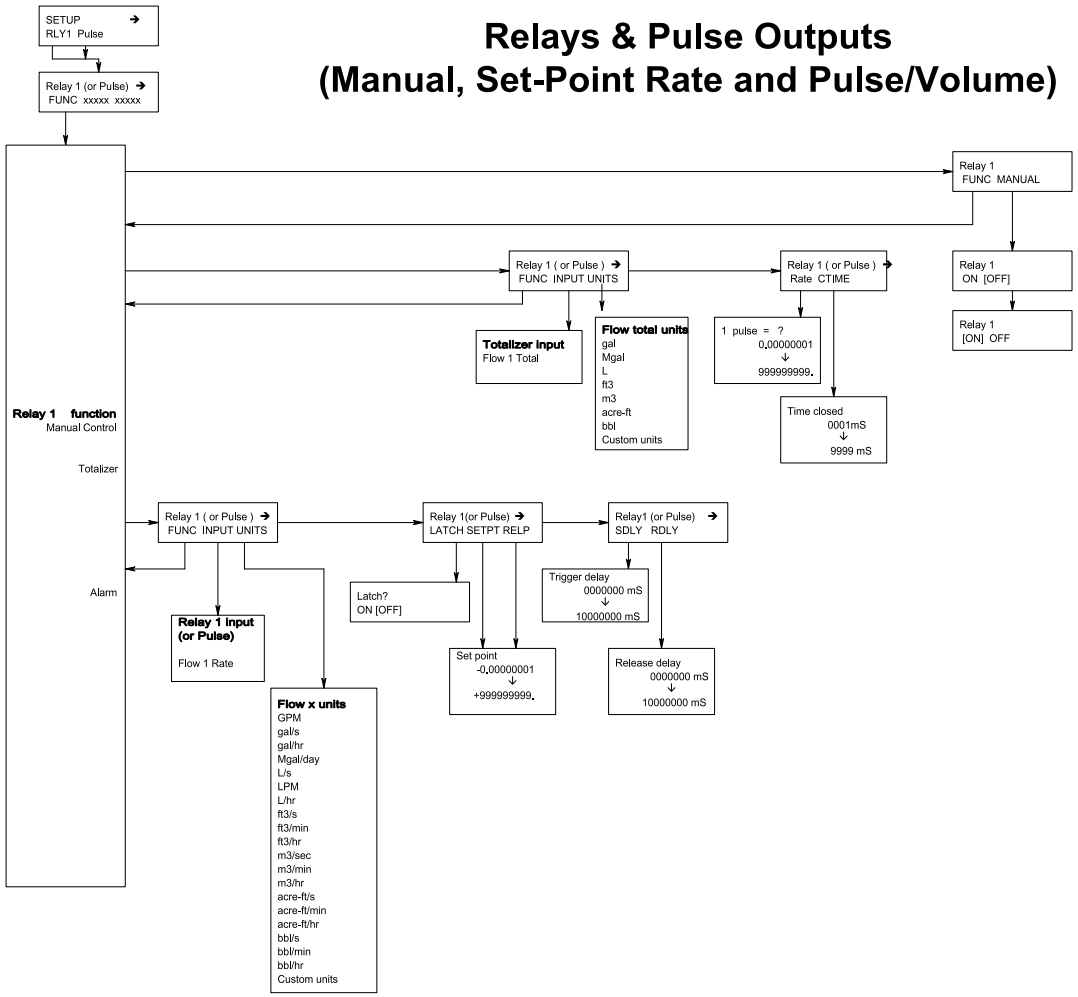
Model 3000
Programming Flow Chart
Software Version 1.2.2



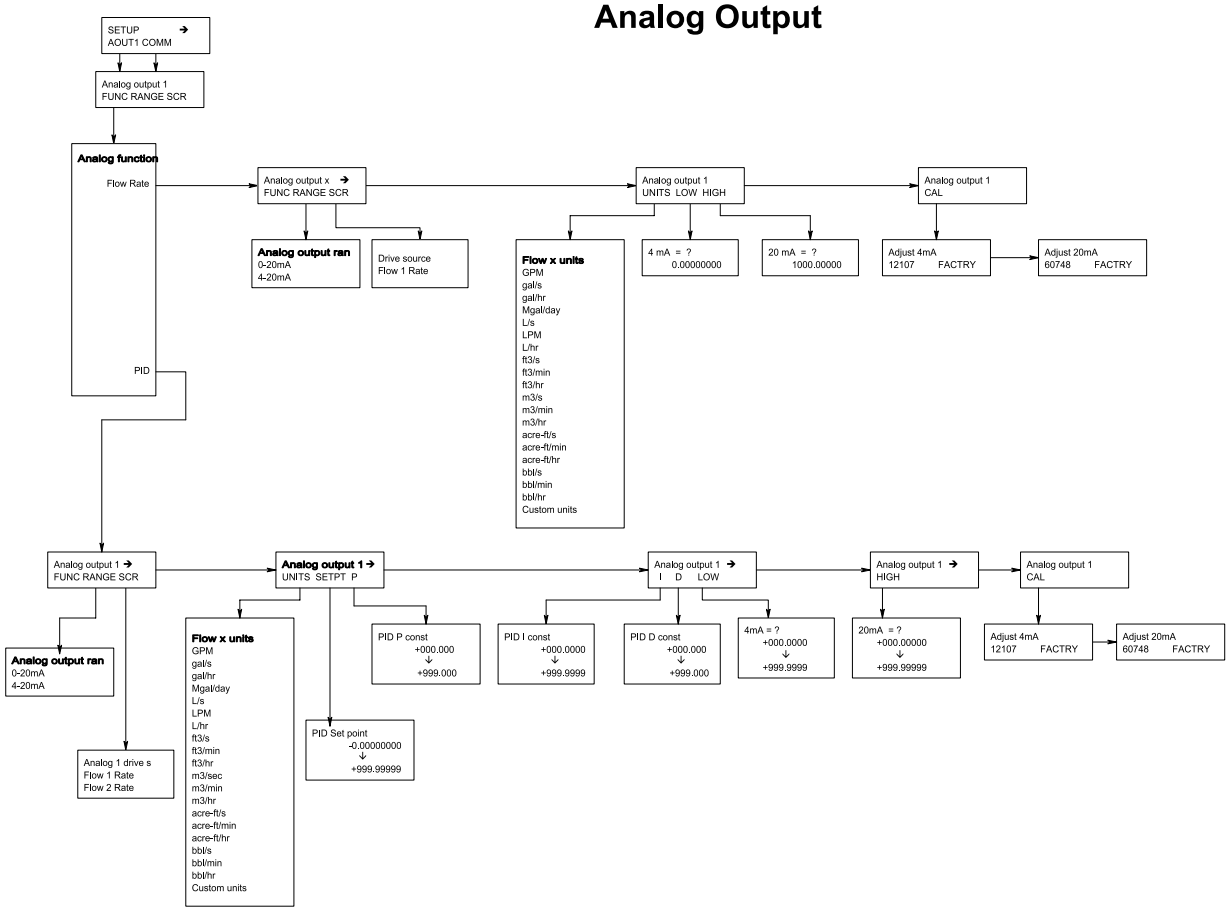
Flow Inputs



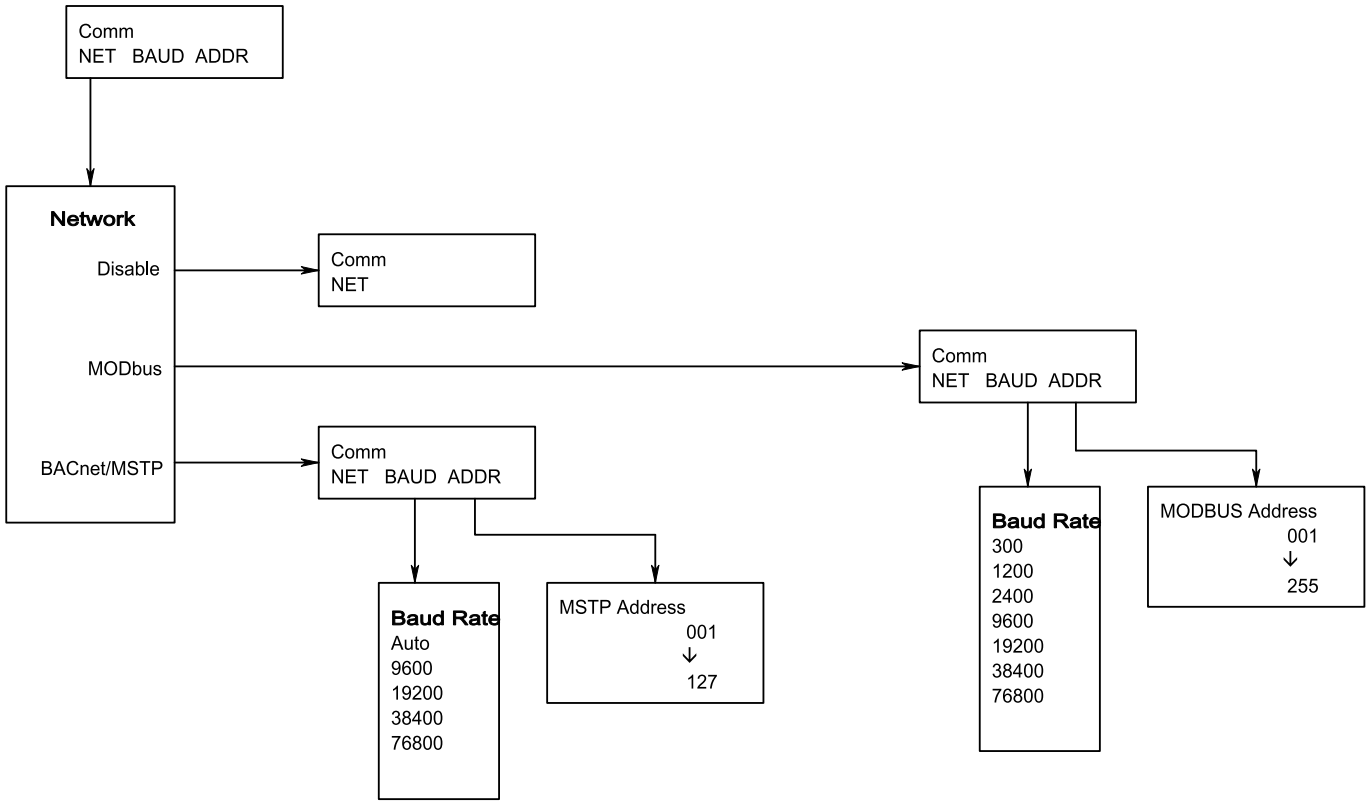
Relays & Pulse Outputs (Manual, Set-Point Rate and Pulse/Volume)



Analog Output



RS485 Communication Port



USB Communication

If the Badger® Data Industrial® Model 3000 was 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 is required.

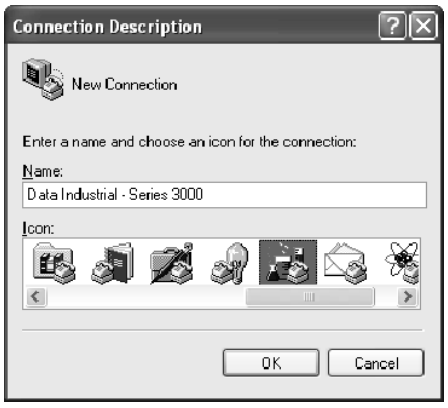
1. PC with USB ports, and Windows Hyper-terminal or other communications software
2. FTDI Virtual COM port Drivers http://www.ftdichip.com/Drivers/CDM/Win2000/CDM_Setup.exe
3. USB 2.0 A to Mini-B 5 Pin cable

To communicate using Hyper-Terminal, use the following procedure.

1. Make sure that the Model 3000 has Mini-B five pin connector on the back panel.
   (The Model 3000 must have an Analog Output Option Card installed and will be marked Model # 3000-1x)

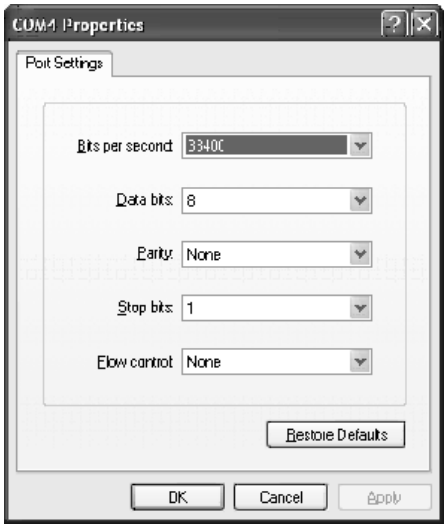
2. Be sure that the appropriate FTDI Virtual COM port Drivers are installed on you computer.

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 Model 3000



4. Run Hyper-Terminal (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 LED’s on the front of the Series 3000 should flash once, and the “Badger Meter DIC … Software Version…” text message should appear.

The Badger® Data Industrial® Series 3000 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: SineKFactor*
4: 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	0.4Hz to10kHz	1K to12VDC	-	12VDC@30mA	K + Offset
Pulse-K Factor	2.5 VDC	30VDC	0.4Hz to10kHz	-	-	12VDC@30mA	Pulse/Gal
Pull-up-K Factor	2.5 VDC	30VDC	0.4Hz to10kHz	1K to12VDC	-	12VDC@30mA	Pulse/Gal
Sine-K Factor	10mVPP	30VDC	0.4Hz to10kHz	-	10k Ω	12VDC@30mA	Pulse/Gal
Analog – 4-20mA	-	50mA Fused	-	-	100 Ω	12VDC@30mA	Linear
Analog – 0-20mA	-	50mA Fused	-	-	100 Ω	12VDC@30mA	Linear
Analog – 0-1 VDC	-	30VDC	-	-	100k Ω	12VDC@30mA	Linear
Analog – 0-5 VDC	-	30VDC	-	-	100k Ω	12VDC@30mA	Linear
Analog – 0-10 VDC	-	30VDC	-	-	100k 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

Model 3000 Ordering Matrix

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Data Industrial®

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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